

radiation's deadly effects could show up years after exposure. He warned that small children were being asked to drink or inhale tonics containing dangerous levels of radium, and that chocolate bars were being marketed with up to 0.064 micrograms of the radioactive element. He reviewed the famous case of Eben Byers, the Pittsburgh iron magnate who had died from his daily infusion of radium, and he called for a ban on chocolates and tonics containing radium salts. Even Marx, though, was convinced that as long as a tonic did not contain radium *salts* (radon gas was OK) and the doses were kept within reason (he did not specify a level), then radon inhalation and ingestion would "doubtless" have "a health-promoting effect."⁷⁹

The most notorious early cases of radiation poisoning were those suffered by the American radium dial painters. The tragedy is well known: at least a hundred women died from radiation poisoning after "pointing" (swirling and licking) their radium paint brushes in their mouths in the course of producing luminous faces for instrument dials and novelty items made to "glow in the dark." The women died horribly and painfully, from bone and mouth cancers often classed as "venereal ulcers" and only later recognized as occupational cancers.⁸⁰ Luminous dial painting was an important military industry in Germany, too, and grew increasingly important when blackouts were imposed after the beginning of Allied bombing in 1941.⁸¹ Fewer women seem to have been affected, however, apparently because Germany had much stricter occupational health and safety practices. (As in the United States, radium dial painting in Germany was almost exclusively a female occupation.) Injuries were not unknown—three workers at a Berlin compress factory complained of fatigue and nervous disorders after working in air with a radium content of about 13 ME—but German dial painters do seem to have suffered less than their American counterparts. The difference appears to have stemmed from the fact that German women did not "point" their brushes in their mouths.⁸²

The U.S. radium dial painting scandal was important in certain symbolic respects: the victims were women, the diseases were dramatic and debilitating, and sometimes fatal, but the numbers in-

volved were fairly small—probably only about a hundred deaths and several thousand injuries. In Germany, very few women are known to have died from radium dial painting. By far the largest occupational cancer hazard from radioactivity was that faced by *miners*, especially the uranium-cobalt-silver miners in and around the Saxon town of Schneeberg, near the Czechoslovakian border. The "Ore Mountains" (*Erzgebirge*) south of Dresden had long been mined for rare metals, and high rates of lung cancer had been discovered on the German side of the border, in Schneeberg, in the 1870s.⁸³ Lung cancers were discovered at Joachimsthal on the Czech side of the mountains in the 1920s,⁸⁴ by which time suspicions had begun to grow that the root cause of the malignancy was not a TB germ or arsenic or silica dust or molds from rotting mine shaft supports, but radiation.⁸⁵

Radium emanation had been found in the air of the mines as early as 1905 by Viennese scientists; measurements conducted after the First World War showed that air in different mines of the region could vary from 1 to 50 "Mache-Einheiten" per liter—roughly 400 to 20,000 pCi/l in the units used in the United States today.⁸⁶ A detailed and insightful epidemiological study published in 1926—using workers at an Oberschlema dye factory as a control, plus a separate control group from the general population—showed that 60–75 percent of the uranium miners in the region were (still) dying from lung cancer, a very high rate for what, at that time, was still a rare disease in the general population.⁸⁷ Rostowski, Saupe, and Schmorl's three-year study prompted the German government to classify the *Schneeberger Krankheit* (uranium miners' lung cancer) as a compensable occupational illness. The hazard was clearly a real one—though not everyone at the time agreed that radiation was the primary cause.

In the 1920s, evidence began to accumulate that radium-derived alpha radiation was responsible for the *Schneeberger Krankheit*. Animal experiments were undertaken to test some of the alternative hypotheses—that the disease was caused by fungi on wooden mine posts, for example, or by arsenic—but the results were ambiguous. Mice were fed or forced to breathe various dusts from the mine under laboratory conditions,⁸⁸ but experimenters found it