Samuel Abraham Goudsmit: The physicist who hunted for Hitler's atom bomb

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Samuel Abraham Goudsmit (1902-1978) is "famous for jointly proposing the concept of electron spin with George Eugene Uhlenbeck in 1925", or so an anonymous contributor to Wikipedia informs us (Wikipedia contributors 2018).[1] Famous? Really? He seems to be virtually unknown outside the world of physics. Martijn van Calmthout, chief science editor of *De Volkskrant*, has sought to change this with a biography of Sam Goudsmit published in 2016 (Van Calmthout 2016). I recently finished translating it for a US publisher (Van Calmthout 2018). Assuming the book gets some publicity, it should earn recognition for a man who certainly deserves it.

Goudsmit was born in Den Haag, the younger of two children in a petit-bourgeois Jewish family. His parents worked in the retail sector as owners of small enterprises, and the family was financially comfortable without being wealthy. Goudsmit himself was earmarked for the world of trade and commerce, but he showed an early interest in science, and after graduating from the gymnasium in 1922, he entered Leiden University, the first in his family to attend university.

Among the people Goudsmit met there were two men who had a lasting influence on his life and career. One was the brilliant professor of theoretical physics, the Austrian-Dutch Paul Ehrenfest; the other was Goudsmit's fellow student and friend for life, George Eugene Uhlenbeck. (You may remember hearing this last name before: Uhlenbeck was the nephew of C.C. Uhlenbeck, the anthropologist and linguist who studied the language of the Blackfoot and about whom Mary Eggermont-Molenaar has lectured and written. See Eggermont 2005 and Genee & Hinrichs 2009.) Goudsmit seems to have been the more intuitive of the two, Uhlenbeck the more methodical. The two were working together in the summer of 1925 when they came up with a solution to a problem that had been puzzling physicists for some time: the nature of some kind of internal circular

[1] This is the text of a presentation delivered to the annual meeting of the Canadian Association for the Advancement of Netherlandic Studies / Association canadienne pour l'avancement des études néerlandaises (CAANS-ACAEN) held at the University of Regina in Regina, Saskatchewan, on May 26-27, 2018.

motion in the atom. The solution was the electron spin. The two students might have kept this idea to themselves, but Ehrenfest arranged for its publication in *Naturwissenschaften*, at that time the leading journal in physics. It appeared in November 1925 and, in one stroke, made the two students famous (Uhlenbeck & Goudsmit 1925). They never got the Nobel Prize for their discovery, although they were nominated many times. However, Isidor I. Rabi, a Nobelist in physics, later remarked: "Physics must be forever in debt to those two men for discovering the spin" (Encyclopedia Brittanica 2018).

In 1927, Harrison M. Randall, head of the Department of Physics at the University of Michigan, recruited both Goudsmit and Uhlenbeck, in the process laying the basis for what would become one of the pre-eminent departments in theoretical physics in the United States. That year, too, Goudsmit obtained his doctorate from Leiden and married Jeanne (Jaantje) Logher. The couple had one child, Esther.

For the next fourteen years Goudsmit and his family lived in Ann Arbor, although he got back to the Netherlands more than once. In any case he was not isolated from the European world of physics, at that time more important than the North American one. Even before 1927 Randall had launched a summer school that brought physicists from Europe to meet with their counterparts in the United States. Among the European visitors were Ehrenfest, the Italian Enrico Fermi, and the German Werner Heisenberg. Fermi had studied under Ehrenfest, and Heisenberg had also visited Leiden. He and Goudsmit first met there in the mid-1920s, and they became good friends.

For years Goudsmit entertained the hope that he would be offered the professorship at the University of Amsterdam, which was held by the Nobelist Pieter Zeeman until 1935. When the position was offered to him in 1939, however, Goudsmit declined it. He had become concerned about political developments in Europe and especially in Germany. Indeed, he tried to persuade his reluctant parents to emigrate to the U.S. The visas did not arrive in the Netherlands until May 1940, however, and Isaac and Marianne Goudsmit either never got them or were unable to arrange passage. They were murdered in Auschwitz in 1943. Goudsmit's sister Rachel was able to flee to France and eventually reached the United States, but almost all members of the extended Goudsmit family met a violent end during the Nazi years.

In 1941 Goudsmit volunteered for war-related research, working on radar at the Massachusetts Institute of Technology. Two years later he was asked to become the scientific head of the Alsos Mission.

Unlike the Manhattan Project, to which it was intellectually linked, Alsos is little known today. The Manhattan Project was the name given to the effort to produce a nuclear weapon. The origins of the project date from 1938-1939, when

the German physicists Otto Hahn and Fritz Strassmann, and the Austrian physicists Lise Meitner and her nephew Otto Frisch – he later worked on the Manhattan Project – discovered nuclear fission. The possibility that this discovery could lead to a new and more powerful weapon than any so far known, and information that the Germans were probably trying to develop such a weapon, prompted the United States government to move aggressively in this direction. A key contributor in this process was Goudsmit's and Uhlenbeck's friend Enrico Fermi.

Fermi, whose wife was Jewish, left Italy after the promulgation of new racial laws in 1938 and moved to the United States, where he became a key figure in the Manhattan Project when it was established in 1942. While teaching at the University of Chicago, Fermi was in charge of the first major step in the building of the atom bomb. "In the squash courts under the west stand of the University's Stagg Field, Fermi supervised the design and assembly of an 'atomic pile,' a code word for an assembly that in peacetime would be known as a 'nuclear reactor'" (Arbeitsgruppe Radiochemie n.d., 2). On December 2, 1942, the first self-sustaining chain reaction, initiating the controlled release of nuclear energy, was accomplished here.

This was of key importance in the development of the atom bomb. It also demonstrated the importance of knowing how far the Germans were in their progress to such a weapon. General Leslie Groves, who had been appointed director of the Manhattan Project in September 1942, launched the Alsos Mission in early 1943. Its objective was to find out whether and how far the Germans had progressed to an atom bomb. Put in charge of it was a military intelligence officer, Colonel Boris Pash, while Goudsmit was made the scientific head of the mission.

Goudsmit seemed made for the part. Although he was a theoretical physicist, he was not part of the Manhattan Project. This meant that, were he to fall into enemy hands, he would not be able to tell the Germans anything about the progress American scientists and engineers were making toward an atom bomb. He spoke four languages, Dutch, English, French, and German, and, most important, he knew all the leading German physicists personally. Some, like Heisenberg, were friends. His personal connections in the community of German physicists, it was thought, would help him in interrogating them once they had been taken into custody.

Goudsmit gave his own account of the Alsos Mission in a memoir published soon after the war (Goudsmit 1983 [1947]). The first year of Alsos was one of staffing the operation and preparing for the work that would begin once the Allies had a foothold in northwestern Europe. On D-Day, Goudsmit flew to London, where his team was put together and equipped. In late August, he and members of his team flew to Cherbourg and drove to Paris. This is where the real work was supposed to begin, but the breakthrough came only after Pash and his men

entered Strasbourg University in November 1944. At this institution, Germanized after Alsace was incorporated into the German Reich in 1940, several notable physicists had been working, among them the prominent nuclear physicist Carl Friedrich von Weizsäcker. Goudsmit reached Strasbourg a few days after Pash. From the documents that were captured he concluded that the Germans had either just recently reached the point that the Americans had in late 1942, or were not even that far yet. "Everything is still at the academic stage. The conclusion is in any case clear: *there is no German atom bomb*" (Van Calmthout 2018, 97). But when he spoke about this to Major Robert Furman, the information officer assigned to him, with a sense of relief, and said that now the American bomb would not have to be used, the more realistic Furman set him straight: "Of course you understand, Sam, if we have such a weapon, we are going to use it" (Goudsmit 1983, 76).

Figure 1. ALSOS members Goudsmit, Wardenburg, Welsh and Cecil, November 1944. Author: US Army. Image in the public domain.

Goudsmit might have been sure no German atom bomb existed, but all the same, after the Allies crossed the Rhine in March 1945, the Alsos team was soon visiting small communities in Württemberg where the Germans' nuclear project had moved after bombing raids made life and research in the Berlin area increasingly hazardous. At Haigerloch and Hechingen, in the area between Stuttgart and the Bodensee, the Alsos team found evidence of experiments indicating that the Germans had been working on nuclear power but had been far from developing a

nuclear weapon. This assessment did not change when prominent German physicists, having been taken into custody, were interrogated by Goudsmit and other scientists. The most prominent of the captives was Goudsmit's old friend Werner Heisenberg. He, like the other physicists, was taken to Alsos headquarters in Heidelberg and interrogated. Later, from July 3, 1945, to January 3, 1946, ten of them, including Hahn, Weizsäcker and Heisenberg, were interned at Farm Hall, an estate outside Cambridge, England, as part of a project known as Operation Epsilon. Every room had concealed microphones in it, and everything the men said was recorded for later analysis. (The Farm Hall Tapes were released in 1992 and eventually formed the basis of a play.)

The tapes confirmed the conclusion Goudsmit had reached before the end of 1944: the Germans had been nowhere near making an atom bomb. Given that nuclear fission was first accomplished by German and Austrian scientists, what explained the German failure to develop a nuclear weapon? Goudsmit offered his explanation in the March 15, 1946, issue of the *Bulletin of the Atomic Scientists*, expanding it a year later in his ghostwritten book, *Alsos*.

In his *Bulletin* article Goudsmit explained, point by point, what the Germans and their scientists thought they were doing in the years from 1939 to 1945:

> 1. An energy-producing uranium engine is more likely to succeed than a bomb. In fact, they had entirely abandoned the hope of making a bomb during this war.
> 2. An atomic bomb is an [sic] uranium engine which gets out of control; therefore the road towards a bomb leads via the construction of the uranium engine.
> 3. To make a bomb of pure plutonium never entered their minds, or at least was not considered feasible and not taken seriously. The idea of using a pile to produce plutonium and to make a bomb out of that material came to them only slowly, after the detailed radio descriptions of our bomb in August 1945.
> 4. An [sic] uranium engine is just as important as a bomb because it will make Germany economically self-supporting by the enormous power it may produce. (Goudsmit 1946, 4)

The remarkable thing was that throughout the war the Germans thought they were far ahead of all competitors. Only after the American atom bombs fell on Japan in August 1945, did they realize how far behind they had been. Goudsmit thought the physicists themselves could not be held responsible: the suffocating Nazi regime handicapped science. Moreover, several different departments worked separately on the uranium problem. That lack of coordination was corrected only in 1943, and by then it was too late.

By the end of the war the Germans knew from their experiments that augmentation of the liberated neutrons in a nuclear reaction was possible, but they certainly did not have a self-maintaining source of neutrons (necessary for a reactor or a bomb). Nevertheless, the German nuclear scientists thought that not only would the German route to atomic energy prove interesting for the world, but it would also put German science on the map after the war. "These thoughts were, indeed, the driving force behind the German scientific efforts" (Goudsmit 1946, 5).

Goudsmit estimated that altogether the Germans had put around ten million dollars into nuclear research, and that in all those years at most a hundred scientists had worked on it. Both were a small fraction of what the Americans and their Allies had devoted to the Manhattan Project.

Goudsmit's version of the events did not go unchallenged. Werner Heisenberg, in particular, took issue with his friend's analysis of the German failure to develop a bomb. He was offended by Goudsmit's assertion that the Germans had not fully understood the physics of a nuclear weapon, and set out to explain that the real, perhaps the only, problem facing German physicists was a lack of resources. He also signaled a reluctance to pursue the military potential of nuclear fission.

Benjamin Bederson later wrote, in an article commemorating the thirtieth anniversary of Goudsmit's death:

> Over many years Goudsmit and Heisenberg engaged in a coolly polite argument concerning the actual quality of the German effort, complicated by some later discredited claims of German passive resistance to bomb research. Even so, Goudsmit states in an obituary of Heisenberg that his scientific accomplishments were 'as revolutionary as those of [Albert] Einstein and as profound as those of [Niels] Bohr,' but he also states 'many of us hoped that he would have been more outspoken in condemning the Nazi regime.' This was about the most direct criticism that Goudsmit could level at his revered colleague and erstwhile good friend. (Bederson 2008, 3)

Goudsmit's post-Alsos career has interest for the historian of science as well. In 1946 he joined the faculty of Northwestern University. Two years later he moved to the newly-established Brookhaven National Laboratory on Long Island, where he served as head of the physics department. He was also the long-time editor of the *Physical Review* and, after 1958, of the *Physical Review Letters*, which he helped found. These positions made him a gatekeeper in the worlds of American and international physics: he knew everybody, and everybody knew him. He also contributed regularly to the *Bulletin of the Atomic Scientists*, and spoke regularly in public, in the United States and also in the Netherlands.

When he retired in 1974, he moved to Nevada, with his second wife, Irene Bejach. He taught part-time at the Reno campus of the University of Nevada until his sudden death of a heart attack on December 4, 1978. The headline of his obituary in *The New York Times* read: "Samuel Goudsmit, Codiscoverer of Electron's Spin, Is Dead at 76." His work during the war and at Brookhaven was mentioned at length, as well as his editorship of *Physical Review* and *Physical Review Letters*. "Long a leading figure in American physics," was the science editor's assessment (Sullivan 1978). To this must be added that Goudsmit was an accomplished Egyptologist, having become interested in the subject while studying at Leiden. He occasionally wrote about Egyptology, and he left his collection of Egyptian antiquities to the Kelsey Museum of the University of Michigan.

The obituary that appeared in the *Physical Review Letters* in early 1979 concludes in this way: "Though few men have contributed more than Sam to the shape of the world physicists know today, the private memories many of us have of Sam's kindness and consideration, all salted with his bluff wit, are not less important than his more concrete achievements" (Adair et al., 1). May his memory be a blessing.

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