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Introduction "The history of ionospheric radars"

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Edward Appleton was awarded the Nobel Prize in Physics in 1947 for his work on the properties of the Earth's ionosphere (Appleton, 1947). The existence of a conducting atmospheric layer that could effectively reflect low-frequency radio waves was experimentally demonstrated by Guglielmo Marconi (Marconi, 1909) at the beginning of the century, but only in 1926 did Robert Watson-Watt give it the name "ionosphere" and a year later, in 1927, Appleton confirmed its existence by receiving echoes from continuous radio waves sent upwards (Appleton, 1932).

Immediately after the discovery of the existence of radio waves in the late 1800's it was demonstrated that they could be reflected from solid objects. In 1904 the first patent application for a full radar (i.e. detection of an object and its distance) was submitted in Germany (Huelsmeyer, 1904). This idea was quickly adopted and before the Second World War radar technology was developed to a highly sophisticated level where the use of a pulsed radar signal instead of continuous wave transmission was understood to be the key issue for new technological applications.

The need for long distance communications during war time also speeded up studies of radio wave propagation paths involving reflections at the Earth's surface and in the ionosphere. In radio wave propagation studies in the late 1930s it became apparent that radio waves in the HF and VHF frequency ranges were effectively backscattered from propagating wave-like fluctuations in the auroral ionosphere, produced by plasma instabilities in the auroral electrojet (Harang and Stoffregen, 1938). These "radio auroras" appearing in the polar regions were highly varying in occurrence, intensity and extent, and seemed to depend on processes taking place in the Earth's magnetic field that were highly controlled by solar wind variations. Hence, the study of radio auroras quickly became part of magnetospheric research and various types of coherent ionospheric radars were developed to promote this research.

In 1958 William Gordon (Gordon, 1958) at Cornell University in the United States proposed that individual ionospheric electrons might react to an incoming radar signal by oscillating at the same frequency, thus producing an (incoherent) electromagnetic signal measurable on the ground. The idea was experimentally confirmed in the same year by Kenneth Bowles (Bowles, 1958) at the University of Illinois. Bowles found that each ion in the upper ionosphere is surrounded by a cloud of electrons and scattering was essentially from the clouds. Soon it was stated that the incoherent scatter method allows measurement of ionospheric electron density, ion temperature and electron temperatures, ion composition and plasma velocity. A new powerful tool for studying the Earth's ionosphere was invented. Already in the 1960's several incoherent scattering radars were built around the world and the most advanced tri-static facility (EISCAT) operating in the auroral zone began operation in 1981.

The journal *History of Geo- and Space Sciences* has decided to publish articles on the histories of various coherent and incoherent auroral and ionospheric radars. A majority of the radars are still in operation, but there are also facilities which, after having a productive scientific period of operation, have been closed. Many of the old radar systems have been upgraded to meet with the current scientific challenges. Some radars are entering a new-generation phase by being completely re- designed. The history series starts with articles describing the steps taken in various European countries to create EISCAT. Invitations to submit articles have been sent also to key persons familiar with the histories of the Jicamarca, Millstone Hill, Arecibo, Chatanika, MU-Radar, SuperDARN and STARE radars, and, obviously, this list will be extended in the future.

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