Chapter 2
Designing (for) a New Scientific Discipline

In the mid-1910s, the physicist Victor von Lang, director of the I. Physikalisches Institut in Vienna, and Eduard Suess, director of the Austrian Academy of Sciences, intensified their attempts to establish a new institute appropriate for the study of radioactivity.[1] Up to that point, radioactivity research had been hosted in Vienna's Physics Institute, inside a shabby building with temporary laboratories on Türkenstrasse, a side street close to the university. A "very primitive, converted apartment house" and "a miserable space," as Lise Meitner described it, the institute was interspersed among the neighborhood's residences and shops.[2] Although it included lecture halls and laboratory space, it was insufficient for both teaching and research. In the big lecture hall, there were no desks. The students had to write on their knees. The floor was so rickety that it quivered whenever someone crossed the room, affecting apparatus sensitive to motion.[3] For those who envisioned Austria as "the centre of research on radioactivity," such a makeshift institute was inappropriate for these new "exact studies."[4] 1

Besides being exact, this new science was profoundly interdisciplinary. As Lawrence Badash points out, "radioactivity was something of a hybrid between physics and chemistry." Its data came from an impressively diverse number of scientific disciplines.[5] Tracing the changing cultures of theory in nuclear science from 1920 to 1930, Jeffrey Hughes similarly argues that "in a field [radioactivity] which drew its practitioners from such a wide range of backgrounds, including chemistry, physics, geology, and medicine, the variety of interpretative practices was unusually large."[6] 2

Arne Hessenbruch has recently traced the connections of radioactivity to technology by focusing on Ernest Rutherford's 1901 experiment on radiation energy. As Hessenbruch surmises, "Who precisely were the many different constituencies and individuals involved in the early history of radioactivity? There were physicists, chemists, and medics, each having a different perspective."[7] The cultures engaged in radioactivity research, however, were not only scientific. Soraya Boudia and Xavier Roque have convincingly argued that Marie Curie and her colleagues deliberately organized the radium industry in France and defined radioactivity as a field of enquiry that impinged both on science and on industry.[8] 3

At the same time, those involved in radium research came to consider themselves as a distinct disciplinary community. As Rutherford reported to Bertram Boltwood about the International Congress of Radiology and Electricity held in Brussels in 1910, "we had a rather good section and practically all the radioactive people were present." Self-references to the "radioactive people" or the "radioactivists" certainly signaled newly acquired identities, acknowledged even by K. B. Hasselberg, the president of the Swedish Royal Academy of Sciences.[9] Yet, scientists at the crossroads of well-established disciplines such as physics, chemistry, and an emerging field such as radioactivity experienced the encounter as a transition. As Rutherford admitted, "Really, I was startled at my transformation at first but afterwards saw that it was quite in accord with the disintegration theory."[10] How else might a self-defined physicist describe his feelings at the award ceremony for the 1908 Nobel Prize in Chemistry? Linked to the conventional map of physics and chemistry, radioactivists such as Rutherford were at the same time persistently remaking the map of science, fitting radioactivity within its borders. 4

Recent histories of radioactivity, departing from a linear narrative focused exclusively on theories, have explored the material culture of the discipline and its social practices at the intersection of academia, industry, and the modern state.[11] Attention has been paid to instruments, to experimental cultures, to exchanges of materials and techniques among disciplines, and, recently, to the gender politics that characterized different institutional settings.[12] Here, I introduce urban history and the architecture of science buildings as further important contexts for the history of radioactivity. I investigate what it meant to the Viennese physicists to acquire a new institute for radioactivity research and design a building, the first of its kind, for such a multifaceted field of inquiry, taking into account not only the malleable present but also the future of their discipline. How did architecture and the urban positioning of the institute affect the identities of its scientists? Examination of these questions sheds light on the mostly unexplored history of radioactivity in Vienna. 5

The Biography of an Institute

During the first decade of the twentieth century, the institutionalization of radioactivity was essential to those who wished to legitimize their epistemic claims about new radioactive elements and their cultural position on the map of science. International rewards certainly contributed to this choice of direction.[13] Three 6

Nobel Prizes had already been awarded to researchers in the new field. In 1903, Henri Bequerel shared the Nobel Prize in Physics with Marie and Pierre Curie. In 1908, Ernest Rutherford was awarded the Nobel Prize in Chemistry, and in 1911, Marie received her second Nobel Prize, this time in chemistry. The publication in January 1904 of *Le Radium*, a special French journal devoted to radioactivity research, was yet another attempt to legitimize research on the newly discovered radioactive elements.

The first editors, Jacques Danne and Henri Farjas, aimed to popularize radioactivity. Six months later, in July 1904, the journal shifted toward a more scientific audience, altering its content. The new volumes included scientific sections on radiophysics, radiochemistry, medicine, radiotechniques, and even photography in relation to photochemistry. Danne remained the secretary of the journal while a new committee oversaw the publication. The names of those involved—Becquerel, Antoine Béclère, René Blondlot, André Debierne, the Curies, and Rutherford—reveal efforts to bestow prestige on the field. 7

However important they are for assuring credibility and enlarging epistemic authority, journals and prizes cannot be compared to the advantages that might be provided to researchers by a specialized research center. Indeed, buildings of science play the double role of configuring the identities of those involved in scientific production and symbolically displaying the identity of the scientific processes that take place inside. It is indicative that during the first decade of the twentieth century, radioactivity researchers were distributed across laboratories in Europe and North America but had no single specialized institution devoted exclusively to the new field. Systematic attempts by scientists to obtain a designated space for their practices were related to their coordinated efforts to make disciplinary space within the sciences for their new enterprise. 8

Rutherford, the foremost authority on radioactivity in the Anglo-Saxon world, based his early work at McGill University in Montreal. The director of the physics laboratory there, John Cox, provided Rutherford with a lavish laboratory which, nonetheless, specialized not in radioactivity research but in training students in medicine, engineering, and industrial chemistry.[14] In Paris meanwhile, Marie and Pierre Curie were working at rue Lhomond in the Ecole municipale de physique et de chimie industrielles inside a damp storehouse turned into a physics 9 laboratory.[15] After the announcement of the Nobel Prize in 1903, Pierre hoped that "all this noise will not perhaps have been useless, if it gets me a chair and a laboratory."[16]

A modest laboratory was soon set up, but only at the science faculty in rue Cuvier, 10
where Pierre taught a physics course to those preparing for the *certificat d' études*. Eventually, in 1909, a decision was made to found the Institut du radium, a specialized institute for radium research in Paris. However, it was not until 1914 that the new Curie Institute, including two laboratories, one for physics research and one for biological and medical research, were ready for work.

In 1907 meanwhile, Rutherford had already moved to Manchester, where he once 11
again located his work at the university physics laboratory without gaining an autonomous research centre for his experiments. As he admitted to Bertram Boltwood, "The laboratory is good, but there was not much in the radioactive line." He added that the main advantage to being back in Europe, however, was the "hope to be able to raise a good deal [of radium]."[17]

The precursors of the Curies in institutionalizing radioactivity research were the 12
Viennese physicists. Since the end of the century, radioactivity had attracted the attention of Vienna's physicists through both its promise of scientific development and because, having access to the Bohemian radium and uranium mines in St. Joachimsthal, they were often asked to play the role of radium providers to the wider scientific community. Despite these advantages, bureaucracy and lack of money delayed the foundation of a specialized radium institute for years and embarrassed the Viennese scientists during international meetings.[18] The solution came from Karl Kupelwieser, who offered a munificent sum for the establishment of the Radium Institute in Vienna.

Although one of the most interesting and influential personalities of the late 13
Habsburg era, Kupelwieser has not received much historical attention. He was born in 1841 into a bourgeois Viennese family. His father, Leopold Kupelwieser, was a famous painter and professor at the Academy of Fine Arts in Vienna. Karl's mother, Johanna Lutz, was related to the president of the senate, Theobald Rizy. Both parents were members of an artistic circle including the painter Moritz von Schwind, the musician Franz Lachner, and the composer Franz Schubert.[19] Karl studied law at the University of Vienna, learned to play the piano, and showed literary talent. At the age of 28, he married Bertha Wittgenstein, the sister of his best friend Paul Wittgenstein. This marriage marked the beginning of a strong

relationship between the two families, as well as the development of Karl into an astonishingly powerful and affluent industrialist. His brother Paul offered the directorship of a rolling mill in Bohemia to Karl Wittgenstein, later father of the famous philosopher Ludwig Wittgenstein. Within the next five years, the wealth of the company increased enormously thanks to Wittgenstein's organizational skills. As an astute lawyer, Karl Kupelwieser bought most of the company's stocks and two additional smaller enterprises, and served as the legal adviser of the consortium.

By the end of the nineteenth century, Kupelwieser had amassed a huge personal fortune with which he supported several social and scientific projects. His charity work included financing a residence for blind, deaf, and mute people in Vienna and a tuberculosis hospital for children and adults. In 1907, he also patronized the Biological Station in Lunz.[20] His son, the biologist Hans Kupelwieser, became its first director. **14**

In 1908, Kupelwieser's role as a patron of science was further boosted by a generous donation to the Academy of Sciences for the foundation of the Institut für Radiumforschung (Institute for Radium Research). In a letter to the academy, Kupelweiser clearly indicated that he wanted to "prevent the shame" of his country, caused by letting others "snatch away" the privilege of conducting radium research.[21] He notified them that he was willing to place a contribution of 500,000 crowns at the disposal of the academy for the construction and maintenance of an institute to be dedicated to research of the physical and chemical properties of radium. It was no surprise that his offer was considered a patriotic act, which would foster the country's progress and increase the empire's prestige.[22] **15**

There was indeed a sense of "national pride" in establishing the institute. The institutionalization of the field gave Austrians the chance to put their own radium supplies to good use. This, for example, threatened Bertram Boltwood, as became clear in a letter to Rutherford: "I see that someone has given a lot of money for a Radioactive Institute at Vienna and I am afraid that the wholesome business will drive the small dealer like me to the wall."[23] **16**

During the next two years, with his private initiative, Kupelweiser achieved what Exner and his colleagues had not managed to do despite their persistence for over a decade. The negotiations with the sloppy bureaucratic system of the Austro-Hungarian monarchy and its ministries were Kupelweiser's expertise. Being a lawyer, he knew the tricks. His donation set the officialdom into frenzied action. **17**

Since 1894, the administrations of the Ministries of Education and Finance had been in constant negotiations about the site where the physics institute should be established. Already on March 14, 1908, Suess and Lang had written the Ministry of Culture and Education, supporting their case. "The new building for the Physics Institute is an essential condition for the possibility of radium research, since the current one is absolutely useless for such exact studies." [24]

When Kupelweiser offered his donation five months later, both physicists and the state unhesitatingly seized the opportunity immediately. On June 5, 1909, a protocol for the erection of the institute was granted by the state and signed by those involved in the construction. The list of signatories reveals the overlapping communities and interests involved: Eduard Suess signed as the president of the Austrian Academy; Franz Exner represented the physicists; Zdenko Skraup, director of the II Chemisches Laboratorium, signified the presence of the Viennese chemists in the project; a number of engineers and city planners stood for the state; and Eduard Frauenfeld was the architect.[25] 18

Following Kupelwieser's specifications, although the institute was established in a separate building, it was located between a physics institute and a chemistry institute. The proposed site was a spacious state property at the intersection of Boltzmanngasse, Währingerstrasse, and Strudlhofgasse in the ninth district of Vienna. The physicists chose the quietest corner of Boltzmangasse and Strudlhofgasse to host their institute. On the corner of Währingerstrasse and Boltzmanngasse, the chemists designed their own facilities. The Radium Institute was located between the two buildings, facing Boltzmangasse. 19

In contrast to the Radium Institute—a semi-autonomous research centre of the academy—the physics and the chemical institutes were subject to the University of Vienna and were to be used for both educational and research purposes. By the time the Radium Institute was completed and ceremonially opened on October 28, 1910, the building of the Physics Institute had already begun and it was finished two years later. The advent of the First World War disrupted the ongoing construction of the Chemical Institute, which was partly completed in 1920 but didn't fully open its doors until 1924.[26] 20

The physicist with direct interest in radioactivity research was Franz Serafin Exner, member of the Austrian Academy of Sciences since 1885 and *Professor Ordinarius* at the University of Vienna since 1891. Soon after the discovery of radium, Exner played a major role in persuading the academy to establish the Commission for 21 the Investigation of Radioactive Substances. He was deliberately trying both to ensure adequate amounts of radium for research and to enlist supporters in establishing radioactivity as a strong field in Vienna.[27] His influence in the Viennese scientific community was distinctive. Following the reorganization of university physics in Vienna and the creation of three separate institutes in 1902, Exner held the directorship of the II. Physikalisches Institut and proved to be the most important experimental physicist of his generation. In 1907, he reached the highest point of his academic career by becoming rector of the University of Vienna and participated in a number of scientific commissions, decisively shaping science in Vienna. During the first decade of the twentieth century, he was the main force in negotiations between the Austrian Academy and the Curies to provide the latter with considerable amounts of pitchblende for their scientific investigations. He was also Rutherford's closest contact in the Austrian Academy, guaranteeing his radium supplies. Scientifically, Exner was acknowledged not only for his original work on atmospheric electricity, color theory, spectral analysis, and radioactivity, but also for the wide circle of students he mentored.[28]

Thus, in 1910, there was no doubt that the establishment of the institute, made possible by Kupelwieser's donation, was also the result of Exner's attempt to legitimize the field of radioactivity in Austria. Having enormous prestige in the Viennese and international scientific communities, Exner was able to make important decisions on the research agenda, personnel, and research students' work, as well as the entire organization of the institute. He celebrated the building of such a specialized research centre as a symbol of scientific authority. He saw it as having the potential to bring Vienna to the forefront of radioactivity research and probably as a personal victory after twenty years of frustrations and difficulties in the institute at Türkenstrasse. It is significant that his only publication concerning the establishment of the institute appeared in French, in the journal *Le Radium*, the main forum of the international community of the "radioactivists." He proudly described the institute as "unique of its kind," with "the most modern facilities in the world." With the generosity of a confidently satisfied director, he assured the community that "the Academy of Sciences will be glad to see the largest possible number of scientists working there."[29] Exner was, however, already 64 years old and far from being in the most creative period of his scientific career. Under these circumstances, Stefan Meyer seemed best to fit the role of the active director (*Leiter*) of the institute, while Exner retained the position of its official director (*Vorstand*). **22**

A key figure in the institute's history, Meyer belonged to a family of Jewish intellectuals. He studied physics at the University of Vienna under Exner and Ludwig Boltzmann. His ascent in the university hierarchy was remarkable. In 1900, he became *Privatdozent* at the University of Vienna and in 1906, he succeeded Boltzmann as head of Vienna's Institut für Theoretische Physik, a position he held for a year. In 1908, he became *Ausserordentlicher Professor* and Exner's assistant. He expressed an early and strong interest in radium research and when the International Radium Standards Committee was founded in 1910, Meyer was appointed its secretary, an indication of his scientific success. It was this dynamic involvement in the field which prompted Exner to entrust Meyer with the scientific organization of the institute, including its design and the purchase of instruments and furniture.[30] **23**

Concerns About Noise and Vibrations

As Christoph Hoffmann has argued for the German situation, "An ordinary physics institute at the end of the nineteenth century embodies in bricks and mortar, stone and lime precisely this command: disturbances have to be avoided."[31] No case better illustrates physicists' concerns about disturbances than the Physikalisch-Technische Reichsanstalt, Berlin's Imperial Institute of Physics and Technology. At the end of the 1890s, the city's street company decided to lay electric streetcar tracks in front of the Reichsanstalt, which might interfere with the institute's electromagnetic research.[32] The decision generated a serious controversy between the physicists and the streetcar company, which lasted for six years. It ended only when the company agreed to take measures to minimize disturbances for the institute. **24**

Concern about disturbance was not restricted to the Germans, but also troubled Austrian physicists. They were just as uneasy with the heavy traffic of electric streetcars on Währingerstrasse and just as worried about external factors which would interfere with their attempts to measure radium preparations precisely or to perform spectroscopic analysis. Their installations' stability had always been important. When the physics institutes were still at Türkenstrasse, the physicists' main complaint was the shaking of the floor and the disturbances caused by vibrations. "Whenever someone was ironing in the neighboring house," Benndorf recalled, "the needle of the magnet was going here and there and we very often experienced this nasty situation."[33] There was no solid spot where an instrument could be set up nor where magnetic measurements could be carried out. In 1896, **25** the directors of the three physics institutes, Exner, Ludwig Boltzmann, and Viktor von Lang, sent a letter to the deacon of the philosophy faculty, complaining about the intolerable situation in their laboratories:

> Any precision measurements whatsoever are impossible from the start due to the constant shaking [of the building], not only during the day but even at night, finer measurements cannot be carried out, in part due to the traffic on Währingerstrasse and due to the wind, in part due to the constant currents in the adjacent houses. Moreover, the spaces are extremely impractically arranged and far too small for scientific purposes, such that often due to the presence of the observer in the room, the temperature there rises in a troublesome way. Even the local middle schools have far more suitably arranged laboratories than the university.[34]

For the physicists, it was out of the question to put up with similar circumstances in their new location. This was the main reason they refused to accept either of the other two sites originally under consideration for the natural-science district. **26**

The first proposed site was on Währingerstrasse, where the Volksoper was finally built. The second was the old Gewehrfabrik, the gun factory at the corner of Währingerstrasse and Schwarzspanierstrasse, where, in 1904, the Institute for Physiology was established.[35] Both sites were very close to the city and within the university quarter. According to the physicists, however, they seemed insufficient for the natural-science district. The first was too close to the street, while the second was next to the Anatomical Institute, which was equipped with high-voltage current. The induction current it generated affected the functioning of the electromagnetic apparatus, which made the physicists' research impossible.[36] **27**

In order to control vibrations, noise, and electromagnetic disturbances, Viennese physicists chose the location across the Josephinum as one which might produce a less disruptive environment for research. The proposed location was a spacious state property of 12,065 square meters across from the Josephinum known as Bäckenhäusel.[37] Historically, the building belonged to a baker in the fifteenth century, and from 1648 to 1784 it served as a small hospital. Later on, it was converted into a residential building. Just before Vienna's physicists decided to build their institute at this spot, the building hosted a tobacco administration and storeroom.[38] After tearing down the old Bäckenhäusel, a complex of three buildings went up in its place. Traffic was redirected further away from the new building by adding an extra lane on both sides of the street. Instead of passing close to the institute's building, the streetcars traveled along the middle lane of Währingerstrasse. In this way, mechanical vibrations through the ground were **28** eliminated. In addition, trees on the pavement in front of the buildings and inner courtyards protected the small natural-science quarter from street disturbances. By locating the Radium Institute between the Chemistry Institute and Physics Institute, Exner and Meyer also aimed to eliminate the interference of external factors with research. In collaboration with the architects, they chose to build a relatively small edifice with three stories and about 20 workrooms facing tranquil Boltzmanngasse, thereby avoiding the busy traffic of Währingerstrasse. Concerned with disturbances, they moved the façade two meters further from the street to avoid the noise of the already infrequent traffic on Boltzmanngasse.[39]

Radium: An Unpredicted New Inhabitant

While they were able to take care of external factors, such as noise and mechanical vibrations, the physicists were not yet fully aware of radioactive contamination as a new kind of disturbance. As Meyer admitted, "It was a new concern; we were setting up something untested; experiences of radioactive 'contamination,' mutual interference, and so on were for the most part absent."[40] Unfortunately, they located two storerooms for radioactive materials along with the accumulator (a 469-volt battery) and a transformer in the cellar. Workrooms were grouped on the other side of the cellar, separating the area of research from that of the apparatus and the radioactive sources. Double walls on the external sides reduced the amount of radiation exposure. **29**

According to Meyer, it became apparent that such an arrangement was a mistake since the radioactivity was spread throughout the building and was inhaled daily by the personnel. It was not until the mid-1920s that they moved 1 gram of radium to a room on the top floor of the building and surrounded the solution with lead bricks. A better resolution was chosen for the stronger radioactive materials. They built a special room in the cellar with thick concrete walls and a heavy steel door to seal the storage of strong preparations and eliminate contamination. **30**

It was probably because of radiation precautions that the institute's design broke with the German architectural stereotype of hosting the director under the roof of the research centre. In Vienna's Radium Institute, there were no residential apartments either for Exner or Meyer. The presence of radium, a new and unpredictable inhabitant, forced changes in the common architectural canon. **31**

The institute's first *Ordentliche Assistent*, Viktor Hess, later admitted that a second architectural mistake was to locate the radiochemical laboratory of the institute on its ground floor. Inside the front entrance, one would encounter on the left two rooms for chemical work, a darkroom, and a space for precise measurements of radioactive materials. In the hallway, showcases housed glasses for chemical analysis and other devices. Performing all the radiochemical tasks in the ground floor "was unfortunately a wrong choice," Hess recalled. He added, "The upper floor or a special building for radiochemistry would have been a better solution, because one could not avoid working with large amounts of preparations there."[41] **32**

While mechanical vibrations and noise had always been familiar disturbances that could interfere with experiments, radiation hazards were a viciously malevolent disturbance that scientists were neither ready to face nor willing to admit. Elisabeth Rona, one of the female experimenters who worked at the institute and who specialized in polonium preparations, seemed to be one of the few who had a clear sense of how hazardous radiation could be. In the autumn of 1926, she spent a few months in the Curies' laboratory in Paris to learn from Irène Curie how to prepare polonium sources.[42] It was there that Rona first experienced the danger of radioactivity. Marie Curie and she were attempting to open a flask containing a solution of a strong radium salt when a violent explosion scattered glass all over the laboratory. It was only by mere luck that they were not injured or highly contaminated.[43] **33**

When Rona returned to the Vienna Institute at the start of 1927, her experience with radium hazards led her to insist on taking precautions. The entire building was by now of course highly contaminated. Although hoods were used and the rooms were fairly well ventilated, the walls of the chemistry laboratory on the ground floor were especially contaminated. Rona recalled that "separated by a narrow corridor was the instrument room containing Geiger counters for beta counting and parallel plate condensers for alpha counting."[44] That spatial arrangement resulted in the contamination of instruments that finally had to be carried to the neighboring Physics Institute. Rona's own room was also one of the most contaminated. As she discovered, it was there during the 1910s that Otto Hönigschmid carried out his atomic weight experiments. The unprotected Hönigschmid often shook the solution by hand in order to homogenize the radium solution.[45] **34**