Unveiling the earth's tiara

NASA

Satellite images show the nearly round auroral arc against the backdrop of the earth's dark side. Left, the aurora is quiet; right, 24 minutes later, a storm peaks.

To the wonder of peasants and kings, poets and scientists, the aurora borealis for centuries has performed its undulating, celestial light show. Admirers of the aurora had seen only localized swaths of the northern lights until recently when high-resolution photographs were revealed, showing the entire aurora in its nearly round, tiara-like glory.

Auroras, which occur roughly over the earth's magnetic poles, develop when subatomic particles are energized as they encounter the earth's magnetic and electric fields. The recent photographs were taken from the National Aeronautics and Space Administration's Dynamics Explorer A satellite. Scientists studying the images hope that further data about the aurora borealis and its southern counterpart, the aurora australis, will help resolve ongoing questions about different mechanisms that may excite auroras during the day and at night. Researchers also hope to learn whether each northern and southern aurora is a continuous band or two arcs that overlap into a circular, oval or horseshoe shape.

The dayside aurora is longer-lasting and more structured than the nightside aurora, said Robert A. Hoffman, Dynamics Explorer project scientist. Unlike the aurora on the earth's dark side, which is usually visible at high northern latitudes, the dayside aurora is invisible to the naked eye and is difficult to photograph because the sunlit earth reflects about a million times as much light as the aurora over the night hemisphere. The satellite's camera system, developed by scientists from the University of Iowa, uses "super-reflecting" mirrors that reject unwanted light from the earth. One line is added to the image with each of the satellite's ten revolutions per minute. A ground-based computer forms the lines into a final image.

By design, the satellite launch coincided with a decline in the solar maximum, the time each 11 years when solar activity begins to taper from its peak activity. Auroral storms tend to be more active during the solar maximum than the solar minimum, Hoffman said, and for reasons unknown, some of the most active storms ever recorded occurred during periods of decline. The recent round of images recorded a complete auroral storm, a burst of electromagnetic energy that causes the aurora to brighten and spread over large areas. Typically, the aurora borealis is about 4,000 kilometers in diameter; the bands that encircle the poles may be as wide as 1,000 km. Auroras usually begin about 100 km from the ground, and from there may extend up from tens to hundreds of kilometers.

The Explorer satellite missions are intended to provide information about the near-earth space environment and the processes by which solar energy, in the form of radiation and particles, flows through interplanetary space and into the earth's magnetic field. Some information gathered by the Dynamics Explorer satellites since they were launched in August 1981 is surprising when compared to data collected by the earlier Atmosphere Explorer series (satellites C, D and E). Hoffman said that the Atmosphere Explorers collected information mostly during a period of minimum solar activity six or seven years ago. The newer satellites show that at least over the polar regions the density of oxygen in the upper atmosphere is four times higher than when earlier measurements were taken. Recent measurements also show that neutral winds in the upper atmosphere blow faster than about 1,600 km per hour, more than twice the speed of winds measured during the solar minimum.

The Dynamics Explorer will have its shot at the aurora australis in summer 1983, when the South Pole will be in its annual phase of maximum darkness.

— *C. Simon*

How exercise protects the heart

There is ample circumstantial evidence that exercise can protect people against heart disease caused by clogging of coronary arteries with cholesterol. But now direct physical indications of such protection have been obtained as well — in monkeys — and are reported in the Dec. 17 NEW ENGLAND JOURNAL OF MEDICINE by Dieter M. Kramsch and colleagues at Boston University School of Medicine.

Kramsch and his co-workers divided 27 young monkeys into three groups — a sedentary normal control group, a sedentary high-cholesterol group and an exercising high-cholesterol group. The first group got a control diet of monkey chow and banana mash for 36 months and exercised only in small cages. The second group got the control diet for 12 months, then a high-cholesterol diet for 24 months and also only exercised in small cages during the total 36 months. The third group consumed a control diet for 18 months and a high-cholesterol diet for 24 months and exercised one hour three times a week on a treadmill (comparable to jogging in human beings) for the total 42 months. At the end of the study the animals were sacrificed so that the investigators could see how exercise had affected their hearts and coronary arteries.

The diameters of the coronary arteries of the exercising, high-cholesterol monkeys were considerably larger than those of the sedentary normal control animals or of the sedentary high-cholesterol animals. A larger coronary artery diameter in turn might help protect against heart disease due to clogged coronary arteries since such clogging reduces blood flow to the heart. But even more compelling evidence that exercise can protect against heart disease due to clogged arteries was the discovery that the monkeys that had exercised while eating high-cholesterol diets had less-clogged coronary arteries than did the monkeys that had eaten lots of cholesterol but that had not exercised. "Our data," Kramsch and his team conclude, "suggest that moderate exercise may prevent or retard coronary heart disease in primates."

And in an accompanying editorial, Robert A. Bruce of the University of Washington at Seattle writes: "If these provocative findings can be independently validated by other competent investigators, important clinical, epidemiologic and public-policy implications may emerge. Effective preventive measures would involve not only regular, periodic physical activity ... during childhood and adolescence, but also maintenance of such activity in later life." □