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Robert Arthur Helliwell

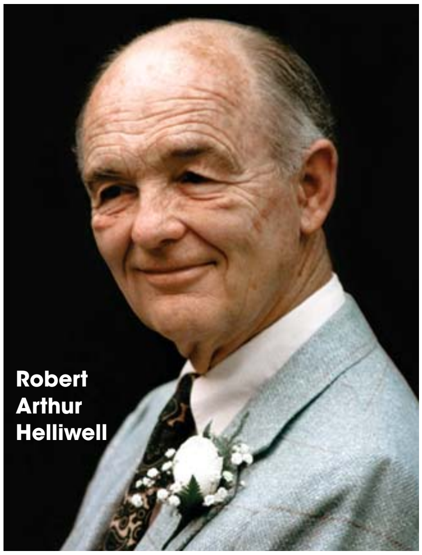
On 3 May 2011, Robert Arthur Helliwell, who broke new ground in the study of the whistler phenomenon and whistler-mode propagation in space, passed away at age 90 at his home in Los Altos Hills, California.

Born on 2 September 1920 in Red Wing, Minnesota, Helliwell spent most of his life near Stanford University in California, where he enrolled in the department of electrical engineering in 1938. He obtained BA and MA degrees in 1942, an engineer's degree in 1944, and a PhD in 1948, then remained as a faculty member. His PhD thesis, signed by Hugh Skilling, was entitled "Ionospheric virtual height measurements at 100 kilocycles."

In 1949 Helliwell serendipitously encountered the whistler phenomenon, highly dispersed radiation from lightning in the very low frequency (VLF) range. The previously unknown propagation paths of whistlers in space and their potential use for remote sensing of plasma densities at altitudes of several Earth radii were introduced by Owen Storey in 1953. Helliwell turned his full attention to whistlers and associated radio noise phenomena and established a network of VLF receivers from Alaska to Antarctica during the 1957–58 International Geophysical Year.

In their earliest observations, Helliwell and his associates found evidence that whistlers observed at ground stations propagated on discrete, or "ducted," paths aligned with the geomagnetic field. Further, the researchers found that the frequency–time dispersion properties of a whistler made it possible to identify the latitude of the field-line path it had followed. Data from the whistler network therefore became the basis for global maps of Earth's inner plasma envelope, or plasmasphere, with its unexpected sharp outer boundary, the plasmapause (first reported by one of Helliwell's associates, a former student). The network also provided material for Helliwell's highly influential 1965 monograph, *Whistlers and Related Ionospheric Phenomena* (Dover reprint, 2006).

Realizing that above the ionosphere was a rich variety of nonducted


Robert Arthur Helliwell

whistler-mode waves that did not penetrate to ground receivers, Helliwell worked with colleagues on the pioneering *Orbiting Geophysical Observatories* in the 1960s. Previously unknown classes of lightning-induced whistlers, transmissions from powerful communication transmitters, and naturally occurring discrete and diffuse VLF emissions were observed and their propagation paths inferred through ray tracing.

More than most whistler observers of his time, Helliwell took a lively interest in the energy and momentum exchanges that could, in principle, take place between subluminously propagating whistlers or other ground-injected VLF waves and the energetic electrons of Earth's radiation belts. As early as the 1960s, he and his associates were considering the possibility of active experiments in which whistler-mode wave injection might be used to reduce or increase radiation-belt particle energies through cyclotron resonance interactions. He realized early on that although the high-density, low-

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22 May 1913 – 16 September 2011

energy component of Earth's plasma envelope governed the frequency–time dispersion properties of ground-observed whistlers, the tenuous hot plasma of the radiation belts was the key to understanding the widespread occurrence of discrete or hiss-like emissions that occur either spontaneously or by some in situ triggering mechanisms.

The Siple experimental transmitter in Antarctica, established by Helliwell's group in 1973, was an engineering marvel. For almost a decade before its closing in 1988, Siple Station was host to crossed 42-km-long horizontal dipoles mounted over a 2-km-thick Antarctic ice sheet. The transmissions, in the low kilohertz range, were received in the Northern Hemisphere geomagnetically conjugate region and provided a rich reservoir of information on what came to be called the coherent wave instability. As a consequence of the CWI, weak Siple-injected narrowband waves propagating along ducts regularly underwent exponential growth by order of 30 dB to saturation levels and also triggered free-running emissions. Although Helliwell's dream to find a simple explanation for that remarkable phenomenon remained largely unfulfilled, the complexities of the CWI were nonetheless revealed, and today experiment remains well ahead of theory.

Helliwell's contributions as a researcher, teacher, and member of the science community were many. At Stanford he cultivated a strong sense of group loyalty and a collegial atmosphere in which members could work with a large measure of independence. He authored or coauthored more than 150 papers and supervised the work of 44 doctoral students. He fostered wide-ranging collaborative investigations, including many at Siple Station; served as president of the American Geophysical Union's section on solar–terrestrial relations; and chaired several committees of the National Research Council. His legacy continues through the contributions of his many former students and the ongoing work of the Stanford VLF Group.

Donald Carpenter
Umran Inan
Stanford University
Stanford, California

Simon van der Meer

Simon van der Meer, the inventor of stochastic beam cooling, passed away on 4 March 2011 in Geneva.

Stochastic cooling is essential for the increase in density of rare particle beams to obtain, for example, high interaction rate (luminosity) in a proton–antiproton collider. In 1984 the Nobel Prize in Physics was awarded to Simon and Carlo Rubbia for the discovery of the W and Z bosons in the CERN Super Proton Synchrotron (SPS) collider. Their CERN colleagues described the pair's accomplishment using a phrase coined by Gösta Ekspong, head of the Nobel Committee: Simon made it possible, Carlo made it happen. Without cooling, scientists would never have reached the density of antiprotons required to provide evidence for the existence of the W and Z bosons.

Simon was born on 24 November 1925 in the Hague, the Netherlands. His parents worked to ensure that Simon and his three sisters received a high-quality education. Despite passing his final school examination in 1943, he stayed in high school for another two years; Dutch universities were closed because of World War II. Simon's interest in electronics was sparked by his physics teacher, and he filled his home with all sorts of electronic gadgets.

He began his studies in electrical engineering in 1945 at Delft University of Technology and received his degree in 1952. Inspired by his previous practical work, Simon focused on feedback circuit analysis and related RF measurement methods. He told colleagues that those early studies may have paved the way for his main invention, two decades later, of stochastic beam cooling. But during the intervening years, his work experience deepened his knowledge in other fields of electrical engineering. His work on high-voltage equipment and electronics for electron microscopes at the Philips Research Laboratory in Eindhoven during the early 1950s helped him in designing particle accelerators, which later became the center of his professional life.

In 1956 Simon joined CERN, which had been founded in 1953. He was given the task of designing the pole-face windings for the magnets of the 26-GeV Proton Synchrotron, which is still in operation today. Limited computational tools were available then; hence the task required a lot of practice in solving complicated magnetic field problems by analytical means. That art is close to extinction today but was essential in the early days of CERN.

Inspired by discussions with his colleagues and support from supervisors John Adams and Colin Ramm, Simon became interested in particle physics. Using the framework of his magnet design, he looked for methods to produce dense neutrino beams by focusing their parent muons. That work triggered the idea of the magnetic horn, Simon's first great invention, which is nowadays used worldwide for focusing and separating different kinds of particles near a target station.


CERN
Simon van der Meer

The next step in his professional life was the $g-2$ experiment in 1965. A small storage ring was used to carry out precision measurements of the magnetic moment of the muon. Simon was a member of both the design and the measurement teams.

In 1967 Simon returned to working on magnets, but at a much higher managerial level: He was responsible for the magnet power supplies of the Intersecting Storage Rings (ISR), the 30-GeV proton–proton collider. There he made his second great contribution to particle physics, the "van der Meer" scan, a method for measuring and optimizing the luminosity of colliding beams.

During that period he devised his third great concept, stochastic cooling. The object was to improve the beam density and thus the interaction rate in the ISR. However, in 1968 the idea looked farfetched to Simon and the few colleagues with whom he shared it. In addition, it was anticipated (and confirmed right after startup in 1971) that the ISR could store already without cooling such dense beams that stochastic cooling was not useful, even impossible, given the density limitations by space charge and beam instabilities. So for another four years the idea was regarded as a curiosity and not further pursued.

In 1972, almost by accident, Schottky noise signals of the beam coasting in the ISR were observed. Those signals are due to the granularity of the beam; they are similar to the noise in a DC electron beam, identified by Walter Schottky in