

# The Montreal Protocol - Roles Played by Canadian Ozone Measurement Instruments (Dobson and Brewer) and The Engineer Who Made It All Happen - by Archie Asbridge

## Introduction

This item is to recognize the contributions of **Archie Asbridge**, Dobson spectrometer specialist and technical expert on installation and maintenance of the later Brewer spectrophotometer at many world wide locations. Selected radiosonde stations around the world form the ozone network. At these stations, an ozonesonde is attached to the radiosonde. The ozonesonde reports the vertical ozone profile from the ground to the balloon's highest point. On the ground, the total ozone is calculated manually using a Dobson instrument. A Brewer instrument can do the same calculation automatically, faster and more accurately. The measurements revealed "ozone holes" and later their diminishment following the signing of the *Montreal Protocol* in 1987. The elimination of chemicals which were destroying the ozone layer, as specified in the Montreal Protocol, was made possible by this ozone network of instruments carefully installed and maintained by Archie.

Archie Asbridge began his career as a Meteorological Technician and served often in remote arctic stations launching and recording key radiosonde data vital to the models used for today's forecasts. Later he was transferred to Meteorological Service Headquarters and became an expert on the Dobson ozone measuring equipment. Learning on the job, he also became the Service expert on the newer Brewer Spectrophotometer. The appearance of the ozone holes made it urgent to measure stratospheric ozone at many locations. WMO became involved and supported Archie during the expansion of the world ozone network.

Following is a summary of Archie Asbridge's work and travel to maintain and improve the network of instruments which measured stratospheric ozone levels. His work was critical to developing and signing and the *Montreal Protocol* in 1987, but even more critical to standardizing global ozone measurements after 1987 which resulted in verifying the solution of the ozone hole problem.

His recognition here is in four parts:

- A) A list prepared by Archie, of his related activities and travel, immediately below.
- B) International Association of Meteorology and Atmospheric Sciences Award, 2012.
- C) An article for the AES magazine *Zephyr*, authored in 1989 by **Lewis Poulin**, on the occasion of Archie's retirement.
- D) An article, authored by Archie for *Zephyr*, on his 1979 trip to China.

**See also:** [Signing of the Montreal Protocol](#)

**A) A list prepared by Archie, of his related activities and travel:**

- 1) 1974, WMO Calibration of East European Dobsons, at Belsk in Poland.
- 2) 1977, WMO Calibration of World Dobsons, Boulder, Colorado.
- 3) 1979, China ZEPHYR Report
- 4) 1979, WMO Calibrations of East European Dobsons, Potsdam, East Germany
- 5) 1979, WMO ZEPHYR Calibration of four Dobsons. Vigne-Di-Valle, Italy.
- 6) 1980 Absolute calibration of Canadian Standard Dobson, Mauna Loa. Done by colleague John Bellefleur and myself.
- 7) 1981 WMO Request Italy to re-visit Vigne-Di-Valle
- 8) WMO Request to assess status of the Dobson in Cairo
- 9) 1981 WMO Calibration of the Dobson in Quetta, Pakistan
- 10) 1984 WMO Installation of spare Canadian Dobson at U. of Nairobi, Kenya, also teaching three students the ozone program. Four weeks.
- 11) 1989 WMO Inspection and assessment of Dobson program in Iceland.
- 12) 1990 WMO World intercomparison of Dobson instruments at Arosa.
- 13) 1990 AES Invited by AES with **Tom McElroy** and a Brewer spectrophotometer to the geophysical station at Kislovodsk in the Caucasus Mountains, USSR. Inspection and calibration of the resident Brewer Instrument.
- 14) 1990 WMO Inspection and assessment of the Dobson in Singapore.
- 15) 1991 SCI-TEC Installation of Brewer Instrument at Belsk, Poland.
- 16) 1991 Sci-TEC Assisted Sci-Tec technologist in the calibration of Brewers in Italy, Switzerland and USSR.
- 17) 1991 WMO Calibration of Dobson in Singapore, assessment of Dobsons in Bangkok, Thailand and Quezon City, Philippines.
- 18) 1991 AES Brewer calibration, Mauna Loa, Hawaii.
- 19) 1992 SCI-TEC Brewer calibrations in Rome, Sestola and Brindisi in Italy, followed by Lisbon, Portugal and Madeira Island.

- 20) 1992 WMO St. Petersburg, Russia. Visit to the Academy of Sciences.
- 21) 1993 WMO Install a Dobson in Lagos, Nigeria and teach three technicians the measuring program. Assessment of the Dobsons in Nairobi, Kenya and Quetta in Pakistan.
- 22) 1993 WMO Intercomparison of European Dobsons in Hradek Kralove, Czech Republic.
- 23) 1993 WMO NOAA Laboratory, Boulder, Colorado. Repair and calibrate a spare Dobson for eventual placement in Iran.
- 24) 1993 SCI-TEC Calibration of Italian Brewer stations at Sestola (Bologna), Brindisi (the heel of Italy) and Messina in Sicily.
- 25) 1994 WMO Tromso, Norway. Assessment of the resident Dobson and calibration of the Dobson brought in from Oslo. Plus an invite to visit the Science Laboratory in Spitsbergen.
- 26) 1994 WMO Intercomparison and recalibration of European Dobsons at the Geophysical Observatory near Tenerife, Canary Islands.
- 27) 1994 A Swiss request to examine Dobson #15 which had been in continuous service at Arosa since 1935 and was last optically adjusted in that year. Calibration and adjustments. Instrument now in service in East Africa.
- 28) 1994 WMO Request from WMO to inspect two new Dobsons at the site of the manufacturer Ealing/Beck in London, England.
- 29) 1994 SCI-TEC Installation of a new Brewer at Douradas in northern Portugal. Followed by a visit to Casablanca to isolate a Brewer problem.
- 30) 1994 WMO Installation of a Dobson in the ancient city of Isfahan, Iran. Introducing and teaching the program to three technicians.
- 31) 1995 South Africa Approached me independently requesting my services to install a new Dobson at Springbok on the west coast and to calibrate the resident Dobson in Pretoria.
- 32) 1995 WMO While returning from South Africa, WMO requested visits to the ozone observing stations in Lagos, Nigeria and Nairobi, Kenya.

I made several other work trips not reported above. Three Brewer instruments used as reference standards by AES were individually calibrated at 12,000 feet on top of Mauna Loa, Hawaii and in this regard I give worthy recognition to my colleague **John Bellefleur** who shared this duty with me.

One other example is the Stratospheric Balloon Projects by AES at Vanscoy, Saskatchewan in the mid-1980's. Several other trips were SCI-TEC related occurring in the 1990's when I did about ten visits to Arosa, Switzerland, Ispra, Northern Italy, Hradeck Kralove, Czech Republic, Ohenpeisenberg, Bavaria and Lindenberg, near Berlin. My final work trip in 1999 was to Poprad in the Slovak Republic. Meanwhile, during all of these years, my colleague **John Bellefleur** and I kept the Canadian Dobson network on track.

*Archie Asbridge*  
*14 February 2022*

## B. International Association of Meteorology and Atmospheric Sciences Award, 2012

International Association of Meteorology  
and Atmospheric Sciences (IAMAS)

International Ozone Commission (IO<sub>3</sub>C)



*The Lifetime Achievement Award for outstanding service*

*is presented to*

***Mr. Archibald Asbridge***

*Mr. Asbridge is a leading expert in the field of operation and service of the Dobson and the Brewer spectrophotometers in the global network. For more than 40 years, he has provided invaluable services to the scientific community contributing to the monitoring of the ozone layer and to understanding its variations. During many trips to some of remotest corners of the earth, Mr. Asbridge worked hard and tirelessly, testing, fixing, aligning and calibrating many of these key instruments. Without his help, it would be hardly possible for the newer generations to keep the operations of the important global ground-based network for monitoring of the ozone layer with the required accuracy and precision. Even after his retirement, Mr. Asbridge continued sharing his knowledge by publishing his "Dobson-Notes", a detailed document on operating and trouble-shooting the Dobson spectrophotometers.*

*27 August 2012, Toronto, Canada*

The President

Prof. Christos Zerefos

The Vice President

Dr. Richard Stolarski

The Secretary

Dr. Sophie Godin-Beekmann

# Canada's "Mr. Ozone", retires

by Lewis Poulin

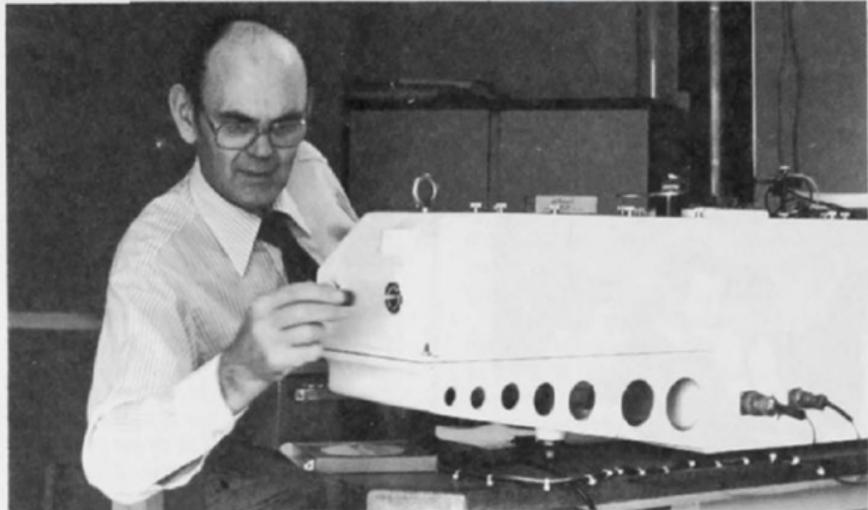
C) An article for the AES magazine *Zephyr*, authored in 1989 by Lewis Poulin, on the occasion of Archie's retirement.

A big gap opened up in the ozone research team on March 23 when Archie Asbridge retired from AES Experimental Studies Division (ARQX) after an adventure-packed 37-year career with the weather service . . .

In the early 1950s Archie began a military career. Even though he was diagnosed as color deficient, he was assigned as a flagman on a

instructor where he has done ozone work ever since.

Among other things, he trained over 150 ozone observers, wrote the official Canadian Ozone Observers' Handbook, launched ozone sonde programs at most of the Dobson instrument sites and worked with Dr. Ray Olafson on improving Dobson calibrations worldwide.



Archie Asbridge and Brewer Spectrometer.

firing range and nearly got shot raising the wrong color flag.

Before long he joined military weather offices and served at Trenton, Comax, Fort Nelson, Moose Jaw, Winnipeg and Gimli. In 1957 he was interviewed for a weather observer's job with the Met Office. Based on his previous weather training, he was offered a Met Tech position at \$2,400 a year.

Immediately, Archie applied for upper air training. The course was then given on Toronto Island near the old lighthouse. "If you missed the morning ferry, you'd miss half your morning classes", he reminisces.

A year later, now a qualified upper air technician, Archie went to the Arctic . . . to Isachsen where there was no running water. "Have you ever brushed your teeth with seawater for seven months, or taken a shower in the kitchen from a 50-gallons fuel drum?", he asks. "After the cook was finished you could melt sea ice on the stove, climb a ladder and pour it into the drum for a salt water shower". He adds that to fly in and out of Isachsen, they had to line the runway with fuel-soaked toilet paper to allow the pilot to see.

Archie began ozone work in 1959. He was the first Met Tech to operate a Dobson Spectrometer. He flew down to Scarborough to train with scientists Carl Mateer and Al Kennedy; then began work in Resolute.

Gradually Archie grew tired of the North, so he took a lower level job in Winnipeg . . . and got in a little golf. But as usual it was shift work. To escape the "grind", he applied in 1961 for an OIC's job in Coral Harbour, NWT. Two years later, he was back in Toronto as an ozone

Archie's international ozone work began in Poland in 1974. Officials of the World Meteorological Organization chose that location to compare simultaneous measurements from Dobson instruments around the world. At first they were disappointed. But the Canadian team of Ray Olafson, Archie Asbridge and John Bellefleur gained an international reputation by maintaining consistently accurate instrument calibrations.

Archie's understanding of the Dobson took him around the world. He was the first AES employee to work in China which had turned off its two Dobson instruments during the Cultural Revolution. They needed help to get them started again. Since Canada had established diplomatic relations with China before the U.S., Canadians were invited to do the work. And that meant Archie!

Another memorable trip was to Pakistan where he got to calibrate a Dobson in the Biblical setting of Baluchistan among the Pathans with their black beards and goat herds.

Since the early 80s the Brewer Spectrophotometer has replaced the Dobson as the main ozone measuring instrument in Canada. Archie took the lead in collecting data for Brewer-Dobson intercomparisons. Now that Canada is phasing out Dobson instruments from its networks, Archie says it's sad, but he adds that the Brewer offers many additional advantages.

Archie starts his "retirement" by flying to Resolute for five weeks to work on more Dobson and Brewer instruments. Then he'll be cleaning some of his own intercomparison data sets. He also plans to do WMO contract work on a Dobson in Kenya this summer. "I've never had an idle day in my life", he concludes, "and I

don't intend to start now. The only difference is I'll now be taking my wife with me".

A giant ozone hole has opened up at ARQX! Archie's dedication . . . and humor will be sorely missed.

Mr. Poulin is a research assistant with ARPX in Downsview.

**D) An article, authored by Archie for *Zephyr*, on his 1979 trip to China.**

# Glimpses of China

by Archie Asbridge



*The Great Wall near Pataling*

*The World Meteorological Organization (WMO) through its technical co-operation program often searches for specialists around the world to provide expertise to nations who request it. Occasionally, Canadian expertise is sought and AES is pleased to give it.*

*Over the last year or so, there was a good deal of interest from China and the Far East. Three AES employees, specialists in their fields, travelled thousands of kilometres to provide training and assistance to China and Mongolia.*

*In this issue, and in following ones, Zephyr will feature articles describing the experiences of AES scientists in these exotic areas.*

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A request to modernize and recalibrate a couple of ozone spectrophotometers is not too unusual for the staff of the Experimental Studies Division at AES Headquarters, but it creates a lot of interest when it is learned that the instruments have been sitting unused in China for about twelve years. What made it even more attractive, was that the request included an invitation to visit Peking to help get an observing program started.

That, essentially, was the start of some work which we were asked to do in the summer of 1979 on behalf of the World Meteorological Organization (WMO), and which led to my visit to China in late November after we had completed the recalibration of one of the instruments in Toronto.

A thirty-five hour journey from Toronto to Peking via Zurich, Athens and Bombay does not generate too much enthusiasm with which to commence a visit. A night view of Peking from the air is quite dull

when compared with the well lit cities of Canada, but it was a most welcome sight after the long flight. The usual tiresome job of customs and health clearance was thankfully speeded up by my hosts from the Academy Sinica, and within an hour I was settled in at the Peking Hotel.

Twelve hours of sleep and a good breakfast restored me to the point where I was ready to tackle some work, only to be informed that my first day in Peking should be spent resting. My presence, however, was requested at a reception to be given at noon in my honor, by the Academy. Held at the famous Roast Peking Duck Restaurant, it was a truly unforgettable experience. The Director of the Institute of Atmospheric Physics, Professor Yeh Tu-Zheng, and his staff, gave me a very warm welcome. A traditional Chinese meal followed. The specialty, of course, was roast duck but the array of extra dishes seemed endless, as were the toasts. After a while I wondered how many parts of a duck can be eaten and was soon informed that the real delicacy, the tongue, had been saved for me, the guest of honour! Well, after having already eaten parts of the feet, I tackled the tongue without too much difficulty. The reception was followed by a three hour tour of the Forbidden City and my so called 'day of rest' turned out to be a very pleasant introduction to China.

My work was carried out at a small observatory in the town of Shianger, about 70 kilometres east of Peking. This meant an early rise each morning, since the journey by car took up to 90 minutes. The volume of traffic and its variety, rather than the state of the road, accounted for the long travel time.

The work consisted of installing the ozone spectrophotometer and teaching a staff of three observers how to operate it. Work progressed at a comfortable pace, and any potential language problems were overcome with the help of Wang Ming-hsing, a scientist from the Academy who interpreted without hesitation.

The staff expressed their eagerness and enthusiasm with a constant flow of questions. As I was not used to speaking so extensively, my voice suffered. But frequent cups of hot jasmine tea helped me get through the day.

Lunch hour at Shianger would have satisfied a discerning gourmet. As there are no cafes or restaurants in that part of rural China, arrangements had been made to have lunch at the county hostel in the

town. The hostel serves as a local government seat and is rather large. The manager, who had not entertained foreign visitors before, did not know what to provide. To get around the problem, he seemed to serve everything available: chicken, beef, pork, duck, fresh water fish, soups, rice, various vegetables and several salt water items which included a spong-like fungus contained in most soups. There was sufficient food to feed ten people (but I was assured that the leftovers would not be wasted).

Although the car ride to and from the observatory was time consuming, it gave me a chance to see the farming country. The coastal plain is extremely flat. Trucks, tractors, mule and donkey carts, hand carts and wheelbarrows frequently moved the earth from place to place, presumably to achieve this flatness that will give the best results for the extensive irrigation systems in that area.

The winter wheat had been planted in October and was well sprouted by late November. It is harvested in late spring or early summer, at which time corn is sown. A common sight in December is to see people of all ages sitting in the farmyards rubbing the corn cobs with a small tool to release the kernels, while some winnow the accumulated pile to separate the chaff. The corn stalks had previously been bundled and stacked against the outer walls of most rural dwellings to serve as a windbreak and probably for use as fuel as the winter progressed.

The small town of Shianger did not have any noticeable industry, but once a week was the gathering place for thousands of peasant farmers who had goods for sale or exchange. One particular morning we were stopped by police about five miles from the town and given and escort the rest of the way to the observatory. It was market day and it took us 40 minutes to reach the observatory, the escort car incessantly blowing the horn ahead of us. The two lane road became increasingly congested with vehicles, bicycles, people and animals. An ingenious way of getting a live pig to market is to strap it on the carrier seat of a bicycle, upside-down, though the cyclist usually had some difficulty keeping his balance as the pig struggles, its four feet in the air. The main streets of the town served as the marketplace, and I felt somewhat embarrassed at the confusion we created in trying to reach the observatory.

The extreme tidiness of the countryside

in rural China is impressive. The roads are usually elevated a few feet above the level of the land and invariably have trees planted very uniformly on each side. The trunks are whitewashed from the base up to about five feet. It appeared that every mile of road was walked each day by peasants with hand carts cleaning up manure and fallen branches. There was no litter anywhere.

In sharp contrast to the simple slow-paced lifestyle of rural China, Peking presents a bustling appearance. Nobody seems to know the population, but estimates range from seven to nine million. Peking seems to be less sprawling than Toronto. Apart from several majestic looking government buildings and museums the city is rather drab, but my impressions were probably influenced by the lack of vegetation and greenery at that time of year.

Familiar features such as plazas and gas stations are seldom seen, with shops being concentrated in just a few areas. The lack of neon lighting was very obvious and, apart from the names on the store fronts, there seemed to be no advertising. One sees little but row upon row of small-brick dwellings and low-rise apartment blocks, with concentrations of factories in certain areas. The city was blanketed in smog during my visit, with early morning visibility sometimes at about two hundred yards, and little better than a few miles by afternoon. About one person in four wore a gauze mask over the mouth and nose.

The major traffic arteries were very wide, and facilitated the endless flow of cyclists. Apart from commercial vehicles, most of the cars on the street were taxis; but it is not possible to flag one down. To get a cab, you must phone a depot to arrange for one, or be at one of the major hotels with a depot office. This is the law.

It took me a few days to figure out how the traffic system works in Peking. The main avenue is wide enough for four lanes each way, with the two lanes closest to each curb limited to bicycles, leaving two lanes each way near the centre for vehicles. There are two solid white lines down the centre of the avenue, but you are allowed to cross them to overtake slower traffic. Actually, you have the use of the whole road to jockey for position when the traffic light turns green! It becomes a mad dash to the next traffic light, the only stipulation being that you must be on the proper side of the double white line when you get there. The horn blowing is incessant,

since it is mandatory when overtaking another vehicle.

The City of Peking offers some fine attractions for visitors, especially historical sites. The Emperor's Palace, also known as the Forbidden City, is a major attraction situated in the heart of the city and covers many acres. It is probably the best example of Chinese architecture in its original, undisturbed setting.

The Summer Palace on the northwest outskirts of the city is equally impressive, standing on the edge of a lake receding northwards on the side of a steep hill. Both

by car northwards from Peking lasted about ninety minutes and took us through farm country for about thirty miles before reaching the foothills. My visit was to the Pataling area, where the wall is well maintained. When I reached the Wall, I was overwhelmed by the lay-out and total picture as my eyes followed the course across steep mountainsides and deep valleys. A close inspection of the structural design left me marvelling at the workmanship and the engineering feat accomplished centuries ago. The main walls are constructed of cut stone blocks tightly set and

stone entrance doors were closed from within at the time of entombment. The archaeologists took about three months to figure out how to open the doors, mostly because a heavy stone pillar had been leaned against the doors on the inside.

A stay in Peking would not be complete without a trip to the opera. I was fortunate to see two of them, one based on an old traditional story and the other extolling the virtues of contemporary life. Wang Ming-hsing kept me informed of the story lines, but, even if I had not understood the words, it would still have been great entertainment just to see the colorful sets and costumes, and the acrobatics which comprise a fair amount of the show.

My only source of information about contemporary life in China was from Wang. He had recently spent a year studying in England and was fully aware of our different lifestyles. He considered himself fortunate to have a dwelling consisting of two bedrooms and a kitchen, where he lived with his wife and son. His rent was about three dollars a month, and his only complaint was that the family had to share a common bath house and toilet facility with others on the street. His wife worked full-time, as is prevalent in China. This meant that their son had to live with grandparents, and that they could see him only twice a week.

Wang had the option of going to work by bus or bicycle, but preferred the half hour bike ride. (After seeing the problems of trying to get aboard a bus at rush hour I could understand his preference.)

It is difficult to compare wage structures. A factory worker, it seems, earns forty or fifty dollars a month, and needs three months' salary to purchase a bicycle.

A first visit to Peking and the surrounding area does not make one an expert on China, but it certainly creates the desire to see and understand more of the complexities of such a large nation. The eleven days I spent there were some of the busiest of my life, not so much because of the work that had to be done, but largely because of the activities my hosts had planned. The hospitality extended to me was unostentatious yet generous and beyond all expectations. I am indeed very grateful to have had the chance to make such a visit. □

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*Shanghai Observatory - Back row: (left to right) Wang Yang, Archie Asbridge, Wei Ding-wen, Wang Ming-hsing. Front row: Ye Wei-chuo, Chao Yan-tiang, Yang Siu-fen.*

palaces are perfect examples of geometric layout, with buildings and archways separated by hundreds of feet in perfect alignment.

Tien An Men square is next to the Forbidden City, and the difference between the old and the new China can be seen by a turn of the head. Standing in the middle of the square is like being in the middle of a wheatfield, since it must be a quarter of a mile long and almost as wide. It is not unusual to see a million people gather in the square on a national holiday.

A trip to the Great Wall was the highlight of my visit to China. The journey

measuring about two by three feet, and are wide enough to accommodate eight foot-soldiers walking abreast. Turreted watch towers occur every few hundred yards, and were used to warn of impending attack by bonfires.

A short detour on the return journey from the Great Wall led us to the tomb of the 10th Emperor of the Ming Dynasty, located at the start of the foothills. The tomb was opened in 1958, and is believed to be one of thirteen in that area. Buried deep in the ground, its layout is similar to the palaces in Peking. A mystery still surrounds the manner in which the huge