Hilde Levi:
A Jewish Woman's Life in Physics in the 20th Century

Rebecka Mähring

September 30, 2023

Hilde Levi (1909-2003) was a prolific and versatile physicist. During her 50-year career, Levi conducted research on the frontiers of biophysics; taught radioisotope applications; introduced radiocarbon dating to Denmark; drafted legislature on radioactive safety; and more. After her "retirement" in 1979, Levi became a historian of science, and helped assemble the materials at the Niels Bohr Archive. Among these is an oral history of her life, which when transcribed amounts to over 120 pages.

Figure 1: Hilde Levi, circa 2000. (Niels Bohr Archive, Hilde Levi Collection)

Although Levi doubted whether her story would "ever be used for any purpose except to supplement to a modest degree" existing information about the Niels Bohr Institute and its famous physicists (Niels Bohr Archive; *Recollections of Hilde Levi*[1], 13), her own life is of immense value to historians. Firstly, it contributes to growing scholarship on how the careers of female Jewish physicists were impacted by WWII, where earlier studies have focused primarily on well-established physicists such as Lise Meitner (Lewin Sime 1996) and Marietta Blau (Lewin Sime 2013). Secondly, it contributes to scholarship (Abir-Am & Outram 1987) on how women in science continuously renegotiate their identities as women and scientists and navigate the expectations of the predominantly male professional community. Lastly, Levi's career challenges the idealization of specialization in science. In this paper, I draw on Hilde Levi's scientific publications and her rich oral history, thereby providing unprecedented detail and insight into her life.

[1] Citation is hereafter shortened in text as *"Recollections"*.

Biographical Account

On January 30, 1933, Hitler came to power. Levi recalls hearing the announcement on the radio and immediately bursting into tears since she "realized that this was the end of my possibilities for a future in Germany" (*Recollections,* 4). Despite her fear, Levi stayed in Berlin until she had finished her thesis and passed her final examinations (*Ibid.,* 4-5). Once done, she reached out to the Danish branch of the International Federation of University Women, which arranged with Niels Bohr for her to come to the Niels Bohr Institute (*Ibid.,* 7). At the age of 25, Hilde Levi therefore left Germany and her family, and moved alone to Copenhagen.

Over the following six years, Levi worked as a research assistant at the Institute. During 1934-1935, she and James Franck investigated photosynthesis from a physical perspective (*Ibid.,* 9), and co-authored two papers on the fluorescence of chlorophyll (Franck & Levi 1934; Franck & Levi 1935). Levi transitioned to working with George de Hevesy in 1935 (*Recollections,* 10-11). They studied induced radioactivity in rare earth elements (Hevesy & Levi 1935, Hevesy & Levi 1936) and radioactive isotopes as tracers in biological processes such as animal metabolisms (Hevesy *et al.* 1938, Hevesy *et al.* 1940). Hevesy travelled widely, and Levi therefore frequently performed their planned experiments alone (*Recollections,* 16). Additionally, Levi assisted Otto Frisch extensively in 1935 (*Ibid.,* 14-15) and Lise Meitner briefly in 1939 (*Ibid.,* 38), but did not publish with either.

Levi's background was not in biophysics[2], and she therefore had to learn new concepts and experimental techniques. Furthermore, since radioisotopes were quite new, scientists at the Institute built much of the necessary equipment themselves. With Franck, Levi assembled the optical bench and spectrographs (*Ibid.,* 9); with Frisch, she built Geiger counters, amplifiers, and even resistors (since there were none of the necessary ninth-order Ohm resistors commercially available) (*Ibid.,* 14-15).

Levi was also adept at fostering connections and friendships, both with male scientific staff and with female secretaries and wives of physicists. She recalls going on evening bike rides and visits to Tivoli (Copenhagen's amusement park) with others at the Institute (*Ibid.,* 11), as

[2] Levi's dissertation, supervised by Fritz Haber and Peter Pringsheim, constituted an experimental study of the spectra of alkali haloids (*Recollections,* 4).

well as eventually spending Christmas together with the Bohr family (*Ibid., 39-40*). During this time, Levi also carried out traditionally female-gendered tasks for her male colleagues. This began with her acting as "secretary and helper" for Franck, who asked her to "type letters for him or to make telephone calls for him and things of that kind" (*Ibid.,* 9). Levi insists that "she did it with great enthusiasm" and "didn't mind at all" (*Ibid.,* 9). Additionally, she mentions George Placzek for whom she "had the great privilege, almost every day at lunchtime, to make scrambled eggs" (*Ibid.,* 18). She also regularly served coffee together with the secretaries at conferences. This can be seen, for instance, in the photographs presented in Figures 2-3, which were taken in 1936 at a conference at the Institute for Theoretical Physics, Copenhagen University.

Figure 2: Hilde Levi, Rudolf Peierls, and Wolfgang Pauli. (Niels Bohr Archive, Hilde Levi Collection)

Figure 3: Hilde Levi and Niels Bohr. (Niels Bohr Archive, Hilde Levi Collection)

In April of 1940, the German occupation of Copenhagen forced Levi to go largely into hiding, and she therefore transitioned to working at the Carlsberg Laboratory, which was closer to her apartment (*Ibid.,* 45). The war stymied their supply of radioisotopes, (*Ibid.,* 45), and Hevesy and Levi therefore worked instead on using heavy water in biological research (*Ibid.,* 47). Finally, in September of 1943, persecution intensified enough that Levi and several of her friends fled to Stockholm (*Ibid.,* 50-51). While there, she resumed research on radioisotopes at the Wennergren Institute for Experimental Biology, until her return to Copenhagen in 1945 (*Ibid.,* 53).

After the war, Hevesy stayed in Stockholm and Bohr discontinued biological research at the Institute (*Ibid., 58-59*). Levi was instead recruited in 1946 to work at the Zoophysiological Laboratory by its director August Krogh, where worked as a research assistant to biologist Hans Henrik Ussing (*Ibid.,* 61). Levi found "the way of thinking, the way of doing

experiments, the way of organizing a laboratory" to be "entirely different again" from her experiences in physics (*Ibid.,* 60). This constituted yet another period of adjustment.

Towards the end of the 1940's, "the thought occurred to me and also to the others that maybe it was time for me to get out and look at the world outside Copenhagen." (*Ibid.,* 61) Therefore, it was arranged for Levi to go to the US for the first, but not the last, time during the academic year 1947-1948 (*Ibid.,* 61). Although Levi initially planned to study tracer techniques with Franck, she was grabbed by Willard Libby and his lab (*Ibid.,* 65). She therefore instead learned to handle radiocarbon and, on her later visits, to perform autoradiography and date biological samples using the carbon-14 isotope (*Ibid.,* 65-66). This visit would prove a true turning point in her life and was instrumental for her further work as a scientist in three primary ways: she learned methods of experimental biophysics which were not well-known in Europe; gained valuable contacts; and obtained economic support independent of the Zoophysiological Laboratory. Her resulting work 1949-1979 can be divided into four primary areas: building expertise on medical uses of radioisotopes, developing capabilities for radiocarbon dating of archaeological finds, increasing radiation safety in Denmark through testing and legislature, and performing independent research on quantitative autoradiography. All these efforts took place simultaneously, and I describe them briefly below.

Firstly: in the winter of 1949-1959, Levi began teaching a course at the Laboratory on uses of radioisotopes in medicine (e.g., for imaging, and radiation therapy), as well as how to handle radioactive materials and operate relevant machinery (*Ibid.,* 75-76). Most of the students were medical professionals and other scientists (*Ibid.,* 76), and lectures therefore took place during evening and night. The courses were "so much in demand" that she taught several parallel courses each year, and would do so until 1970 (*Ibid.,* 76).

Secondly: soon after her return to Copenhagen in 1950, Levi was contacted by archaeologists of the National Museum, who consulted her on the feasibility and practicalities of dating archaeological samples using carbon-14 (*Ibid.,* 77). Levi's expertise and American contacts enabled Denmark to build Europe's first functioning dating machine by 1951 (*Ibid.,* 78-79). For the coming 20 years, she was one of three scientists on a committee of archaeologists which decided what samples to date next (*Ibid.,* 79). In her words, Levi found this experience

"exceedingly interesting" since she "simply learnt so much" about concepts and methods in archaeology (*Ibid.,* 81).

Thirdly: Levi contributed to increasing radioactive safety in Denmark in two significant ways. During 1952-1970, she was a consultant to the Danish National Board of Health and helped draft Denmark's first legislations for radiation protection (*Ibid.,* 85), which regulated the purchase and storage of radioisotopes (*Ibid.,* 87). In the 1950's, such legislation was entirely new in Europe; the only country in the world with existing expertise was the USA (*Ibid.,* 88). Therefore, Levi had leveraged her American contacts to learn gain insight into their regulations, and then adapt them to Denmark (*Ibid.,* 88). Additionally, starting in 1954, Levi assisted the Health Authorities in investigating radioactive fallout from bomb testing. She became "exceedingly busy" with preparing and analyzing samples of ground water and soil (*Ibid.,* 91) and answering questions from the press (*Ibid.,* 92).

Fourthly and finally: the economic support Levi secured in the USA allowed her to pursue independent research in autoradiography (*Ibid.,* 84-85). She hired a lab assistant, Elise Fredriksen, who for the coming 30 years assisted her in the laboratory and carried out planned experiments while Levi was away (*Ibid.,* 102), and Arne Nielsen, who helped with advanced statistical analyses (*Ibid.,* 104-105). Levi's interests were in developing a method of quantitative autoradiography (*Ibid.,* 77) and while engaged in this work, she discovered a mechanism of the shedding process involved in forming new skin which contradicted the prevailing consensus among biologists (*Ibid.,* 110). The results were published shortly after her retirement in 1979 and were positively received by the community (*Ibid.,* 111).

Discussion

As has hopefully been indicated by the (much abbreviated) account above, Hilde Levi lived a rich and productive life. There are two aspects of her life that I wish to focus on: her "gender-conforming", non-scientific work at the Niels Bohr Institute in the 1930-1940's, and her focus on interdisciplinarity over specialization.

It is highly doubtful that a male research assistant with a PhD from a prestigious institution would have cooked, served coffee, or performed secretarial duties, especially since these tasks were intensely gendered and correspondingly low-status in the early 20th century. By serving coffee at a conference, Levi ostensibly lost time that could have been spent gaining

scientific contacts and instead strengthened her identity as a low-status worker in the minds of her colleagues. Nevertheless, Levi performed such tasks with enthusiasm, and did not address their problematic nature in her recollections. Instead, she stated that she felt like "one of their comrades or colleagues" and that "the Institute never presented any problem for me as a woman" (*Ibid.,* 18-19). At first, these statements appear contradictory to the reality shown in Figures 2-3 and could be viewed as complete ignorance of gender inequality or inability to stand up for herself. However, such interpretations seem to be in tension with the practicality, stubbornness, and social intelligence which Levi displayed.

An alternative interpretation is that Levi's actions had concrete, strategic value for her career. In engaging in gender-conforming tasks alongside, but not to the exclusion of, her scientific work she probably garnered good-will among her male colleagues and made herself less threatening. In turn, this could have given her access to spaces where she might otherwise not have been welcome – e.g., conversations over coffee at conferences – as well as cemented friendships and scientific contacts that in the coming years helped her win positions and grants. Therefore, Levi might have been welcomed as a "comrade or colleague" precisely because she performed female-gendered tasks.

Levi's interdisciplinarity is also subtly intertwined with her identities as a woman and Jewish refugee. Namely, until the 1950's Levi worked primarily as a research assistant to various professors, and therefore could not pursue her own interests and hone her expertise in a specialized discipline. Instead, she frequently changed scientific field, and had to learn new concepts, forms of inference, and experimental techniques. As has been previously studied, even well-established female physicists such as Lise Meitner and Marietta Blau struggled intensely with continuing their own research after becoming refugees. As a newly minted PhD, things would have been significantly harder for Levi, meaning that research assistantships were probably the only available option.

Eventually, Levi seems to have embraced an interdisciplinary approach to physics. Even when she did secure funding for her own research in the 1950's, she continued to engage in "excursions or side trips to various fields rather than sticking to my own research […] as many scientists do" and never "resented" doing so. She consistently speaks with enthusiasm about learning new concepts and skills, arguing that her willingness to jump into new fields

and projects is not “a weakness” but has rather made her “life rich and eventful”. (*Ibid.,* 95) Thus, interdisciplinarity is certainly something that Levi came to value and find meaningful.

Many would not view Levi as a particularly successful physicist. However, this represents a narrow view of scientific work which trivializes the crucial role of teaching and pedagogy, the importance of using science to benefit society, and the benefits of cross-pollination between research disciplines. The ideal of the specialized scientist, as enshrined in the Nobel Prize, was largely unattainable for minorities such as refugees and women, and served to eclipse their varied contributions to science and society. Hilde Levi proved herself to be versatile in adapting to new research fields, prolific in collaboration and publishing, and sought-after for teaching and consultancy. As such, her life in physics serves to challenge prevailing conceptions of what constitutes a successful scientist.

Acknowledgements

I thank the staff of the Niels Bohr Archive, particularly Christian Joas, Rob Sunderland, Signe Stricker, and Richard Staley, for their help and hospitality.

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