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Uranium Mining and the Environment in East and West Germany

The comparative method in historiography is not a recent invention. Yet even today studies seldom center on a systematic and explicit comparison of two or more cases. In environmental history, as in other subfields of the historical profession, either detailed case studies or global overviews predominate. This article tries to demonstrate the advantages of the comparative method through the example of uranium mining in East and West Germany during the Cold War. The remainder of this section will look at the comparative method and its potential benefits for environmental history. Section One describes the extent of uranium mining in East and West Germany in general, while Sections Two and Three analyze in detail the pollution due to uranium mining in East and West Germany respectively. Section Four discusses the results and tries to identify the advantages of the comparative approach.

Basically, the comparative method in history can have one or more of the following functions: first, a heuristic function, discovering phenomena that otherwise would have been overlooked. Second, a descriptive function, making the peculiarities of one case more visible. Third, an explanatory function, helping to identify important variables that shape a particular development. In this function, the comparative method works as an indirect experiment. Fourth, it can deprovincialize historiography by making familiar events appear in a new light.[1]

Comparisons try to identify similarities and differences. Depending on the subject and interpretive framework, they may stress the former or the latter. Paul Josephson's study *Industrialized Nature* is a particularly useful example of how the comparative method may be applied, for his subject, the environmental history of the Cold War era, suggests a number of ideas that are relevant to the present essay. Josephson looks at large-scale technological changes in the landscape, such as river dams, irrigation systems, and highways. Without denying national differences in the application of these technologies, he stresses the similarities even between such different societies as the

1 Juergen Kocka and Heinz-Gerhard Haupt, "Comparison and Beyond: Traditions, Scope, and Perspectives of Comparative History," in *Comparative and Transnational History: Central European Approaches and New Perspectives*, ed. Heinz-Gerhard Haupt and Juergen Kocka (New York: Berghahn, 2009), 3–5.

USA and the USSR. Fuelled by a belief in science-driven progress, these (and other) societies have developed and put into practice what Josephson calls "brute force technologies" with an "overemphasis on unforgiving technologies of massive scale."[2] With their faith in the ability of technology, so the argument goes, US and Soviet engineers and politicians had more in common than often assumed.[3] Obviously, for the present study this assertion is a useful starting point. Were East and West Germany really different in their exploitation of natural resources like uranium? Or is uranium mining just another example of "brute force technology"?

Uranium Mining in Germany

The beginnings of uranium mining in Germany are to be found in the aftermath of World War II and the incipient Cold War, when both the USA (and its Western allies) and the USSR began to look for uranium deposits, as they were in need of raw material for nuclear weapons, and later for nuclear reactors as well. However, whereas uranium mining was new, a tradition of radium mining already existed in the Erzgebirge (Ore Mountains) on both sides of the German-Czech border. The first regulations setting limits on miners' radiation exposure were enacted here during World War II.[4] However, they were limited to the protection of the workforce, and no attempt was made to measure or limit the damage to the environment. It was known that uranium mining caused lung diseases. Moreover, while the carcinogenic effect of radiation had already been discovered in the 1920s, little research existed about the dangers of radiation in mining.

In the 1950s, the recommendations of the International Commission on Radiological Protection (ICRP) provided the most important point of reference. They set limits to the maximum exposure considered safe for both workers exposed to radiation and the general population. The background was the controversy about fallout from nuclear weapon testing during that time.[5] By introducing a unit for measuring exposure (rem),

2 Paul R. Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World* (Washington, DC: Island Press, 2002), 12.
3 Ibid., 3.
4 W. Schüttmann, "Das Radonproblem im Bergbau und in Wohnungen: Historische Aspekte" in *Strahlenrisiko durch Radon*, ed. Christoph Reiners and Dietrich Arndt (Stuttgart: Fischer, 1992), 14.
5 Samuel Walker, *Permissible Dose: A History of Radiation Protection in the Twentieth Century* (Berkeley: University of California Press, 2000), 12, 23f.; Catherine Caufield, *Multiple Exposures: Chronicle of the Radiation Age* (New York: Perennial Library, 1989), 64–74, 134–39.

an attempt was made to find a common denominator for the effects of different kinds of radiation.[6] According to the ICRP recommendations of 1956, a person should not be exposed to more than 500 mrem a year (for employees exposed to radiation, the limit was set at 5 rem). This was not legally binding, but the ICRP values influenced radiation protection measures in both East and West Germany. Also, the differentiation between employees exposed to radiation and the general population was one which has been upheld ever since. In general, this distinction is based on arguments that the general population never willingly accepted the health risks resulting from exposure, that the effects are not monitored (as for miners) by regular medical examinations, and that this group consists mainly of women and children. Radiation protection regulations that were passed in West Germany (the Federal Republic of Germany, FRG) and in East Germany (the German Democratic Republic, GDR) in 1964 also made this distinction. The latter was especially strict in limiting the exposure of the general population to only 1/100 of the maximum exposure for employees.[7] Before the early sixties, Soviet regulations were applied in the GDR.

The scale and scope of uranium mining in both German states showed vast differences. In East Germany, uranium prospecting began immediately after World War II, with mining operations starting in the Erzgebirge in 1946. Later, mining activity shifted to Ronneburg and other places in Thuringia, also situated in the south of the GDR. The mining company, called "Wismut" (bismuth), was at first fully controlled by the Soviet government. In 1954, it was changed to a Soviet-German joint venture. The uranium produced continued to be delivered to the Soviet Union, however. It is estimated that this amounted to more than 200,000 tons of uranium between 1946 and 1990, making the GDR the third largest producer of uranium in the world. At its peak in the early fifties, Wismut employed more than 200,000 workers (including administration).[8]

In West Germany, uranium mining began later and never reached similar dimensions. First of all, suitable deposits had to be found. A number of possible sites in various regions were found, but actual mining activities took place in only two of them: in

6 The unit "rem" means "roentgen equivalent in man." It is a combination of the absorbed dose of radiation with weighting factors that take the different nature of radiation (x-rays, gamma rays, alpha rays etc.) into account. It is used to measure the biological effect of radiation. Today, the more commonly used unit is "sievert" (1 rem = 0.01 sieverts).

7 *Gesetzblatt der DDR,* Teil II, no. 76, 6.8.1964.

8 Rainer Karlsch, *Uran für Moskau: Die Wismut—eine populäre Geschichte,* 3rd ed. (Berlin: Ch. Links, 2008), 83, 260f.

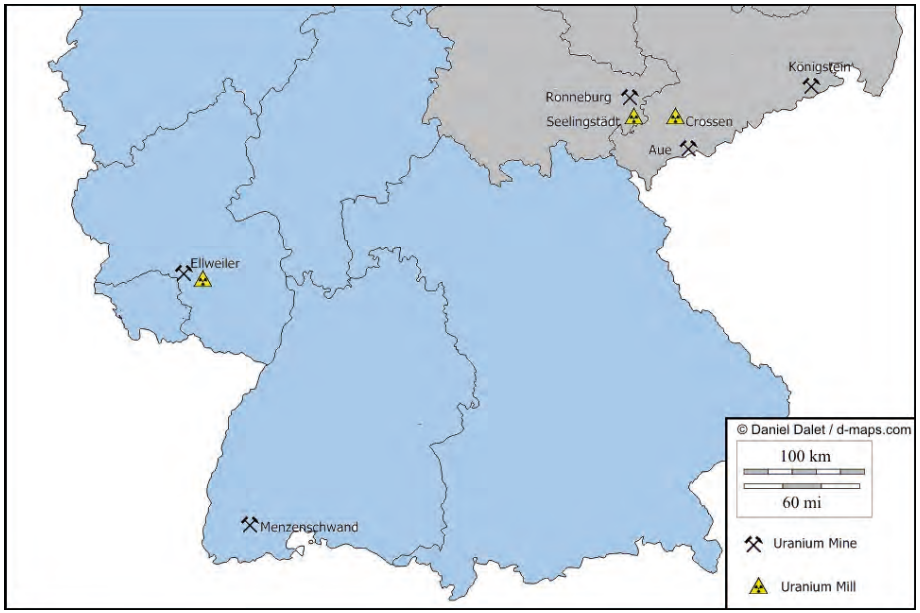

Figure 1: Sites of uranium mines in the southern part of East and West Germany (Source: d-maps.com. Markings added by the author)

Ellweiler (Rheinland-Pfalz) and in Menzenschwand in the Black Forest (Baden-Württemberg).

Furthermore, mining was limited in time and scope: in Ellweiler open-pit mining took place between 1959 and 1964. It was abandoned largely for economic reasons. In Menzenschwand, mining began in 1961, but had to be stopped two years later and was resumed from 1974 to 1982 and again from 1989 to 1991. Officially, it was never more than prospective drilling.[9] All in all, no more than 720 tons of uranium were produced in Menzenschwand between 1961 and 1991—in other words, less than half a percent of the Wismut production.[10]

There was one feature of both German states that distinguished them from other areas where uranium was mined: the high population density. Whereas in most other countries (USA, Canada, Australia) uranium mining took place in sparsely populated areas,

9 Armin Simon, *Der Streit um das Schwarzwald-Uran: Die Auseinandersetzung um den Uranbergbau in Menzenschwand im Südschwarzwald 1960–1991* (Bremgarten: Donzelli-Kluckert, 2003); Wolfgang D. Müller, *Geschichte der Kernenergie in der Bundesrepublik Deutschland*, vol. 2 (Stuttgart: Schäffer-Poeschel, 1996), 483–90.

10 Simon, *Schwarzwald-Uran*, 194.

such was not the case in Germany. The southern part of East Germany in particular had long been an industrial area and was one of the most densely populated areas in Germany.[11] This made uranium mining even more hazardous than elsewhere.

Pollution at Wismut AG

We do not have much information about the environmental impact of the mining during the early years of Wismut, due to the fact that pollution had yet not been recognized as a problem and there were no measurements of radioactive (or, indeed, any other) emissions. This state of affairs changed only in the late fifties. The immediate trigger was a 1958 investigation which looked for the possible causes of radioactive contamination of surface and groundwater observed in the vicinity and therefore measured the emission of radionuclides of a uranium processing plant in Crossen which belonged to the Wismut complex. The results were so alarming that the investigation was extended to two other Wismut facilities in Freital and Ronneburg and to all their emissions. This document was the first environmental report of the Wismut AG. It was compiled in 1959 by a group of Soviet scientists, was originally written in Russian, and was not intended to become public.[12]

The most important results were as follows. The surface water contained 3–4 times more radium and uranium than the limit, sometimes even more. In the Zwickauer Mulde, one of the larger rivers in the region, the contamination covered 150 km. The Oberrothenbach stream contained 12–20 times more uranium than the legal limit. That was especially worrying given the fact that drinking water was taken from the Oberrothenbach near the processing plant in Crossen. At the pumping station, the radium concentration oscillated, but always exceeded the legal limits both for drinking and process water. Investigations were also carried out with regard to soil and plants.

11 The district of Zwickau in southwestern Saxony had a density of 432 inhabitants per km² in 1990. "Demografische Entwicklung," Sächsische Staatskanzlei, accessed November 25, 2011, http://www.demografie.sachsen.de/6421.htm. In Saxony as a whole, the population density was 259 inhabitants per km². In comparison: Thuringia (1990) 161; South Australia: 1.5; Saskatchewan (Canada): 1.5; Arizona (USA): 17; Colorado (USA): 79; New Mexico (USA): 6; Kazakhstan: 5.4. Data from Jan Lahmeyer, "Population Statistics: Historical Demography of All Countries, Their Divisions and Towns," accessed 25 November 2011, www.populstat.info.

12 W. D. Kutscherenko et al., *Bericht über die Ergebnisse der umwelthygienischen Untersuchung des hydrographischen Netzes und der Umgebung von Betrieben der SDAG Wismut*, 1959 (Wismut-Archiv M 428), 4f.

While the plants and soil adjacent to the rivers and streams were contaminated, the contamination near tailing storage areas, by contrast, did not exceed the legal limits, not even in a vegetable garden adjacent to a uranium ore tailing.

The report documented the widespread contamination of surface and ground water in the mining region. The amount of pollution is probably representative for the early period of mining activity in which not much thought was given to potential environmental effects. However, it covers only the pollution caused by the normal working of the mines and processing plants. In April 1961, an accident near Crossen caused a significant increase in pollution levels.[13] Due to a break in a concrete pipe, 700,000 m^3 of radioactive mud poured into the Oberrothenbach and further into the Zwickauer Mulde. For a short time, the contamination rose to unprecedented levels of 100–1,000 times the legal limit. The wells in the vicinity were closed and pasturing livestock was prohibited. With the help of the police, fire brigade, and the Red Army (among others), the mud was cleared by early May. According to a report, the population was pleased with the concentrated and vigorous effort. It must be added, however, that the people were probably not aware of any radioactivity. The local press only published a short notice that spoke of a pipe damage at a mining company's site.[14] Neither the company's name nor the substances concerned were mentioned.

The two instances, the 1959 report and the 1961 accident, ushered in a phase in which environmental concerns were taken more seriously. Another report (again not for the public) was written in 1963.[15] It largely confirmed the results of the earlier report, although the Zwickauer Mulde was slightly less contaminated. A well in Zinnbach, the closing of which had already been recommended in 1959, was still active and still contained a high concentration of uranium. The authors of the report concluded that the investigations showed unequivocal evidence for continuous radioactive contamination of water, soil, plants, and air. Given the dense population of the area, they regarded the problem as very serious.[16] Most serious was the contamination of the smaller waterways and the ground water near the processing plants.

13 Bundesarchiv Berlin DC 20/12062, fol. 3–23.
14 Ibid., fol. 24–27.
15 It is discussed in greater length by Harm Schröter, "Die Wismut, der Umweltschutz und ein zentrales Dokument," in *"Strahlende Vergangenheit": Studien zur Geschichte des Uranbergbaus der Wismut*, ed. Rainer Karlsch and Harm Schröter (St. Katharinen: Scripta-Mercaturae-Verlag, 1996), 356–63.
16 Wismut-Archiv Bestand 13, no. 68, fol. 25.

To ameliorate the situation, a number of measures were necessary. One of them was the containment of seepage coming from the processing plants. A 1974 report pointed out that the seepage from the processing plant in Crossen always contained more uranium than the legal limit and sometimes more radium as well.[17] A containment facility was finished in 1975, but for unknown reasons did not begin to operate until 1978.[18] The increasing amount of regulations in the seventies and eighties made a widespread contamination of waterways, as in the fifties and early sixties, less likely, but at certain points the sewage was still a problem.

In the eighties, new problems arose. One was an accident at the Königstein mine in October 1984, where 120,000 m³ of wastewater containing 720 kg of uranium poured into the Elbe River.[19] The legal limits for radium, uranium, and solid matter were exceeded. The danger for the population was thought to be small, however, as no drinking water was taken from the Elbe.

Another incident happened at a settling basin near the processing plant in Oberrothenbach village in November and December 1987, when a number of wild ducks and other birds were observed to have died. The cause was at first not known. One day a citizen counted more than 70 ducks and one cormorant being collected by Wismut employees, who claimed that the birds had been killed by a fox. The citizen did not believe this story, as no blood could be seen. He wrote a petition voicing his fears that radioactive dust may have been the cause.[20] Veterinary examinations showed, however, that the birds had not died of radioactivity but of arsenic poisoning. Their arsenic content was between 4 and 120 times higher than normal.[21] Wismut decided early in 1988 to stop arsenic emissions into the Zwickauer Mulde and to erect a fence around the settling basin in Oberrothenbach, even though this was not an insurmountable obstacle for birds.[22]

Arsenic contamination was not limited to Oberrothenbach village, but spread to large parts of southwestern Saxony. A Wismut mine had been emitting mine water with high arsenic content since the fifties. What made the problem worse was that the arsenic con-

17 Ibid., no. 67, fol. 82.
18 Ibid., fol. 111, 137, 161.
19 Ibid., no. 64.
20 Wismut-Archiv Bestand Geschäftsstelle Berlin, no. 39/10.
21 Ibid., no. 39/11.
22 Ibid., no. 39/9.

tent of the uranium ore became higher in the eighties. In addition, Wismut had begun to mine for silver ore with a high arsenic content in 1984. The mine emitted 9.5 kg of arsenic into the Zwickauer Mulde on a daily basis. Drinking water was not taken from this part of the river, so there was no immediate danger to the population, but the arsenic content was so high as to present a danger to birds and animals.[23]

Another problem in the eighties concerned the pollution of the river Weiße Elster. Starting in March 1987, the hardness of the water rose to unprecedented levels because of wastewater from a Wismut mine and processing plant. In October, the hardness of the river water was nearly ten times the recommended amount, making it unsuitable to use even in industrial processes. Complaints came from industrial users downstream, including a chemical factory and a sugar producer. From February 1988 on, a computer-coordinated wastewater management system largely helped to solve the problem.[24]

In an internal report drawn up in 1989, Wismut's scientific and technical center (Wissenschaftlich-Technisches Zentrum, WTZ) wrote about the contamination of waterways. As a whole, there was a considerable increase in the concentration of radionuclides in smaller rivers and streams (especially the Wipse), a demonstrable increase in the rivers Weiße Elster, Zwickauer Mulde, and Pleiße, and only a theoretical increase in the Elbe. According to the report, the concentration as a whole was under the limit for drinking water, and the risk for the population negligibly small.[25] This may be true, but certainly the population was exposed to higher doses of radiation than they would have been without uranium mining. Moreover, the environmental effects were not limited to radiation, but also included arsenic and salt, lowering water quality and endangering the fauna. However, the situation was certainly no longer as bad as in the fifties.

A bigger health hazard for the population was probably the slag and tailings. As early as the late fifties, the Bureau of Nuclear Technology and Nuclear Research (Amt für Kerntechnik und Kernforschung, AKK) conducted investigations of the Wismut tailings.[26] The motivation for this research was a plan to use tailing slag as building material, which was in short supply in the GDR. The measurements of the AKK were not very accurate, but the findings seemed to confirm doubts about its suitability for the intended purpose.

23 Ibid., no. 39/4, 11.12.87.
24 Ibid., no. 39/4, 39/5, 39/13.
25 Ibid., no. 39/27, 3f.
26 Bundesarchiv Berlin DF 1, no. 1550.

For example, tailings contained isolated stones or boulders that were highly radioactive, containing 20 percent uranium. A test house was built in Rossendorf from tailing slag in the summer of 1958. The air within it contained 300 times as much radon as the legal limit. The experts judged the use of tailing slag as building material to be inappropriate.[27] On the other hand, they did not regard the tailings as such as dangerous for people living in the vicinity of the dumps.

Although the potential dangers of uncontrolled use of slag material had been known since the late fifties, no concrete steps were taken until the mid-seventies to limit its use. In the seventies, when shortage of building material became ever more acute, the use of slag material increased, and in 1974 the Federal Office for Nuclear Safety and Radiation Protection (Staatliches Amt für Atomsicherheit und Strahlenschutz, SAAS) issued a guideline for the use of tailing slag that introduced a five-level classification system based on the amount of gamma radiation and radium content.[28] In 1980, this was turned into a regulation and became legally binding.[29]

Officials at the Wismut mines were also aware of the radioactivity of tailings. In 1974, a suggestion was even made to search the tailings for uranium that could be processed, because in some cases the uranium content seemed to be considerable.[30] The use of tailing material for buildings seems to have been quite liberal, even at the Wismut. In a shack erected for the scientific and technical center in 1971, a high concentration of radon daughters[31] in the air was discovered in 1985; contaminated material had been used for the foundations.[32] Even in the eighties, regulations regarding the use of tailing slag were ignored. The SAAS wrote: "It has been observed again and again that combines and territorial institutions are ignoring clear legal regulations in spite of having been informed about this repeatedly, and thus it is essential that these combines and institutions put greater effort into inspection and creating admissible conditions."[33] Examples could be found in newly erected houses in Johanngeorgenstadt (Erzgebirge) and Freital (near Dresden) where the 1980 regulation had been ignored.[34]

27 Ibid., 18.
28 Wismut-Archiv Bestand 13, no. 68, fol. 77.
29 Bundesarchiv DF 10, no. 214, Bündel 2.
30 Wismut-Archiv Bestand 13, no. 68, fol. 81, 83.
31 Radon is a gaseous radioactive element. Its decay products, or daughters, are polonium, astatine, lead, bismuth, and thallium, all of them radioactive.
32 Wismut-Archiv Bestand Geschäftsstelle Berlin, no. 41/3/9.
33 Bundesarchiv Berlin DF 10, no. 45; translation by the author.
34 Ibid., no. 711/7–15.

All in all, the scientific and technical center of the Wismut considered the inhalation of radon daughters as the greatest radiation hazard. They even estimated the concrete exposure of the average population in particular areas to radon and its daughters, including the natural radon content of the atmosphere: around Ronneburg 9 millisievert (mSv)[35] per year, around Seelingstädt 7 mSv, around Crossen 6 mSv, around Aue 9 mSv—with a peak value of 22 mSv.[36] According to the regulations, the maximum exposure should not exceed 5 mSv. The center recommended covering the tailings, which at that time were usually stored open to the air.

How did the people react to the dangers of radiation and other forms of pollution through uranium mining and processing? First of all, the information collected in this article was not known to the East German public. Instead, rumors about radiation circulated. Independent environmental groups became active in the eighties and tried to measure radiation, often with inappropriate means. In the fifties and sixties there seems to have been no critical discussion about Wismut, although the dangers of radiation were known in principle. Even the accident in Oberrothenbach in 1961 did not provoke any nuclear fears, let alone panic. Petitions from worried citizens are first documented in the early seventies. In particular, they expressed fears about uncontrolled radiation from nuclear power plants and the use of contaminated slag. By the late seventies rumors were circulating about allegedly dangerous radioactive tailings adjacent to residential houses, for example in Schmiedeberg (Erzgebirge).[37]

The activities of independent environmental groups often took up these rumors. The inhabitants of Crossen and Oberrothenbach (near Zwickau) in particular complained about symptoms such as cancer, hair loss, tiredness, and impotence, which they attributed to radiation exposure. The two villages became known as the "tired villages."[38] This caused environmental activist Michael Beleites to investigate the radiation on his own initiative. He gathered information through his own measurements and observation and also received valuable data from the department for water management (Wasserwirtschaftsdirektion) in

35 Like rem, sievert is a unit measuring the equivalent dose of radiation. Cf. footnote 6.
36 Wismut-Archiv Bestand Geschäftsstelle Berlin, no. 39/27.
37 Bundesarchiv DF 10, no. 214, 14.9.1978.
38 Michael Beleites, *Altlast Wismut: Ausnahmezustand, Umweltkatastrophe und das Sanierungsproblem im deutschen Uranbergbau* (Frankfurt am Main: Brandes und Apsel, 1992), 130; see also Michael Beleites, *Untergrund: Ein Konflikt mit der Stasi in der Uran-Provinz*, 2nd ed. (Berlin: Basis Druck, 1992), 89; Wismut-Archiv Bestand Geschäftsstelle Berlin, no. 39/1.

Gera.[39] He published the results in samizdat copies under the title "Pechblende" ("pitchblende," that is, uranium-rich ore) in May 1988. Only a few East German citizens ever saw a copy, but the information in the pamphlet was passed on to West German media (both newspapers and television), who ran features in November 1987 and summer 1988.[40] However, due to lack of knowledge and a desire to dramatize, these reports contained exaggerations and sometimes even outright nonsense, for example in claims that the government distributed free wigs in the mining areas to alleviate hair loss caused by radiation. Still, the West German media reports also had a wide reception in the GDR and sensitized people to the dangers of radiation. Wismut employees were confronted with the content of these reports, while parents discouraged their adolescents from seeking employment at Wismut. One citizen who had moved to Aue in the Erzgebirge reported that he had been repeatedly discouraged from doing so because the air was allegedly so bad that wounds would not heal.[41]

Due to the continuing rumors, the council of the district of Karl-Marx-Stadt, where a large part of the mining took place, felt compelled to compose an informational brochure about radiation in the southern districts of the GDR. This was unusual, because until then the official media had never discussed the dangers of radiation. The informational brochure, of course, tried to downplay the radiation risks. Both the high exposure of miners and radioactive pollution were portrayed as a problem of the early years of uranium mining that had been overcome in the meantime. The emissions had been controlled since the sixties, the brochure claimed, the radiation of tailings was in the range of natural rocks, and even in the immediate vicinity of the tailings there was therefore no cause for concern. Interestingly, the records of the SAAS contain a comment that this information was correct in substance, but problems arose because of the deviation from legal norms like the 1980 regulation about tailing slag.[42]

It is no new finding in environmental history that the perception of pollution does not always correspond to actual pollution levels. Still, it is a point worth noting. The radioactive contamination of waterways, as well as of soil and plants, was much higher in the fifties and early sixties than in later decades. This does not mean, however, that everything was fine in the eighties. A particular cause for concern was the tailings and the irresponsible

39 Beleites, *Untergrund*, 120, 167.
40 Ibid., 111.
41 Wismut-Archiv Bestand Geschäftsstelle Berlin, no. 39/3, 39/7.
42 Bundesarchiv Berlin DF 10, no. 45, 28.10.88.

use of contaminated slag as building material. Another important result is that pollution through uranium mining consists of not only radioactive substances, but also salt and arsenic. It was not until the eighties that serious protests started to come from the population living near the mines, when both local environmental activists and especially West German media made it an issue. Towards the end of the eighties, many people lost confidence not only in the political elite, but also in the scientific and technical elite who tried to dissipate fears. So it is probably correct to say that the environmental problems were a nail in the coffin of the socialist regime,[43] even though, ironically, the perception was in some ways worse than the actual problems. The blame lies with the information policy of the regime, which tried to stifle discussion and hence lost credibility.

Pollution in West Germany: Ellweiler and Menzenschwand

Admittedly, the problem of pollution did not present itself to the same degree in West Germany simply because uranium mining took place on a much smaller scale. Still, environmental aspects did play a role even at a fairly early stage. In Menzenschwand, where uranium was discovered relatively late, mining was unpopular from the beginning. The reasons for what would become a long conflict were simple: the community wanted to protect its status as a popular tourist resort in the Black Forest. So protests not only arose from local activists, but also had the support of the local and parts of the regional administration. The federal government, however, was not prepared to give up on Menzenschwand, because this was by far the most promising deposit in West Germany, if not in Western Europe. The uranium content of the ore was estimated to lie at one percent or more.[44] The mining company, the Gewerkschaft Brunhilde, was also responsible for exacerbating the relations by proceeding in a manner that was regarded as high-handed, selfish, and reckless by the local administration.[45] But it was not only, as sometimes argued in the literature,[46] a problem of diplomacy or of conflicting personalities. Rather, right from the beginning the fear of pollution played a role in motivating local resistance. So the municipality and the Office for Water Management (Wasserwirtschaftsamt) expressed

43 So Ilko-Sascha Kowalczuk, *Endspiel: Die Revolution von 1989 in der DDR* (Munich: C. H. Beck, 2009), 127.
44 Bundesarchiv Koblenz B 138, no. 2278, Bd. 1, fol. 199 f.; no. 2281, Bd. 1, fol. 23–25.
45 Ibid., Bd. 2, fol. 531.
46 Müller, *Kernenergie,* 485; Joachim Radkau, *Aufstieg und Krise der deutschen Atomwirtschaft 1945–1975: Verdrängte Alternativen in der Kerntechnik und der Ursprung der nuklearen Kontroverse* (Reinbek bei Hamburg: Rowohlt, 1983), 442–45.

concerns that uranium mining presented a danger to the local waterways and ultimately also to the drinking water supply, as radioactive water might seep from the tunnels and shafts to other, uncontaminated areas. The critics found support from the regional government, which argued that the mining plans were irreconcilable with the Feldberg conservation area.[47] As a compromise, regional and federal governments agreed to spare the Farnwitte, a part of the Feldberg conservation area.[48]

Other factors contributing to the protests were the environmental consequences of prospective drilling, including noise from ore transports and, as critics had feared, problems of water management. Untreated mine water drained into the river Alb, where it caused episodes of fish die-off. Later a settling basin was built; however, it was inadequate to clear the water of minerals.[49] The radioactive contamination of the water was measured by an independent institute in 1964. It showed an increase of 10–20 times above normal values in the area. This was not considered a health hazard, however.[50] Another issue was the blastings, which caused a spring to run dry that had hitherto provided water for part of the town. The replacement well did not work properly.[51] The mining company defended itself by declaring that the fish deaths had been caused by other forms of pollution, that they had built a new waterworks facility, and that only two trucks a day drove through town to make transports.[52] The municipality remained unimpressed, sued the company, and won. The prospective drillings were stopped in October 1963.[53]

When they were resumed in the seventies, the public had become more critical of nuclear power in general. Leading environmental organizations such as the BUND (Bund für Umwelt und Naturschutz in Deutschland) were opposed to uranium mining, not simply because of its direct consequences for the environment, but because it was part of the nuclear industry.[54] However, it was a small group from the university town of Freiburg, calling themselves "Arbeitskreis Strahlenschutz" ("Working Group for Radiation Protection") that made the issue public in 1978. The focus of their protests was the use of slag from uranium mining for road building, as they feared an uncontrolled spread of radioactive material. Further, the transport of uranium ore caused problems. Members

47 Bundesarchiv Koblenz B 138, no. 2278, Bd. 1, fol. 64f., 138; Bd. 2, fol. 486–88.
48 Ibid., Bd. 2, fol. 399.
49 Ibid., Bd. 2, fol. 415.
50 Staatsarchiv Freiburg, F 235/9, no. 61, Bd. 1, 20.1.64.
51 Bundesarchiv Koblenz B 138, no. 2278, Bd. 2, fol. 408f.
52 Ibid., Bd. 2, fol. 534, 557–60.
53 Ibid., Bd. 1, fol. 135–52.
54 Simon, *Schwarzwald-Uran,* 160f.

of the Freiburg group made their own measurements with Geiger counters and found higher than normal radiation in certain places, for example at a parking lot at the end of Menzenschwand, and on the loading ramp and the freight cars at the railway station. Measurements by the Landesanstalt für Umweltschutz (State Environmental Protection Agency) largely confirmed these findings, but the mining authorities and a report by a radiologist did not consider them a danger to the population. Still, recommendations were made to reduce radiation, for example to cover the ore that was transported in trucks to the next railway station, to put up warning signs around the company grounds, and to clean the loading ramp (which was not actually done until 1992).[55] In the late seventies, the inhabitants of Menzenschwand seemed to have come to terms with uranium mining, and saw the activists from Freiburg not as their allies but as their enemies who brought the town into disrepute. This attitude changed suddenly in 1982, when measurements by a local group of activists and subsequently by the Landesanstalt für Umweltschutz found high concentrations of radionuclides in the sediment of the Alb river. Up to 370,000 Bq/kg were measured, 1,000 times more than in 1978.[56] The ensuing local protest made the regional government decide in 1983 that no further concessions for uranium mining would be given.[57]

In the town of Ellweiler, too, water quality was the dominant issue. The wastewater from the mine flowed into the Steinaubach stream. Proposals to build a wastewater canal to protect a nearby water collection point were rejected because it might give rise to concerns about pollution.[58] In January 1960 the mining company (the Gewerkschaft Brunhilde, as in Menzenschwand) received permission for a test run of in situ leaching with an acid solution that began on 1 February. The wastewater was collected at the beginning. It contained three times as much salt as declared, and the limit for copper was exceeded. The leaching had to be stopped after five days, because pipes and pumps had been damaged by the acid solution. The wastewater basin was then emptied without permission.[59] The legal limit for uranium in wastewater was not exceeded, but measurements in July 1959 showed it to be close to the limit.[60]

55 Simon, *Schwarzwald-Uran*, 143–58, 195.
56 Ibid., 172f.
57 Ibid., 178.
58 Bundesarchiv Koblenz B 138, no. 2282, fol. 122, 165–67.
59 Ibid., fol. 144.
60 Ibid., no. 2281, fol. 55, 71f.

Open-pit mining in Ellweiler was abandoned in 1967, not because of protests but for reasons of economy. However, a uranium processing plant was in use there until 1989. A medical investigation of the early nineties showed that there was a significantly higher incidence of leukemia among children and adolescents between 1970 and 1989 in the surrounding area (5 km around the plant). The reasons were not quite clear, but the author assumed that a higher than normal radium content in drinking water could be responsible. There is no reliable time series data about radium in drinking water in this area, but measurements from 1979/80 suggest it is possible that the limit of 40 mBq (megabecquerel, a unit of measuring radioactivity) per day was exceeded.[61]

Although pollution in the FRG was certainly less serious than in the GDR due to the smaller scale of uranium mining, a link has been established between the incidence of cancer and uranium mining (and processing) in Ellweiler. This makes it difficult to believe that no such connection existed in East Germany, even if definitive evidence has not been found. An exception is the miners, where the higher incidence of lung cancer is well known. Aggregate data about cancer rates show a higher incidence of lung cancer in males in the district of Aue, where many miners live.[62]

In West Germany, then, uranium mining led to considerable environmental stress that was not limited to radiation exposure. Most important was the danger for surface and ground water and therefore also for drinking water. The resistance to uranium mining in Menzenschwand was not irrational. It can be explained by the mixture of very concrete environmental damage (noise, fish die-off) and very abstract dangers (radiation).

Uranium Mining and the Environment in Comparative Perspective

It would be useful to extend this comparison to other countries. It seems plausible, for example, that uranium mining in a colonial context was even more devastating than in

61 Wolfgang Hoffmann, *Inzidenz maligner Erkrankungen bei Kindern und Jugendlichen in der Region Ellweiler, Rheinland-Pfalz: Epidemiologie und biologische Dosimetrie zur Ermittlung möglicher Belastungspfade* (Aachen: Shaker, 1993), II.39, V.1.

62 "Krebsregister Sachsen 2001–2005," Gemeinsames Krebsregister der Länder Berlin, Brandenburg, Mecklenburg-Vorpommern, Sachsen-Anhalt und der Freistaaten Sachsen und Thüringen, accessed 25 November 2011, http://www.berlin.de/imperia/md/content/gkr/daten/sn_daten.pdf.

the two German states.[63] However, more research needs to be done before this hypothesis can be accepted. The following remarks are therefore limited to the case studies presented here. Even so, the comparison shows interesting similarities and differences.

As was to be expected, the forms of pollution were similar. Above all, the dangers were the pollution of waterways, the emanations from tailings, or the use of contaminated slag. However, the environmental problems of uranium mining were not limited to radiation; they included a number of other emissions as well, from noise to salt and arsenic. While the concrete problems differed from one place to another, the multi-faceted nature of pollution through uranium mining is similar. Broadly similar were also the risks of higher cancer rates for the population, although experts still disagree about how risky low-level radiation really is. It is worth noting, however, that there did not seem to be a general disagreement between East and West German scientists over this question. In the political arena, similarities arose despite the different political systems. In both countries, national governments faced a difficult choice between the protection of their population and the exigencies of the Cold War, which made uranium a strategic resource. As the comparison shows, it would be simplistic to claim that the East German dictatorship opted for reckless exploitation of natural resources whereas the West German democracy opted for protection of the population. Compromises had to be made in both cases. Still, as will be argued below, differences in the political systems did have an effect.

Another similarity is the lack of effective environmental protection. It is hard to escape the conclusion that at least some of the pollution was avoidable. The reason was not so much lack of knowledge in general; the dangers of radiation were already well known in the 1950s. The problem was rather the tradition of self-regulation in mining. The companies were often left to their own devices, and authorities only intervened when problems became acute and obvious. The SDAG Wismut was not as much of an exception in this respect as has often been assumed.

Similarly, there was a lack of social acceptance of uranium mining in the 1980s. In East Germany, however, protests arose much later than in the West Germany. Indeed, it is perhaps in this area—namely, the attitudes of the population to uranium mining—

63 Rainer Karlsch, "Das Erz des Kalten Krieges: Uranbergbau in West und Ost," in *Uranbergbau im Kalten Krieg: Die Wismut im sowjetischen Atomkomplex,* ed. Rudolf Boch and Rainer Karlsch (Berlin: Ch. Links, 2011), 1: 101–107.

that the differences between the political systems were most pronounced. In Menzenschwand, local activists and the regional government already raised opposition to uranium mining in the 1960s with a certain degree of success. This was not only due to the more pluralistic political system, but also to the freedom of the press. In the GDR, uranium mining was at first hidden under a veil of secrecy. The environmental reports cited in this article were never published, and it was only in the 1980s that an independent environmental movement formed and began to ask critical questions. Another important difference, of course, is the scale of mining activities. The effects of pollution in West Germany were bound to be more local, given the limited scale of operations. Here, it would be an exaggeration to speak of "brute force technology" in Paul Josephson's sense. The mining activities of the SDAG Wismut in the early years up to the late 1950s come closest to this notion, perhaps. Thereafter, steps were taken to limit the damage to the environment, even if more could have been done.

This article is meant to show that the comparative approach makes sense in environmental history, as in other historical fields. As already noted in the introduction, a comparison can have different functions and serve different purposes. In this case, it was helpful in several ways. It had a heuristic function by highlighting that environmental damage from uranium mining is not confined to East Germany, but also exists in West Germany where it is much less well known. While some historical work has been done on the Menzenschwand mine, there is still no substantial research on the Ellweiler mine and processing plant. Further, the comparison has an explanatory function in the sense that we can see how different political regimes dealt with uranium mining. As mentioned above, environmental protection was deficient in both countries. The real difference lay in the fact that there were more opportunities for dissenting voices to make themselves heard, from both inside and outside the political system of the FRG. The comparison also helped to deprovincialize research that hitherto has often looked at the SDAG Wismut in isolation. At least some features that were seen as peculiarities, such as the low level of direct government control and interference, appear in a new light.