

Notes on the history of nuclear physics FREE

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Letters

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The good article by Joseph Reader and Charles Clark (PHYSICS TODAY, March 2013, page 44) about the history of nuclear physics brought back some pleasant memories of Ferdinand Brickwedde (1903–89). He was a Pennsylvania State University physics professor who lived just across the street from my family in State College. It was amazing to listen to him tell about how he and Harold Urey discovered deuterium in 1931. Brickwedde retired from his professorship in 1968.



Commemorative medal issued by the Norwegian Home Guard's Chief of Defense for the 70th anniversary of the successful Operation Gunnerside raid on the Norsk Hydro heavy-water facility, 27–28 February 2013. Medal maker: Per Hauge.

I have minor corrections to Reader and Clark's account. They incorrectly write that Allied bombing forced the Germans to abandon the Norsk Hydro heavy water plant in 1942.

Leif Tronstad, a professor of physics at the Norwegian Technical University in Trondheim before he escaped to Britain during World War II, saw early on the possible dangers of Adolf Hitler's obtaining a nuclear bomb. Tronstad warned the Allies that heavy water from the Norsk Hydro factory at the Vemork hydroelectric power plant at Rjukan could be used in Hitler's experiments toward making a nuclear bomb.

The British First Airborne Division, using two Halifax bombers each pulling a Horsa glider plane with paratroopers on board, attempted to destroy the factory in November 1942. The Allied raid, called Operation Freshman, failed when three of the four planes crash-landed in bad weather and survivors were executed by the Germans; 41 British soldiers died altogether.

Tronstad next planned a raid by Norwegian commandos. Four paratroopers who had been sent prior to Operation Freshman as an advance party for the British raid would be joined by six more, as part of Operation Gunnerside. The two groups of Norwegian soldiers joined forces and made a successful attack on the factory on the night of 27–28 February 1943. With one man serving as lookout, the remaining nine crept along the un-mined railway track up to the factory and blew up the heavy-water production cells and tanks containing 900 liters of heavy water. Not one shot was fired in that successful second raid, and nobody was killed or injured. Afterward, several of the Norwegian soldiers skied cross-country for two weeks and escaped to Sweden; the others remained in Norway.

In the 1948 Norwegian documentary film *The Battle of the Heavy Water*, several of the military personnel appeared as themselves. The British adventure film *The Heroes of Telemark* was made in 1965, starring Kirk Douglas and Richard Harris, but it did not accurately depict the operation. Reader and Clark therefore should not have cited that film as a historical reference.

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■ **The March 2013 article** by Joseph Reader and Charles Clark credited Carl Anderson and Seth Neddermeyer for discovery of the muon in March 1937, without mentioning the independent, complementary, and only slightly later report by Curry Street and Edward Stevenson the next month. That the two groups used different techniques makes the combined result much more robust than if only a single experiment had been done. The two efforts are discussed in detail by Peter Galison in his book *How Experiments End* (University of Chicago Press, 1987).

The authors also at best oversimplify when they say that Anderson "beat to the punch" Patrick Blackett and Giuseppe Occhialini in the discovery of the positron. In fact, on the one hand, the latter work was several months later, so the suggestion of a race with one winner is hardly fair, but on the other hand, Blackett and Occhialini were able to detect pair creation of electron and positron together and thus verified directly that the positron is the antiparticle of the electron. That history is discussed beautifully by Norwood

Russell Hanson in *The Concept of the Positron: A Philosophical Analysis* (Cambridge University Press, 2010, originally published in 1963).

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■ **Reader and Clark reply:** We did not write that Allied bombing forced the Germans to abandon the Norsk Hydro heavy water plant in 1942. We wrote that "the Allies undertook to disable the Norsk Hydro plant. Because it was nestled among steep mountains, aerial bombardment was difficult. But eventually Allied bombing forced the Germans to abandon the plant." The two commando raids that Tom Segalstad mentions were a gripping part of the story of the Norsk plant. Indeed, that was part of our originally submitted article that did not make it to the final draft.

After the successful attack by the Norwegian commandos on 27–28 February 1943, the plant was rebuilt and soon returned to operation. As documented in reference 5 of our article, the plant was bombed by the Americans on 16 November 1943. Knut Haukelid, one of the Norwegian commandos, relates in his book, "But the bombing was successful as far as the production of heavy water was concerned. The management of Norsk Hydro succeeded in convincing the Germans that further manufacture was useless, even after rebuilding; so production at Vemork was stopped."¹

Like many films, *The Heroes of Telemark* occasionally prefers dramatic effect to historical accuracy, but it is a good overall portrayal of the story, can be easily obtained for viewing, and is accessible to a general audience.

Alfred Goldhaber's remarks are a welcome addition to the story of the heroic era of research treated in our essay. The report of Patrick Blackett and Giuseppe Occhialini is indeed a masterpiece of experimental virtuosity and analysis.

Reference

1. K. Haukelid, *Skis Against the Atom: The Exciting, First Hand Account of Heroism and Daring Sabotage During the Nazi Occupation of Norway*, North American Heritage Press, Minot, ND (1989), p. 178.

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