Chapter 6
The Aftermath of the Cambridge-Vienna Controversy: Radioactivity and Politics in Vienna in the 1930s

1 Consequences of the Cambridge-Vienna episode ranged from the entrance of other research centers into the field as the study of the atomic nucleus became a promising area of scientific investigation to the development of new experimental methods. As Jeff Hughes describes, three key groups turned to the study of atomic nucleus. Gerhard Hoffman and his student Heinz Pose studied artificial disintegration at the Physics Institute of the University of Halle using a polonium source sent by Meyer.[1] In Paris, Maurice de Broglie turned his well-equipped laboratory for x-ray research into a center for radioactivity studies and Madame Curie started to accumulate polonium for research on artificial disintegration.

2 The need to replace the scintillation counters with a more reliable technique also led to the extensive use of the cloud chamber in Cambridge.[2] Simultaneously, the development of electric counting methods for measuring alpha particles in Rutherford's laboratory secured quantitative investigations and prompted Stetter and Schmidt from the Vienna Institute to focus on the valve amplifier technique.[3] Essential for the work in both the Cambridge and the Vienna laboratories was the use of polonium as a strong source of alpha particles for those methods as an alternative to the scintillation technique.

3 Besides serving as a place for scientific production, the laboratory was definitely also a space for work where tasks were labeled as skilled and unskilled and positions were divided to those paid monthly and those supported by grant money or by research fellowships. Pettersson's departure from Vienna meant the loss of the soul of the Viennese group. That led not only to disarray in the study of atomic disintegration but also to the development of a severe financial crisis at the institute. Most deeply affected were the women of the team given the fact that they lacked stable university positions and monthly payments from the state. As soon as the flow of grant money and generous donations ended, the women financed from these sources faced professional and financial instability. It was probably this insecurity that prompted most of them to look for stipendiums and fellowships in other institutes.

As most of the women who were actively engaged in radioactivity research remained single, their personal lives were flexible and it was easy for them to travel. Undermining the stereotype of their "devotion" to science, I want to argue that these women lived through a transitional period. Meanings of sexual difference, of what a man and a woman signified, were in flux. The social democratic politics of Red Vienna that coincided with the time of Pettersson's research at the institute offered a new conceptual framework for addressing issues of gender identities. Caught in the drastic shift from traditional values to those that envisioned women and men as socially, scientifically, and politically active, the female scientists faced the dilemma of either/or concerning scientific career and personal life. 4

Such being the case, when Pettersson left the institute his female collaborators scattered to other European research centers, obtaining yearly fellowships and small stipendiums. The official academic politics outside of the Radium Institute kept them away from university positions and limited their career advancements. Instead of viewing this discrimination in terms of exclusion and victimization, I argue that women took their lives and careers in their hands and, forced by the circumstances, altered the boundaries of their discipline. It is at this moment that the nature of radium as a trafficking material offered them opportunities to carry their expertise in other related fields and to other cities. By doing so, they were able to acquire grant money, widen their professional network, and remain scientifically active and innovative in a world in flux. 5

The Women of the Vienna Group

As the Cavendish Laboratory had no radiochemist before Chadwick left Vienna, Rona recalls that "He extended Rutherford's invitation to me to join the staff at Cavendish Laboratory." Declining the invitation, Rona chose to stay in Vienna.[4] Given that Rona's expertise in preparing polonium sources was highly in demand by different researchers and used in a number of newly developed methods for detecting radiation, she moved from one laboratory bench to another, forming collaborations with remarkable flexibility. In 1928 with the help of Ewald Schmidt, she modified P. Bonet-Maury's method for the vaporization of polonium. In 1930, while Blau was already working on photographic emulsions, the two women combined their expertise in the study of the H-rays, using strong polonium sources and recording the tracks on photographic plates.[5] With Karlik's return from England in 1932, Rona was able to carry her knowledge of preparing polonium to 6

another workbench. Abandoning the ordinary scintillation counter, Karlik worked on the determination of the alpha particle ranges, utilizing a photoelectric cell while she kept the fluorescent screen intact as part of the instrument. In collaboration with Rona, she applied her method to the study of the ranges of alpha particles emitted from actinium and polonium.[6]

7 Although Rona had previously declined Chadwick's invitation to join the British group, she did not miss the chance to visit Paris once again in 1934. That year Meyer received a telegram from the Joliot-Curies announcing their discovery of artificial radioactivity. In his usual kind manner of appreciation, Meyer invited them immediately to Vienna to present their startling work. As Rona recalls, "I had the opportunity to hear a first-hand report about this fundamental discovery which was to have such far-reaching consequences for different branches of science. The talk was given by Irene Joliot-Curie."[7] During their visit, Rona and Karlik entertained the couple in the Vienna outskirts and before the Joliot-Curies left the city, they invited her to Paris to work on artificial radioactivity.

8 No doubt, when Rona arrived in Paris, the atmosphere at Curie's Institut du Radium was quite different from what it had been during her first visit. "La patrone" was dying, as Frederick Holweg, a senior scientist at the institute, explained to Rona. Since December 1933, Curie had been agonizing between illness and health. In her good days, she went to the laboratory and when she was dizzy and weak, she stayed home. In mid-May 1934, she saw her lab for the last time and a few days later, she left to a sanatorium on the advice of her doctors. On July 4 of that year, Curie died from pernicious anemia at Sancellemoz.

9 The day the news arrived at the institute, Rona was present and ill herself.[8] As Pettersson wrote to her on July 29, 1934, "We had no idea that you were sick in France." Meyer reminded her that "The most important thing in life remains always health," and Gleditsch urged her to pay attention before it was too late. All of them must have been shocked by Marie Curie's death. Eventually, Rona recovered and returned to Vienna the following fall. She carried over to the Radium Institute experimental knowledge on artificial radioactivity, which she introduced to her colleagues in Vienna. Forming a group with Pettersson, Kara-Michailova, and Ernst Föyn, Gleditsch's assistant from Sweden, Rona studied the effects of bombarding radioactive isotopes with neutrons.[9] In 1936, she was joined by research student Elisabeth Neuninger and they investigated the artificial radioactivity of thorium.[10]

10 After Pettersson's departure, Blau was still working on photographic emulsions. As she described her research strategy, "The grain thickness of proton tracks was appreciably smaller than that of alpha tracks and it was evident that the photographic conditions (emulsion characteristics and development conditions) would have to be improved if high energy protons-with smaller ionization thickness-were to be observed."[11] In the following years, the method was applied to the disintegration of various atoms.

11 Blau also improved the quality of the processing techniques and emulsions and was able to increase the thickness of the emulsion layers. In spite of her close collaboration over the years with Rona who provided her with stronger radioactive preparations, and the investigation of the penetrating radiation of polonium in collaboration with Kara-Michailova, Blau had not yet succeeded in making fast protons visible with the photographic technique.[12] The low intensity of radiation limited the accuracy of the measurements. What proved to be decisive for Blau's career and for the success of her method was the exposure of the emulsions to cosmic radiation. In this achievement, Blau's collaborator was Hertha Wambacher.

12 Nine years younger than Blau, Wambacher had a similar education. She went to the same *Volksschule* (elementary school) as Blau in the first district of Vienna and entered the private Mädchen Obergymansium in 1914.[13] In contrast to Blau's Jewish family, Wambacher's was Catholic. Her father, Ferdinand Wambacher, was an industrialist and thus able to ensure her studies at the elite gymnasium and later on in the department of physics at the University of Vienna.[14] Although she enrolled in the chemistry department in the fall semester of 1922, she soon quit for health reasons. She eventually studied law and then moved into physics.[15]

13 According to Leopold Halpern, Wambacher did her *Praktikum* at the Radium Institute, working closely with Blau on the improvement of the emulsion technique. Since Blau did not hold any position at the University of Vienna, she was not able to officially advise a student. Blau's help, though, was indispensable to Wambacher in completing her dissertation on the impact of photographic desensitizers to the imprints of alpha, beta, and gamma rays on photographic plates.[16] In 1931, Wambacher published her work in the *Mitteilungen,* arguing mainly that the organic dye pinakryptol yellow functioned as a desensitizer on photographic emulsions while the effect was smaller with chromic acid.[17]

14 The first coauthored paper with Blau appeared in June 1932 and a month later, the two women were able to detect photographically protons liberated by neutrons.[18] As Galison describes, their result was "bizarre and counterintuitive."[19] Particles liberated by neutrons did not leave an imprint unless the photographic plates where desensitized by means of pinakryptol yellow.[20] As a consequence of this first success in photographically detecting the ionization protons and explaining the effect of desensibilization, Blau was invited by the German photographic giant Agfa, "as their guest of honor" and a medal was bestowed upon her by the Photographic Association. In the fall of 1932, Blau also received a scholarship from the Association of Austrian Academic Women and spent the next six months at Robert Pohl's physics institute in Göttigen. In 1933, she accepted an invitation from Marie Curie to spend the rest of her stipendium time at her Laboratoire du radium in Paris. During her absence, Wambacher teamed with Kirsch on an investigation of neutrons from beryllium using Blau's photographic method.[21] On Blau's return in 1934, neither the institute nor Vienna was the same. The political upheavals of 1933 had deeply affected both.

Carrying Trafficking Materials and Crossing Disciplinary Boundaries

15 Since Pettersson's first visit to Vienna, he and his family kept moving back and forth over the years from Vienna to Göteborg, resembling nomadic travelers. In the beginning, from 1922 to 1925 Pettersson spent the academic years in Sweden teaching at the Göteborg Högskola, a *Kommissionen* lectureship position in oceanography. Each spring, he went to Vienna to work with his colleagues at the Radium Institute. In 1925 the fellowship from the International Educational Board offered him the luxury to stay in Vienna most of the year, spending only the summers in Sweden. The year 1927 was decisive in his career. The end of the financial support from the International Education Board along with the repercussions of Chadwick's visit in Vienna forced Pettersson to look for an alternative solution. Svante Arrhenius died that autumn, leaving his position vacant.[22] To Pettersson, that was a chance to finally obtain a professorship, to regain his authority, and continue research on radioactivity. In the Radium Institute, he was the leader of the group working on artificial disintegration. Otherwise, he was simply a lecturer in a position made up through his father's connections.[23]

16 In 1928, Pettersson applied for Arrhenius's vacant position, but his application met the tenacious opposition of Manne Siegbahn from the appointment committee. Caught in the academic politics of Sweden, Pettersson lost the battle despite the supportive letters that Meyer solicited from Hevesy, Fajans, and Marie Curie.[24] To the eyes of the scientific community the controversy was still unresolved. "[T]he results of Mr. Pettersson's and his collaborators' work are still a subject of controversy,"[25] Curie wrote to Meyer and thus, she suggested, it was not fair to deny the professorship to him. She further assured Meyer that Pettersson left a great impression on her when he visited Paris. He had definitely known how to gather capable collaborators around him and inspire them with his lively interest for research. Despite Curie's affirmations, the contradiction of Pettersson's research with the work done in Cambridge and in Berlin by Bothe and Fränz was enough of an excuse for his opponents in Sweden.[26]

17 In the spring of 1928, Pettersson returned to Vienna once more with his family.[27] This time he had with him a few red clay samples from sea-bottom sediments which he wanted to analyze for their radium content. Rona was assigned the task. As she soon found out, "The contamination of the Radium Institute was too high to permit small amounts of radium to be determined. The needed equipment was moved to the oceanographic station in Bornö on Gullmarfjord, in south Sweden. Here, I spent many summer months, staying sometimes well into the fall."[28]

18 The station had been built on a property that belonged to Petterrson's father on the Bornö island right on the shoreline in 1901. "The station is located at an extraordinary favorable position-unparalleled in Europe-on a steep cliff," Otto Pettersson ensured the Swedish Hydrographic-Biological Commission. It is "at the waterfront of the wind and waves and protected by Gullmarr Fjord which forms a natural experimental basin of 3 miles length for hydrographic and biological research-instruments." A fully equipped biological and chemical laboratory, a workshop, and two big storerooms were located on the ground floor of the building where nets were usually hanging from the ceilings and oceanographic instruments were stored. In addition, two aquariums were immured in the rock. On the second floor were located a small library, a spacious dinning room, and two bedrooms.[29]

19 Hosting work at the boundary of oceanography and radioactivity and encompassing research from biology to hydrology and metrology, the Bornö station was developed into Pettersson's main research institute during the 1930s. Starting in 1931, Pettersson and his colleagues performed daily measurements of the temperature and salinity at different depths of the Bornö station and extracted

sea samples from different depths to be analyzed for their radium content. With the intervention of Pettersson's father, the wealthy Swede Knut Mark offered funds for a new chair in oceanography at the Göteborg Högskola, which Pettersson easily obtained. "This meant," as Pettersson's daughter put it, "that my parents for the first time in their family life could afford a place of their own to live. Until then, they had 'lived in' with my maternal grandparents during winter times."[30]

20 To Pettersson, the new position offered a sense of professional recognition and eased his personal life. To his female collaborators in Vienna, it meant even more: a paradoxical opportunity for professional stability in temporary occupation. Carrying with them their portable apparatus, most of the women who previously worked with Pettersson in Vienna soon crossed the boundary of their discipline, analyzing sea bottom samples for their radium content in Bornö. By Pettersson's choice, laboratory technologies traveled across disciplinary lines from radioactivity to oceanography and geographically moved from Vienna to Bornö at the station which also functioned as a summer cottage of his family. The transport of materials and instruments went both ways. "Two bottles of seawater were sent at the beginning of the week to Vienna," Pettersson informed Rona.[31]

21 Once again, radium functioned as a trafficking material which this time linked a physics laboratory to an oceanography one. Women researched radium's properties not only in an academic site at the center of Vienna but also in a remote cottage-laboratory setting on Sweden's shoreline. During most of the winters, the station was impossible to reach from the mainland due to the bad weather. Developing a complex set of skills far from Vienna's academic environment, women's new scientific practices resembled workshop culture and old craft routines. Their research relied mainly on portable apparatus measuring the radioactivity of the samples, on handmade instruments for extracting the seawater from various depths, on boat communication with the rest of the world, and on the patronage system that Pettersson ensured.

22 Unable to get serious funding for their work on artificial disintegration, Rona, Blau, and Karlik visited Bornö during the summers for almost the next decade. Having fewer choices than their male colleagues, holding unstable positions in Vienna, and leading flexible personal lives as single women, the road to Bornö became a summer vacation ideally combined with serious research. With his unique talent to enlist patrons and donors, Pettersson financed his oceanographic research, secured funds for the women of the Radium Institute, and purchased the necessary apparatus for his new endeavor. Besides turning the Bornö station into

a state-owned permanent center for hydrographic research, he persuaded Alice and Knut Wallenberg, Swedish industrialists, to donate money for new facilities. Adding central heating, sanitary installations, electric lights, telephones, and new equipment, Pettersson made the space of the institute available for research during the whole year for different working groups.

23 In 1935, Rona reported to Meyer that "This is an ideal institute for work."[32] She was probably right. Situated in close proximity to Oslo and Copenhagen, the oceanographic institute in Bornö placed women in a convenient environment for research, for scientific visits to Gleditsch's and Bohr's institutes, and for social entertainment in the Swedish Kalhuvudet, an island north of Göteborg where Pettersson's grandparents once maintained an old herring factory. Now a summer cottage, the house in Kalhuvudet regularly hosted Karlik, Rona, and occasionally Blau, all of whom became close friends with the family.[33] When, for example, Rona worked in Bornö the summer of 1935, she visited Gleditsch in Oslo and met with her old colleague Hevesy in Copenhagen who at the time was in Bohr's institute. In Kalhuvudet, she spent time with Karlik and the Petterssons.[34] The summer before, Karlik paid a visit to Copenhagen as well where she had the chance to discuss their earlier work on artificial disintegration with Bohr's team.[35] In 1935, while Blau deputized Karlik as *wissenschaftliche Hilfskraft* at the Radium Institute, the latter had the chance to spend a longer period at the oceanographic station in Sweden.[36]

24 For the Viennese women becoming a part of the broader radioactivists' network proved to be important during the difficult years of the political persecution by the Nazis after 1938. Yet that was not the only benefit. Working on the boundaries between oceanography and physics, the opportunity for research was also a central concern to their work. After Rona analyzed the first ocean sediments, she discovered that the radium content was high and this undermined previous results that saw a connection between the radium content and water depth.[37] To resolve the discrepancy, Rona and Pettersson embarked on a wider project, intending to perform exact measurements of the concentration of radioactive elements in seawater.

25 It was then that Karlik, Föyn, Rona, and Pettersson formed a group on seawater research, joined from time to time by Gleditsch.[38] They started by analyzing the radium content of seawater taken from Gullmarfjiord and the more open Swedish sea of Skagerak. During the following years, Rona and Karlik spent part of their

summers in Bornö analyzing sediments. During the winters in Vienna, they kept up their collaboration with Pettersson who often sent sealed bottles of seawater for analysis to the Radium Institute.[39] Pettersson's wife Dagmar "did jobs when needed" and helped him regularly in his experiments. Their daughter recalls, "She used to do much of the routine titration on the innumerable samples of seawater coming, e.g., from the Bornö station. She liked the simple but accurate work and got paid. I remember her doing it, measuring the NaCl content by adding certain amounts of $AgNO_3$ with a drop of a color agent signaling neutrality."[40]

26 Concurrently, Karlik and Friedrich Hernegger, a research student at the Radium Institute, raised concerns on biological issues in relation to the uranium content of seawater. "It appears not unlikely that an accumulation of uranium in the tissue of marine organisms may occur which again may possibly account for some interesting results obtained concerning the high radioactivity of the waters in the petroleum districts in Russia."[41] Working in Przibram's research group, Hernegger had already developed an optical method for detecting and measuring small quantities of uranium based on the fluorescence phenomenon.

27 Owing to uranium's weak radioactivity, previously employed electrometric methods were not satisfactorily accurate. In 1933, with the support of a grant from the Rockefeller Foundation, Karlik and Hernegger acquired a glass spectrograph of high light-gathering power.[42] Expert in spectroscopic measurements due to her earlier work with Przibram and Herbert Haberlandt, Karlik joined by Hernegger, photographed the characteristic band-spectra due to uranium fluorescence and then compared those with spectra of known uranium content.[43] Supported by a stipendium from the Austrian ministry of education, Karlik performed the first experiments in Bornö in the summer of 1935 and she moved some samples to Vienna the following fall.[44]

28 The whole investigation became possible through the support and encouragement of both Meyer and Pettersson. As Karlik and Hernegger stressed in their article, they were hoping to enlarge their research project "through a continued collaboration between the Institut für Radiumforschung and the Oceanografiska Institutet of Göteborg Högskola."[45] The collaboration between the two institutes proved to be important for scientists in both countries. Besides the women conducting research at the Bornö station, one of Pettersson's Swedish colleagues, Börje Kullenberg, visited the Radium Institute in the end of 1938. He was the first assistant of the Svenska Hydrografisk-Biologiska Kommissionen and he appeared

as the Radium Institute's collaborator in the academy's almanac in 1939. On the other hand, as their publications reveal, Rona, Karlik, and Pettersson continued their research on the intersection of radiochemistry and oceanography throughout the 1930s.[46] At the same time, they remained by and large on the margins of research on nuclear physics.

From Radioactivity to Nuclear Physics

29 The transformation of the experimental culture in both the Cambridge and Vienna laboratories was only the tip of an iceberg that indicated a deeper transformation in the material culture of physics and its theories during the 1930s. Granting the possibility of partial autonomy to instrumentation, experimentation, and theory, Peter Galison argues that quasi-autonomous traditions carry their own periodization.[47] In the case of radioactivity, although during the 1930s theorists, experimentalists, and instrument makers had "a life of their own," they often met in the same laboratories and collaborated, altering the boundaries and the focus of their field.

30 As early as 1928, the Russian theoretical physicist George Gamow, a research fellow at Niels Bohr's laboratory in Copenhagen, applied the new quantum mechanics to the nucleus. He showed that the emission of alpha particles from radioactive sources follows a tunneling process that can be explained by the wave properties of fundamental particles. This explained why the emitted particles had lower energies that classic mechanics and the work of Rutherford and Chadwick could not account for. "On the strength of this work," as Brown argues, "Gamow became a frequent and valued visitor to the Cavendish." Although primarily an experimentalist, Chadwick coauthored a paper with the theoretician Gamow in 1930 on the artificial disintegration of alpha particles. The next year, Gamow's newly published book, *Constitution of Atomic Nuclei and Radioactivity*, was devoted to the Cavendish laboratory, making tangible the intersection of theory and experiment in what was formerly the field of radioactivity.[48]

31 Envisioning the potential of Gamow's theoretical work in disintegration by artificially accelerated particles, John Cockcroft, who had been working at Rutherford's lab since the early 1920s, put his hands on the instruments of the field. Joined by Ernest Walton, they designed a high-voltage apparatus for producing accelerated protons which were directed at various materials. The emitted particles were recorded in a zinc sulfide screen by means of the old scintillation technique.[49] However, nuclear physics was already the focus and

practice of those who worked on radioactive substances throughout the 1920s. Theory, experiment, and instrumentation fed one another while each reserved its partial autonomy and its scope of research.

32 In 1932, the discovery of the neutron by Chadwick based on the work done at the Cavendish certainly benefited from the radiochemical work of Irene Curie and Frederic Joliot in their institute in Paris. Their paper on the penetrating radiation from beryllium that appeared in the *Comptes rendus* gave Chadwick the answers he needed.[50] As Ernest Lawrence from the University of California at Berkley admitted, "The pioneer work of Rutherford and his school clearly indicated that the next great frontier for the experimental physicist was surely the atomic nucleus."[51] Somewhat sadly, Blau reported to Meyer from Göttingen that "For the photographic method, there is probably no time left, since all should be in the service of neutrons."[52] At the 1933 Solvay Conference in Brussels devoted to the atomic nucleus, all but the Viennese attended the meeting.[53] Shortly thereafter, in 1934, the Joliot-Curies discovered artificial radioactivity. Their Nobel Prize in Chemistry in 1935 gave them the power to control "every piece of nuclear work in France," and added to the prestige of the Institut du radium in the international scientific scene.[54]

33 For Enrico Fermi, the Italian physicist working in Rome, that "was a golden opportunity." His idea was to produce effects like those recorded in Paris, using neutrons instead of alpha particles. While the Italian group, formed by Emilio Segre, Edoardo Amaldi, Franco Rasetti, and Oscar D'Agostino exploited the slow neutrons, Meitner was working jointly with Hahn at the Kaiser Wilhelm Institute for Chemistry in Berlin. As Meitner later described, "From 1934 to 1938, Hahn and I were able to resume our joint work, the impetus for which had come from Fermi's results in bombarding heavy elements with neutrons. This work finally led Otto Hahn and Fritz Strassmann to the discovery of uranium fission."[55]

34 Described as the "happy thirties" for physics, and as a transition from atomic to nuclear physics, the 1930s combined apparently fruitful research in physics with an increasing political horror in Europe.[56] Behind a façade of legality, Hitler seized absolute power in March 1933 and put an end to parliamentary democracy in Germany. His first and main concern was to purge Jews from public life. He immediately succeeded with the "Law for the Restoration of the Professional Civil Service." Non-Aryans were excluded from government and civil service positions including the universities. Numerous historical studies have tackled the

consequences of the rise of National Socialism for German academic life, ranging from institutional and disciplinary histories to scientific biographies and comparative studies.[57] The persecution of Jews and the gender discriminatory politics of the Third Reich were, nevertheless, an acute indication of the rise of nationalist and fascist movements in Europe.[58] While still at the physics institute in Göttingen, Blau mentioned in her regular correspondence to Meyer, "On the political circumstances, one realizes here absolutely nothing, since, in principle, one should not talk about politics in the institute."[59] In Pohl's institute, scientists might have avoided facing Hitler's reality, but in Austria, the transition from Red Vienna to Austrofascismus and consequently to the Anschluss was hard to dismiss.

From Austrofascismus to the Anschluss

35

Apparently,the evidence of scintillation counting and relying upon the individual observer and his or her experience was not the only uncertainty that the Viennese experimenters faced during Chadwick's visit in 1927. In the city elections on April 2 of that year, the Austrian Social Democrats experienced their greatest electoral victory of the interwar years. As Rabinbach points out, "Its [SDAP's] electoral gains were illusory as long as it controlled neither the legal structure of the state nor the instruments of power."[60] Three months later, on July 15, the police violently stamped out a massive demonstration led by socialist workers, leaving 85 dead and hundreds injured. The event marked the beginning of the SDAP's decline and the uprising of the fascists. Although the political Catholicism and fascism preceded the National Socialist ideology, as Friedrich Stadler points out, the transition was a seamless one. In 1931, in the context of the world's economic crisis and the crash of the *Creditanstalt,* the prominent Vienna bank that financed much of Austria's industry, mobilized a wider economic and political crisis in the country.[61]

36

In May 1932, Austria underwent a parliamentary restructuring once again. The coalition between the Christian Socialists and the Pan-German People's party was dissolved and the new chancellor, Engelbert Dollfuss, fellow of the Christian Socialists, turned toward the Social Democrats, offering them a coalition with his party. When the Democrats responded negatively, Dollfuss made a deal with the *Heimwehr*, an antirepublican paramilitary organization supported by big business and Catholic political leaders.[62] National Socialists had already emerged as a

serious political force in the city elections a month earlier and now posed a threat for the conservative Christian Socialists who held a fragile majority in the parliament.

37 Eventually, faced with a still strong Social Democratic party on the left and an emerging Nazi regime on the right, Dollfuss and the other Christian Socialists suspended the Austrian parliament in March 1933. Seizing the opportunity, the Nazis committed a number of serious terrorist acts, mainly in Vienna but also in the rest of the country. That gave Dollfuss the chance to ban their party. Although illegal, the Nazis continued to exist without much difficulty.[63] With Mussolini as his ally and protector, Dollfuss fought on two fronts, against the Nazis and more fiercely against the Social Democrats. All newspapers and primarily the *Arbeiter-Zeitung*, the social democratic paper, were placed under strict government censorship. Part of Dollfuss's anti-democratic politics was to drastically reduce the budget of the city of Vienna and cancel all the social reform programs that were put forward by the Social Democrats.[64] In the following months, in the context of the wider European political crisis and Hitler's rise to power in Germany, the political situation in Vienna was increasingly unstable. The SDAP was the main concern of the new fascist regime. Under Mussolini's pressure, Dollfuss proclaimed not only the end of the liberal state and the constitution of the Austrian fascist *Ständestaat*, he also tried to extinguish any opposition from the Social Democratic camp.

38 The obituary of Red Vienna was finally written on the streets of the city just a few days after the arrest of the mayor, Karl Seitz. For three days, from February 12 to 14, 1934, frustrated armed workers fought with government troops in an already lost fight between socialism and Dollfuss's fascist regime. Although the Social Democrats were defeated and the dissolution of all parties was a fact, the Nazis were franticly planning Dollfuss's assassination. With Hitler's approval, the Nazis attacked the chancellery in Vienna and killed Dollfuss.

39 In July of the same year, another Christian Socialist, Kurt von Schuschnigg, came into power. For the next two years, Austria remained independent in the midst of a serious political crisis. In 1936, as his own solution to the uprising problems, Schuschnigg signed an agreement with Hitler, giving amnesty to imprisoned Nazis and including Nazis in the government.[65] It was these acts and the undermining of the Austrian democracy that paved the way for the German invasion in 1938. The

Austrian-German reconciliation promoted Hitler's plans for Austria's annexation to Germany which finally took place on March 12, 1938, when German troops marched into Vienna.[66]

Dismantling the Mediziner-Viertel

40 In the ideological context of German nationalism and political Catholicism, Jews and Social Democrats were among the first targets of both the fascist and Nazi regimes. The antidemocratic tensions that surrounded politics were immediately reflected in Vienna's scientific community. The excellent collection of articles put together by Friedrich Stadler and Peter Weibel, *The Cultural Exodus from Austria*, draws a vivid picture of the decline of the Mediziner-Viertel.[67] Even before Hitler's arrival on the Austrian scene, the destruction of Viennese culture and science, centered at the university and its institutes, started with the Austrofascists. The Viertel, an in vivo cultural and epistemic laboratory during the 1920s, was brutally eradicated by anti-Semitic and anti-democratic attacks.

41 From early on, the fascists controlled teaching appointments at the University of Vienna. At the same time Nazi students distributed "black lists" of Jewish and socialist professors, demanding restrictions and dismissals. The purge of educational institutions started with the Ernst Mach Society, which was dissolved soon after the February events on the accusation that the society disseminated Social Democratic propaganda. In April 1934, Otto Neurath's Social and Economic Museum in Vienna was closed and replaced by a new institute for Austrian picture statistics headed by the *Heimwher*.

42 In such a political context, the murder of Moritz Schlick, a constitutive member of the Vienna Circle, and its public justification by the press in 1936 did not come as a surprise. By 1938, most of the Vienna Circle associates were forced to emigrate.[68] The threat to the Psychoanalytic Society also became apparent with fascist and Nazi propaganda where psychoanalysis was targeted as "Jewish" science. Out of the 50 official members of the society, 47 were forced to flee Austria. The fate of the psychologists and their institute was similar and even harsher. As Bernhard Handlbauer describes, the dissolution of the SDAP disrupted the work of the Viennese psychologists, most of whom were deeply involved in the educational reforms of Red Vienna.[69] Handlbauer's argument is supported by the fact that the majority of Viennese psychologists were Jewish, liberals, and among them there were many women. One of the first to be harassed by the fascist regime was the Jewish psychologist Marie Jahoda who, after her imprisonment for nine months,

fled Austria in 1936.[70] Of those science institutes that hosted a high number of women during Red Vienna, the Vivarium was banned and destroyed after the Nazis seizure of power in 1938.[71]

A similar dark picture can be seen when one considers the gender and racial politics of the fascist regime in reference to women. As the statistics indicate, the number of female students at the University of Vienna dropped sharply after the civil war. In 1933–34, 1,761 Austrian women were enrolled on the philosophical faculty, 690 on the medical faculty, and 279 on the faculty of law. By 1938–39, the numbers had dropped to 768 in philosophy, 387 in medicine, and most remarkably, in the faculty of law where only 72 women were enrolled as students. (See Chart 01/6.)[72] 43

More specifically, during the academic year 1933–34, female students in physics accounted for the 18.1 percent of those in the faculty of philosophy. By 1938–39, the percentage had dropped to 12.5.[73] Although at the turn of the century when the University of Vienna opened up its doors to women Jewish women entered in disproportionately large numbers, by the academic year 1933–34, they represented only 2.8 percent of those enrolled. By 1938–39, there were none.[74]

The discriminatory gender politics of the Christian Socialists and their anti-Semitism was not news in 1933. During Red Vienna, any Social Democratic attempt to alter the gender politics concerning issues of abortion, birth control, or sexuality faced the tenacious and even violent resistance of the Christian Socialists.[75] At the same time, the anti-Semitism of the Christian Socialists was clearly stated even in their party's program. According to Gruber, "That the SDAP allowed such gutter politics to go unchallenged from the beginning of the republic to its end with the prominent Jews in its leadership keeping a low profile weakened the party and undercut the republic as well."[76] Overall, the ideological mechanism of the political Catholicism of the Christian Socialists and the anti-Semitism of the National Socialists absolutely destroyed the social reforms in education and, especially in the academy, those that socialists such as Otto Glöckel and Julius Tandler had put forward in Red Vienna. 44

Thwarting a Promising Proposal

The failure in 1932 to establish a joint radium laboratory under the auspices of two liberal institutes in Vienna, the Vivarium and the Radium Institute, was only the most outward sign of a deeper destruction. Tandler's political power and the 45

reform projects of the municipality were at issue much earlier than the fascist's seizure of power in 1934 and certainly long before the Nazis' arrival in Vienna. When on June 2, 1932, the directors of the Vivarium drafted a letter addressing the Austrian Academy of Sciences and presented their joint project with the Radium Institute, it was already too late for any further substantial reforms of Vienna's educational and welfare system.

46 The story runs as follows. In June 1932, two of the founders of the Institute for Experimental Biology, Hans Przibram and Leopold Portheim, directors of the botanical and zoological departments respectively and of the institute in general, addressed the *Kuratorium* of the Vivarium.[77] The *Kuratorium* was the scientific and administrative supervisory committee, the intermediary between the institute and the academy that among other things handled the institute's finances.[78] The directors' aim was twofold, exceeding a simple scientific request.

47 The first stage of the proposal included the establishment of a laboratory devoted to the study of the effects of radium on plants and animals. Of special interest was the investigation of the impact of radium on the sex hormones, a topic not sufficiently researched at the time and one that attracted great attention. Biologists interested in studying the effects of radium on organisms were also invited. The annual amount for the function of the new laboratory was estimated at 36,000 schillings. The project was specifically targeted to the physiological work on the sex hormones of Eugen Steinach who was proposed to be, according to the plan, responsible for the new laboratory.

48 Born in a Jewish family in Voralberg in 1861, Steinach was the son of a physician. In 1879, he moved to Switzerland at the University of Geneva to study natural sciences. In 1880, he returned to Vienna where he enrolled at the university to the medical faculty. At the beginning of his career, he worked closely with Emil Zuckerkandl, director of the first anatomical institute in Vienna.[79] As Michael Hubenstorf points out, the anatomical institute under Zuckerkandl and Tandler was populated by Jewish, liberal, socialist, and foreign students.[80] It was probably there that Steinach developed close contacts with Tandler, later Vienna's councilor for health and social welfare. In 1886, Steinach graduated with a degree in medicine from the University of Innsbruck and for the next two years served as an assistant at the Physiological Institute in Innsbruck. In 1889, Steinach became first assistant to the eminent physiologist Ewald Hering in the Physiological Institute of the German University in Prague where he served for four years. Meanwhile, he completed his habilitation in physiology and became a *Privatdozent*

at the university. His rise up the academic ladder was impressive. In 1895, he was named *ausserordentlicher Professor* of physiology and two years later, *ordentlicher Professor*. Still in Prague in 1902, he created and organized an innovative laboratory, the first of its kind in German speaking countries, for "general and comparative physiology." [81]

49 In 1910, already 49 years old and still in Prague, Steinach published a fundamental article on the physiology of the testis and sex biology, which marked his most productive period of scientific research. The article appeared in *Zentralblatt für Physiologie* and although it emphasized the pre-existence of female and male sex, it proved that maturation and preservation of sex characteristics were definitely controlled by the internal secretion of the testis. When the testes were removed, sexual lethargy developed whereas implantation of the testes elsewhere in the body restored sexual characteristics. Actually, Steinach was the first experimenter to successfully transplant animal testis in such a way that it became vascularized and remained functional at its new site. According to Chandak Sengoopta, his experimental results challenged fundamental beliefs about masculinity and femininity and were utilized within the larger context of homosexual rights movements in early twentieth century Central Europe. "If Steinach was right, homosexuality resulted from a specific congenital anomaly. It was not a progressive disease; it could not be spread by seduction; and, far from being a crime, it was no more dangerous than psychosexual femininity."[82]

50 Steinach left Prague in 1912 to become director of the physiological department of the Vivarium in Vienna, where he continued his experiments on the sex glands of animals and extended them to humans with the help of the Viennese urologist Robert Lichtenstern. From the laboratory to the clinic, Steinach's aim was to control human sexuality by manipulating the sex glands. During the 1920s, a second line of his research concerned human rejuvenation. He argued that bilateral vasectomy to senile males could achieve sexual rejuvenation. Experiments first on rats and then on three human subjects seemed to prove his claims.

51 The "Steinach Operation" soon gained popularity in both Europe and the U.S. Rejuvenation was not only applicable to men but equally to women in whom the germinal cells of the ovary could be destroyed by low-dose radiation.[83] By 1926, when the first International Congress of Sexual Research took place in Berlin, Steinach was already a world-famous figure. Between 1921 and 1938, he was

nominated for the Nobel Prize in Physiology six times. However, he never received it. Overall, his views on masculinity and femininity depended on "glandular politics" and certainly undermined traditional social certainties of his times.

52 Given Steinach's own research interest to irradiation experiments, the initiative to establish a radium laboratory at the Vivarium does not come as a surprise. Scientifically, the Vivarium was in a position to foster experimental biological research as, for example, the study of the effects of radium on plants and animals required. The only thing missing was the expertise in working with radioactive substances. As the directors of the Vivarium argued, a laboratory with a focus on the biological effects of radium was necessary and would be complementary to the research done in the Radium Institute given the fact that a condition Kupelweiser posed in 1910 restrained the latter from doing research on living organisms.[84] "According to the protocol, the participation in medicine for our institute," Meyer would admit in 1950, "was impossible, but at that time, the reciprocal interest was big."[85] Politically, the directors of the Vivarium could have the support of the municipality given their good connections to Tandler. As it appears in the Vivarium's annual reports published in the almanac of the Austrian Academy of Sciences, the institute received several donations from the city of Vienna over the years.[86]

53 What for the directors of the Vivarium was necessary, the director of the Radium Institute found to be a definite chance to enlarge the research agenda of his institute. Kinship relations between researchers and ideological proximity to the directorship and the working ethos between the two institutes promised an environment for fruitful research. The assistant of the Radium Institute, Karl Przibram, was the brother of Hans and one of those who financially supported the Vivarium when it was first established. Meyer's wife, Emilie Maas, was the niece of Leopold von Portheim.[87] Additionally, many of the researchers of the Radium Institute had already expressed their interest in working on the boundary between physics and medicine. These included Blau, Kara-Michailova, Rona, Eduard Jahoda, and Franz Urbach.[88]

54 At the time, Urbach was the director of the *Physikalische Laboratorium* at the municipal hospital in Lainz. Meyer himself had already published on the physical basis of radium emanation therapy in 1929. The next year, he collaborated with Erhard Suess, the son of the president of the academy, Eduard Suess, on the use of radium emanation as an indicator for diagnostics and in therapy. Meanwhile, Meyer supervised the work of Maria Renata Deinlein on the residence time of

radon in the human body after drinking therapy.[89] In 1932, Meyer was invited to prepare a special issue of the *Pharmazeutische Presse* on radioactivity, in which he involved Karl Przibram, Gerhard Kirsch, and Rona.[90] Thus, the proposal for a joint research radium laboratory that would be housed in the Vivarium seemed not only reasonable but indispensable.

55 Besides the scientific concerns, the second stage of the proposal carried a political dimension. As the directors of the Vivarium revealed in their plan, the proposed laboratory would function as the regulator for the supplies, the dosimetry, and the handling and shipment of radium in Austrian hospitals.[91] It was one thing for the scientists to require a new research laboratory and it was quite another to envision themselves as the regulators of radium supplies in the hospitals of the entire country. To control the distribution of a valuable trafficking material for scientific laboratories, clinics, and commercial sites meant more than the movement of equipments, materials, or experts among laboratories. It meant the absolute power over laboratory and clinical work on radium in the entire country, the expansion of the budget for both institutes, and their future scientific and financial independence from state control. Under such conditions, people like Steinach could carry out their research agenda, undermining traditional social values. Magnus Hirschfeld's example leaves no doubt about the Nazis' stand toward similar lines of research. Hirschfeld was a practicing physician and founder of the Institute for Sexual Science, which was dedicated to research on human sexuality and especially homosexuality. When the Nazis took over Germany, they ransacked his institute and burnt his books and records. Hirschfeld subsequently fled to France.[92]

56 In Austria, the establishment of the radium laboratory at the municipal hospital in Lainz in 1930 was already a persuasive sign of the Social Democrats' political plans to alter welfare services in Vienna. Meyer's position as the consulate for the radium purchases from the municipal hospitals implied a direct connection to Tandler's political agenda. Obviously, the proposal that was put forward from the Vivarium met Tandler's ambitions as well for a centralized station for radium supplies that exceeded the borders of the city of Vienna, but given the wider political crisis of the country, the timing was not propitious.

57 Just five days later, a committee was invited to meet at the academy to discuss the proposed project.[93] Among them were Meyer and Schweidler from the Radium Institute, and Hans Przibram and Portheim from the Vivarium. Hans Molisch, the president of the University of Vienna and an earlier collaborator with the Radium

Institute, attended the meeting along with Arnold Durig, the director of the Physiological Institute of the University of Vienna. Durig was a member of the supreme hygiene councilors and one of the first to be dismissed for political reasons after the Anschluss in May 1938.[94] Unfortunately, no further notes about the discussion appear in the protocol book of the Austrian Academy of Sciences. A letter to Molisch signed by both Prizbram and Portheim on June 6, 1932, a day earlier than the actual meeting of the committee, however, sheds some light on the issue. After informing Molisch that they had just had 400 visitors and 80 children in the aquarium, they mentioned that "Unfortunately, nothing will happen with the other project because the one who proposed it did not contact us and the available information does not shed any favorable light on it."[95]

The proposed project never took place, thwarting the possibilities of interdisciplinary research on radiobiology. Less than two months later, on July 31, 1932, Steinach retired.[96] The failure of the Vivarium and the Radium Institute to establish a joint radium laboratory could be attributed to many factors. The fact that two of the most liberal institutes in Vienna formally tried to play not only a scientific but also a political role in the country at a time of a deep antirepublican crisis is not negligible. Adding the fact that most of the researchers, especially those in the key positions of the directors, were Jewish, one could anticipate the outcome of the proposal. The unfruitful initiative was only the beginning of what was going to happen in the political life and the scientific research of the country. 58

Franz Urbach and the Fascist Politics of Persecution

In its early days, the new fascist regime in Austria was more interested in destroying the social democratic forces of Vienna than in Jewish scientists. Still, some fit in both categories. Franz Urbach, collaborator of the Radium Institute, was among the first to be fired from his position as director of the *Physichalische Laboratorium* at the municipal hospital in Lainz. The reason was clearly political, but Urbach was also from a well-known Jewish family in Vienna. 59

Urbach completed his dissertation on the phenomena of luminescence after radioactive irradiation in 1926 under Przibram. He continued to work with Przibram until 1932 when he was appointed director of the *Physikalische Laboratorium* in the hospital in Lainz. According to Wolfgang Reiter, the new municipal authorities expelled Urbach from his office in 1934, accusing him of gaining the position under the political influence of his uncle Otto Urbach, an active Social Democrat.[97] Besides this odd excuse, the fascist regime knew very well that Urbach had a key 60

position similar to the one that the directors of the Vivarium envisioned to obtain through the joint laboratory with the Radium Institute but on a smaller scale. Indeed, the *Physikalische Laboratorium* of the municipal hospital did create the space for interdisciplinary exchanges among physicists, technicians, and physicians. Combining radioactivity and medicine, the physicists crossed the boundary of their expertise and provided scientific support to doctors over issues of radium dosimetry.

61 Employing a director, two physicists, and a technician, the laboratory offered technical support to the physicists who worked in the relevant pavilions of the hospital. Open to medical practitioners, it further functioned as an intermediate space of collaboration between physicists and physicians for the development and improvement of methods applied in radium therapy. Besides playing the role of an information and research center, the *Physikalische Laboratorium* had another key function. It controlled the radium carriers, 400 in total, for medical use. The whole endeavor, as Urbach acknowledged, became possible through the municipality's initiative and the support of three professors at the University of Vienna: Meyer, Thirring, and Hermann Mark.[98]

62 For the fascists, the removal of Urbach from his key position in the hospital at Lainz was an issue of control and demonstration of power. Red Vienna and the reforms of the Social Democrats were clearly past. The municipality was in the hands of the Christian Socialists and appointments were now controlled by Schuschnigg's regime. When Urbach found himself unemployed, he turned to the Radium Institute and his close collaborators there, Meyer and Karl Przibram. In the 1935 publication of the almanac of the Austrian Academy of Sciences, Urbach appeared as the institute's collaborator, as he was before he obtained the position in Lainz.[99] The same year, working in Przibram's group, he published an article in the *Mitteilungen* on the spontaneous change of latent pictures. He remained in the institute until his immigration in 1939.[100]

Hilda Fonovits-Smereker: A Puzzling Case

63 In these odd circumstances, Hilda Fonovits-Smereker, *Assistentin* of the Radium Institute from 1919 to 1922, took over Urbach's position. The politics behind this appointment are not clear. In 1932, Fonovits-Smereker was hired as an assistant director at the Radiumtechnische Versuchsanstalt, the radium station at the General Hospital of Vienna.[101] The decision was made by the federal ministry for social administration and the ministry for justice. The connection had probably

been made through Meyer and the director of the *Radiumtechnische Versuchsanstalt*, Albert Fernau. That same year, Fernau was in frequent correspondence with Meyer, discussing the therapeutic value of drinking water containing radon.[102] By that point, it was mainly the personnel of the Radium Institute that prepared radium for medical purposes in the general hospital. As Fernau mentioned, Rona had recently prepared radium D for hospital use.[103]

64 Although no direct evidence exists, under these circumstances, Fernau probably suggested the hiring of a physicist and Meyer mentioned Fonovits-Smereker. The function of the Radiumtechnische Versuchsanstalt and thus Fonovits-Smereker's tasks were to measure and prepare radium for medical use. She worked closely with Fernau until his death in 1934.[104] Meyer informed Rona, who at the time was at Curie's Institute in Paris, "You probably have heard that poor Fernau died last August. He was not a great scientist, but he was a very nice man and had achieved a lot for the dosimetry of medical preparations and was not always acknowledged. I have not yet heard more about whether and how his institute will be further directed."[105]

65 At that time, Fonovits-Smereker was promoted to Fernau's position, but that was not the only change. Based on a work contract, the city of Vienna was controlled by Schuschnigg's regime. It now entrusted the Radiumtechnische Versuchsanstalt and consequently its director, Fonovits-Smereker, to perform control measurements of the radium preparations and the rest of the scientific work previously done in the Physikalische Laboratorium at the hospital in Lainz by Urbach's group. As her publication record reveals, Fonovits-Smereker published extensively in the ensuing years on medical physics and in the prestigious journal, *Strahlentherapie*.[106]

66 The *Oberarzt* of the radiation department, to which the Physikalische Laboratorium belonged, was Emil Maier. When the department was established under Tandler's supervision, Maier visited several sites in Europe to gain experience in radium therapy. At the end of May 1938, right after the Anschluss, Maier became a member of National Socialists (NSDAP) and on December 1 of the same year was promoted to *Primararzt*.[107] In 1941, Fonovits-Smereker and Maier were married.[108] In 1943, her habilitation was accepted at the medical faculty of the University of Vienna and she retained the position of the director until the end of her life in 1954. Her death was attributed to severe blood damage due to her work with radioactive materials.

A puzzling case, Fonovits-Smereker was the only woman who ever held the position of a second assistant at the Radium Institute in the interwar years. Following an expected pattern of women in science, she quit her career in 1922, unable to combine motherhood and scientific work. Nevertheless, she held a prominent position ten years later, this time as an assistant director at the Radiumtechnische Verschuchsanstalt in the general hospital of Vienna. In 1934, although the fascists ousted Urbach from the hospital in Lainz, she became the director of the Physikalische Laboratorium. No letters indicate any connection to the rest of the women at the Radium Institute, and no evidence seems to exist of her political positioning. Her marriage to Maier further complicates the story. However, by being able to handle a trafficking material such as radium, she was able to be evasive and to cross disciplinary boundaries to regain entry into science. Carrying her physics expertise to the general hospital and then to the hospital in Lainz, Fonovits-Smereker secured a career in the boundary zone of medical physics. 67

A History of Disarray: The Institute for Radium Research, 1933–38

From 1933 to 1938, the history of the Radium Institute, affected by the political upheavals, can be written as a history of disarray. Besides losing the full benefits of a position as a *wissenschaftliche Hilfskraft* in 1933, even the scientific connection to the Second Physics Institute was threatened.[109] At the end of March 1934, Gustav Jäger, Exner's successor, was forced to retire as director of the Second Physics Institute at the age of 69.[110] In a state of anxiety, Stetter reported to Pettersson that "The disaster has already come. The ministry of education has informed the faculty-in which form, I do not know-that Hofrat Jäger should retire by the end of March and that the Second Physics Institute is dissolved."[111] 68

On March 5, 1934, the same evening that Stetter wrote his letter, the faculty was planning to meet and discuss its strategy. The special commission hoped to gain time by keeping Jäger for one more semester and to save the institute in some form or other. Although as Stetter admitted, "they" were not optimistic about saving Jäger, "they" proposed to mobilize the American envoy, concentrating their efforts on saving the institute. "The way through the ministry of foreign affairs is the one that can be successful. Perhaps an intervention from Rockefeller, perhaps a letter from Curie or similar?"[112] Stetter never explained who "they" were and, as it becomes obvious through Karlik's correspondence with Pettersson, a number of 69

different strategies were proposed. "I had a very long talk with Kindinger who seems to have been discussing the matter with Stetter in details . . . I hope he has some influence on the others; his ideas about the tactic seem very sound."[113]

70 Stetter's main concern was that the dissolution of the institute would definitely affect his research. On the basis of his work in Pettersson's group, Stetter completed his habilitation in 1927 and six years later, in October 1933, he was promoted to an *ausserordentliche Privatdozent.*[114] Since 1922, he had been working as an *ausserordentliche Assistent* at the Second Physics Institute and used its facilities for his research. With the dissolution of the institute, Stetter's professional career was at stake and his fears were well-founded. Since 1932, he had been a member of the National Socialist Teachers League and a month before Dollfuss banned the Nazi party in July 1933, Stetter joined it.[115] On top of facing the dissolution of the Second Physics Institute, Stetter was risking possible dismissal as an illegal Nazi.

71 Obviously, Stetter was not the only one in the institute who subscribed to the National Socialist ideology. Ortner had been a member of the National Socialist Teachers League since 1934. Kirsch, Pettersson's close collaborator during the 1920s, became a leader of a *Keimzelle* of the National Socialist Teachers League at the University of Vienna in 1933 and had been a member of the NSDAP since 1923.[116] Probably the most outspoken one of this group, Kirsch made Karlik and Pettersson nervous. Already in 1933, she expressed her aversion toward him: "I have been to the institute this morning. Kirsch has come back and now one has to face politics again. I feel so disgusted!!" A year later, it became obvious to Pettersson that Kirsch's scientific work was "probably the least dangerous occupation one could find for him." It was the time, as Karlik reported in her regular correspondence to him, that "Many things are not pleasant" in the institute, but letters did not seem to be a safe way for conveying more details.[117]

72 In the meantime, Karlik decided to apply for the position of *Dozent*. In the beginning of May 1936, she put together her papers and, as the procedure required, Karlik presented her file to all the members of the examination committee to ask whether they had any objection. She recounts the situation:

> Schw.[eidler] was charming and addressed me kindly in all the formalities. Th[irrin]g—to my great surprise—took the question *au serieux*. Looked up the number of *Dozenten* we had already, asked me what I meant to lecture about and who was the last Doz.[ent] appointed and when was that and so on. But finally he wound up by

> saying that, of course, he would not object, that he always had had an excellent impression from me and some more such compliments.[118]

73 At that time, Thirring was director of the Institute for Theoretical Physics and already knew Karlik and her work, since he was on the examination committee of her doctoral thesis. Schweidler had been director of the First Physics Institute since 1920. In 1936, he was also appointed director of the Second Physics Institute which had remained without a director for two years after Jäger's retirement.[119] Felix Ehrenhaft, the director of the Third Physics Institute, was next on the list. They were all housed in Boltzmangasse next door to the Radium Institute and knew Karlik from the time she started her studies on radioactivity. However, things did not go as smoothly with Ehrenhaft as with the others. "He [Ehrenhaft] was 'terribly busy' for several days (Planck was in Vienna) and could not receive me. Then at last, I was asked to come on Saturday which was a day too late for sending the application for the May meeting of the faculty. Whether he knew this or not, I don't know."[120]

74 Karlik was prepared for the delay and finally Ehrenhaft presented no objection. Even with their affirmations, nothing guaranteed the outcome of the final examination. She was planning to study during the summer and present her colloquium the coming October. Given that Schweidler was the dean and also positive about her application, she expected to easily satisfy the formal requirements and complete the paperwork in the next two upcoming faculty meetings before the end of the academic year. She continued to run her own experiments with uranium, part of her research project in Bornö and found herself "unexpectedly" busy with the task of performing photometric measurements for Thirring. "I don't mean to devote too much time to this job which is really not mine, but to go a little bit into the matter, I think will pay."

75 Accustomed to the collegial style of her earlier work at the institute, she was hoping to learn a lot in various respects, "especially things which may also be of some use for your work," Karlik wrote to Pettersson. "I am also glad the thing is of interest to Schmidt, and Blau and Wambacher will also probably profit." The arduous work and her numerous research obligations did not curb her willingness to go through with her application. As Pettersson assured her, "I have not the least doubts about your coming up out top dog in the end, but you are in a

strenuous time."[121] Eventually, Karlik received the *Venia Legendi* in 1937, the formal requirement for gaining the right to teach at the university and she started teaching the physics of inert gases in 1937–38.[122]

Other than delays and an incredible amount of work, Karlik did not seem to have faced any serious objections. Blau, however, did not receive similar treatment when she asked for the permanent position of a *Dozent*. According to her brother, a professor told her that "to be a woman and a Jew was just too much."[123] Given that Karlik was able to obtain the position, Blau's case indicates that gender was not the main discriminatory factor. The fact that Blau was Jewish and probably more politically engaged than Karlik contributed to her rejection.[124] The international attention brought by her success turned out to be a disadvantage. **76**

After her return from Paris in 1934, Blau continued her collaboration with Wambacher. The two women worked on two fronts. First, they improved the emulsion technique by thickening the photographic plates to allow a better deposit of the particle tracks. Ilford, the English photographic company, offered to produce sufficiently thick plates, but as Blau explained, "To obtain still thicker emulsion layers, new developments methods had to be worked out." Second, while still struggling to alter their apparatus to suit their experimental needs, Blau and Wambacher applied the photographic technique to neutron studies.[125] Yet their collaboration turned out to be threatening for Blau's existence in the institute and for the control over her own method. In June 1934, Wambacher had joined the National Socialist Party and around that time, she had been intimately involved with Stetter. Facilitated by the political changes in 1936, Stetter soon started to interfere in the relationship of the two women and their scientific work. **77**

That year, following Mussolini's suggestion, Schuschnigg sought an accommodation with the Germans. An agreement signed between the two countries led to the empowerment of the Austrian Nazis. These changes were immediately reflected in the institute. As Karlik somewhat ironically reported to Pettersson, "Stetter is looking much interested in everybody's work and affairs and he is behaving like an ideal 'chef.'"[126] What he was following very closely, though, was the work done by Blau and Wambacher. The two women were supported by Victor Hess, the institute's first assistant before World War I and an expert in cosmic radiation. In 1936, they exposed their emulsions for four months on the Haferlekar, a mountain near Innsbruck. **78**

79 Their research project consisted of determining the existence of heavy particles such as protons, neutrons, and alpha particles in cosmic radiation, which at the time was quite doubtful. Proton tracks, longer than anyone else had observed by that time, were apparent in a first examination of the plates. To their surprise, the two women observed in the emulsion a "contamination star" (several tracks emanating from a point) that could neither be explained by irregularities in the emulsion nor from unknown radioactive products in the handling and storage of the plates in the laboratory. "This 'star' had to originate with cosmic radiation, since we had never observed a similar phenomenon in plates, even those that had been lying in the laboratory for much longer periods of time."[127] The assumption was that the large stars originated with the disintegration of heavy particles, probably bromine or silver, and the smaller ones originated perhaps from light elements in the gelatin. Given the theoretical limitations of nuclear physics of the time, Blau and Wambacher could not determine the nature of the primary particle and the exact process of the disintegration.

80 These impressive results, which Galison considers the first "golden event" using emulsions, provoked the interest of the scientific community and the brutal interference of Stetter.[128] In 1937, on the basis of their discovery, the two women were awarded the Ignaz Lieben Prize of the Austrian Academy of Sciences.[129] Furthermore, through Meyer's assistance, the two women were awarded a grant from the Austrian Academy of Sciences that was to be used for balloon flights with emulsions distributed at several of the country's mountain stations.[130]

81 The international recognition also came with Heisenberg's immediate response. As Karlik informed Pettersson, "Heisenberg takes personally the most vivid interest in it [the new phenomenon] and is in continual correspondence with Blau and Wambacher. He has been talking about it in a conference with the Upper Ten in Bologna." While the two women were preparing a publication, Stetter approached Blau. He accused her of being unfair to Wambacher and expected her to change the order of the names on their publication. After all, Stetter argued, Wambacher was the first to look into the microscope and find the first star. Blau refused.[131]

82 In 1927, the skill of observing scintillations, performed by the women of the institute, had been characterized by Chadwick and historically read as routine and technical, separate from the decisive parts of the experiment. In 1937, Stetter used Wambacher's skill of observing and situating a star as the decisive part of the whole experiment performed by both women. Symptomatic of how the Viennese valued the task of observation, Stetter's argument is at the same time ironically

symptomatic of his ardent anti-Semitism. During the days of Meyer's directorship, incidents like this did not occur, yet the Nazi regime imposed different practices in the institute. Although Stetter's anti-Semitism is clear, his interference implies something more. Assuming his male power, he intervened in the relation of the two women, taking control of their collaboration. Meyer, a Jew himself, was unable to play the leading role his position required.[132]

83 The colleagues that knew Blau, including Karlik, recognized that she was miserable after Stetter's intervention and even thinking of abandoning her research., Karlik was very close to Blau and knew that in spite of her poor health, she had been working intensely for the last months. "The enormous pleasure the work gave her actually made her feel a little stronger." As for Wambacher, "She certainly has been very diligent, too, since the summer (chiefly examining the plates in the microscope), but Etta Blau has done all the very tiresome calculating." Also, as Karlik reminded Pettersson, Blau was still the more "mature partner" between the two.

84 At the same time, given her affair with Setter, Wambacher was strongly attached to him. Although, according to Karlik, she recognized that his handling of the situation was not quite correct, her emotional dilemma was important. Wambacher's behavior toward Blau was extreme. Either by being rude or as enormously generous as she often was, she had turned the relationship into an uneasy one. The most suitable solution seemed to be for Blau to leave the institute for a while. Karlik turned once again to Pettersson, asking for his intervention and suggesting that he could invite Blau to his oceanographic institute, offering her a research project and a small stipendium.[133]

85 The solution came from another direction. Ellen Gleditsch, probably informed by Rona, took a personal interest in Blau's situation.[134] Her research assistant, Ruth Bakken, was pregnant and Gleditsch suggested that Blau replace her for three months. The solution was ideal. Away from Vienna, Blau could work with Ernst Föyn whom she already knew through her summers at Bornö. Looking forward to her visit to Oslo and under the enormous pressure from her ex-advisee and Stetter, Blau rushed to arrange research matters with Wambacher, an arrangement which was a total defeat for her. Even before Hitler's troops marched into the city, her Nazi colleague was able to take over the most interesting part of her research project.

86 As the agreement went, Wambacher, in collaboration with Ortner, was going to investigate the relation of the grain and density of the tracks recorded on the photographic emulsions to the energy of the particles produced by them. By measuring the grain thickness of the tracks, one could even estimate the energy of the particles that were not lying completely in the emulsion but passed through without ending it. That had the potential of identifying the particles and the total energy released in the projects, the two key points of Blau's and Wambacher's earlier work. "It is actually one of the main points started by Bl[au] in which she is particularly interested," as Karlik reported to Pettersson. "Blau kept for herself the absorption experiments. It's less promising and more tiresome and it will take months before she can examine the first plates . . . she sacrificed more than I considered right."[135]

87 In his usual manner of supporting his female collaborators at the Radium Institute, Pettersson proposed to present Blau's work in the Swedish press. However, it was more urgent for Blau to give a paper at Bohr's institute on her way to Oslo. Wisely enough, Pettersson foresaw that the Bohr connection could pave her way to other prominent research centers in Europe.[136] Very cautiously and discreetly, Hevesy, who at the time was in Bohr's institute, arranged the visit for March 14, 1938.[137] The connection was made by Rona, Hevesy's earlier collaborator and friend.

88 While at the Radium Institute, Stetter, Ortner, and Wambacher orchestrated Blau's purge and the seizure of her scientific research, Kirsch tried to present the Nazi version of the two women's collaboration to Pettersson. In January and February 1938, Kirsch was on a scientific tour in Berlin, Kiel, Oslo, Stockholm, and Göteborg, giving lectures about his work.[138] Traveling from Oslo to Stockholm, he visited Pettersson for just an evening. That was enough for Kirsch to discuss the matter and allege that Blau had exploited Wambacher in their cooperative project. Amid the threats of those who surrounded her in Vienna and those who were willing to present to the international scientific community a version of the case convenient to Wambacher, Blau was ready to leave the institute.

89 Karlik expected that her leave would be temporary and both Blau and Wambacher "will find some way to each other again after her return." Karlik's naiveté went so far as to suppose that "Stetter already begins to feel sorry, but his *weltanschauliche* convictions and his sympathy for and his wish to help H[erta] W[ambacher] are very strong."[139] Contrary to Karlik's predictions, Blau's temporary distance from the institute and her Nazi colleagues turned out to be a

permanent struggle for existence. On March 12, Germans entered Austria in a triumphal parade. The day before Hitler gave his speech in Vienna, Blau left the city.[140]

Anschluss and Exile

90

To answer the question "What was particularly Nazi in science after 1938 in Vienna?" one should first consider what was particularly different in the Viennese scientific community before 1934. As I have argued throughout, the physicists conducting research on radioactivity were an inseparable part of the Viennese culture and the democratic politics of Red Vienna. The collegial ethos of working in the Radium Institute and the leadership style of Stefan Meyer defined the atmosphere in the institute and welcomed a number of young scientists, many women among them. Right after the Anschluss, well-preserved patterns of research and cooperation were abruptly disturbed. The so-called friendly visit[141] of the German army to Vienna was not so friendly for the Jews of the institute. Although the final decisions on the dismissed personnel were not expected earlier than April 10, the scientists at the institute were forced to swear allegiance to the Third Reich during the last week of March and at least two of them were excluded for racial reasons.[142] Meyer had already applied for a permanent retirement to the philosophical faculty on March 18 and voluntarily retreated from his academy membership in an attempt to avoid any confrontation with the Nazis and the humiliation of a dismissal from the academy.[143] Przibram's position was also threatened and, as Karlik described to Pettersson, "When I see Karl, tears come to my eyes."[144] Both Meyer and Przibram remained at the institute as "guests" until January 1939, when a hate campaign against them forced Ortner, the new director, to forbid their work at the institute.[145]

91

During the war, Meyer and his family retreated to his summer residence in Bad Ischl, close to Salzburg, while Przibram and his wife immigrated to Brussels.[146] Wolfgang Reiter points out that after the Anschluss, "the Radium Institute lost a quarter of its collaborators, in particular those who had shaped the profile of the institute with their scientific achievements."[147] In front of the Radium Institute, a long banner with the slogan "One Nation, One Empire, One Leader" made tangible the dramatic changes in the city and most obviously in the institute itself. Most expressive was the slogan hanging in the Physics Institute: "*Juden sind hier unerwünscht*" (Here the Jews are undesirable).[148]

92 While anti-Semitism in the Institute forced the Jews into exile, the promotions of the Nazi gang after the Anschluss were impressive. Besides taking over the directorship of the institute, Ortner was named *extraordinarius Professor*.[149] As Karlik explained:

> He [Ortner] is comparatively decent but perfectly happy and very pleased with what is going on. What he does not want to know, he does not know and what he does not want to think, he does not think about. So he is flourishing and made a remark a few hours ago at which I felt I should like to smack his face. George's [Stetter] beaming satisfaction with himself is sometimes almost unbearable. His psychology is as primitive as can be. To have to listen to remarks and explanations by him and his friends is the greatest strain; much worse even then to watch the distress of some friends.[150]

93 Ortner's friends, Stetter and Kirsch, were both promoted to the position of *ordinarius Professor* and took over the responsibilities of those who left. "Gerhard [Kirsch] is now supervising the third [Physics] Institute and is also lecturing five times a week in E.[tta Blau]'s place . . . George [Stetter] has taken over Charles's lectures."[151]

94 By the beginning of May, the situation deteriorated. "A number of changes have taken place here again. Mark, Thirring, Schrod., and Ludloff had to leave," Karlik wrote to Gleditsch.[152] Filling up the positions that the Jews such as Blau, Meyer, and Przibram left behind was not ambitious enough. The continuation of the research was accompanied by a plan of expansion. Supported by the German ministry for financial developments in Berlin, Stetter seemed to have played an instrumental role in establishing an institute for nuclear research as a joint program between the Second Physics Institute and the Radium Institute.[153] The Vierjahresplan-Instituts für Neutronenforschung was directed by Stetter, and Ortner was named his official substitute.

95 The Nazi authorities were not opposed to science, so they channeled large amounts of money to scientific research and renovations. To accommodate the changes, the Radium Institute underwent a decisive reconstruction. The whole building was cleaned and painted, the furniture was well washed, everything was put in order, and the door leading to the staircase toward the roof was bricked shut while another one was opened up. The aim was to eliminate the radioactive contamination in the institute and use the previously contaminated rooms for the sensitive Geiger-Müller counters for measurements.[154]

While the Jews of the institute were cut off from their research and forced into exile, the Nazi circle, including Max Kindinger, Josef SchintImeister, Willibald Jentschke, Stetter, Ortner, Kirsch, and Wambacher, secured the support of the Third Reich to play a role in the development of nuclear physics.[155] In this politically polarized atmosphere, the non-Jewish anti-Nazis, such as Berta Karlik, faced a crucial dilemma. "The question is: to stay or not to stay? I have decided to stay," she admitted to Pettersson.[156] 96

The following table, when compared with Table 04/4 of chapter 4, illustrates the major changes in the institute's personnel as have been described above. Notice that none of the Jews, men and women alike, remained at the institute after 1938/39. (See Table 01/6.) 97

Berta Karlik

In 1938, anxious about the political circumstances, Pettersson proposed to Karlik, his closest friend and long time collaborator, a one-year fellowship in his new oceanographic institute in Göteborg. "Remember, I am reserving my first research fellowship for you and am moreover not pressing you for an answer, but in case you do not foresee any changes where you are, I shall be very happy to have you here in 1939." 98

The changes in Vienna were drastic. With Ortner as the new director and Przibram's purging from the position of the first assistant, Karlik took over his responsibilities and most of his research agenda. The new arrangements brought her professionally very close to Ortner, a collaboration that threatened her own research agenda and her role at the institute. "He [Ortner] is a bit of an egoist, too, in his work and there have already been a few incidents which showed me that I had to look out or he would use me as a well-qualified kuli, [which would be] most comfortable for him."[157] 99

The changes in the directorship marked not only the rise of anti-Semitism within the institute and the flourishing of the Nazi group but also tended to transform the role of women scientists. Out of the 17 women at the institute in 1938, only seven remained in 1939.[158] With the departure of Blau and Rona—the women most seriously engaged in the institute's research—and the decrease in the total number of women, the responsibilities of those who remained increased. Yet there was little place for research and less time for creative work. "It's not a matter of career," Karlik admitted to Pettersson. "I hope you know me well enough to 100

realize that I don't care for that. But I want *decent* conditions to work in; not just endless drudgery work and a lot of responsibility in all sorts of silly little matters and the care of some stupid students."[159]

101 In May 1938, afraid that she would lose her research status at the institute, Karlik prompted Pettersson to demand back the apparatus he left in Vienna after his departure in the early 1930s. Financed by Swedish donors and the Rockefeller Foundation, the laboratory instruments used in the disintegration experiments of the 1920s officially belonged to Pettersson. During the 1930s, while he was still in close collaboration with the women of the institute, Pettersson never claimed his instruments even when he was in need to equip the station in Bornö. Wanting to ensure her access to the most important experimental apparatus for her work, Karlik asked Pettersson to leave the glass spectrograph to her responsibility. "Years ago, Gerhard [Kirsch] hinted already at taking it away from me should he once leave Vienna. Perhaps it was more to show his power over me at that time that he actually meant it—anyhow, I am not safe."[160]

102 While Karlik was struggling to retain her research position at the institute, she was assigned the reorganization of the library, Przibram's administrative tasks as assistant, several odd jobs in the renovation of the building, and the supervision of a number of young students besides her own. With a feeling of ambivalence and "torn to pieces," Karlik decided to stay and rejected Pettersson's offer to take up the fellowship at his Oceanographic Institute in Göteborg. "I will have to put up with many things. I want at least the possibility to do some research that interests me," but it was not only the research Karlik was interested in. As she admitted to Gleditsch, "I think perhaps some of my English friends wonder why I am not leaving Germany in protest. I have come to the conclusion that protest on the part of a German individual is quite useless at the moment and that more is done by staying and trying to improve matters from inside the country."[161]

103 Indeed, Karlik remained in Vienna and during the war years, she reached the peak of her career. In 1940, she officially became *wissenschaftlichen Assistent* at the Radium Institute and in 1942, she was promoted to *Diätendozentin.* In collaboration with Traude Cless-Bernert, she discovered the natural occurrence of isotopes of astatine by observation of their radioactive alpha particle decays. Bernert was supervised by Ortner and after her graduation in 1939, she remained at the institute. The two women worked extensively together until 1945. By the end of the war, after Ortner's "disappearance," Karlik became the director of the institute and retained her position until her retirement.[162] In 1956, she was

promoted to the highest academic rank of an *ordentliche Professor*, the first woman in Austria to reach such a position. The Austrian Academy of Sciences elected her as a member in 1973, the second female member of the academy after Meitner.[163]

Elizabeth Rona

104 Although Karlik had the choice to remain at the institute, Rona had to flee. She left for Budapest on April 7, 1938. She was so upset and disturbed by the new political status that she abandoned her research and left her latest measurements in disarray.[164] In a letter written the same day, Karlik admitted to Gleditsch, "I have just seen Elisabeth off. I am going to miss her *very* much. We got more attached to each other in those weeks then ever, but we both felt that it was time she was going; this atmosphere of departure was beginning to tear our nerves."[165] One of Rona's last papers published in the *Mitteilungen* was in collaboration with the Nazi Josef SchintImeister, who was under Stetter's influence.[166]

105 It was not only the rise of the Nazis within the institute that threatened Rona, but her everyday life became troublesome as well. "She has had to provide innumerable certificates concerning taxation, etc. and everywhere she had to queue up. Every day brought new regulations that meant some more certificates. There was a very severe control of the luggage at the station, but I hope," Karlik continued, "she will get home safely."[167]

106 At the age of 48 and after 13 years of work at the Radium Institute, Rona was in search of a new job. Pettersson was ready to offer her a position in Bornö for three months in the autumn, replacing his assistant, Börje Kullenberg, who was going to work in the new oceanographic institute in Göteborg. Because Hungary was still independent, Rona left for Budapest where she considered working at the university.[168] Dissatisfied with the conditions there, she instead worked in industry. As she informed Meyer, "The possibility of work for the immediate future makes me worry a lot. I have found a comfortable job in the Vatur industry through the kindness of the director, Patai."[169]

107 She was able to retain the job until September of 1938 when the industry shifted to mere production, eliminating laboratory positions. Threatened by the political upheavals in the neighboring countries, Rona was hesitant to accept Pettersson's invitation. In the absence of any other option, the woman who was one of the most distinguished experts in polonium preparations eventually spent October

through December of 1938 in Sweden, working on oceanography.[170] Her close friend Gleditsch offered her another temporary solution. She invited Rona to spend a year in Oslo, replacing a staff member in her laboratory who was on a leave of absence. "We have had much trouble in getting the permission for Dr. Rona to enter Norway. I believe, however, that by now, everything is in order," Gleditsch informed Karlik on January 17, 1939.[171]

108 By the end of her stipendium in Oslo, Rona returned to Budapest in 1940. Working on the boundary of physics and medicine and taking advantage of her earlier experience preparing radium for hospital use, she obtained her next one-year position at the Radium-Cancer Hospital in Budapest.[172] As she later recalled, "In 1941, I made a big decision. Hungary was threatened from two directions; on the right bank of the Danube were the Russians; on the left, the Germans. There was no future for me in Hungary."[173] After a last visit to Vienna in January 1941, Rona fled to the United States on a visitor's visa. Hunting for a job at the annual meeting of the American Physical Society, she was able to obtain her first position at Trinity College, a Catholic College for women in Washington, D.C., as a chemistry teacher.

109 Rona's earlier work in the intersection of radioactivity and oceanography was the vehicle for securing a joint research position at the Geophysical Laboratory at the Carnegie Institute in Washington. Rona's experience at the oceanographic laboratory in Bornö appealed to C. Piggot and W. Urry from the Geophysical Laboratory as they investigated the radioactivity of ocean sediments. A year later, she was invited to work for the Office of Scientific Research and Development (OSRD), using her expertise in preparing polonium for work related to the war effort. Obtaining security clearance, Rona revealed her method to the Canadian Radium and Uranium Company which had contracted the mass production of polonium for the OSRD.[174] Without any compensation and accustomed to the collegial ethos of researching physics during the interwar years, Rona generously offered the knowledge she obtained at the Radium Institute in Vienna and Curie's laboratory in Paris to her colleagues in OSRD. She was fortunate to be needed for the secret work on the atomic bomb and thus, she was able to forge a new career in the United States.

Marietta Blau and Hertha Wambacher

110 The day that the German troops marched into the city of Vienna, Blau was on her way to present her work at Bohr's Institute in Copenhagen. After a successful talk, "She was tired and rather miserable" when she finally visited the Petterssons for a few hours on her way to Oslo in mid-March.[175] In Vienna, she had left her mother and was anxious about her return but, as Pettersson assured Karlik, "Ellen Gleditsch will do her a lot of good and put her to work which is the most important point." He was planning to bring her to Sweden during the summer and carefully mobilized his connections for a more permanent solution.

111 Simultaneously, Karlik kept in touch with Blau but wisely screened the news she conveyed to her and hide the fact that in the meantime, her aunt had died and her mother was hospitalized with a broken leg. She once more reminded Pettersson to reclaim the instruments he had brought to the institute in the early 1920s, including the tabletop, portable objectives and microscopes that could be of use to Blau or even Rona who were searching for a research position. "There is also Etta [Blau] to think of and perhaps even Elisabeth to consider. Especially as regards Etta some help might perhaps be offered to her by the loan of instruments. Heaven knows what her fate is going to be."[176] Indeed, Blau's fate was eventful. She was 44 years old when she was forced to start a new career, first in Mexico and later on in the United States.

112 In a letter of April 18, 1938, Albert Einstein addressed the American Association of University Women, asking "how it may be possible to find a position for Miss Blau where she can continue her research." Easther Brunauer, associate in the International Education of University Women, responded immediately but with unfortunate news. She promised to do whatever possible but, although she was not explicit, their priority was Meitner. James Franck had already informed them that she was to lose her position at the Kaiser Wilhelm Institute. Concluding her letter, Brunauer asked Einstein to keep Meitner in mind "if you hear of any opening at a research institute where you think her line of work might be developed."[177]

113 Einstein's attempts to secure a position for Blau in the United States were not successful. In July, Bakken, Gleditsch's assistant, returned to the institute and Blau planned to do translations in order to survive in Sweden.[178] In the meantime, Einstein arranged a position for her at the Polytechnic School in Mexico City.[179] In November, after a delay due to formalities, Blau left Sweden first for Copenhagen

to visit Bohr's institute and then to London to accept an invitation from Fritz Paneth. On her way to Mexico, the Gestapo confiscated her scientific notebooks after forcing her zeppelin down in Hamburg. As Blau later speculated, the notebooks ended up in the hands of her Nazi colleagues in Vienna.[180]

114

With or without Blau's scientific notebooks, Wambacher continued to use the experimental facilities of the Radium Institute while her Jewish colleague was in a desperate search for a research position and depended on Pettersson to secure some of her instruments in Vienna. The break between the two women was definite. Wambacher had been an applicant for the NSDAP party since 1934 and heavily depended on Stetter for her scientific and emotional life. As Karlik acknowledged, "H[erta] W[ambacher]'s morality inside, I believe, is in a great mess."[181] Within just two weeks of the Anschluss, Wambacher was promoted to the position of assistant at the First and Second Physics Institutes, which were now combined and directed by Stetter. The following year she received her habilitation based on her work on the "nuclear disintegration through cosmic radiation in the photographic emulsions." This enabled her to become *Dozentin* in 1940, and in the winter semester of 1941–42, she started teaching at the University of Vienna. Publications in major German journals such as the *Zeitschrift für Technische Physik* and *Physikalische Zeitschrift* accompanied her rapid promotion in the university ranks. Nevertheless, by the end of the war and although her Nazi male colleagues such as Stetter, Ortner, and Kirsch maintained the power they gained during the National Socialist period, Wambacher lost her previous advantages.[182] She died in 1950 at the age of 46.

115

Meanwhile, Blau was in search of a permanent position far from Vienna on another continent. In 1941, after an unfortunate research period in Mexico, she tried to enter the United States for a second time.[183] In a letter of May 21, Alvin Johnson, director of the New School of Social Research wrote to Thomas Appleget at the Rockefeller Foundation concerning her case. She had just lost her position in Mexico and was looking for employment. As Johnson concluded, "I have informed her friends that our project does not cover cases in Latin America."[184] The same day, Herbert Solow passed Blau's file on to H. Miller from the Rockefeller Foundation with the following note:

> Perhaps you will be interested to know that her friend Mrs. Szego has told me that she thinks the reason for the failure of the Polytechnic School to renew the Blau contract has to do with some not too happy political shift since the last Mexican election. Dr. Blau is a Jewish refugee from Vienna and some of her relatives were Viennese

> Socialists. Conceivably, she could be the victim of any of a half a dozen conflicting types of factionalism.[185]

Two days later, Solow tried to put Blau in touch with Fritz Bach, director of the General de Estadistica in Mexico, asking for advice since he did not know her personally. It was Blau's friend Szego who brought the case to Solow's attention. Within three days, Blau's request was put in the drawer. In a letter of May 26, 1941, Appleget informed Johnson that there was no possibility of assistance under their present program.[186] Bach's response to Solow on June 5 sheds light on this speedy closure of her case. Despite her contract with the Polytechnic in Mexico, Blau's payment was suspended. The official reason was the lack of money. As Bach admitted, "I believe that the reasons may be different. At the Ministry of Education, the Stalinists are still strong and she, without being a Stalinist of course, has always been in close contact with them. I do not want to take care of this matter mainly because of the kind of friends she has and besides, I do not think that I would succeed."[187] 116

As Blau's situation was "rather delicate," both the New School for Social Research and the Rockefeller Foundation did not take the risk of pursuing her case. Blau remained in Mexico for three more years. When she finally entered the country in May 1944, she was on leave from the Escuela Tecnica Superior until December but she never returned.[188] It was probably through the efforts of the Jewish community in Mexico that Blau was able to find her first position in industry, working for the International Rare Metals Refinery in New York.[189] 117

Gender, Race, and Science

Ideology, as the system of ideas and representations that one holds and according to which one acts, is inscribed in the everyday practices and choices of individuals. In the relevant literature, Social Democracy has been coded as political pluralism while National Socialism has often been characterized as ideology and certainly applying a negative meaning to the term. One should not forget, however, that Social Democracy in Austria during Red Vienna carried and implemented an ideological apparatus as well, advocating and using, democratic procedures. In contrast and without doubt, totalitarian and authoritarian as they were, Nazi and fascist ideologies repressed democracy and cruelly invaded the autonomy of the individual. In the totalitarian regime that Austria was after 1933, the first system to be targeted was education. 118

The dismantling of the Mediziner-Viertel was only a symptom of how Christian and National Socialist ideologies tried to transform Austrian society. The purging of outspoken liberal and social-democratic faculty and staff members of the University of Vienna, the racial politics enacted especially after the Anschluss, and the use of brutal violence were part of the ideological apparatus that fascists and Nazis mobilized and used to exercise their power. That ideological apparatus was used to produce students educated in race, science, and in new population policies; to transform the university through dismissals and changes in positions; and to take total control of key positions that the Social Democrats managed to obtain on their terms. By 1938 the entire range of educational reforms and social and cultural policies of Red Vienna was destroyed on the basis of an anti-Semitic and anti-Social-Democratic propaganda and exercise of political power. The dissolution of the Vienna Circle, the Ernest Mach Society, and Neurath's Social and Economic Museum, as well as the obstruction of the research agent of the Radium Institute, the Vivarium, and a number of other "Red" institutes occurred before Hitler's arrival on the Austrian scene and was accomplished by the earlier fascist regime. **119**

During the fascist regime, changes in the Radium Institute did not directly concern its structure. Probably, because it was an institute devoted to research and not to education, the fascists had less interest in transforming the institute's internal hierarchy and in dismissing its undesirable personnel. For strategic reasons, their interest was focused on institutions and educational establishments with direct influence on the public and the young generation of students. It is indicative that most of the institute's personnel continued research in much the same manner as before. Karlik succeeded in becoming *Dozent* and the Jewish Blau shared the Lieben Prize awarded by the Austrian Academy of Sciences with Wambacher. The purge and transformation of the university's and the academy's members had not been radical yet. The fascist regime, however, thwarted Meyer's ambitions to elevate the Radium Institute to a national regulator of radium supplies for medical use and it cut the institute off from any key role it could have had at the municipal level. **120**

After the Anschluss, science was turned into a servant of state ideology. The fate of the Radium Institute was absolutely in the hands of those who saw in politics a chance to rise in the scientific ranks and impose their world views. Stetter, Ortner, and the rest of the institute's Nazis were able to establish their order and fulfill **121**

their ambitions. What could it mean to be a physicist in such a context? Karlik's agonizing over the question of remaining in Austria and pursuing research at the institute or leaving gives a glimpse of the dilemmas experimenters had to face.

To sharpen the question: What could it mean to be a Jewish physicist at that time and particularly, a Jewish female physicist? As Doris Bergen argues, "Any study of women as outsiders in Nazi Germany and German-occupied Europe is necessarily a discussion of race; it is not possible to separate sex from blood in Nazi ideology and practice."[190] The National Socialist ideology constructed gender as intertwined with and inseparable from race. As the Blau-Wambacher case indicates, the complexity of their story cannot be captured by reducing the historical analysis to the interplay of gender and race as two distinct factors. To reduce women to either one or to suggest that both factors added to what it meant to be a woman in Austria is to argue against the complexity of how subjectivities were and are formed. What it meant to be a woman (and a man as well) was after all the outcome of women's (and men's) location within a range of different situations such as their gender, race, nationality, religion, and ideological commitments.

Notes

Note 1: Hughes, *The Radioactivists* (1993), 206, 222.

Note 2: Chaloner, "The Most Wonderful Experiment" (1997); Brown, *The Neutron and the Bomb* (1997), 88.

Note 3: Hughes, *The Radioactivists* (1993), 157; Schmidt and Stetter, "Die Anwendung" (1929); Schmidt and Stetter, "Die Ionisastion" (1930); Schmidt and Stetter, "Untersuchungen" (1930).

Note 4: Rona, *How it Came About* (1978), 22. To reconcile Chadwick's invitation to Rona with his account of the work in Vienna, he probably believed Rona was a good technician having a skill that he could use for the experiments in his own group. On the contrary, as Przibram was fully aware of her research, he described Rona as the chemist of his group referring to the time that she worked on a joint research project with Karlik, Haberlandt, and Przibram on the fluorescence of fluorides; see Przibram, "1920 bis 1938" (1950), 32. According to her autobiography, instead of accepting Chadwick's invitation to join the Cavendish lab, Rona visited Paris in 1928; see Rona, *How it Came About* (1978), 23.

Note 5: Rona and Schmidt, "Eine Methode zur Herstellung" (1928). The same article appeared in the *Zeitschrift für Physik* (1928). On Bonet-Maury's method, see Bonet-Maury, "Sur la vaporisation du polonium" (1927); Bonet-Maury, "Sur la vaporisation du polonium" (1927); Blau and Rona, "Anwendung der Chamie'schen photographischen Methode" (1930).

Note 6: Karlik, "Eine Lumineszenzmethode" (1933); Karlik and Rona, "Untersuchungen der Reichweite" (1933); Karlik and Rona, "Untersuchungen uber die Reichweite" (1934).

Note 7: Rona, *How it Came About* (1978), 33.

Note 8: Crossfield, "Irene Joliot-Curie" (1997), 114. Curie, *Madame Curie* (1937). Rona to Meyer, July 4, 1936, AÖAW. Already in February 1934, Pettersson mentioned Rona's blood problems in his letter, wishing quick recovery. Pettersson to Rona, February 24, 1934, GUB. The letter was sent to Vienna. Pettersson to Rona, July 29, 1934, GUB. Meyer to Rona, September 12, 1934, AÖAW. Gleditsch to Rona, August 19, 1934, AÖAW.

Note 9: Föyn, Kara-Michailova, and Rona, "Zur Frage der Künstlichen Umwandlung" (1935), 159; Föyn, Pettersson, and Rona, "Künstliche Umwandlung" (1935), 391. Föyn came to the institute at the end of 1934 after Gleditsch's arranged his visit with Meyer. He remained there for a year and worked closely with Rona; see Meyer to Gleditsch, August 18, 1934, AÖAW; Gleditsch to Meyer, August 30, 1934, AÖAW; Meyer to Rona, September 12, 1934, AÖAW. See also Almanach der Academie der Wissenschaften, (1935), 196; (1936), 213, AÖAW.

Note 10: Rona and Neuninger, "Beiträge zur Frage" (1936).

Note 11: Blau, curriculum vitae, Leopold Halpern Papers. See also Blau, "Bericht über die Entdeckung" (1950).

Note 12: Blau and Kara-Michailova, "Über eine durchdringende" (1931).

Note 13: Hertha Wambacher, curriculum vitae, Rigorosentakt, 10860, AUW. The school attracted the girls from the Viennese upper class and bourgeoisie and, not surprisingly, included more than 35 percent Jewish pupils; see Anderson, *Utopian Feminism,* (1992), 31.

Note 14: Bischof, *Frauen am Wiener Institut* (2000), 137.

Note 15: Hertha Wambacher, curriculum vitae, Rigorosenakt, 10860, AUW.

Note 16: Halpern, interview by the author, March 5, 1999, AIP. See also Blau to Pettersson, September 25, 1933, GUB.

Note 17: Wambacher, "Untersuchungen" (1931).

Note 18: Blau and Wambacher, "Uber das Verhalten" (1932); Blau and Wambacher, "Uber Versuche" (1932), 180. In the fall, Blau and Wambacher presented a second lengthier paper on the same topic (Blau and Wambacher, "Uber Versuche II" (1932).

Note 19: Galison, *Image and Logic* (1997), 151.

Note 20: A few months earlier, in February 1932, Chadwick had just discovered the neutron; see Chadwick, "Possible Existence of a Neutron" (1932), 312.

Note 21: Blau, curriculum vitae, GDSCA (in English). Kirsch and Wambacher, "Uber die Geschwindigkeit" (1933).

Note 22: Hughes, *The Radioactivists* (1993), 158. Meyer to Hevesy, October 30, 1928, AÖAW; Meyer to Curie, October 30, 1928, AÖAW; Meyer to Fajans, November 5, 1928, AÖAW. As Curie and Hevesy mentioned in their letters to Meyer, they were willing to support Pettersson since the controversy between his group and Rutherford was not resolved; see Curie to Meyer, November 9, 1928, AÖAW; Hevesy to Meyer, November 3, 1928, AÖAW.

Note 23: In 1914, Gustaf Ekman offered the funds for Pettersson's position after his father's intervention. Svansson, interview by the author, September 21, 2001, Göteborg. See also Deacon, "Hans Pettersson" (1966); Pettersson, "Recent Oceanographic Research" (1933).

Note 24: Hughes, *The Radioactivists* (1993), 158.

Note 25: Marie Curie to Meyer, November 9, 1928, AÖAW.

Note 26: Gütachten von Siegbahn, Meyer Nachlass, AÖAW.

Note 27: Pettersson to Mellbye, April 15, 1928 (in Swedish, Agnes Rodhe Papers, translated by Rodhe); Almanach, Akademie der Wissenscahften in Wien, (1929), 201. AÖAW.

Note 28: Rona, *How it Came About* (1978), 60.

Note 29: Nornvall and Svansson, "Bornö Oceanographic Station" (1998). Pettersson, "Recent Oceanographic Research" (1933). I owe my thanks to Artur Svansson for pointing out this article to me. See also Svansson, *Otto Pettersson*, 2006.

Note 30: Svansson, interview by the author, September 21, 2001, Göteborg. Rodhe to Rentetzi, October 29, 2001.

Note 31: Pettersson to Rona, February 24, 1934, AÖAW.

Note 32: Rona to Meyer, September 9, 1935, AÖAW. See also Rona, *How it Came About* (1978), 63.

Note 33: Rodhe interview by the author, September 22, 2001, Göteborg,.

Note 34: Rona to Meyer, September 9, 1935, AÖAW.

Note 35: Pettersson to Karlik, September 27, 1934, GUB.

Note 36: Meyer, June 22, 1935, Karlik's file, Mitarbeiter/Assistenten, AÖAW.

Note 37: Rona referred to the research done by James Joly which is presented in his book *Radioactivity and Geology* (Rona, *How It Came About* (1978), 63).

Note 38: Rona, *How it Came About* (1978), 64.

Note 39: Hernegger and Karlik, "Uranium in Sea-Water" (1935), 5.

Note 40: Rodhe to Rentetzi, October 29, 2001. Pettersson to Karlik, September 27, 1934, GUB; Pettersson to Karlik, December 27, 1934, GUB. Rodhe to Rentetzi, October 29, 2001.

Note 41: Hernegger and Karlik, "Uranium in Sea-Water" (1935), 4. See also Herneggen and Karlik, "Die quantitative Bestimmung" (1935).

Note 42: Hernegger, "Methoden für einen empfindlichen Urannachweis" (1933). Hernegger and Karlik, "Uranium in Sea-Water" (1935), 5.

Note 43: Haberlandt, Karlik, and Przibram, "Synthese der blauen" (1933), 235; Haberlandt, Karlik, and Przibram, "Synthese der grünen" (1934), 2; Haberlandt, Karlik, and Przibram, "Zur Fluoreszenz des Flurites II" (1934); Haberlandt, Karlik, and Przibram "Zur Fluoreszenz der Flurites III" (1935; Haberlandt, Karlik and Przibram, "Zur fluoreszenz der Flurites IV" (1935); Haberlandt, Karlik, and Przibram, "Artificial Production" (1934). On the work of this group, see Przibram, "1920 bis 1938" (1950), 32–33. Karlik worked with them as experts in spectroscopic analyses.

Note 44: Hernegger and Karlik, "Uranium in Sea-Water" (1935), 5; Meyer, June 22, 1935, Mitarbeiter/Assistenten, Karlik's file, AÖAW. Bischof, *Frauen am Wiener Institut,* (2000), 107.

Note 45: Hernegger and Karlik, "Uranium in Sea-Water" (1935), 6.

Note 46: *Almanach der Akademie der Wissenschaften*, (1939), 192, AÖAW.Föyn, Karlik, Pettersson, and Rona "Radioactivity in Sea-Water" (1939).

Note 47: Galison, *Image and Logic* (1997), 799.

Note 48: With his letter to *Nature* in November 1928, Gamow addressed the phenomenon of artificial disintegration. He explained why Pettersson's and Kirsch's work in Vienna could not be reliable and stressed his agreement with the observations of the Cavendish team. Gamow, "The Quantum Theory of Nuclear Disintegration" (1928); See also Gamow, *The Constitution of Atomic Nuclei and Radioactivity* (1931); Gamow, *My World Line* (1970); Chadwick and Gamow, "The Artificial Disintegration by a-particles" (1930), 54–55; For secondary bibliography on Gamow, see Hughes, "'Modernists with a Vengeance'" (1998); Hughes, *The Radioactivists* (1993), 208; Pais, *Inward Bound* (1986); Cockcroft, "Some Recollections" (1984); Growther, *The Cavendish Laboratory* (1974), 227–28.

Note 49: On the history of early particle accelerators, see McMillan, "Early History of Particle Accelerators" (1979); Seidel, "The Origins of the Lawrence Berkley Laboratory" (1992). Pais, *Niels Bohr's Times,* (1991). On the work of Cockcroft and Walton, see Growther, *The Cavendish Laboratory* (1974), 227–28; Cockcroft, "Some Recollections" (1984).

Note 50: Brown, *The Neutron and The Bomb* (1997), 103. The Joliot-Curies' paper helped Chadwick to put into context a phenomenon described by Walter Bothe and Hans Becker, who worked in Berlin. They discovered that when beryllium was bombarded by alpha particles, a low intensity radiation was emitted that could penetrate a thick surface of lead. See also Crossfield, "Irene Joliot-Curie" (1997), 112; Trenn, *Transmutation Natural and Artificial,* (1981), 75.

Note 51: Lawrence, "The Evolution of the Cyclotron" (1965).

Note 52: Blau to Meyer, February 18, 1933, AÖAW.

Note 53: See the names in the photo picturing the participants of the conference in Brown, *The Neutron and The Bomb* (1997).

Note 54: Crossfield, "Irene Joliot-Curie" (1997), 115.

Note 55: Segre, "Nuclear Physics in Rome" (1977), 51. On Meitner see Meitner, "Looking Back" (1964), 7. On nuclear fission, see Sime, *Lise Meitner* (1996); Stuewer, "The Origin of the Liquid-Drop Model" (1994); Frisch, "Experimental Work with Nuclei" (1979).

Note 56: Bethe, "The Happy Thirties" (1979). Goldhaber, "The Nuclear Photoelectric Effect" (1979).

Note 57: For examples of institutional and disciplinary histories, see Beyerchen, *Scientists Under Hitler* (1977); Deichmann, *Biologists under Hitler,* (1992); Macrakis, *Surviving the Swastika,* (1993); Hoffman, "Die Physikdenkschriften" (1989). For scientific biographies, see Sime, *Lise Meitner* (1996); Cassidy, *Uncertainty: The Life and Science of Werner Heissenberg* (1992). For comparative studies, see Walker and Sachse (eds.), *Politics and Science* (2005). For a general overview of science and technology under NS, see Renneberg and Walker (eds.), *Science, Technology and National Socialism* (1994).

Note 58: On gender and racial discriminatory politics, see for example Gellately and Stoltzfus (eds.), *Social Outsiders in Nazi Germany* (2001). On the understanding of the rise of Austro-fascism and National Socialism, see Fellner, "The Background of Austrian Fascism" (1971).

Note 59: Blau to Meyer, February 2, 1933, AÖAW.

Note 60: Rabinbach, *The Crisis of Austrian Socialism* (1983), 33.

Note 61: F. Stadler, "The Emigration and Exile" (1995), 14. K. Stadler, *Austria* (1971), 123; Barker, *Austria 1918-1972* (1973), 68–70.

Note 62: Rabinbach, *The Crisis of Austrian Socialism* (1983), 81. On the Heimwehr, see Gruber, *Red Vienna* (1991), 201.

Note 63: Barker, *Austria 1918-1972* (1973), 74.

Note 64: Rabinbach, *The Crisis of Austrian Socialism* (1983), 156.

Note 65: Brook-Shepherd, *Dollfuss* (1978). Stadler K., "Austria" (1969), 109.

Note 66: On Sunday, March 13, 1938, the *New York Times* reported that Germany had entered Austria the day before and Hitler gave a speech at Linz where he proclaimed the Anschluss; see "Hitler Enters Austria" *New York Times,* March 13, 1938, 1. On the Austrian history of this period, see Rabinbach, *The Crisis of Austrian Socialism* (1983); Stadler K., *Austria* (1971); Kindermann, *Hitler's Defeat in Austria* (1988); Brook-Schepher, *Dollfuss* (1978).

Note 67: Stadler and Weibel, *The Cultural Exodus from Austria* (1995). See also Stadler, *Vertrieben Vernunft I* and *II* (1987) and (1988).

Note 68: F. Stadler, "The Emigration and Exile of Austrian Intellectuals" (1995), 15; F. Stadler, "The Vienna Circle and the University of Vienna" (1995); Cartwright et all, *Otto Neurath* (1996), 83; Dahms, "The Emigration of the Vienna Circle" (1995); Feigl, "The Wiener Kreis in America" (1968).

Note 69: Handlbauer, "The Emigration of the Viennese Individual Psychologists" (1995).

Note 70: Mühlleitner and Reichmayr, "The Exodus of Psychoanalysis from Vienna" (1995), 99; F. Stadler, "The Emigration and Exile of Austrian Intellectuals" (1995), 20; Handlbauer, "The Emigration of the Viennese Individual Psychologists" (1995); Gardner and Stevens, *Red Vienna and the Golden Age of Psychology* (1992), 80, 160. See also Ash, "Psychology and Politics in Interwar Vienna" (1987); Ash, "Women Émigré Psychologists and Psychoanalysts in the U.S." (1995).

Note 71: Reiter, "Zerstört und vergessen" (1999).

Note 72: We should note, nonetheless, that the number of men enrolled in the University of Vienna also dropped drastically from 1933–34 to 1938–39. Although in 1933–34, there were 8801 men enrolled, by 1938–39 their number had dropped to 4081; see Tuma, "Die österreichischen Studentinnen" (1993), 85.

Note 73: Tuma, "Die österreichischen Studentinnen" (1993), 88.

Note 74: Heindl, "Die konfessionellen" (1993); Freidenreich, "Gender, Identity, and Community" (1998), 154.

Note 75: For example, in 1925, Hugo Bettauer, a democratic novelist who championed women's rights through his sexual reform magazines, was killed. Bettauer's assassination was the result of a hate campaign of the Christian Socialists and the Chancellor Ignaz Seipel who demanded that the municipal government exercise censorship on Bettauer's writings; see Gruber, *Red Vienna* (1991), 165; F. Stadler, "The Emigration and Exile" (1995), 15.

Note 76: Gruber, *Red Vienna* (1991),. 27.

Note 77: The directors of the Vivarium to the Kuratorium of the Vivarium, June 2, 1932, AÖAW. Wilhelm Figdor and Eugen Steinach were the directors of the physiological and plant departments respectively but not of the whole institute.

Note 78: *Almanach der Akademie der Wissenschaften in Wien*, Biologische Versuchsanstalt, (1914), 231, AÖAW.

Note 79: Reiter, "Zerstört und vergessen" (1999), 605.

Note 80: Hubenstorf, "Anatomical Science in Vienna" (2000), 1386.

Note 81: Eugen Steinach, Rigorosentakt, AUW; Benjamin, "Eugen Steinach, 1861-1944: A Life of Research" (1945).

Note 82: Sengoopta, "Glandular Politics" (1998).

Note 83: Sengoopta, " 'Dr Steinach coming to make old young!'"(2003).

Note 84: The directors of the Vivarium to the Kuratorium of the Vivarium, June 2, 1932, AÖAW; Meyer, "Die Vorgeschichte" (1950), 12–13.

Note 85: Meyer, "Die Vorgeschichte" (1950), 19.

Note 86: In the course of Red Vienna, the Vivarium received financial support from the city; see *Almanach, Akademie der Wissenschaftern in Wien* (1922), 180; (1923), 155; (1924), 189; The mayor Karl Seitz supported the installation of general heat system in the *Vivarium,* Almanach, Akademie der Wissenschaftern in Wien (1926), 209; (1927), 205; (1928), 227.

Note 87: Reiter, "Zerstört und vergessen" (1999), 596.

Note 88: In 1922, Jahoda co-authored a paper with the radiologist Guido Holzknechkt on the luminosity of x-rays; see Agetter, *Guido Holzknecht* (1998), 69. At the institute, Jahoda was working at Przibram's group.

Note 89: Meyer, "Physikalische Grundlagen" (1929), 557–80; Meyer and Suess, "Zur Verwendung" (1930); Deinlein, "Verweilzeiten" (1933); Maria Renata Deinlein, Rigorosenakt 11725, AUW. Erhard Suess was a physician and lung specialist. Meyer to Kautz, May 11, 1934, AÖAW.

Note 90: Meyer to Kollassa, February 3, 1933, AÖAW.

Note 91: The directors of the Vivarium to the Kuratorium of the Vivarium, June 2, 1932, AÖAW.

Note 92: Sengoopta, "Glandular Politics" (2003).

Note 93: Protocol book of the Austrian Academy of Sciences, 1932, AÖAW. I thank the archivist Stefan Sienell for directing my attention to the protocol book of the academy.

Note 94: Arnold Durig, Rigorosenakt, 3, AUW.

Note 95: Przibram and Portheim to Molish, June 6, 1932. Vivarium file, AÖAW.

Note 96: Bundesminister to the Präsidium der Akademie, July 1, 1932; Eugen Steinach, Rigorosenakt, AUW.

Note 97: Reiter, "The Year 1938" (1995), 198.

Note 98: Urbach, "Einiges aus dem Physikalischen Laboratorium" (1933), 537n.

Note 99: *Almanach der Akademie der Wissenschaften* (1935), 197.

Note 100: Urbach, "Über eine spontane Veränderung" (1935). Reiter, "The Year 1938," (1995), 198. Urbach's wife, Anni Urbach, entered the institute in 1935; see *Almanach der Academie der Wissenscaften* (1935), 197. Daughter of the psychoanalyst Paul Federn, Freud's collaborator, Anni studied law and worked in a juvenile court. After her marriage to Urbach, she turned to physics. No publication appeared in the *Mitteilungen* under Anni Urbach's name. In the institute's kassa where Meyer recorded the finances, Anni appeared to have received minor amounts of money, probably for performing technical tasks (Kassa, 1933–38, AÖAW. She remained in the institute until their immigration in 1939.

Note 101: Hilda Maier, Lebenslauf, undated, Personalakt, AUW.

Note 102: As Fernau informed Meyer, Frederick Flinn, a radiologist from Columbia University in New York, visited him on August 25, 1932 (Fernau to Meyer, August 26, 1932, AÖAW). Flinn was involved in the case of Eben Byers, whose death on March 30, 1932 shocked the medical community in the United States and prompted legislation acts concerning radium products. Since 1927, Byers, an internationally known industrialist from Pittsburgh, had been drinking a radium product called Radithor as a tonic. He soon suffered from radium poisoning with symptoms similar to those of the radium girls, the famous case of the women licking their brushes while painting the dials of watches with luminous radium paint; see Clark, *Radium Girls* (1997); Rentetzi, "Women Radium Dial Painters" (2004). Flinn was involved in both cases and tried in vain various methods to remove the radium from Byers' body; see Mullner, *Deadly Glow* (1999), 114–118. Although in the radium dial painters' case, Flinn refused to recognize the radium hazards working for the corporation that hired the women, in Byer's case he issued strong warnings against the use of radioactive products for internal use. The national scandal of Byers' death prompted Flinn to travel to Vienna and also to visit Paris and Berlin hoping to discuss with the international scientific community questions concerning radon therapy (Fernau to Meyer, August 26, 1932, AÖAW).

Note 103: Fernau to Meyer, September 19, 1932, AÖAW.

Note 104: Hilda Fonovits-Smereker, Lebenslauf, Personalakt, AUW. A coauthored article appeared in *Strahlentherapie* in 1933 on Byers's case. Fernau and Smereker, "Über das Verbleiben" (1933).

Note 105: Meyer to Rona, September 12, 1934, AÖAW.

Note 106: Hilda Fonovits-Smereker, Lebenslauf, Personalakt, AUW. See for example the articles published up to 1938. Smereker and Juris, "Messung der Beta-Strahlung" (1935); Schloss and Smereker, "Zur Radiumbehandlung" (1936); Smereker, "Untersuchungen" (1937), 267; Smereker, "Dosimetrische" (1937), 676; Smereker and Juris, "Versuche über die nicht directe Ionisierung" (1938).

Note 107: Emile Maier, Lebenslauf, Personalakt, AUW; Emile Maier, Personalblatt, AUW.

Note 108: Hilda Fonovits-Maier, Heiratsurkunde, Personalakt, AUW.

Note 109: Meyer to Dekan, March 21, 1933, Karlik's file. Mitarbeiten/Assistenten, AÖAW; January 10, 1934. Berta Karlik's file, Mitarbeiten/Assistenten, AÖAW.

Note 110: Hittner, *Gescichte des studienfaches* (1949), 210. The reasons for his retirement are not stated.

Note 111: Stetter to Pettersson, March 5, 1934, GUB. Karlik conveyed the same information to Pettersson four days later without giving any specific reasons for the decision of the ministry (Karlik to Pettersson, March 9, 1934, GUB).

Note 112: Stetter to Pettersson, March 5, 1934, GUB.

Note 113: Karlik to Pettersson, March 9, 1934, GUB.

Note 114: Kommissionsbericht n. 59, Georg Stetter, Personalakte, AUW; The Dean to the ministry of education, December 20, 1933, n. 65, Georg Stetter, Personalakte, AUW.

Note 115: Galison, *Image and Logic* (1997), 153.

Note 116: Galison, *Image and Logic* (1997), 153.

Note 117: Karlik to Pettersson, September 13, 1933, GUB, (in English); Pettersson to Karlik, September 9, 1934, GUB, (in English); Karlik to Pettersson, April 15, 1934, GUB, (in English).

Note 118: Karlik to Pettersson, May 12, 1936, GUB (in English).

Note 119: Berta Karlik, Rigorosenakt 9765, AUW. Hittner, *Geschichte des studienfaches* (1949), 79.

Note 120: Karlik to Pettersson, May 12, 1936, GUB, (in English).

Note 121: Karlik to Pettersson, May 12, 1936, GUB, (in English); Pettersson to Karlik, August 3, 1936, GUB.

Note 122: Bischof, *Frauen am Winer Institut* (2000), 108; Lintner, "Berta Karlik Nachruf" (1990), 304; Vorlesungen an der Universität zu Wien, 1937/18, AÖAW.

Note 123: Halpern, "Marietta Blau" (1993), 57; Galison, *Image and Logic* (1997), 149.

Note 124: For some hints on Blau's political engagement, see Miller to Solow, May 21, 1941, GDSCA; Solow to Bach, June 5, 1941, GDSCA; Interview of Arnold Perlmutter to the author, 1999, deposited in the AIP.

Note 125: Blau, curriculum vitae, Leopold Halpern Papers For a detailed description of their experimental work, see Galison, *Image and Logic* (1997), 152.

Note 126: Karlik to Pettersson, February 11, 1936. GUB. (in English).

Note 127: Marietta Blau, curriculum vitae, Leopold Halpern Papers.

Note 128: Galison, *Image and Logic* (1997), 154.

Note 129: In her self-description written around 1963, Blau mentions that she received the Haitinger Prize of the academy in 1936. However, according to the records of the academy, Blau received the Lieben Prize in 1937; see *Almanach der Academie der Wisssenschaften* (1939), 136; Bischof, *Frauen am Wiener Institut* (2000), 79; Pettersson to Karlik, 7 June 1937, GUB. From 1865 to 1937, Blau and Wambacher were the only women besides Lise Meitner (1925) who received the Lieben Prize. The only women from 1905 to 1938 who received the Haitinger Prize of the academy were Rona and Karlik, both in 1933; see *Almanach der Akademie der Wissenschaften* (1939), 141.

Note 130: Marietta Blau, curriculum vitae, Leopold Halpern Papers. Given the political events of the 1938, the two women never actually used the grant.

Note 131: Karlik to Hans Pettersson, December 30, 1937, GUB, (in English). I was not able to locate Heisenberg's letters to Blau and Wambacher.

Note 132: On Meyer's personal difficulties under the Nazis, see Reiter, "Stefan Meyer" (2001); Sime, *Lise Meitner* (1996), 287–88.

Note 133: Karlik to Pettersson, December 30, 1937, GUB. The attempt to find a solution to Blau's problem was Karlik's initiative and nobody at the institute knew the content of her correspondence to Pettersson, not even Blau.

Note 134: Karlik to Pettersson, February 3, 1938, GUB.

Note 135: Karlik to Pettersson, February 3, 1938, GUB.

Note 136: Pettersson to Karlik, February 17, 1938, GUB.

Note 137: Blau to Bohr, March 5, 1938, NBA. Blau confirms to Bohr the information she got from Rona on the arranged colloquium in Copenhagen.

Note 138: January 20, 1938, Gerhard Kirsch, Rigorosenakt, 92, AUW.

Note 139: Pettersson to Karlik, February 20, 1938, GUB; Karlik to Pettersson, February 24, 1938, GUB (in English).

Note 140: "Hitler Enters Austria in Triumphal Parade," *New York Times*, March 13, 1938; Blau to Paneth, March 21, 1938. AGMPG.

Note 141: Karlik to Pettersson, March 14, 1938, GUB.

Note 142: Karlik to Pettersson, March 30, 1938, GUB.

Note 143: Reiter, "Stefan Meyer" (2001), 122; Sime, *Lise Meitner* (1996), 287–88.

Note 144: Karlik to Pettersson, March 14, 1938, GUB.

Note 145: Karlik, "1938 bis 1950" (1950), 35.

Note 146: Karlik, "1938 bis 1950" (1950), 35.

Note 147: Reiter, "The Year 1938" (1995), 195.

Note 148: Karlik to Pettersson, April 9, 1938, GUB; Karlik to Pettersson, March 19, 1938, GUB.

Note 149: Galison, *Image and Logic* (1997), 159.

Note 150: Karlik to Pettersson, July 2, 1938, GUB (in English).

Note 151: Karlik to Pettersson, May 1, 1938, GUB (in English).

Note 152: Karlik to Gleditsch, May 2, 1938, AÖAW.

Note 153: Karlik, "1938 bis 1950" (1950), 36. As Galison points out, Stetter was a member of the commission that met in May 1938 to consider the restructuring of physics in Vienna; see Galison, *Image and Logic* (1997), 158n.

Note 154: Karlik to Pettersson, July 20, 1938, GUB; Karlik to Gleditsch, October 16, 1938, AÖAW.

Note 155: As Karlik reported to Pettersson, Max Kindinger was involved in the NSDAP with great enthusiasm after the Anschluss; see Karlik to Pettersson, March 19, 1938, GUB. For Jentschke and Schintlmeister, see Bischoff, *Frauen am Wiener Institut,* (2000), 140.

Note 156: Karlik to Pettersson, July 20, 1938, GUB (in English).

Note 157: Pettersson to Karlik, March 30, 1938, GUB (in English); Karlik to Pettersson, July 20, 1938, GUB, (in English).

Note 158: *Alamanch der Akademie der Wissenschaften*, (1938), 193–4; (1939), 192–93.

Note 159: Karlik to Pettersson, July 20, 1938, GUB, (in English).

Note 160: Karlik to Pettersson, May 1, 1938, GUB, (in English).

Note 161: Karlik to Pettersson, May 11, 1938, GUB; Karlik to Pettersson, July 20, 1938, GUB; Karlik to Gleditsch, September 11, 1938, AÖAW, (in English).

Note 162: Berta Karlik, Curriculum vitae, 1949, Rigorosenakt, 104, AUW; Karlik and Bernert, "Über eine vermitete" (1942), 685; Karlik and Bernert, "Zur Frage" (1942); Karlik and Bernert, "Über die Entemanierung" (1942), 267; Karlik and Bernert, "Über eine dem Element" (1943); Karlik and Bernert, "Das Element 85" (1943), 51; Karlik and Bernert, "Eine neue natürliche alpha Strahlung" (1943), 298; Karlik and Bernert, "Ein weiterer dualer Zerfall" (1943), 492; Karlik and Bernert, "Das Element 85" (1944), 44; Karlik and Bernert, "Über swei neue Alpha-Strahlungen" (1944), 2–3; Karlik and Bernert, "Entsehung" (1945), 34–35; Karlik, "1938 bis 1950" (1950), 37–38.

Note 163: On Karlik's scientific career and life, see Bischoff, *Frauen am Wiener Institut* (2000), 101–119; Lintner, "Berta Karlik Nachruf" (1990). Vogt, "Women Members of the Academies of Science" (2000).

Note 164: Karlik to Pettersson, April 9, 1938, GUB; Karlik to Pettersson, May 11, 1938, GUB, (in English).

Note 165: Karlik to Gleditsch, April 7, 1938, AÖAW (in English).

Note 166: Rona and SchintImeister "Untersuchung der Alphastralung" (1938), 49–62. SchintImeister worked closely with Stetter starting in 1934 (Karlik to Pettersson, March 9, 1934, GUB). During the National Socialist period, SchintImeister became Stetter's assistant and was promoted to *Dozent* for experimental physics in 1939 while he was a member of the NSDAP (Bischof, *Frauen am Wiener Institut* (2000), 140).

Note 167: Karlik to Gleditsch, April 7, 1938, AÖAW.

Note 168: Pettersson to Karlik, March 30, 1938, GUB (in English); Karlik to Pettersson, July 27, 1938, GUB.

Note 169: Rona to Meyer, July 7, 1938, AÖAW. It is not clear from Rona's letter what kind of industry Vatur was.

Note 170: Rona to Meyer, October 3, 1938, AÖAW.

Note 171: Gleditsch to Karlik, January 17, 1939, AÖAW (in English); Rona, *How it Came About* (1978), 42–43.

Note 172: Rayner-Canham M. and G., "Elizabeth Rona" (1997), 214.

Note 173: Rona, *How it Came About* (1978), 53.

Note 174: Rona, *How it Came About* (1978), 56–7.

Note 175: Pettersson to Karlik, March 30, 1938, GUB; Blau to Bohr, March 5, 1938, NBA.

Note 176: Pettersson to Karlik, March 30, 1938, GUB, (in English); Karlik to Pettersson, May 11, 1938, GUB, (in English). Karlik sent a microscope table to Gleditsch in Oslo, on March 25, after Blau's departure from Vienna (Karlik to Gleditsch, April 7, 1938, AÖAW). She also planned to send a counter for Blau and Föyn to repair and work with it (Karlik to Gleditsch, May 2, 1938, AÖAW). Karlik to Pettersson, May 1, 1938, GUB, (in English).

Note 177: Einstein to McHall, April 18, 1938, AAUW; Brunauer to Einstein, April 22, 1938, AAUW.

Note 178: Karlik to Pettersson, 11 May 1938, GUB, (in English); Karlik to Pettersson, July 17, 1938, GUB, (in English).

Note 179: Galison, *Image and Logic* (1997), 155.

Note 180: Blau, curriculum vitae, GDSCA.According to Halpern, the Gestapo confiscated Blau's scientific notebooks in 1938 as she was leaving Germany from Hamburg. The fate of those notebooks is not clear. However, Stetter's and Wambacher's later publications

indicate a relation of Blau's missing scientific notes. As Galison suggests "although we may never be able to confirm this, we can know something of Wambacher's attitudes in the years of Nazi rule." (Galison, *Image and Logic* (1997), 157). Karlik's letters to Pettersson suggest that Wambacher and her Nazi colleagues seized Blau's research much earlier than the Gestapo's confiscation.

Note 181: Galison, *Image and Logic* (1997), 157; Karlik to Pettersson, December 30, 1937, GUB, (in English). Karlik to Pettersson, February 24, 1938, GUB, (in English).

Note 182: Wambacher, "Kernzertrümmerung" (1940); Wambacher, "Mehrfachzertrümmerung" (1938); Wambacher, "Mehrfachzertrümmerung" (1938); Wambacher, "Wirkung" (1939); Stetter and Wambacher, "Neuere Ergebnisse" (1939); Wambacher, "Höhenstrahlung und Atomkernbau" (1940). Bischof, *Frauen am Wiener Institut* (2000), 139.

Note 183: For Blau's work in Mexico, see Galison, *Image and Logic* (1997), 155–6.

Note 184: Johnson to Appleget, May 21, 1941, GDSCA.

Note 185: Solow to Miller, May 21, 1941, GDSCA.

Note 186: Solow to Bach, May 23, 1941, GDSCA; Appleget to Johnson, May 26, 1941, RAC.

Note 187: Bach to Solow, June 5, 1941, GDSCA.

Note 188: Blau to Venegas, April 14, 1944, E.S.I.M.E. Blau asked the director of E.S.I.M.E. to grant her a leave of absence from May 1 to May 31, December 1944.

Note 189: The *Comite Central Israerita de Mexico* contacted the World Jewish Congress in New York as well as the Canadian Government Trade Commissioner asking for a possible position on behalf of Blau (Glikowski to Tartakower, no date, CDICAM; Lisker to the Canadian Government Trade Commissioner, February 10, 1942, CDICAM). They also financially supported Blau when her mother was sick and in need of constant attention during the difficult years of 1942–43. (Blau to Comite Central Israelita de Mexico, November 3, 1942, CDICAM; Glikowski to Blau, May 17, 1943, CDICAM).

Note 190: Bergen, "Sex, Blood, and Vulnerability" (2001), 273.

