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KRISTIAN BIRKELAND (1867-1917): THOUGHTS ON HIS SPACE PROPULSION IDEAS AND  
EXPERIMENTS

**Abstract**

The brilliant Norwegian-born physicist Dr. Kristian Birkeland (1867-1917) is world-acclaimed for his theories of upper atmospheric electric currents that elucidated the nature of the aurora borealis, popularly called the “northern lights.” In order to better examine the phenomena of the aurora borealis besides the near and space environment in general, he also developed and constructed, from about 1895, several models of “terellas,” a Latin term literally meaning “little Earths. ” Birkeland’s terellas simulated the vacuum environment, Earth’s magnetic fields, and electrical discharges in space and up to 1913, he was able to also simulate auroras and other cosmic phenomena, such as the Sun’s corona, sunspots, and the rings of Saturn. More than 50 years later, in 1966, Birkeland’s theories on the origins of auroras were proven correct by findings made by the U.S. Navy’s Transit 5E-1 navigation satellite. He thus became posthumously heralded as the “first space scientist” by Dr. Alv Egeland, a leading authority on Birkeland.

Far less known is that in June 1912, Birkeland also conducted what are believed to have been the world’s first experiments of cathode ray propulsion in a simulated space environment, in one of his terellas. Unfortunately, however, Professor Birkeland only considered these experiments merely as a passing curiosity and not entirely relevant to his far more significant work in unravelling the then great mysteries of the aurora. He therefore took no known notes on them, even though today, they are considered as the earliest known space propulsion experiments.

Nevertheless, for the first time, our paper focusses upon this aspect of Birkeland’s remarkable achievements and we also add considerably new background history that appears to have prompted him to undertake the experiments. We also show how Birkeland’s work on space propulsion first came to be known to the early astronautical community, although was at first misinterpreted.

Lastly, we briefly examine the earlier theoretical work on electrical propulsion for spaceflight proposed by Dr. Robert H. Goddard in 1906 and how Goddard’s theories compared to those of Birkeland, although they worked completely independently of each other. So far as is known, however, Birkeland was the first to apply his own theories on this type of propulsion and successfully demonstrate them in a laboratory in a simulated space environment.