

A Nobel tale of wartime injustice

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Recently released documents give the inside story of Otto Hahn's 1944 Nobel prize in chemistry for the discovery of nuclear fission. They reveal flaws in the award-making process — and an attempt to rewrite history.

MANY historians think that an injustice was done in 1945 when Otto Hahn was awarded the 1944 Nobel prize in chemistry for the discovery of nuclear fission. From the beginning the award was controversial and seemed unfair because Hahn's two colleagues, the physicist Lise Meitner and the chemist Fritz Strassmann, did not share in the prize¹.

The Royal Swedish Academy of Sciences' official records of the Nobel prize deliberations of 1945 were released to scholars after the usual 50-year delay. These documents, together with records from earlier years and private correspondence², shed light on why Hahn was honoured and Meitner and Strassmann were not. Although 1945 was the year of the final decision, it marked the end of a long process that began when nuclear fission was first announced in 1939. Taken together, the documents do not present a complete picture, but they do reveal flaws in the Nobel decision-making process. They show the difficulty of evaluating an interdisciplinary discovery, and a lack of scientific expertise in theoretical physics. And they shed light on Sweden's scientific and political isolation during the Second World War, which hindered understanding of Meitner's contributions to the discovery.

The discovery of nuclear fission, late in 1938, was the end-result of a complex investigation pursued by physicists and chemists across the world. The story began in 1934 in Rome when Enrico Fermi first irradiated uranium with neutrons, detected several new radioactive species and suggested that transuranic elements had been produced. In Berlin, Meitner, Hahn and Strassmann formed an interdisciplinary team that relied on analytical chemistry and radiochemistry for assigning the activities to specific elements and isotopes and on nuclear physics for measuring and interpreting the reaction parameters and mechanisms. Meitner, who was of Jewish origin, fled Germany in July 1938 and took a position in Stockholm.

Their collaboration continued, however, through Meitner's regular correspondence with Hahn and in their crucial meeting in Copenhagen in November

1938, when she objected to the most recent findings and urged him to verify them. A few weeks later, Hahn and Strassmann identified barium among the uranium products — evidence that the nucleus had split. Meitner was informed and, with her nephew, the physicist Otto Frisch, provided the first theoretical interpretation of the fission process.

In Nazi Germany, however, joint publication was not an option. Hahn and

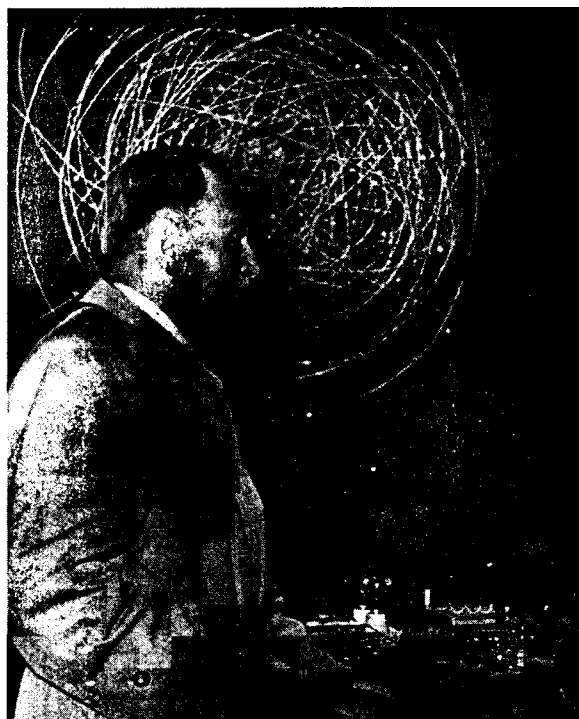
mittees evaluate only scientists who have been nominated. Nominations may be made by Swedish and foreign members of the academy, members of the committees for physics and chemistry, Nobel laureates in physics and chemistry, and invited scientists. The nominating period ends on 1 February. A select group of candidates is examined in special reports prepared by a committee member. These reports are discussed in the committees and summarized in a general report, which ends with a recommendation. The special and general reports are the basis for the academy's decision, which must be made before 15 November.

Over the years, the committees' work had come to reflect two principles: precedence — each new decision should reflect the accumulated wisdom of previous ones; and consensus — all recommendations should have the full support of the committee. Both principles came into play in the case of Hahn, Meitner and Strassmann. Radioactivity and radioactive elements had traditionally been subjects in the domain of the chemistry committee³. Until 1945 nuclear fission was always evaluated in this committee — even though it was discussed in the physics committee — with important consequences.

Both Hahn and Meitner had been nominated repeatedly for Nobel prizes, but they had never been recommended for an award.

The discovery of nuclear fission in December 1938 changed all that. By 1 February, the deadline for the 1939 prizes, Theodor Svedberg, chairman of the chemistry committee, proposed an undivided prize for Hahn. Svedberg ignored Strassmann, probably because he was the junior member of the team, but did suggest that the prize might be divided between Hahn and Meitner because of their prior collaboration.

In his report, Svedberg mentioned the article in *Nature* in which Meitner and Frisch gave the theoretical explanation for fission, but he apparently misunderstood it or did not read it carefully. Meitner and Frisch had used the liquid-drop model developed by Niels Bohr and others as the basis for their theoretical explanation. But



Otto Hahn: winner of the 1944 Nobel prize in chemistry.

Strassmann published the barium finding in *Naturwissenschaften* in January 1939; Meitner and Frisch's theoretical note appeared in *Nature* the following month. These separate reports seemed to split the discovery between chemistry and physics, experiment and theory, and Germans and émigrés. Rather than reflecting the science, which remained interdisciplinary to the end, the divided reports were the result of Meitner's forced emigration and the political oppression of the time.

Nobel prizes in the physical sciences are awarded through a three-stage process involving the committees for physics and chemistry, the relevant sections of the academy and, finally, a meeting of the entire academy. The five-member com-

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Svedberg noted only that Bohr's liquid-drop model had been used, without mentioning that Meitner and Frisch had used it. Indeed, as proof that Bohr was responsible for the theoretical explanation, Svedberg cited articles that Bohr had published after the appearance of Meitner and Frisch's paper, and which built on their work.

The war created unusual circumstances for the evaluation of candidates. The prizes were deferred in 1940, cancelled in 1941 and 1942, and reserved in 1943. Finally, in 1944, the reserved 1943 prizes

handed the matter over to the chemistry committee. In 1943 Manne Siegbahn, chairman of the physics committee, attempted to reopen the question and nominated Hahn alone for the physics prize. Nuclear fission, he wrote, "lies on the boundaries between physics and chemistry". But the physics committee again decided to refer the evaluation to the chemistry committee.

The chemistry committee remained in charge of the matter until 1945. There were no external nominations, but Hahn's candidacy was kept active through a

de Hevesy had already been recommended for the 1940 prize in chemistry, it placed Hahn in line for the next award. Dissension arose within the committee in 1942. Wilhelm Palmaer proposed that the prize should be divided between Hahn and Meitner, whereas Westgren argued that it should be awarded to Hahn alone. Palmaer referred to arguments made in Svedberg's 1939 report and to Meitner's work in 1939 and later. However, when Palmaer died in June 1942, Westgren's opinion gained the upper hand.

That year, Westgren was charged with

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Beyond recognition: Lise Meitner and her collaborators Otto Frisch (left) and Fritz Strassmann (right).

were awarded in physics, chemistry and medicine. Invitations were sent out to nominators, although because of the war the invitations and replies did not always arrive. The committees also continued to evaluate and, to some extent, rank candidates. But wartime conditions made it difficult for committee members to consult informally with members of the international scientific community. So, more than in peacetime, they had to base their evaluations on articles in scientific journals, which often arrived after great delay.

Some international nominators urged that nuclear fission should be recognized by a Nobel prize in physics. The Nobel prize-winning physicist James Franck nominated Hahn and Meitner for a joint award every year from 1940 to 1943 and drew attention to the fact that Meitner had not "co-worked" the paper published by Hahn and Strassmann because she had been forced to leave Germany. She and Frisch were the first to see the "importance of the result" and to conclude that the fission products would "fly" with "tremendous energy".

In its 1941 general report, however, the physics committee noted that Hahn and Meitner had been nominated for a Nobel prize in chemistry and that their work appeared to "belong to chemistry", and

nomination made each year by the committee secretary Arne Westgren, professor of chemistry at the University of Stockholm, who became a committee member in 1943.

In 1941 the chemistry committee asked Svedberg to update his 1939 evaluation in view of the intense research activity in the field. The subsequent report listed more than 150 publications in leading journals dealing with various aspects of fission research. Svedberg also alluded to the possibility of a chain reaction and to the enormous energy it would release. He argued that "Hahn's discovery" was fundamentally important for nuclear chemistry.

By contrast, Svedberg noted that Meitner had not produced works of "great importance in the past two years" (while living in Sweden after having been forced to flee Germany) and claimed that the work she had published alone or together with Frisch in 1939 had not "significantly influenced developments in the field". Svedberg's bibliography listed Meitner and Frisch's *Nature* article giving the theoretical explanation for fission, but he again cited only Bohr's theoretical work in the text. The committee followed Svedberg's recommendation and agreed that a Nobel prize in chemistry should be awarded to Hahn alone. Because George

evaluating the respective merits of Hahn and Meitner. Westgren first attacked the argument that Meitner's and Hahn's joint researches had significantly contributed to the discovery of nuclear fission. Indeed, Hahn himself had not acknowledged Meitner's contributions, both theoretical and experimental, made in letters and in person, during the critical period just before the discovery of barium as a fission product.

Westgren then dismissed the claim that Meitner had contributed to the understanding of nuclear fission after its discovery. The Swedish chemist cited only Meitner's and Frisch's experimental work confirming the existence of fission products, and pointed out that such confirmation had been provided by many scientists. Once again, their theoretical explanation was not mentioned. Instead, Westgren reiterated Svedberg's opinion that Bohr had made the major contribution. He concluded that if Meitner had not been forced to break off her collaboration with Hahn in 1938 because of "unhappy circumstances", she would no doubt have participated in the investigations that led to the discovery of fission, and a joint award would have been "justified".

Westgren's firm stand and the committee's position on the issue of a divided

prize did not change during the rest of the war. After his election to the committee in 1943, Westgren moved to the key position of chairman and became permanent secretary of the academy. He proposed Hahn for foreign membership of the academy (an honour that, for other scientists, had preceded a Nobel prize) and may have arranged for him to give a talk at the academy when he visited Sweden in the autumn of 1943.

In 1944 the committee's general report recommended that Hahn should be awarded that year's prize for chemistry. At the same time, de Hevesy was put forward for the prize that had been reserved in 1943. The chemistry section and the academy went along with the committee's recommendation of de Hevesy, but they rejected the one for Hahn, and the 1944 prize was reserved until the following year. The committee's recommendation may have leaked out, for Hahn and others were now certain that the prize had been set aside for him.

Hahn's Nobel prize in chemistry was finally decided in 1945. There was still only one nomination in chemistry — Westgren's for Hahn. In physics there was now a smattering of nominations for the discovery of nuclear fission, including, most importantly, Meitner and Frisch by Oskar Klein, professor of theoretical physics at the University of Stockholm. Klein argued that the discovery of nuclear fission had a chemistry and a physics side and that Meitner and Frisch's theoretical explanation of the phenomenon made them co-discoverers together with Hahn. Furthermore, their article in *Nature* had been the foundation for all subsequent theoretical work, including that by Bohr and John A. Wheeler. At the end of February 1945 Klein was elected a member of the academy, putting him in close contact with decision-making about the prizes and, among other things, giving him access to the committees' general and special reports.

Klein's nomination forced the physics committee to grapple with the issue of rewarding Meitner and Frisch, while the question of a prize for Hahn remained with the chemistry committee. After preliminary discussion during the spring, Erik Hulthén, professor of physics at the University of Stockholm, spectroscopist and member of the Siegbahn school, was asked to evaluate Meitner and Frisch's contribution. Hulthén's three-and-a-half page memorandum, dated 9 June 1945, was based on the 1939 articles in *Nature* and *Naturwissenschaften*, the only information, as he pointed out, available to him. Hahn's and Strassmann's articles in *Naturwissenschaften* showed that they had grasped the process of fission "to the fullest extent". Even if Meitner and Frisch had made an important contribution to the understanding of the physical side of

fission, Hulthén concluded, so had many other researchers.

Hulthén's negative report led Klein to contact Bohr, the obvious person to appraise Meitner and Frisch's theoretical contribution. Klein felt that Meitner had not been treated fairly by Hahn. But Bohr, who had fled Denmark in October 1943, was still in the United States. Klein entrusted Hulthén's report to Bohr's wife, Margrethe, who was travelling to meet him, and asked Bohr to make a statement that he could present when the physics section met in October.

At the end of the war, Hahn and nine colleagues connected in varying degrees with the wartime nuclear fission project were rounded up by Allied forces, brought to England and interned at Farm Hall, a country manor near Cambridge. On 6 August they heard the news that the atomic bomb had been dropped on Hiroshima. Hahn was hit hard by the realization that nuclear fission had been used as a weapon of mass destruction. But it is perhaps most interesting to note that Hahn and his colleagues immediately began writing Meitner out of the discovery of nuclear fission as part of the apology they developed at Farm Hall⁴.

By contrast, the importance of Meitner and Frisch's theoretical contribution was clearly stated in the first reports on the Manhattan Project prepared by the British and US governments and published a month after Hiroshima. Bohr, who had returned to Copenhagen in late August, sent both reports to Klein. Bohr felt that simultaneous awards to Meitner and Frisch in physics and Hahn in chemistry, both men having been involved in atomic bomb projects but on opposite sides, could perhaps help the cause of international control of atomic energy. Klein contacted Hulthén to discuss the matter, but learned that the physics committee was going to recommend Wolfgang Pauli, a long-standing candidate for the prize. Klein now concentrated his efforts on the chemistry committee in the hope of stalling an award to Hahn in order to allow a re-examination of the discovery.

When the chemistry committee handed in its report to the academy in late September, it recommended unanimously that the decision should be deferred. Surprisingly, this was motivated not by a desire to re-evaluate the original discovery but "by the revelations which have been made lately in connection with the sensational news about the atomic bomb". The members of the committee seemed concerned that unpublished research carried out by Allied scientists in the Manhattan Project had escaped their notice. Putting off rewarding the discovery would enable them to gain more exhaustive knowledge about "contributions that might even be on a par with the original discovery".

As the November meeting of the full

academy drew closer, Klein had reasons to hope that his campaign to fend off an award to Hahn in chemistry would be successful. Despite Hulthén's negative evaluation, the physics committee had left open the matter of an award in physics for nuclear fission. When the full academy meets to decide the year's prize-winner, the discussion is normally a closely guarded secret and the vote is not recorded. But we know what happened in 1945 because of information contained in a letter Klein wrote to Bohr. There were two motions: one, that the 1944 prize in chemistry should be reserved; the other, that it should be awarded to Hahn. Westgren, and especially Svedberg, pleaded that the prize should be reserved because the committee's previous evaluations had been made without the information now available in the United States and France. Klein spoke along the same lines.

But the physiologist Göran Liljestrand, professor at the Karolinska Institute and an influential member of the academy, did not accept that argument and spoke strongly in favour of Hahn. Klein felt that other members, who did not speak at the meeting, were also disturbed by the abrupt reversal of Svedberg and Westgren, which they felt had been caused by political motives, especially the wish to be favourably viewed by the United States. When the vote was taken, slightly more than half the votes were cast in favour of the motion to award Hahn the prize.

Following this decision, efforts were made to rectify the injustice to Meitner by nominating her for a prize in either physics or chemistry, alone or together with Frisch. Fuller knowledge about why these and other nominations were not successful will have to await the year-by-year opening of the Nobel archives and, very likely, the private papers of the scientists involved. Any subsequent award to Meitner might have implied that the academy had made a mistake. In any case, it was much easier to close the books on the discovery of nuclear fission and move on to other scientists whose work also deserved a Nobel prize. □

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