Zbynek Zeman and
Rainer Karlsch

Uranium Matters

Central European Uranium in International Politics 1900–1960

CEU PRESS

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by

Zbynek Zeman and *Rainer Karlsch*

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For Kačka and Ms. Crawford

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Preface

The present study concentrates on the development of uranium industries in the Soviet zone of occupation in Germany and Czechoslovakia during the crucial years after the war, and touches on how and why Soviet influence was extended far into the center of Europe. Apart from the book before you, the uranium project resulted in an edition of contributions to a conference,* a double issue of *Der Anschnitt, Zeitschrift für Kunst und Kultur im Bergbau* (2–3, 1998), articles, research papers, several conferences in Germany, a seminar in Washington DC and exhibitions in both Germany and the Czech Republic. Indirectly, Dr. Karlsch's interest in uranium matters led him to the subject of his last book, *Hitlers Bombe*, which was published, to much acclaim and some controversy, by Deutsche Verlags-Anstalt in Munich in 2005.

It summarizes the findings the authors considered important. Both the English and German versions were based on the same material, although they were drafted by Dr. Karlsch and Professor Zeman independently.

The Erzgebirge, or Ore Mountains, mark the border between Bohemia and Saxony. In Czech, the mountain range is called Krušné hory, or the Cruel Mountains.

Zbynek Zeman

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* Rainer Karlsch and Harm Schröter, eds. *Strahlende Vergangenheit, Studien zur Geschichte der Wismut*. St. Katharinen, 1996.

Part 1

Unparalleled Power

Terminal

On 24 June 1945, Joseph Stalin reviewed a great victory parade in Moscow. Regiments of Red Army infantry, cavalry and tanks threw innumerable banners and standards, taken from Adolf Hitler's armies, at Stalin's feet. The day of torrential rain was charged with symbolism: once again, through endurance and suffering, Russia had won a great war. Mikhail Kutuzov's soldiers had once thrown the standards of Napoleon's armies at the feet of Tsar Alexander in the same way. In that summer of 1945, Marshal Zhukov, the victor of Stalingrad and Berlin, stood next to Stalin. A month later, at Potsdam on 24 July, Harry S. Truman told Stalin that America possessed an atomic weapon.

The third and the last conference of the Second World War's Big Three was given the code name Terminal. It was to take place in Berlin, where few buildings escaped damage during the Red Army's final sweep into the city. Cecilienhof, the residence of the former Crown Prince of Hohenzollern in nearby Potsdam, was proposed as the most suitable venue for the conference. It had a large ballroom, and the Berlin suburb of Babelsberg offered accommodation for the delegates and their staff. On their way to Schloss Cecilienhof, the delegates were able to avoid the center of Potsdam, which had been heavily damaged, and cross the Jungfernsee on a pontoon bridge. The journey took about ten minutes by car.

The eighth plenary session in Potsdam started on 24 July, at 3:15 in the afternoon. Winston Churchill immediately complained about the situation of British military and diplomatic missions in Romania and Bulgaria. He told Stalin that he "would be astonished to read the catalogue of incidents to our mission in Bucharest and Sofia. They were not free to go abroad. An iron curtain had been rung down."[1] The session in Potsdam was, however, memorable for another reason.

When it ended late in the afternoon, the delegates stood around in twos and threes, chatting. Churchill saw Truman go to Stalin, and the two men were left alone with their interpreters. Churchill, standing about five yards away, watched them with close attention. He agreed with Truman that Stalin would have to be told about the successful test of the atom bomb in New Mexico, which had taken place ten days before the meeting in Potsdam. In his memoirs, Churchill noted:

> I knew what the President was going to do. What was vital to measure was its effect on Stalin. I can see it as if it were yesterday! He seemed delighted. A new bomb! Of extraordinary power! Probably decisive on the whole Japanese war! What a bit of luck! This was my impression at the moment, and I was sure that he had no idea of the significance of what he was being told. Evidently in his intense toils and stresses the atomic bomb had played no part. If he had had the slightest idea of the revolution in world affairs which were in progress his reactions would have been obvious. Nothing would have been easier than for him to say "Thank you so much for telling me about your new bomb. I of course have no technical knowledge. May I send my expert in these nuclear sciences to see your expert tomorrow morning?" But his face remained gay and genial and the talk between these two potentates soon came to an end.
>
> As we were waiting for our cars I found myself near Truman. "How did it go?" I asked. "He never asked a question" he replied. I was certain therefore that at that date Stalin had no special knowledge of the vast process of research upon which the United States and Britain had been engaged for so long, and of the production for which the United States had spent over four hundred million pounds in an heroic gamble.[2]

Franklin D. Roosevelt and Churchill were convinced of the need to shield the nuclear project from German intelligence. The requirement for absolute secrecy rebounded on Stalin as well as on most of the members of Churchill's own cabinet. Neither the British war cabinet, nor the Defence Committee, had discussed the bomb before it was dropped. In a telegram to Eden on 18 April 1945, Churchill proposed that the Americans should advance into the region south of Stuttgart before the French troops reached it. Churchill believed that German nuclear research installations were to be found there, and he asked Eden to treat his suggestion as "background in deep shadow."[3]

Truman had lunched with Churchill on 18 July, and the first part of their conversation concerned the atomic bomb. It was left out of the record for the cabinet, and only Anthony Eden and Sir John Anderson received a note of it. Truman asked Churchill what should be done about telling the Russians. The President was determined to tell them, but was uncertain about the timing. Should he do so at the end of the conference in Potsdam? Churchill advised him to link the news with the experiment in New Mexico, "a new fact of which he and we had only just had knowledge. Therefore we must have a good answer to any question 'why did you not tell us this before?' "[4]

The Race for the Ultimate Weapon

The race for the atomic bomb was, in the end, won by America. The explosions over the New Mexico desert, and then over Hiroshima and Nagasaki in the summer 1945, marked the beginning of a new age. The scientists who had fled from fascist Europe, where Hitler made a point of distrusting "Jewish physics," helped to draw the attention of the governments in Washington and London to the potential threat of Nazi Germany developing the "ultimate weapon." Leo Szilard helped persuade Albert Einstein to write, on 2 August 1939, a letter to president Roosevelt, warning him of the destructive potential of nuclear fission. Einstein's letter also contained a reference to the importance of the uranium mines at Jáchymov, which had come under Nazi control after the Munich agreement in September 1938. In response to the letter, Roosevelt established a uranium commission in October 1939, in order to determine the feasibility of building the bomb. Other, similar impulses came from Britain.

Between the two wars, nuclear scientists had formed a small international group: they knew each other and worked closely together. When Otto Hahn and Fritz Strassman concluded that they brought about nuclear fission in their experiments, they reported on their findings in a well-known scientific journal, *Naturwissenschaften*, at the beginning of 1939. Research in the instability of matter was marked, however, by bad timing. Important advances were made about the time of the outbreak of the Second World War. The international group of scientists fell apart, and articles on their work disappeared from academic journals. As politicians grasped the possibility of developing the ultimate weapon, secrecy and military necessity came to dominate the scientists' work.

After the defeat of France in May 1940, Joliot Curie, the leading French nuclear physicist, stayed in Paris and sent two of his assistants to England. They brought heavy water in tin cans, and continued their work on slow neutrons in Cambridge. The team at the Cavendish Laboratory discovered that, in the course of neutron reactions, plutonium emerged. Virtually unknown in nature, it behaved like uranium 235.

In April 1940, Rudolf Peierls and Otto Frisch, refugee scientists in England, wrote a memorandum suggesting that a lump of pure uranium

235 would create chain reaction necessary for the bomb. They also proposed an industrial method for separating uranium 235 from uranium 238. They also forecast the horrors of the bomb, and explored its strategic and moral implications. A five kilogram bomb would liberate the energy of several thousand tons of dynamite, causing radiation fatal to living beings long after the explosion. The British government established the "MAUD committee," which concerned itself with the feasibility of producing the nuclear weapon. In July 1941, the committee reported that it would be possible to make a bomb, which was "likely to lead to decisive results in the war." Churchill made the MAUD report available to Roosevelt.

The Japanese attack on Pearl Harbour took place on 7 December 1941, and the German declaration of war on the United States followed four days later. Roosevelt was anxious to receive British cooperation and wrote to Churchill about a joint atomic project. The British response was measured, because they wanted their own project—code-named Tube Alloys—with American cooperation.

In the summer of 1942, the Americans began to construct a large technological venture around research hitherto confined largely to university laboratories. The atomic project was given the code name "Manhattan," and Lt. General Leslie R. Groves, a West Point graduate who had supervised the building of the Washington Pentagon, became its manager. There was some hesitation over the appointment of Robert Oppenheimer as the head of research. A university teacher of theoretical physics with an international reputation, he was more interested in pure research than in its application. He was also regarded as something of a political risk. When his appointment was confirmed, Oppenheimer began bringing together the best available scientists in America. He assumed that about 150 of them could successfully complete the project; eventually, their number grew to some 2,500.

By the end of 1942, the advantage of the American project became apparent. The British knew that the US had cornered the Canadian market in uranium and heavy water for the next two years, and that their own project would have to move to North America. The British tried to come in on the US project, but the Americans were reluctant to accept them. The exchange of information ceased, and the western allies remained united by the fear that Germany would beat them in the atomic race.

On 27 February 1943, Churchill telegraphed Roosevelt that "My whole understanding, was that everything was on the basis of fully sharing the results as equal partners. I have no record, but I shall be very much surprised if the President's recollection does not square with this."[5] Churchill was convinced that the possession of the bomb would provide the key to national power after the war, and he tried hard, in August 1943, to convince Roosevelt to sign the Quebec agreement. It helped the British to participate in the Manhattan Project, and led to joint purchase and utilization of uranium supplies. The partners in the agreement promised never to use the bomb against third parties without the other's consent, nor to pass on atomic information to third parties. All available British scientists joined the US project, while the Anglo-French team from Cambridge moved to Canada. They could not go on working in Britain, and the Americans would not have them. The US government had little liking for the Free French, while the leader of the Anglo-French team was unacceptable to American scientists.

After the Quebec agreement was signed, the Americans underwrote the British project in Canada. John Cockroft, the English Nobel Prize-winning physicist, became its head. Canada joined Britain and America in the nuclear project as an additional partner and the main provider of uranium. Canadian officials sometimes played the role of an intermediary between Britain and America.

On 2 December 1942, Enrico Fermi successfully set up a self-sustaining chain reaction in a reactor built into a squash court at Chicago University. In addition to the reactors built by DuPont, the Manhattan Project had six other reactors, which produced uranium 235 by three different methods. All of this—as well as the construction of the first experimental bomb—was achieved at a time when the US armament industry was nearly stretched to its limit producing conventional weapons, as well as advanced new equipment such as radar. The atomic project cost the American government some $2 billion.

The Manhattan Project scientists fulfilled their objective and delivered the bomb to the US government. The first plutonium bomb was tested in the New Mexico desert on 16 July 1945. The Germans had signed unconditional capitulation and the Potsdam conference was to start the following day. In the morning of 6 August, a uranium bomb was exploded over Hiroshima, and on 9 August a plutonium bomb destroyed Nagasaki. Stalin declared war on Japan on 8 August, and on 14 August, the Japanese emperor declared his willingness to capitulate.

Throughout the war, the Allied intelligence services' fear that Germany would develop its own atomic weapon was never quite allayed. The Germans had the necessary technology and scientific strength. They had Jáchymov under their control and, after the occupation of France and Belgium, came into possession of large stores of uranium. Yet early in the war, and at least until the first months of 1942, it seemed that Germany would win the war with conventional weapons alone. The political will of the Nazi leadership to create the weapon did not remain constant, and the German scientific effort was not centralized on the scale of the Manhattan Project.

On 29 April 1939, the president of the Physikalisch–Technische Reichsanstalt, Professor Abraham Esau, organized the foundation meeting of the Uranium Society (Uranverein). Several research groups joined as members: Nobel Prize winner Werner Heisenberg and his colleagues in Leipzig and Berlin; the scientists from the Ordnance Office (Heereswaffenamt), who were working under Kurt Diebner in Gottow-Kummersdorf to the south of Berlin; a group around Paul Harteck in Hamburg; and the physicists at the Kaiser-Wilhelm Institute for Medicine in Heidelberg, with Walter Bothe at their head. Nikolaus Riehl, a pupil of Hahn, also joined the Uranium Club. As head of the research division of the Auergesellschaft, Riehl offered the Heereswaffenamt the services of his department.

Early in December 1939, Heisenberg delivered a report on the “possibility of using nuclear fission as a technical source of energy” to the Heereswaffenamt. It outlined plans for the building of a nuclear reactor. An effective moderator, which would slow down neutrons without absorbing them, was required. Graphite and heavy water were considered: a complicated electrolytical process was required for the production of heavy water. The technology became available to the Germans after the occupation of Norway and the merger of Norsk Hydro in Rjukan with IG Farbenindustrie. Norsk Hydro was obliged to increase production, making it available exclusively to the German Reich.

In the summer of 1940, the Wehrmacht overran France, the Netherlands and Belgium, acquiring large supplies of uranium. Though the director of the Union Minière, Edgar Sengier, had ordered the shipment of uranium and radium reserves to New York in September 1939, some remained in Belgium and fell into German hands.

Beginning in July 1940, the German companies Auergesellschaft and Degussa began purchasing uranium compounds from the Union Minire. The largest lot (1,244 tons) was secured by Roges GmbH, a German war materials company, in May 1942. It also made purchases in occupied France and bought further 200 tons of uranium compound from Union Minire. Until the summer of 1944, the Belgian company assisted the Auergesellschaft with the purification of uranium oxide.[6]

Germany’s own production of uranium remained relatively small during the war, and uranium mining enjoyed no special priority. The

Germans took little interest in the known reserves of uranium in Bulgaria and in Portugal. In Jáchymov, the mining of uranium lingered on and no attempts were made to increase production. Only the mines at Schmiedeberg in Silesia were enlarged during the war. In autumn 1939, the Heereswaffenamt requested the Auergesellschaft to help with the processing of uranium and, within a few weeks, the company built a plant at Oranienburg, with the capacity of about one ton of uranium oxide a month.[7] The Degussa plant in Frankfurt am Main followed, and from the end of 1944, another plant was built at Berlin-Grünau.[8] Initially, the military was more concerned with maintaining an adequate supply of luminous paint than with the nuclear project. Early in 1942, the Supreme Command of the Wehrmacht assumed the requirement of 7 grams of radium, in addition to 1.5 grams for the Italian and the Japanese armies. Three grams of radium were produced by Joachimsthal; the rest of the requirement was met with deliveries from France and Belgium. This covered the uranium needs of the Wehrmacht for three years.[9]

The Germans had enough uranium to make the bomb.[10] After the occupation of France, they also acquired the cyclotron at the Joliot Curie institute. The cyclotron was to stay in Paris, and German scientists were to have access to it.[11] Cyclotrons were subsequently constructed in Germany at the institutes of Walter Bothe at Heidelberg and Gerhard Hoffmann in Leipzig, and at the Reich Post Office laboratories at Miersdorf and Berlin-Lichterfelde.

In the meanwhile, experimental work was started in Hamburg and Berlin. Heisenberg and Karl Friedrich von Weizsäcker had a laboratory built on the site of the Institute of Biology and Virus Research at the Kaiser-Wilhelm-Gesellschaft at Berlin-Dahlem. The laboratory was known as the "Virus House." Their experiments, based on Fritz Houtermans' work on the release of nuclear chain reactions, confirmed that the only two suitable moderators were graphite and heavy water.* The Ura-

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* Even by the standards of an abnormal era, Houtermans led an extraordinary life. A half Jewish communist, he fled from Hitler's Germany to the Soviet Union in 1935. He was arrested during the great purges and delivered to the Nazis after the Ribbentrop-Molotov pact in the autumn 1939. He was then put into the care of the Gestapo and released after Max von Laue's intervention. Houtermans found employment in Manfred von Ardenne's team at Berlin-Lichterfelde and worked for the Nazi regime in order to save his life. In the spring 1941, he warned an American agent of the German nuclear programme and in the autumn he took part in the plunder of the Soviet laboratories in Kiev and Kharkov. After the war, his role in nuclear research fell into oblivion. (cf. Paul Lawrence Rose, Heisenberg and the Nazi Atomic Bomb Project, 135 et seq.)

nium Society put its faith in heavy water. Heisenberg established that the chain reaction of natural uranium created element 94, or plutonium. In September 1941, he knew that the way to the construction of a nuclear bomb was clear. The reason why he did not complete the work are still disputed by scientists and historians. Did Heisenberg hesitate to deliver the bomb to Hitler? Did his project simply lack resources after having been put on the back burner by the Nazis? Or did it suffer from conceptual difficulties in connection with his estimates of “critical mass?” At the end of October, the legendary meeting between Heisenberg and Niels Bohr took place in Copenhagen. The two men were unable to establish common ground. While Bohr feared that Heisenberg wanted to pick his brain and convince him to cooperate with the Germans, his former protégé believed that Bohr was unaware of his reservations with regard to the Nazis.

In the autumn of 1941, it seemed as though a German victory was assured, and they had no need for any miraculous products of science, later known as “Wunderwaffen.” The military lost interest in nuclear research and the Heereswaffenamt passed on responsibility for the project to the Reich Research Office (Reichsforschungsrat). On 26 February 1942, the office held a conference of nuclear physicists in Berlin. The captains of the armaments industry kept their distance, and the Reich leaders also seemed rather lackadaisical in regard to the military uses of nuclear fission. On 21 March 1942, Joseph Goebbels wrote in his diary that: “Researches in the field of destruction of the atom have succeeded so far that they could be possibly considered for the conduct of the current war. The tiniest input has such an immense power of destruction that one looks forward with some horror to the course of the war, should it last still longer, or to a later war.”[12]

The German nuclear project was divided among several institutes, among which two were outstanding: Heisenberg’s group at the Kaiser-Wilhelm Institute of Physics in Berlin, and the Heereswaffenamt group under the direction Kurt Diebner at Gottow, near Berlin. The key theoretical question concerned how to achieve critical mass, i.e. the correct amount of fissionable material (U 235 or plutonium) needed to maintain an explosive chain reaction while avoiding a spontaneous explosion. Estimating critical mass would be a deciding factor in determining whether the construction of the bomb should be attempted.

A meeting took place in Berlin on 4 June 1942, in which Albert Speer, the minister for armaments, General Leeb, the head of the Heereswaffenamt, General Field Marshal Milch and other top military officials took part. The generals showed some interest in the possibility of building a nuclear weapon. Questioned by Milch, Heisenberg stated that an atomic bomb, with enormous destructive power, should not be larger than a pineapple. After Heisenberg referred to the enormous investments required, Speer wanted to know what kind of a sum the scientists had in mind. Weizsäcker mentioned a sum that seemed ridiculously low and it became clear to Speer and to the military present that the project could not be significant for the conduct of the war.[13] There were no more meetings between Speer and Heisenberg. Although Speer was not convinced of the practical value of nuclear research, he went on supporting it in a modest way. In 1943 he set aside 3 million Reichsmarks (RM) for it, and 3.6 million RM in 1944.[14] Hitler himself remained skeptical about the nuclear project. In addition, he suffered from deep distrust of "Jewish physics" and dismissed anything having to do with Albert Einstein out of hand.

Still, the leaders of the Third Reich may have known more about the US Manhattan project than had been assumed. The Sicherheitsdienst had tapped the transatlantic telephone connection and broke the radio traffic code between Moscow and the Soviet embassy in Washington.[15] The information thus acquired was passed on to scientists close to the SS. In addition, the Germans and the Japanese received reports on the Manhattan project from Spanish agent Alcazar de Velasco early in 1944.[16] We have as yet no evidence on the uses the Nazis made of the fragmentary information they acquired on the British-American program.

Prominent scientists and heads of the armaments industry remained convinced that nuclear explosives could not be manufactured in time to influence the outcome of the war. After the spring of 1943, Heisenberg made no more references to the "explosive." The Allies, on the other hand, interpreted the situation differently, believing they were in a technological race with Nazi Germany. Assaults by British commandos and the Norwegian resistance in February, and the attacks by the RAF in November 1943, paralyzed Norsk Hydro's production of heavy water near Vemork. A ferry was sunk which was to bring the remaining heavy water to Germany in February 1944. In any case, the heavy water plants in Norway were dismantled in the middle of 1944 and shipped to Germany. New methods of producing heavy water were developed and new plants were built at the Leuna Werke near Merseburg.

In the meanwhile, experimental work in Germany had advanced. Kurt Diebner's group made important discoveries, leaving the achievements of Heisenberg's group behind. At the end of 1943, Professor Walther

Gerlach of Munich took over the running of the Uranium Society, and attempted to make peace between the various research groups there. At the same time, the growing intensity of Allied air attacks prompted the relocation of nuclear research projects under the Reich Research Office to Freiburg, Hechingen, Heidelberg in South Germany and Stadtilm in Thuringia.

Heisenberg and his colleagues believed that Germany's defeat was within sight. During 1944 and 1945, they concentrated on one task: to set off chain reaction in a uranium machine (nuclear reactor). In a cave at Haigerloch, near Tübingen, the final experiments were begun. Early in March 1945, the Heisenberg group was on the threshold of achieving self-contained chain reaction.[17] Other research groups passed beyond that stage, and historians, who had focused their attention on the activities of the most eminent member of the Uranium Society, were long loath to acknowledge this fact. Apart from Heisenberg and Kurt Diebner in Gottow and later at Stadtilm, there were at least two more groups working independently of each other in the atomic field.[18] They were the research groups of the Reichspost at Berlin-Lichterfelde, under Manfred von Ardenne; and at Miersdorf, with Dr. Georg Otterbein at its head; as well as a little-known SS research group divided between Thuringia, Austria and Bohemia.

In addition to its routine work, the research department of the Reich Post Office took over some important military research, including enciphering and radar development. Dr. Wilhelm Ohnesorge, the minister of post and a close party comrade of Hitler since 1920, wanted to give his department extra political weight by supporting research. Ohnesorge had at his disposal a scientific think-tank based in Kleinmachnow, near Berlin.[19] In December 1939, Manfred von Ardenne drew his attention to the "unusual importance of the discoveries by Hahn and Strassmann."[20] It was a shrewd political move, as the post office had a large fund for basic research and an expert minister who carried weight in the Nazi hierarchy.

In January 1940, Ohnesorge decided to support the project "for the technical development of process and production in the field of atom disintegration."[21] Ardenne started building a powerful apparatus for the production of radioactive isotopes and a cyclotron, which became operative at the beginning of 1944. New Post Office research institutes were established at Kleinmachnow and at Miersdorf. Equipment belonging to the main institute at Berlin-Lichterfelde, such as its high tension apparatus and heavy cyclotron, was duplicated at Miersdorf.

Ohnesorge was determined to deliver the first "uranium bomb" to his Führer. He reported to Hitler on several occasions on the work in progress; in June 1942, Hitler was amused by the thought that his minister of posts should be engaged in the development of new weapons. The research conducted by the Reichspost, Heereswaffenamt and SS in the autumn of 1944 was further advanced than it has been hitherto assumed. After the failed assassination attempt on Hitler in July 1944, Himmler's SS became considerably more powerful. Himmler pressed for the transfer of all important armaments and research projects under SS control. Nuclear weapons fell into the same category as the V-Waffen (i.e. rockets and jet fighters). SS General Dr. Hans Kammler, the head of Gruppe C of the SS economic and administrative directorate, was in charge of the considerable enterprise, including extensive underground projects.[22]

Himmler and the SS began to assert their influence when the life expectancy of the Third Reich was low, right before defeat created total chaos. It is not clear how far Kammler was able to pursue the high technology projects under his control. It is also hard to establish whether the scientists who cooperated with the SS, and who worked in the underground complexes in Austria, Thuringia, Silesia and Bohemia achieved significant results. In his 2005 study entitled *Hitlers Bombe*, Rainer Karlsch threw new light on the dilemma of the German bomb. He argued that when Hitler started making references to the Wunderwaffe in the summer of 1944, he had a nuclear weapon in mind. There exists evidence that, in 1944 and 1945, small test explosions took place on Rügen and in Thuringia, taking the lives of prisoners of war and of other prisoners.[23] Stalin apparently kept the film of a test explosion in his desk in the Kremlin.

The Allies' fear that Hitler might possess a nuclear bomb by no means decreased as the war went on. The influential publisher of a scientific magazine, Paul Rosbaud, was the most important source for the British on the German atomic endeavor. He was in touch with prominent scientists and kept sending alarming reports to London.[24] In 1944, General Groves decided to establish a specialized unit that was to gather intelligence on the German atomic program. Lt. Col. Boris T. Pash became the commander of the unit, which was called the "Alsos." Pash's scientific adviser was Dutch physicist Samuel A. Goudsmit.[25] Pash set up office in London in 1944, with Captain Horace C. Calvert as his liaison officer. Calvert discovered that the Germans had acquired large stores of uranium near Brussels when they occupied Belgium, and that Auer-Gesellschaft processed the ore.

The Alsos mission arrived in liberated Paris on 25 August 1944. They contacted Joliot Curie straightaway, who knew much less about the German effort than the Americans hoped. In the middle of November in Strassburg, Pash discovered a German physical laboratory and some documentary material. Goudsmit thought that it proved that the Germans neither had the bomb, nor were they able to construct it.[26] In retrospect, Pash regarded the finding that the German atomic weapon presented no threat with pride. He expressed the view that this was the most important intelligence discovery of the war, and alone justified the existence of the Alsos.[27] Groves regarded the Alsos mission as completed when the remainder of the Belgian uranium was located. However, the hunt for German atomic scientists continued; many were found at Heidelberg, Hechingen, Stadtilm and in Bavaria.

After the end of the war, ten prominent German physicists, including Hahn and Heisenberg, were interned for six months at an English country house known as Farm Hall, near Cambridge. All their conversations were secretly recorded. The British wanted to know whether the Germans had hidden away nuclear material and research reports, and wanted to prevent German scientists from going to work for the Soviet Union. When the Germans heard that the US bomb was used on Hiroshima, they did not believe the news. After becoming aware of the extent of the US-British project, and of its success, Otto Hahn said to his colleagues: "If the Americans have the atomic bomb then you're all second-raters. Poor old Heisenberg."[28]

In reply to the news of the explosion of the atomic bomb, and in an attempt to give an outline of the history of their own project, the German scientists drafted a press release. They stressed that German nuclear research did not center on the development of a nuclear explosive. This later led to the legend that German scientists slowed down their work to keep from delivering the bomb to Hitler. After losing the scientific and technological race, they moved to occupy the moral high ground.*

The observation that history is often no more than propaganda of the victors is reflected in the historiography of the atomic bomb. There exists a whole library of books on the making of the bomb, and only a few vol-

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* Robert Jungk's book, *Brighter Than Thousands Suns*, published in 1956, did much to give that view wide circulation. See also the Bibliographical note at the end of Part 1.

umes on the work connected with the production of a small thermonuclear weapon in Germany. The Japanese nuclear program suffered a similar fate. In the 1970s, the American press reported that the Japanese also had a nuclear program. Japan was among the first three countries in the world with a cyclotron.[29] Professor Yoshio Nishina was the key person in the project code-named NI and financed by the military. NI had been started in July 1941, five months before the attack on Pearl Harbour.

Nishina had spent eight years before the war in Europe, studying with Rutherford in Cambridge and Bohr in Copenhagen. In Japan he became the "father of new physics," and in 1931 he was given his own laboratory at the University of Tokyo. An independent research project was started in Japan by the navy, under the code name F-Go Program, around the summer of 1942. The scientific head of the project was Dr. Bunsaku Arakatsu.[30] Arakatsu had also spent a few years abroad, including time at the Cavendish Laboratory in Cambridge under Rutherford. In 1927, Arakatsu studied at Berlin University (today the Humboldt-Universität) under Einstein, becoming a member of Einstein's circle of friends. Next to Nishina, Arakatsu, who taught physics at the University of Kyoto, was the most prominent nuclear physicist in Japan.

Japanese research projects, however, suffered from shortages of uranium and a dearth of large energy plants. The most important resources of uranium were located on the Korean peninsula, and an industrial complex, run by the Japanese navy, was therefore developed at Hungman (Konan in Japanese). A vast fertilizer factory was built at Hungman, as well as a hydroelectric plant, a propellants plant and a heavy water installation. The approximately 300 scientists working there on the nuclear project probably had a cyclotron at their disposal, as a part of the plant was located underground. Raw materials, uranium in particular, came from the occupied territories in Korea, China and Inner Mongolia.

Shortly before the end of the war, US intelligence came across some unexpected information. Japanese scientists were apparently planning to conduct an atomic bomb test near Konan on 12 August, six days after the Hiroshima explosion. The bomb developed for the Japanese navy was possibly intended to be used by kamikaze pilots. However, this rumor could not be verified, as Konan was occupied a few days later by the Red Army. Most of the Japanese installations were subsequently destroyed.

Though most experts are skeptical about a Japanese nuclear bomb test, it seems that the Japanese project was further advanced than had been assumed. After the two nuclear attacks on Japan, and the country's subsequent unconditional surrender, the history of its atomic project was suppressed. Japan came to regard itself as a victim of the American raids. The scientists who had taken part in the nuclear program remained silent, or insisted they had taken part in developing atomic energy for peaceful purposes. Shortly after the war, the Japanese cyclotron was destroyed by the US Army, and the few extant documents confiscated. The Second World War had hardly ended and new conflicts were starting to emerge. The United States had little interest in publishing information regarding the nuclear achievements of the defeated powers.

The post-war history of Europe, and of the world, was dominated by the conflict between two new superpowers: the United States and the Soviet Union. The conflict was driven by the arms race, especially in the field of the nuclear weapons. Stalin's shrewdness and paranoia helped him to conceal his extensive knowledge of his Western allies' nuclear project in Potsdam on 24 July 1945. He had received the first information on the possibilities of an atomic bomb from London as early as the autumn of 1941. The information came from John Cairncross, private secretary to Lord Hankey, a member of the cabinet responsible for overseeing the work of the intelligence services.[31] It was passed on to Moscow by Anatolii Veniaminovich Gorsky (Vadim), who worked under diplomatic cover as the resident in London. Gorsky's message was sent on 25 October 1941, and reached Moscow shortly before the celebration of the anniversary of the revolution on 7 November. Lavrentii Beria, the head of the NKVD, delivered the report to Stalin.

In March l942, another reminder of the importance attributed by the British to nuclear research reached Moscow. Gorsky reported the details of the nuclear project and the role which Canada, a rich source of uranium, was to play in it. Another report from London concerned nuclear research carried out by Hahn and Heisenberg in Germany. It also referred to the Norsk Hydro plant in Rjukan, Norway, capable of supplying Germany with 4,500 kg of heavy water a year. Beria suggested that consultations with the scientists should take place.

Many leading Soviet scientists were pessimistic about the practical uses of atomic energy. They noted that articles on the subject had stopped appearing in western scientific publications. A young physicist Georgi Flerov, who served as a lieutenant in Voronezh early in 1942, wrote to Stalin in April. It is not certain whether the letter reached Stalin, though it was known in the scientific community. Flerov's letter harshly criticized, in familiar terms of Stalinist invective, the physicists who were pessimistic about the possibility of developing nuclear energy for military purposes.

Beria used intelligence reports from the West to acquaint Stalin and the State Committee for Defense (GOKO, the highest government office concerned with military matters) with the subject of nuclear weapons. The reports showed that research in nuclear physics was considered to have significant military applications, and that the scientific community in Germany, as well as the British and Americans, also intended to use it for military purposes. Beria intended to create a body of scientific consultants and attach it to the State Defense Committee. He named three scientists (Kapitsa, Skobeltsyn and Slutski) as having worked in the field of nuclear fission. As none of them had in fact done so, it seems that Beria was better informed on the British than the Soviet side of atomic research.[32]

Igor Vasilevich Kurchatov, who was then researching the problem of protecting shipping against the threat of magnetic mines, was invited to come to Moscow on 15 September 1942. There he met Mikhail Georgevich Pervukhin, a party technocrat with the rank of deputy prime minister in charge of the chemical industries. Kurchatov possibly met Stalin as well. He moved to Moscow permanently in February 1943, when the State Defense Committee formally established an atomic energy research program. Kurchatov's colleague, Iulii Borisovich Khariton, thought that Kurchatov was "an exceptional leader who organized a strategically correct program from the very beginning."[33]

While Beria was considering how best to use the intelligence material from London, Molotov made it available to Pervukhin. Molotov asked him to find out what Soviet scientists knew about the research carried out abroad, and their opinions about the kind of research that should be undertaken in the Soviet Union. In January 1943, Pervukhin had a meeting with Kurchatov and two of his colleagues, asking them for a memorandum concerning nuclear research. When it was finished, Pervukhin handed it over to Molotov with a warm recommendation. The State Committee for Defense passed a special resolution on the organization of nuclear research, and the laboratory of the Academy of Sciences (which later became known as Laboratory No. 2) was established. On 10 March 1943, Kurchatov was confirmed in the post of the scientific director of the project, thus becoming Robert Oppenheimer's opposite number in the Soviet Union.

After Kurchatov expressed doubts to Molotov about the feasibility of constructing the bomb in the foreseeable future, Molotov decided to pass on the intelligence materials to him. In March 1943, Kurchatov began studying these materials in his room in the Kremlin. Among the scientists, he was the only recipient of information from secret intelligence sources. Though unable to disclose its origin to his colleagues, he abandoned his skepticism about the practicality of the bomb.[34]

In two letters to Pervukhin on 7 and 22 March 1943, Kurchatov compared the work of the Soviet physicists with the intelligence he had from Molotov, wondering whether they were a true reflection of the state of research in the West. He was surprised that Western scientists preferred the diffusion to the centrifuge method of isotope separation. Kurchatov noted that the intelligence reports contained "some fragmentary comments about the possibility of using not only uranium 235 but also uranium 238." In a letter to Pervukhin on 22 March, Kurchatov wrote that "I looked carefully through the latest research in the Physical Review on transuranic elements…and I was able to determine a new direction in the solution of the whole uranium problem…The prospects in this direction are unusually attractive."[35]

Lavrentii Pavlovich Beria knew that Churchill and Roosevelt had discussed cooperating on the atomic project in Washington in June of 1942, and that the main part of the project would move to America. So far, the most valuable information had come from British sources. John Cairncross, who passed the contents of the MAUD report on the feasibility of the nuclear weapon on to the Russians, moved to Bletchley Park, where German radio traffic was deciphered, before getting a job in the Secret Intelligence Service (SIS). John Philby began reporting to the Soviets early in 1944, after the establishment of a section that was to deal with "past records of Soviet and Communist activity." Donald Maclean, a young diplomat and a Soviet spy, dealt with Anglo-American cooperation and the building of the atom bomb at the British Embassy in Washington.[36]

Moscow had several well-placed British sources of political intelligence at its disposal. For scientific and technical information, Klaus Fuchs was probably most valuable. After his move to North America he had his first meeting with the Soviet controller, Harry Gold, on 5 February 1944 in New York. In September 1944, Kurchatov assessed the Manhattan project as "a concentration of scientific and engineering-technical power on a scale never seen before in the history of world science, which has already achieved the most priceless results."[37] The secret service reported to Beria using sources from Los Alamos, apparently for the first time, as late as 28 February 1945. The report contained details of the construction of the bomb, provided by Theodore Alvin Hall, a precocious, nineteen year-old Harvard physicist. Hall was convinced that nuclear arms monopoly would continue to threaten world peace and, together with technical sergeant David Greenglass, became a useful source of intelligence on the Manhattan project. It therefore seems likely that the Russians had two sets of instructions on how to make the bomb before them: Hall may have revealed the implosion method before more detailed instructions came from Klaus Fuchs.[38] When Stalin returned from Potsdam in August, he asked Kurchatov to come and see him. Stalin was impressed with the American achievement, and dissatisfied with Soviet physicists. Kurchatov tried to explain why the Soviet program had made so little progress: many people had died, equipment was destroyed, the country faced famine, and nothing was available. Kurchatov did not say that, during the war, Stalin had hedged his bets as far as the nuclear project was concerned. By the end of 1944, it employed about a hundred scientists.

After the explosions of the US atomic weapons in the summer of 1945, Stalin knew that the power of the Soviet Union and its victory in the war would be called in question. He told Kurchatov that he wanted to know what the scientists needed, and that they would lack for nothing in the future. The Russian people were again compelled to make huge sacrifice. In the midst of post-war devastation and shortages, Stalin began laying down the foundations of the Soviet military–industrial complex.

Uranium Monopoly and the Division of Europe

In the race for the nuclear weapon, availability of uranium ore was of the essence. General Groves tried to secure a monopoly over the purchase and processing of uranium by all available means. On 3 December 1945, Groves confidently reported to the Secretary of War that the Combined Development Trust, a joint British-American government agency, controlled by Groves himself, had cornered 97% of the world's production of uranium, and 65% of thorium.[39]

Sometime in February 1945, Groves recommended to General Marshall that the Auer uranium processing plant near Oranienburg be destroyed by air attack.[40] The role of the Auer Gesellschaft in the supply of uranium was confirmed independently by information from Brussels and from Paris. Auer had taken over the management of a formerly Jewish company in Paris, which traded in rare metals, and thorium in particular. Dr. Egon Ihwe, who looked after this side of the Auer business, had supplied Alsos with the information. By the end of 1944, Groves knew of the central importance of the Oranienburg processing plant. For a long