NCAR Information Release

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A New Look At The Aurora

San Francisco---The dazzling display presented by the Aurora Borealis can be an awesome sight to those who live in northern latitudes. American Indians, Lapps and Eskimos have devised legends explaining this ephemeral light show. And most people have been content to leave it at that.

At the American Geophysical Union meeting here, however, those who study the relationship between the sun, the earth and the upper reaches of the earth's atmosphere have more than a casual interest in the Aurora.

Raymond G. Roble and colleagues at the National Center for Atmospheric Research (NCAR) have been trying to learn more about how the Aurora effects the earth's atmosphere some 100 - 500 km (more than 60 miles) above the earth in a region scientists call the thermosphere.

In the thermosphere, a boundary between the bulk of the earth's atmosphere and outer space, the "weather" is governed by two processes. The first is the absorption of ultraviolet energy from the sun. All of the sun's energy which reaches the surface of the earth, mostly as visible light, must first pass through the thermosphere. Yet something like a million million watts of energy gets caught in the thermosphere, heating it. This is the main driving force in the thermosphere.

The second process is energy in the Aurora-producing zone which girds the earth at either magnetic pole. This energy, sometimes equal to the sun's radiation energy absorbed by the thermosphere, produces the brilliant Aurora displays. The glow associated with the Aurora is produced when particles in the Auroral zone are bombarded. Their motions give off light, somewhat like the gas enclosed in a fluorescent light bulb.

"When you look at the Aurora displays, you can tell something about the energy involved and where it's going," Roble explains. "In a red Aurora the

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energy is entering high in the atmosphere, near 250 km. The green displays indicate more energy at a lower altitude--around 100 km. And each type of display will have a different effect on the 'weather' of the thermosphere."

The thermosphere has its own "weather" patterns, governed by forces from the sun and from the Aurora, which can be measured to show patterns similar to those on a conventional weather map. When the Aurora is quiet the solar radiation controls "weather" in the thermosphere, but when the Aurora is active, it takes over the circulation patterns.

Roble has discovered two things about these "weather" patterns, which he reported to the AGU meeting. The first is that the circulation patterns in the thermosphere do a complete reversal within about a week's time. This abrupt change, from a summer-time pattern to a winter one, occurs around the equinox. When and how it happens depends upon the Aurora.

Another is a connection between the Aurora and the 11-year solar cycle. The energy from the Aurora which enters the atmosphere can vary by as much as five times, depending upon whether the sun is active or quiet.

Although the energy involved in producing the visible Aurora displays is small compared to the total energy from the sun, the fact that the Aurora changes the circulation in the thermosphere is an enticing hint that the Aurora may have other, as yet undiscovered, effects as well.

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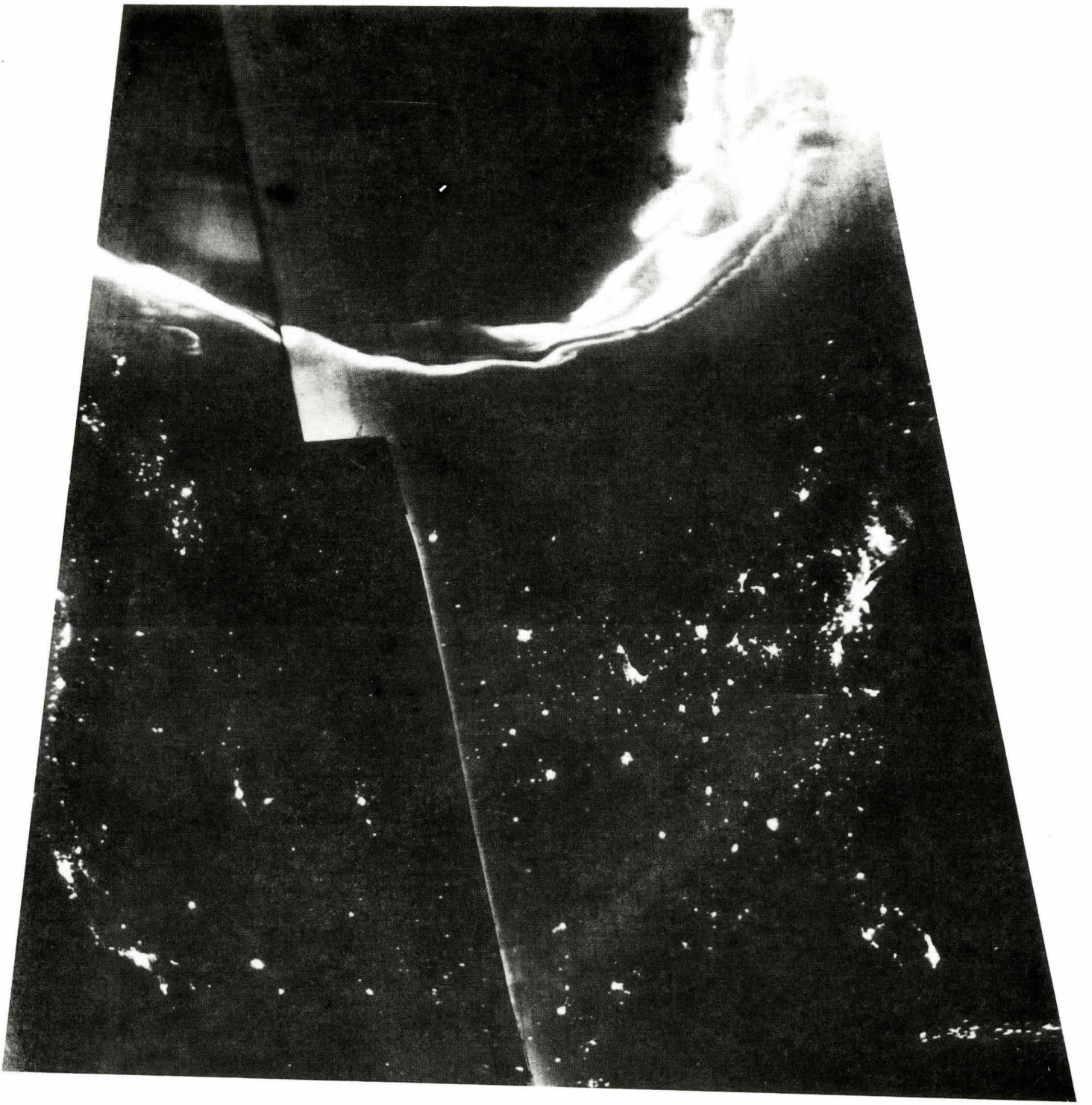
Photo, page 3.



A satellite offers a spectacular view of the Aurora Borealis above the United States. These are two overlapping pictures from an Air Weather Service satellite.