Antarctica's Komhyr Ridge

Honoring an Ozone Research Pioneer

By Sharon Reese

In the 1980's, a scientific discovery was made that changed the world. An extreme thinning or "hole" in the atmospheric ozone layer was discovered over the entire continent of Antarctica. That's one and a half times the size of the U.S.! Without the ozone layer to absorb radiation from the sun, there's a chance we could become extinct. Damage to the ozone layer could cause big problems like an increase in skin cancer, cataracts, and immune system damage. Also, the balance of the entire ecosystem could be upset. Luckily, programs to lower the amount of harmful pollutants being put into the atmosphere by man are protecting our world. Without accurate, scientific instruments and ingenious, atmospheric monitoring programs, this discovery may not have happened. The world today could have been a much more hazardous and ugly place to live.

Ozone Pioneer

One man who pioneered the efforts to improve the quality of ozone measurements is Walter Komhyr. Walter was born on November 12, 1931 on a farm, with no electricity or running water, in the tiny town of Spedden, Alberta, Canada. As he grew, he developed a passion for nature and a curiosity for how things work. He was also an innate perfectionist. It was these traits that eventually led to a mountain ridge in Antarctica being named in his honor.

In 1950, Walter moved to the big city of Edmonton to attend the University of Alberta. There, he noticed a lot of publicity in the newspaper about pollution from coal burning and automobile exhaust. He worried that as the population increased, so would the demand for industry. More pollution in the atmosphere would be terrible. Trees could die, people could become sick, and no one would know the beauty of a star-filled sky. In 1956, Walter graduated with a Master's degree in Spectroscopy. He took a job measuring atmospheric ozone for the Canadian Department of Transportation in Moosonee, Ontario.

There, Walter immediately noticed a problem. He was using an instrument called the Dobson spectrophotometer. He was concerned that his measurements were not as accurate as they could be. All Dobson spectrophotometers were made and calibrated in Oxford, England which was extremely polluted. He feared the base-line calibration of all of the instruments were off. This way of thinking led to major improvements and advances in the quality of ozone measurements throughout the world.

The Dobson Network

In the pristine Canadian air, Walter re-calibrated Dobson spectrophotometer instrument No. 62, correcting the base-line measurement error by several percent. Soon after, Walter was hired by the Canadian Meteorological Services in Toronto. He re-calibrated all Canada Dobson instruments to the strict base-line standard of instrument No. 62 and the Canada Dobson spectrophotometer network was complete.

In 1961, the U.S. Weather Bureau in Washington D.C. hired Walter to re-calibrate their instrument and form a U.S. network. This instrument, known as Dobson spectrophotometer instrument No. 83 was used to calibrate all the U.S. instruments, even those being used in Antarctica. In the early 1970's, all foreign Dobsons were re-calibrated to Primary Standard Dobson Instrument 83 to create a global Dobson network. In the late 1980's, the TOMS satellite ozone data results were in question. Walter was flown to Washington D. C. to share his Dobson network data. Because of the reliable record of the Dobson network data, the TOMS satellite data was normalized to that of the Dobson network. Today, more than 50 years later, Dobson instrument No. 83 is still used as the Primary Standard for all Dobson spectrophotometers throughout the world.

The Invention

Walter had another problem to worry about. The Dobson spectrophotometer, a ground based instrument, measures the total amount of ozone in a column of air. There were other instruments flown about 20 miles up into the atmosphere with a weather balloon. These instruments, called ozonesondes, measured where the ozone was distributed as it ascended into the atmosphere. This was important information for the scientists. The problem was that the instruments being used had measurement errors of 20-50%. Learning about the flaws of these instruments gave Walter the insight to develop his own ozonesonde. His inventions of the electrochemical concentration cell (ECC) ozone sensor, and Teflon pump reduced the balloon-borne measurements errors to approximately 2-3%. An enormous improvement! He patented the ECC ozonesonde in 1963 and soon put it to use at the U.S. station in Antarctica.

The development of this instrument was so important that on February 14, 1965, Walter was awarded a Silver Medal from the U.S Department of Congress "for a valuable contribution to Science and Technology in the development of the highly successful ozonesonde for use by the Weather Bureau."

The Proposal

In 1966, Walter moved to Boulder, CO to work for a new lab at ESSA (later renamed NOAA). Here, Walter had a very important vision that would shape the future of scientific measurements around the globe. On November 9, 1967, Walter presented his paper to the Panel for Weather Modification from the U.S. National Academy of Sciences. He proposed the development of several remote "clean air" stations to monitor trace gases, and man-made and natural pollutants. These particles have the potential to change weather, and climate, and harm plant, animal and human life and should be carefully monitored. He envisioned this to be an international effort. This created a buzz in the scientific community. Walter returned to Boulder to wait and see if his vision would become a reality.

While he was waiting, Walter received a surprising gift in the mail. On March 12, 1968, the National Science Foundation sent him a letter informing him that a ridge in Antarctica had been named in his honor. Komhyr Ridge lies south of the Nimrod Glacier at 82°47′ S. latitude, 160°10′ E. longitude.

The Answer

It took a little more time than he had hoped, but in 1969, a new branch was established at NOAA. Walter was promoted to Chief of Technology and Standards for the Geophysical Monitoring for Climatic Change Division (GMCC). The search to set up "clean air" stations to measure ozone, chlorofluorocarbons, carbon dioxide and other atmospheric trace gases began. Two stations already operating at South Pole, Antarctica and Mauna Loa, Hawaii were designated as "clean air" sites. Two additional stations were added at Tutuila, American Samoa and Point Barrow, Alaska. These stations still operate today and provide a valuable base-line history of data for many atmospheric constituents. Many other countries have joined in and set up their own stations.

In 1988, to commemorate the 30th Anniversary of the International Geophysical Year, the Association of Meteorology and Atmospheric Physics, International Ozone Commission, *formally recognized Walter Komhyr as, "One of the few scientists who have continually made major contributions to the study of ozone during the last three decades."*

Currently, there is a network of over 100 Dobson spectrophotometers in use throughout the world, all calibrated to Walter's Standard No. 83 instrument. Also, many countries have programs to measure ozone using Walter's ECC ozonesondes. Thanks to the efforts of many inspired scientists like Walter Komhyr, the development of highly reliable instrumentation and standards, and well-thought out programs led to the discovery of the "hole" in the ozone layer. This news created a panic that man-made pollution, especially CFCs, was threatening the health of plant, animal, and human life on earth. Programs to reduce man-made ozone destroying pollutants in the atmosphere were quickly developed. Scientists estimate that it will take about 50 years for the ozone layer to recover, but it appears for now that the crisis has been averted.

Sidebars:

Fun Fact: The ECC ozonesonde is so sensitive it can detect 2 molecules of ozone in a billion molecules of air. That's like finding two $5 bills in a 16 mile-high stack of a billion $1 bills. This stack would reach into the ozone layer which is mostly found about 12 to 19 miles above the earth in the stratosphere.

The Ozone Hole: The Antarctic ozone hole happens in the Antarctic spring, mainly during September and October. Scientists began detecting it in the early 1980's and discovered the main culprit: chlorofluorocarbons (CFCs)! CFCs were first used in the 1930's as refrigerants, cleaning solvents and aerosol sprays. The use of CFCs rose exponentially by the 1970's. CFCs rapidly destroy ozone in the unique conditions of the Antarctic stratosphere. This happens when the sun appears again after a cold winter of darkness.

The ozone "hole" is actually a thinning in the ozone layer. Scientists typically measure total ozone in Dobson Units (DU). A typical amount of ozone is about 300 DU. Compressed on the ground, this layer would be 3mm (.12 inches) thick - the height of 2 stacked pennies. In October 1984, the Antarctic ozone, normally 340 DU, had dropped to below 200 DU. By 1990, ozone amounts had dropped to 120 DU and covered the entire continent of Antarctica. By

September 2000 the hole was less than 100 DU and covered 11.5 million square miles which is almost 3 times the size of the U.S.! In 2006, the largest hole ever recorded was similar in area to the one in 2000, but deeper.

In 1987, a program called the Montreal Protocol on Substances that Deplete the Ozone layer was proposed. International efforts to phase out the production of CFCs and other ozone depleting chemicals began. Ozone destroying substances can stay in the atmosphere for decades, so results can take time. In 2012, the second smallest hole in 20 years was observed. Scientists are encouraged that the efforts to reduce man-made substances that damage the ozone layer appear to be working and the ozone hole is recovering.

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