
Science & Technology

A case of U.S.-Soviet scientific cooperation

by Marsha Freeman

In an unusual and informal ceremony this past summer held in Fairbanks, Alaska, Robert W. Freyman, formerly of the Los Alamos National Laboratory, was given a medal honoring his work in radio-wave research by the Polar Geophysics Institute in Murmank, U.S.S.R.

For the past three years, Freyman, who retired from Los Alamos last February, has been conducting experiments in Alaska on the mysterious phenomenon of long-delayed radio signals. This research has also been of interest to Soviet scientists, and the experimental results found by Freyman were recognized by the Soviets as confirming their own theoretical calculations of this phenomenon.

The parallel efforts of the scientists is a good illustration of how basic science can benefit from East-West collaboration, though such collaboration has been waning since the clampdown on U.S.-Soviet exchange in effect since the Afghanistan affair.

Solar plasma effects

Normally when radio signals are transmitted from a point on the Earth, it takes one-seventh of a second for them to circle the globe, rarely making more than two orbits. As early as 1927, however, a Scandinavian engineer discovered that some radio signals generated were followed by echoes at three-second intervals. Since then, 30-second delays have been identified.

Freyman postulated that this delay of radio signals indicated interference in the Earth's magnetosphere region as a result of plasma thrown off from the Sun. The charged solar plasma particles are trapped in the field lines produced by the Earth's magnetic field, Freyman posits, and at times when there is a solar flare or burst of plasma discharge, ducts or channels are formed that transport plasma and the radio waves back out toward the Sun.

When these ducts collapse, at varying times, Freyman believes, the radio signals bounce back toward the Earth,

accounting for the delays and echoes.

The Earth's magnetosphere, the region extending from our planet's surface to about 45,000 miles into space which contains the magnetic field energy extended out from the Earth, changes its shape and configuration of field lines depending upon the flow of solar material and its position relative to the strong solar wind push from the Sun.

Freyman and his assistants expected to observe these delayed radio waves only during the night in Alaska, when the magnetotail is elongated away from the Sun and the magnetic field lines are open. To their shock, Freyman reported in a phone interview, they also observed the delayed phenomenon at 10:30 in the morning when the magnetic field lines are supposed to be closed!

It was this anomalous observation which led him to believe that the merging of daytime magnetic fields from the Earth with the incoming solar wind produces these ducts that temporarily trap radio waves, pull them away from the Earth, and then release them as these short-lived structures collapse.

Scientists in the near-polar Soviet Union and in the northern Scandinavian countries have long been interested in anomalous activities in the upper atmospheric regions of the Earth and the outer magnetosphere because they are near the polar region which experiences the aurora borealis, or Northern Lights.

Though this phenomenon is in itself interesting and quite beautiful, the streams of solar plasma particles that cause them also disturb radio and other wave transmissions from these regions, so scientists from these countries have been anxious to understand their origin.

In 1979 the Soviets, Scandinavians, West Germans and Austrians sent up a high altitude balloon with scientific instruments to measure distortions in signals transmitted from the balloon to the ground. When the balloon drifted over the Soviet Union, Freyman reports, the telemetry signals from the balloon became garbled.

While investigating the possible causes of this disturbance, Soviet scientists became aware of Freyman's work.

The award was presented to Freyman by the head of the Polar Geophysics Institute, N. A. Gorokhov, for significant polar radiowave research, after he had been nominated for the medal by three Soviet scientists who had read his work. The medal was inscribed "To the Glory of Soviet Science" and is the first time it has been presented to anyone outside the Soviet Union.

Gorokhov presented Freyman also with three books from Moscow; one written by himself on radiowave research, and two others on ionospheric experiments in the U.S.S.R.

Freyman explains that his ground-based experiments near the polar region are an important supplement to experimental data NASA hopes to gather "in situ" through the launching of satellites into the ionospheric and magnetospheric regions of the Earth. Freyman was assisted in his research by his wife, Marilyn Freyman, also of Los Alamos, and Al Koelle from the Laboratory's Electronics Division.