James Franck: Science and conscience

Frank von Hippel

feature article

In World War I, Franck helped his native Germany develop gas-warfare defenses. Three decades later he urged the US, his adopted country, to tread carefully with an even more terrible weapon.

Frank von Hippel, a physicist, is a professor of public and international affairs at Princeton University in Princeton, New Jersey. He is one of Franck's eight grandchildren.

James Franck was one of Germany's leading experimental physicists in the 1920s and early 1930s. He is remembered by physicists today primarily because of the Franck–Hertz experiment, for which he and Gustav Hertz were awarded the 1925 Nobel Prize in Physics, and for the Franck–Condon principle. Franck left Germany in 1933. As an immigrant in the US, he resumed his earlier efforts to understand how chlorophyll uses sunlight to form carbohydrates.

Franck is also known, however, for his role in the Manhattan Project during World War II. He chaired the project's committee that produced the secret "Franck Report." Out of concern that a surprise nuclear attack on Japan would make a nuclear arms race with the Soviet Union inevitable, the report recommended a demonstration explosion instead. He may have been sensitized to the ethical and political issues involved in the nuclear weapons project by his participation three decades earlier in Germany's World War I chemical weapons program.

The first biography of Franck, by Jost Lemmerich, a leading historian of 20th-century German physics, was published in German in 2007. This article is based primarily on that book.[1]

Becoming a physicist

Franck was born in Hamburg in 1882, in a Jewish community that had emigrated from Portugal in the late 1500s. His interest in physics was partly stimulated by Wilhelm Röntgen's 1895 discovery of x rays. Indeed, after breaking his arm at age 13 and having it set, he took himself to Hamburg's State Physics Laboratory and asked to have the arm x-rayed. An x-ray tube had just been constructed at the laboratory. So on 7 April 1896, young Franck had the first diagnostic x ray ever taken in Hamburg. It revealed that the bone had been improperly aligned and had to be reset.

Although Franck was interested in science, his father, a successful draper who later went into banking, was skeptical that James would be able to make a living in physics other than as a high-school teacher. Franck therefore first matriculated at the University of Heidelberg as a law student. But he soon switched to chemistry, taking mathematics and physics courses as well. He met Max Born, who was to become a lifelong friend. Both young men were dissatisfied with the science courses at Heidelberg. Franck therefore left to study chemistry at the Friedrich-Wilhelms University in Berlin, and Born left to study mathematics at the University of Göttingen. Six decades later Franck recalled how he finally persuaded his father to let him switch to physics: "If I don't study physics, I am unhappy from now on. If I study physics and don't come along [succeed], I will be unhappy from *then* on. I'd better have *some* happiness!"[2]

In Berlin, Franck was quickly persuaded to study experimental physics. He became a student of Emil Warburg and attended the entire cycle of Max Planck's courses on theoretical physics: mechanics, thermodynamics, acoustics, electricity, and electromagnetism. He also began to attend—and was profoundly impressed by—the series of colloquia in which Planck, later joined by Albert Einstein and Walther Nernst, struggled with the challenges of the new physics, especially the theory of quanta.

Warburg proposed that Franck study the mobility of ions in a point discharge. Franck redefined the problem into one with a more calculable cylindrical geometry. Thus began the work that led to the Franck–Hertz experiment.

After receiving his PhD in 1906, Franck was able to stay on in Berlin as a postdoctoral researcher. He collaborated with a number of colleagues on various topics relating to the physics of gas discharges. By 1911, he had produced enough work to qualify for his *habilitation*—in effect, a license to teach at a German university. With that credential, Franck began to

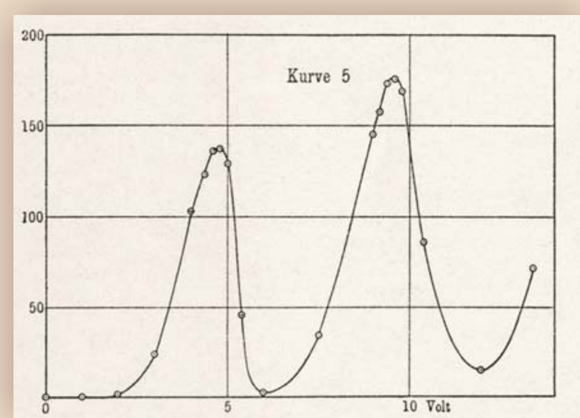

Figure 1. In the 1914 experiment for which James Franck and Gustav Hertz shared a Nobel Prize, they plotted anode current against accelerating voltage for an electron beam passing through mercury vapor in a cathode-ray tube. The abrupt current drops at multiples of 4.9 volts indicate inelastic collisions of electrons energetic enough to raise mercury atoms to their first excited electron state. (From ref. 10.)

Figure 2. German army lieutenants James Franck (left) and Otto Hahn (middle) in mid-winter 1916. At Fritz Haber's institute in Berlin, they stand in front of the shack in which they test the effectiveness of masks against poison gases. (Courtesy of Dietrich Hahn.)

lecture while continuing his research in Berlin.

In 1907 he had married Ingrid Josephson, a pianist from a Jewish family in Göteborg, Sweden. They had a traditional Jewish wedding and their first daughter, Dagmar, was born in 1909. A second daughter, Lisa, was born in 1911.

One of Franck's collaborators during that period was Robert Wood, a visiting professor from the Johns Hopkins University. Wood was interested in fluorescence. So he and Franck tried together to understand the effects of pressure and different gas admixtures on the fluorescence of iodine gas. Franck also began to collaborate with the more mathematically inclined Hertz, whose uncle, Heinrich Hertz, had demonstrated the existence of electromagnetic waves. Their second joint publication describes the beginning of their attempt to measure the ionization energy of atoms by bombarding dilute monatomic gases with electrons accelerated through an adjustable potential. First they discovered that low-energy collisions were elastic unless the gas had a strong electron affinity. Then they made the key discovery that inelastic collisions begin to occur at a certain energy that depends on the element under bombardment.

The experiment and the war

Early in 1914 came the experiment with mercury vapor for which Franck and Hertz would be awarded the 1925 Nobel Prize. As they accelerated electrons across a tube filled with vaporized mercury, they found that the current increased with voltage between dips at intervals of 4.9 eV, as shown in figure 1. At first the experimenters misidentified that energy as the ionization energy of mercury. But from Einstein's photoelectric-effect formula, they realized that 4.9 eV was an excitation level, corresponding to the 0.2536-micron wavelength of a strong UV mercury fluorescence line Wood had discovered. Planck was pleased because the experiment resulted in a much more accurate value for h, his blackbody quantum of action. Franck and Hertz did not make the connection between their result and Niels Bohr's theory of the atom. "We had neither read nor heard about [it]," Franck recalled in later years.[3] But Bohr quickly recognized their result as a confirmation.

World War I began in August 1914. Franck was already enlisted in the army reserves, and in December he was sent to the front in northern France as an engineer. Germany's advance had stalled, and Fritz Haber, the great German physical chemist, recruited Franck and other scientists into a project to break through the Allied lines by releasing chlorine gas when the wind was favorable. Although the first attack, on 24 May 1915, was a failure, it launched a poison-gas arms race. Franck stayed at the front for a time, first in the West and then in Russia, where he contracted dysentery. While recuperating at home in September 1916, Franck learned that he had been appointed to a professorship at the Friedrich-Wilhelms University, his old school.

When Franck recovered, he was detached to work on poison gas at Haber's Kaiser Wilhelm Institute of Physical Chemistry and Electrochemistry in Berlin. There he worked on defensive systems—testing gas masks and filters. The researchers used themselves as guinea pigs, testing the masks in a room filled with poison gas. In those efforts, Franck worked closely with both Haber and Otto Hahn (see figure 2). Hahn would go on to discover uranium fission on the eve of the next, even more terrible war. So both he and Franck were exposed to "weapons of mass destruction" decades before their involvement with nuclear matters.

Franck and Hertz did not stop doing physics during the war. In 1915, while Franck was in a field hospital recovering from a serious bout of pleurisy, he and Hertz wrote and submitted for publication a paper on why, in a glow discharge in a gas mixture, the spectrum of the most easily ionizable gas is excited first.

At the end of 1918, with the war just over, Franck and Hertz wrote an overview article that summarized their conclusions as to what could now be understood about atomic excitations and ionization. They then went their separate ways scientifically. At about the same time, Haber offered Franck his first salaried position, as director of a division for research on atomic and molecular excitation and ionization in Haber's reorganized Kaiser Wilhelm Institute.

Postwar conditions were desperate. The Nazis and other rightist groups blamed Germany's defeat on a "stab in the back" [*Dolchstoss*] by the Jews; extremist groups on both right and left strove furiously to destroy the fledgling Weimar Republic; and in 1923 came hyperinflation. Nonetheless, Franck and his coworkers focused on their research. With theorist Fritz Reiche he analyzed the energy-level structure of helium. They concluded that although He's metastable state would be invisible in the He emission spectrum because electromagnetic transition to the ground state was forbidden, it could be detected via Franck–Hertz electron-beam excitation. Soon thereafter Franck and Paul Knipping found the metastable He level.

Franck finally met Bohr during the Danish theorist's visit to Berlin in the spring of 1920. It was the beginning of a lifelong professional and personal friendship. Bohr's atomic theory had become central to Franck's thinking, and Bohr thought that Franck could devise experiments that would test and facilitate the development of the theory. A few months later, Bohr invited Franck to spend the following spring in Copenhagen to help set up an experimental group in Bohr's new Institute for Theoretical Physics.

Figure 3. Göttingen was a center of physics in the 1920s and early 1930s in part because theorists and experimenters worked together. Sometimes they even commuted together. From left to right: Ludwig Sommer, Werner Heisenberg, James Franck, and Günther Cario. (Photo from the Lisa Lisco collection, courtesy of Karen Lisco Lieberman.)

Göttingen

Meanwhile, in part due to the influence of Born who had become the professor of theoretical physics at Göttingen in 1920, Franck was appointed there as a professor of experimental physics. At the time, the university had two chairs of experimental physics; Robert Pohl held the other. Pohl had been a friend and fellow student of Franck's in both Heidelberg and Berlin. He had become famous at Göttingen because of his spectacular lectures. Göttingen also had a powerful school of mathematicians interested in physics, including David Hilbert, Richard Courant, and Carl Runge.

During those difficult economic times, government funding was cut back drastically, and German physics was increasingly supported by German and foreign industry. Einstein also dispersed money from the budget of his Kaiser Wilhelm Institute of Physics, an institution that existed only on paper. Later, the Rockefeller Foundation became a major funder of physics at Göttingen.

The university became a world center of physics. It attracted not only the best students and young researchers—most spectacularly Werner Heisenberg and Wolfgang Pauli—from other German universities, but also many talented foreigners. Among them were Karl Compton, Edward Condon, Joseph Mayer, and J. Robert Oppenheimer from the US, Edward Teller from Hungary, and Paul Dirac from the UK.

Particularly attractive to the young physicists was the friendly, collaborative atmosphere between the theoretical and experimental physicists (see figure 3). Franck played a central role in creating that community spirit. Before Heisenberg left to take a chair at the University of Leipzig in 1926, he wrote a letter of appreciation to Franck:

> Before I leave here to embark on my new profession, I would like to thank you and your esteemed wife warmly for all the kindness that you have shown me throughout my years in Göttingen. The spirit that one felt at our institute Christmas parties and the "Franck festivities," which permeated all of our working and living together did, of course, come largely from you. And because it is mainly due to this spirit that one immediately feels at home in Göttingen, I'd like to thank you especially for it. I could not imagine anything finer than working in Göttingen again one day under the reign of that spirit.

Franck was now using electron collisions to explore the dissociation of molecules. His approach to understanding molecular processes was more visual than mathematical. In a 1924 paper that discussed ionizations caused by collisions between positive ions and atoms, he wrote, "The assumption underlying the equation is that the ionizing electron jump at the struck atom happens so fast that the ponderous ions do not change their positions during the electron's jump." That was the first enunciation of the Franck–Condon principle, which Franck developed further in a 1926 article on photodissociation of diatomic molecules and Condon elaborated more mathematically in an article that same year. After a binding electron assumes an excited state, the equilibrium distance between the two nuclei in a diatomic molecule is different from the ground-state distance. Therefore, part of the excitation energy goes into interatomic vibration.

Franck's standing in the physics community continued to rise. In 1926 he and Hertz shared the delayed award of the 1925 Nobel Prize. Bohr had been nominating Franck since 1921. The Göttingen students mounted a torchlight procession to Franck's house to celebrate the announcement. In his Stockholm acceptance speech, Franck reflected on the joys of being a physicist in that era:

> Is it not rather we, who have every reason to be thankful?—thankful for the opportunity to work, thankful also to destiny for permitting us, in an epoch so rich and vibrant in our science, to carry building blocks to the magnificent edifice of quantum and atomic theory that men like Planck and Niels Bohr, in particular, have erected.

Göttingen's Institute of Physics remained apolitical, but around it the Nazi tide was rising. In 1926, Adolf Hitler established the Nazi Student League, and a cell was organized at Göttingen the following year. But Franck plowed on with his physics. One of his collaborators in the work on molecular dissociation was Hertha Sponer, whom he would marry in the US after Ingrid's death.

Confronting Nazism

In 1929 Franck turned down a professorship in Munich. But he used the prestigious offer to get increased support for his work at Göttingen from the Ministry of Culture. At the end of 1932, he was invited to succeed Nernst as director of the

Physical Institute in Berlin. He was willing. But that plan, along with countless others, was soon swept away when Hitler was appointed chancellor of Germany on 30 January 1933.

Just two months later, the new government promulgated a law discharging all government employees of "non-Aryan descent," including university faculty. The major exemption, for the time being, was for veterans of World War I. Franck could have invoked that exemption, but he resigned publicly in protest against the new laws:

> We Germans of Jewish descent are being treated as aliens and enemies of the fatherland. Our children must grow up knowing that they will never be allowed to regard themselves as Germans. War veterans are to be permitted to continue serving the state. I decline to avail myself of that privilege, although I understand the position of those who today see it as their duty to remain at their posts.

A few days later, Franck's action was reported in the local anti-Nazi newspaper, which was subsequently shut down, and then in American, British, Dutch, and Italian papers. Franck received many letters of appreciation for his stand. He was also denounced. For example, a letter signed by 42 Göttingen lecturers and published by the local pro-Nazi newspaper argued that "the form of [Franck's] tender of resignation is tantamount to an act of sabotage."

Franck received offers to teach in Istanbul and in Belgrade, and an invitation to visit Johns Hopkins. But at first he hoped to stay in Germany and work in the private sector. Meanwhile, using his international connections, he occupied himself with helping the Jewish researchers and students in his institute find positions abroad. His PhD students completed their theses under Pohl's supervision. My father, physicist Arthur von Hippel, who had married Franck's daughter Dagmar, went to teach for two years in Istanbul.

Bohr offered Franck a visiting professorship at his institute, and in October 1933 Franck finally decided to accept. In Copenhagen he worked briefly on nuclear physics but then decided he could contribute more by working on understanding photosynthesis, to which he devoted the rest of his research career.

Figure 4. James Franck and Max Born in May 1964, during Franck's last visit to Göttingen. The camera catches Franck in a characteristic gesture—pulling out his pocket watch and asking, "Do we still have time?" A few days later, he died suddenly of a heart attack. (Photo from the Lisa Lisco collection, courtesy of Karen Lisco Lieberman.)

Starting over in America

Although Franck loved and admired Bohr and his institute, he realized that the sojourn in Copenhagen could only be a way station. In January 1935, therefore, he accepted the offer from Johns Hopkins. Before Franck left for America, he, his two daughters, and their families had a reunion in the Bohr family's summer home. Von Hippel stayed on as a guest researcher in Bohr's institute until he obtained a position at MIT in 1936. Franck's second daughter, Lisa, and her husband, Hermann Lisco, a pathologist, went back to Berlin. But in 1936 they were able to join Franck in Baltimore.

At Hopkins, Franck continued his research into photosynthesis. The Rockefeller Foundation provided funds for equipment, but the university did not have the funds to hire coworkers. It was a desperate time in Europe. To make possible the emigration of his mother, aunt, and sister to the US, Franck put up his life insurance as collateral to guarantee that they would not become burdens on the public purse.

Early in 1938 Franck accepted a position at the University of Chicago with support for his research from Samuel Fels, who had made his money in the manufacture of Fels Naptha, a popular household soap. Franck now had a group, and they did experiments on the influence of light intensity and duration, CO_2 concentration, and temperature on photosynthesis and fluorescence in hydrangea leaves. They developed a partial theory to explain their results.

Franck's first paper at Chicago was coauthored by Teller, who had been the theorist with Franck's Göttingen group before going to Bohr's institute in 1933 and then to the George Washington University in 1935.[4] The paper considered how light is absorbed by crystals, which helped to lay the basis for the theory of excitons. The authors then applied those ideas to the problem of how blue light creates low-energy excitations in chlorophyll. Teller and Franck were a long way from a true understanding of how photosynthesis works, but their ideas turned out to be relevant to the sensitization of photographic emulsions by light.

Franck wrote about the difficulties of understanding photosynthesis in an undated letter (probably 1941) to his friend Lise Meitner.

> It's completely different from physics, where the simplest solution is almost always the right one. But in living tissue, that's absolutely not the case. Nature has had the time to take very complicated paths to the solution, because they mostly offer safeguards against derailment. I believe I understand the physico-chemical side of photosynthe-

> sis. The chemistry, which actually interests me less, I try to understand as far as I can.

Franck's contributions in the field were recognized in 1955 by the Rumford Prize of the American Academy of Arts and Sciences.

Japan's December 1941 attack on Pearl Harbor resulted in the almost immediate mobilization of US physicists into the nuclear weapon and radar programs. Technology development for plutonium production was put under the leadership of Arthur Compton in the Manhattan Project's code-named "Metallurgical Laboratory" at the University of Chicago. Compton asked Franck to head the Met Lab's chemistry division. Franck responded that he would do so, but with a condition: When the bomb was ready for use—assuming it had not been developed elsewhere first—he must be allowed to present his views as to its use to someone at the highest policymaking level.[5]

Franck's job was mostly managerial; a team under Glenn Seaborg carried out the work. Franck did get deeply involved, however, with questions raised by Eugene Wigner's calculations of the energy stored by neutron-caused atomic displacements in the graphite of the plutonium-production reactors. This "Wigner effect" turned out to be more serious than the DuPont Company, which was responsible for building the reactors on the Columbia River, was initially willing to acknowledge. It led to shutdowns of the reactors after World War II until techniques were developed to release that energy in a controlled way.[6]

The Franck Report

During 1944, the tide of the war in Europe had turned, and the work of the Met Lab was largely completed. Its scientists therefore had time to consider the postwar implications of nuclear energy. The potential for a postwar nuclear arms race was obvious. Indeed, Bohr had been urging the American and British governments to discuss the issue of the bomb with the Soviet Union before it was used.

The discussions at Chicago became more intense after the May 1945 victory in Europe. After one of those discussions, on 5 June Franck wrote the first draft of what was to become the Franck Report:

> [T]he basic knowledge is international that atomic power can be used to make an atomic bomb of an unheard of efficiency. We are quite certain that the United States has for the time being an advantage in this field. It consists in the fact that she succeeded in producing the explosive itself, by separating the active isotope of U as well as by producing a fissionable transuranic element [plutonium] in pure form and on a technical scale. . . . We believe a bomb able to produce a sensational destruction will be available very soon. It took the United States 3 ½ years to reach that goal, and great sacrifices in the wealth of the nation had to be made for this progress and great scientific and industrial organizations were needed.
>
> Just the same, we may expect that other great nations can and will do the same in about the same number of years if enough effort is put behind it. While they may fall somewhat behind in industrial efficiency, they would have the advantage to know in a general way how we proceeded even if the USA should try to keep everything secret. . . . If an armament race in atomic bombs starts, the USA would therefore have an advantage of only a few years.

After the death of President Roosevelt in April 1945, Compton was a member of the Scientific Advisory Panel to the Interim Committee that advised Harry Truman, the new president, on nuclear matters. The other members of the SAP were Oppenheimer, Ernest Lawrence, and Enrico Fermi. The day after Franck wrote his memorandum, Compton appointed six panels of Met Lab scientists to consider postwar implications of nuclear energy. Franck was appointed chair of the panel on social and political implications. Franck's panel included Seaborg, who would go on to chair the Atomic Energy Commission from 1961 to 1971; Leo Szilard, who had agonized over implications of nuclear weaponry ever since he first conceived the idea of a nuclear chain reaction in 1933; and Eugene Rabinowitch, who went on to co-found the *Bulletin of the Atomic Scientists*.

The final version of Franck's memorandum, which came to be known as the Franck Report, was finished in five days. It argued against using nuclear weapons in a surprise attack on Japan, and for the alternative of a demonstration explosion over an uninhabited area:

> The use of nuclear bombs for an early, unannounced attack against Japan [is] inadvisable. If the United States would be the first to release this new means of indiscriminate destruction upon mankind, she would sacrifice public support throughout the world, precipitate the race of armaments, and prejudice the possibility of reaching an international agreement on the future control of such weapons.
>
> Much more favorable conditions for the eventual achievement of such an agreement could be created if nuclear bombs were first revealed to the world by a demonstration in an appropriately selected uninhabited area. . . .
>
> If the government should decide in favor of an early demonstration of nuclear weapons it will then have the possibility to take into account the public opinion of this country and the other nations before deciding whether these weapons should be used in the war against Japan. In this way, other nations may assume a share of responsibility for such a fateful decision.

Compton, Franck, and Norman Hilberry, Compton's deputy, tried to deliver the report to Secretary of War Henry Stimson, chair of the Interim Committee. But he was out of town. So they left it for Stimson with a cover note by Compton that expressed his view that the report had not given adequate weight to the lives that would be saved if use of the bomb accelerated the end of the war.

Compton had already brought up Franck's idea of a demonstration in a meeting of the Interim Committee and its SAP on 31 May. As a result, the SAP was "asked to prepare a report as to whether we could devise any kind of demonstration that would seem likely to bring the war to an end without using the bomb against a live target." They reported back on 16 June that they could not.[7]

Unlike the committee, however, Franck was not focused on the importance of using the bomb to accelerate the end of the war. Indeed, his 5 June memorandum assumed that the war was already virtually won:

> This explosive was not developed in time to be used against Germany. It will probably not be

> needed to win the war with Japan. It is conceivable that its use against Japan might shorten that war. It is probable that it would not materially shorten the war.

Franck's assessment that the war was almost over was shared by Joseph Stalin, who rushed Soviet troops from Europe to the East for fear that Japan might surrender before the Soviet Union could enter the war and help shape postwar East Asia.

A flying start

There is no doubt that dropping the nuclear bomb on Hiroshima gave the arms race a flying start, as Franck had feared it would. Before Hiroshima, Stalin had not given the Soviet nuclear weapons program high priority. After Hiroshima, however, he is reported to have said to Igor Kurchatov, the scientific leader of the Soviet nuclear project, and Boris Vannikov, the commissar for munitions, that "Hiroshima has shaken the whole world. The balance has been destroyed."

To ensure that the project would now get whatever resources it needed, Stalin put it under Lavrenti Beria, the feared head of the NKVD (the People's Commissariat of Internal Affairs).

David Holloway, the American historian who has studied the Soviet program most closely, argues that there was nothing that the US could have done to convince Stalin not to mount a nuclear weapons program. As he puts it:

> The bomb would still have affected the balance of power, and would still have been a symbol of the economic and technological might of the state. Stalin would still have wanted a bomb of his own.[8]

Whether or not the cold war buildup had to reach the levels it did, however, is another question. Stalin died in 1953, four years after the Soviet Union conducted its first nuclear test. He was succeeded by a less paranoid leadership. In his famous February 1956 speech to the 20th Congress of the Soviet Union, Premier Nikita Khrushchev expressed an interest in "peaceful coexistence" with the West.

At that time, the US nuclear stockpile contained between 4000 and 5000 fission bombs and the Soviet stockpile about one-tenth as many. The much more powerful thermonuclear warheads were just being developed. The American buildup had developed such a momentum, however, that during 1958 alone the US added more than 5000 nuclear warheads to its stockpile. By the time Defense Secretary Robert McNamara managed to rein in the buildup in the mid-1960s, the US stockpile contained more than 30 000 warheads. It took two more decades for the Soviet Union to reach and surpass that level.[9]

The postwar years

At the end of the war, Franck was concerned about the fates of his friends and former colleagues in Germany. Late in 1945 he became involved in an appeal for humanitarian aid for Germany, where starvation was rampant. American public-health officials in occupied Berlin estimated that infant mortality would climb to 80–90% during the winter of 1945–46. Franck asked Einstein to sign the appeal, but Einstein refused. After two world wars, he had given up on the Germans. "I still remember too well the Germans' campaign of tears [*Tränencampagne*] after the last war," he wrote to Franck.

In February 1946 Franck wrote to Born, in English, about his reluctance to become involved in political matters.

> I would be quite content . . . if only my conscience would not force me to take a stand on a few political issues. I hate to be involved in anything political; I hate publicity, but I just cannot retire into the ivory tower of free research and forget about the world. And, of course, at our age we are probably more pessimistic than the young people. Even I am not consistent in my pessimistic point of view, because I have an elementary joy in each new grandchild, and feel that whenever I have the opportunity I am a kind of professional grandfather.

Franck soon returned to his work on photosynthesis. In 1947 he was invited by the German authorities to accept a chair in experimental physics in Heidelberg. But he responded that he had made a new home in America. He also confessed,

> I believe I know that the majority of Germans rejected the murders committed against the Jews and the other races that the Nazis labeled inferior. And I do not reproach those people for not throwing themselves down the Moloch's gullet because they deemed it useless. But another considerable percentage of the populace stood by and watched the crimes with indifference. With them I want no contact. So I cannot imagine a fruitful teaching position in which I would have to ask myself whether this or that one with whom I had official or personal business was one of those.

Slowly, however, Franck began to make his peace with the new Germany. In 1948 he accepted corresponding membership in the Max Planck Society (the renamed Kaiser Wilhelm Society). Its president was now his old friend Hahn. In 1951 he accepted, with Hertz, the Max Planck Medal. And in 1953 Franck, Born, and Courant accepted honorary citizenship from Göttingen.

In 1950 Franck had begun to visit his old friends in Europe. Traveling around Germany in the spring of 1964, he and his wife stopped in Göttingen to visit Hahn and Born (figure 4). There on the morning of 21 May, after an evening out with Hahn, Franck died of a heart attack at the age of 81.

An English translation by Ann Hentschel of Lemmerich's biography will be published early next year under the title Science and Conscience: The Life of James Franck *by Stanford University Press as part of its series on the history of the nuclear age.*

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