

YORKSCIENCE

Dr. Gordon Shepherd

Studying the secrets of the northern sky

Richard Dubinsky

The Northern Lights: shimmering, gleaming, meandering sheets of radiation in Canada's frozen skies, have been the object of speculation for centuries.

Explorers have been led astray by the magnetic fluctuations associated with these strange nocturnal emissions, which cause deflection of compass needles and interference with radio communications.

Ancient Indian tribes created elaborate and mystical legends to account for them, and even today, the superstitions surrounding their appearance rival those of the full moon.

These lights, also called *aurora borealis*, *aurora australis* in the southern hemisphere or simply *aurora* have also been the subject of much serious scientific study. Here at York their mystery is being unravelled by Dr. Gordon Shepherd of the Centre for Research in Experimental Space Science, a Canadian pioneer in the study of Space Physics.

The Sky is a Television Set

Dr. Shepherd views the atmosphere "as a giant TV screen where the aurora is a mere footprint." The animal providing this "footprint" is made from magnetospheric plasma; billions of high energy ions, atoms and electrons all colliding together and emitting multi-coloured traces of light.

A constant struggle rages between the immense magnetic fields from earth and our distant sun. Solar winds are mainly super energetic particles (plasma) which blow at our protective magnetosphere charging it with the plasma. This creates energy forces equal to millions of volts as measured from the ionosphere to the surface.

The aurora borealis is caused when gaps in the protective

magnetosphere around earth (which occur as a result of interference from the sun's magnetic field). Allow these particles, or plasma, to enter the upper atmosphere and become visible.

Dr. Shepherd has measured the aurora from below, in earth stations, above by satellites and inside the glowing region using rockets. He has discovered that the aurora is always visible in an oval around the earth at about 70 degrees magnetic latitude at night, moving to 78 degrees in the day time.

The existence of daytime aurora is a recent discovery to which CRESS has contributed a great deal.

A similar effect occurs at the south pole. During periods of severe magnetic storms, the oval becomes expanded and aurora may be seen further south. Sightings in Toronto are not uncommon.

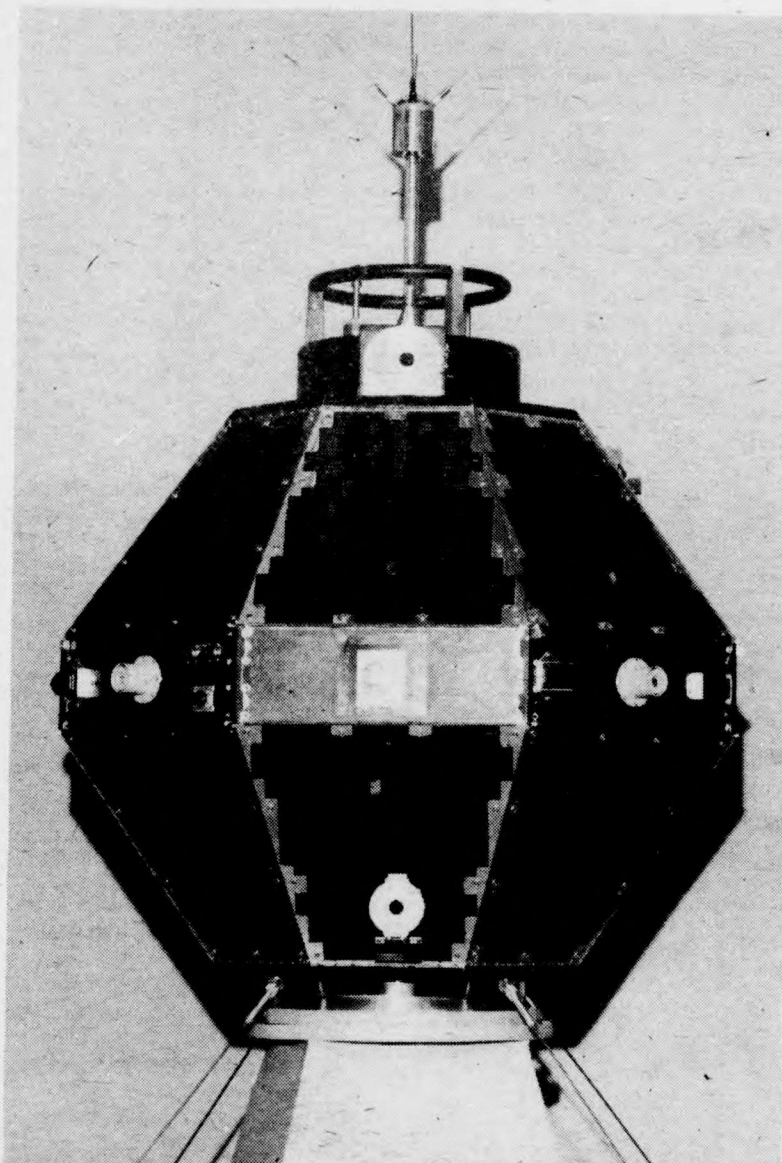
Sun Influences Weather

Dr. Shepherd believes there is a relationship between the aurora, sun and the earth's climate. According to Shepherd, "There are changes in weather that have been linked to the sun."

The sun has an eleven year cycle in which the number of sun spots change regularly; weather patterns tend to follow a similar period. Farmers in the North American plains make adjustments for an eleven year rain sequence identical to the sun spot variations.

In the 17th century the sun spots mysteriously disappeared; this coincided with severe climatic changes, like the freezing over of the Thames River in London, England. This period was referred to as the little ice age in Europe.

Daily influences on the weather may also be caused by the change



ISIS II Satellite showing photometer experiment designed by Dr. Shepherd at bottom centre. This was used for measuring the auroral intensity and played an important part in the discover of daytime auroras.

in direction of the sun's magnetic field (solar sectors) as the earth orbits the sun. These effects are complex and many scientists are

studying them.

Atmosphere is a Vast Storehouse of Energy

The study of aurora or

magnetospheric physics, is only part of Dr. Shepherd's concerns. His interests include investigating the interaction of energetic particles in the atmosphere, giving us additional information about reaction and ionization rates that produce the light we see. Dr. Shepherd states that, "these particles are a major energy source for our atmosphere especially in Canada's polar regions. We are finally beginning to understand how this energy is degraded into forms such as light and heat."

Information about temperature and chemical constituents have come about as a result of theoretical and laboratory work carried on here at York.

Canada in Space

Canada's involvement in the space program is highly advanced. Due to the massive area of this country, there is a high priority for efficient radio communication and satellite surveying. A book about the history of the space program in Canada is now being written by Dr. Shepherd and Agnes Kruchio.

Pioneering space involvement initiated by Canada involved ISIS. The ISIS (International Satellite for Ionospheric Studies) program from 1962 to 1971 contributed significantly to the understanding of radio waves in the upper atmosphere. Dr. Shepherd designed an instrument for use in the ISIS-II satellite which continues to be in operation today.

Gordon Shepherd

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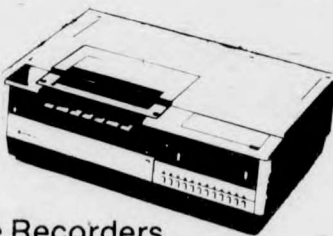
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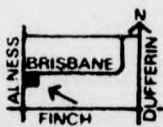
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