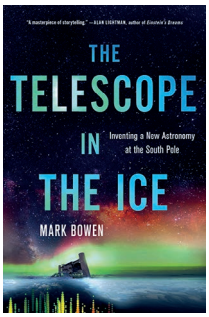
The IceCube chronicles



The Telescope in the Ice: Inventing a New Astronomy at the South Pole

by Mark Bowen

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What makes a modern scientific hero? Lone geniuses revolutionizing science through solitary thinking are a thing of the past. Today, most big discoveries are produced by hundreds of scientific minds, so heroic science legends must be more nuanced if they are to bear any resemblance to reality. That makes the modern scientific hero difficult to define. One obvious condition is that he or she made a scientific contribution of great significance. In addition, having taken risks, overcome harrowing obstacles and having persevered in the face of the most adverse conditions are distinguishing features. But modern scientific heroes may also be human and flawed, as long as there is purity in their intentions and they are driven by the search for truth and the thrill of scientific discovery alone. In *The Telescope in the Ice*, science writer and physicist Mark Bowen attempts to retell the heroic efforts leading to the construction of the neutrino telescope IceCube and portraits the scientists on whose shoulders this success rests.

It is hard to find a better example for the exploration of a modern scientific hero. Embedded in the eternal ice of the South Pole, IceCube is an amazing machine with great scientific achievements and promise. Designed for the detection of astrophysical neutrinos, it accomplished this imperative scientific goal in 2013. IceCube is now an integral part of the exciting age of multimessenger astronomy, complementing the suite of ground and space telescopes and gravitational-wave detectors.

The place and circumstances of construction in themselves deliver ample adverse conditions for splendid heroic stories: IceCube was built by burying over 5,000 digital optical modules in the Antarctic ice at a depth of 1,500–2,500 m, drilling 86 holes with a giant hot-water drill over seven austral summers. At this depth, the ice is crystal clear and bubble free. When neutrinos interact with the ice, secondary particles are produced that emit Cherenkov radiation as they travel through it. This radiation is detected by photomultiplier tubes mounted on the digital optical modules.

The risks that the pioneers of neutrino astronomy took and their perseverance are remarkable, too: IceCube is the result of decades of hard work. Several predecessor experiments, most notably the Antarctic Muon and Neutrino Detector Array (AMANDA) and the Deep Underwater Muon and Neutrino Detector Project (DUMAND), yielded very little reward other than enabling scientists and engineers to learn from the mistakes they made. Nevertheless, there was a group of scientists that never stopped believing.

From his enthusiasm for the project and the people involved, it appears that Bowen indeed wants to weave a modern heroic narrative out of this material. Unfortunately, he does not always succeed. He chronicles all the twists and turns leading to the design, approval, funding and construction of DUMAND, AMANDA and other preceding experiments, as well as IceCube itself, in minute detail, laying bare what it took to make this large-scale project a reality. This works well in the vivid descriptions of life and work at the South Pole and of the dramas of ice drilling. Entertainingly, Bowen describes the audacity of wacky characters who dared to winter at the southernmost spot of the Earth and the genius of chief ice driller Bruce Koci. Having previously published *Thin Ice*, a book about glaciology, mountaineering and climate change that also features Koci, Bowen is no stranger to the adventure/science story and has a knack for this cocktail of thrill.

For other parts of the book — for example, those dealing with conferences, bureaucratic hurdles or scientific developments — the verve of the author to record every anecdote for posterity, whether later relevant or not, makes it challenging to distinguish the main narrative thread. Good general-audience explanations of complicated scientific topics need a deep understanding of the science and utmost clarity, which is jeopardized here by the author's habit of jumping back and forth between developments and starting new topics in the middle of a chapter without prior warning. Bowen's overuse of parentheses (to remind the reader what had been going on before or what he will describe later) makes things worse.

The number of appearing and disappearing characters is greater than in *War and Peace* and, the author not being Leo Tolstoy, many of them stay one-dimensional, inanimate stock characters. There are a couple of exceptions: apart from Bruce Koci, a group of physicists at the University of Wisconsin, Madison, gathered around Francis Halzen, take centre stage, with pages and pages of quotes and comprehensive life stories. It is with this group that Bowen's loyalty lies. He describes them as a likeable and slightly rebellious group of playful boys — human, but with purity of motivation: thrilled by the science only and working towards the greater scientific truth. Undoubtedly, Francis Halzen is a towering figure and an extraordinary human being whose importance to the project of IceCube, and neutrino physics more generally, can hardly be overstated. And the same goes for his Wisconsin colleagues.

It seems unnecessary then that, in the accounts of conflicts and problems, Bowen harshly judges the behaviour of other contributing scientists — for example, Steven Barwick from the University of California in Irvine and George Smoot from Lawrence Berkeley Laboratory. Presenting practically no direct quotes, Bowen denies them the chance to explain events and conflicts from their own perspective. The lack of nuance is a missed opportunity to show that measure and balance do not diminish the prowess of modern scientific heroes.

Bowen's chronicles of how IceCube came to life almost begs the question whether it could be the instrument itself that we consider the hero of the story. As the pioneers of neutrino astronomy make way for a new generation of enthusiastic scientists, it is IceCube that remains, buried deep under the Antarctic ice and patiently waiting for astrophysical neutrinos to arrive on Earth. ❐

REVIEWED BY LEONIE MUECK

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