

Translated excerpt

**Richard von Schirach**

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Weizsäcker und die deutsche Bombe***

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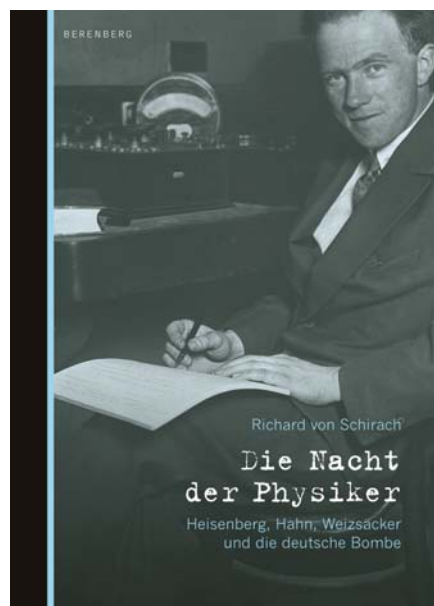
***The Night of the Physicists. Operation Epsilon:  
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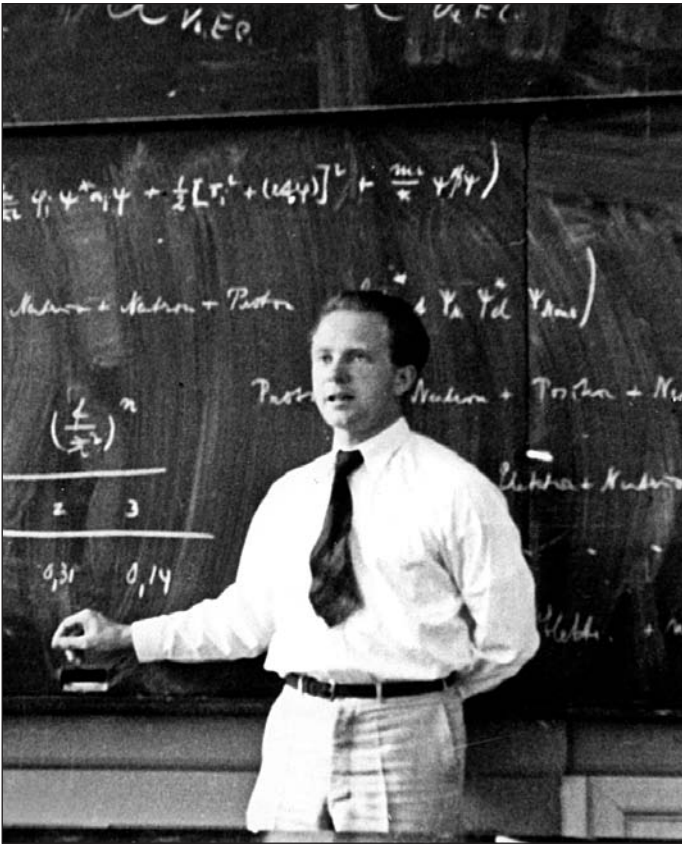
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Werner Heisenberg, 1936.

PROLOGUE

# The Magician's Apprentice and his Master

**T**he 14-year-old Carl Friedrich von Weizsäcker stumbled into the world of physics as if in a dream, and at the age of only 20 found himself at the centre of atomic research. At the outbreak of war in 1939, the 27-year-old was one of the first to draw up a memorandum outlining the military uses of atomic energy. When he gets to know Heisenberg in December 1926, he has a reputation as an unbearable child who continually finds fault with others. Elisabeth Heisenberg describes the boy as 'terribly difficult. He found everything dreadful. He found everyone dreadful and he was very unhappy. His mother hadn't the faintest idea what to do with the boy.' In Copenhagen, where his father Ernst holds a post as an ambassadorial counsellor at the German embassy, his mother makes the acquaintance of a German physicist – and excellent pianist – at a concert. She tells her son about him. When she mentions that the German worked with a famous Danish physicist

by the name of Bohr – of that much she is fairly certain – and is called Heisenberg, Carl Friedrich, whose parents have given him a subscription to a popular science magazine, shoots back: ‘I know that name. You must invite him.’

Werner Heisenberg, who was made Professor of Physics at the University of Leipzig in 1927, is 25 at the time and already something of a rising star. At the first possible dinner invitation on 3 February 1927, he is seated next to the young Weizsäcker and spends the entire evening in conversation with his neighbour. Heisenberg tells him about the exciting new developments in quantum physics. There had been some groundbreaking discoveries and insights in physics in recent years that puzzled even Einstein. In 1925 Heisenberg presented the definitive version of his statements on quantum mechanics, which he had first formulated as a 23-year-old on the island of Helgoland; in 1927 he published ‘The Uncertainty Principle’, and five years later, at the age of 31, he was awarded the Nobel Prize. The development of quantum physics had revolutionised people’s understanding of the world, and the question is no longer whether a new theory is ‘crazy’, but whether it is crazy enough.

The young Weizsäcker declares this meeting ‘the happiest day of my life’. It is the beginning of a dialogue with Heisenberg that is to last a lifetime. He attends Heisenberg’s lectures in Leipzig while still a 17-year-old schoolboy. Heisenberg, for his part, fosters contact with the boy’s parents; he is a frequent guest of the Weizsäckers and their four children in Berlin. Carl Friedrich is the

eldest, followed by his brother Heinrich, who is killed at the beginning of the German invasion of Poland, and then his sister Adelheid. Richard, the youngest, was born in 1920. The skinny, blond, young Heisenberg plays pieces for two pianos with their mother, Marianne von Weizsäcker, before catching the night train back to Leipzig. Heisenberg becomes the young Carl Friedrich von Weizsäcker's mentor and advises him on the best course of study. When Carl Friedrich leaves school he is unable to choose between philosophy and physics, and Heisenberg gives him a useful tip: 'If you want to understand physics, you have to do it yourself. And if you want to do it, you have to start young. It's best to do physics before you're 30. On the other hand, you can catch up on Plato; you can only do good philosophy when you're over 50. You have a lot of time left.' Philosophy is really a bit too hard for humans, was what Heisenberg was saying, whereas physics is 'an honest trade, and you have to do it when you're young.' Nevertheless, he says: 'before you can practise philosophy, you have to be familiar with our century's most important philosophical event, and that is theoretical physics. You can only understand it by doing it yourself, and so you have to get started.' The prodigiously talented freshman follows this advice and resists all philosophical temptations for the next three years, concentrating exclusively on physics, mathematics and astronomy. He seizes the day: 'I was the right age when atomic nuclei were ripe.'

The day after his 20th birthday, Weizsäcker completes his studies in Leipzig under Heisenberg's supervision. A matter of months previously, in early 1932, James

Chadwick had discovered the neutron in Cambridge. At the beginning of the 1920s Ernest Rutherford, the 1908 Nobel laureate for Chemistry, had put forward his supposition that there must be elements within the atomic nucleus that prevented the positively charged protons there from repelling each other; he called them 'neutrons'. After 11 years of diligent research Chadwick was now able to prove this, opening up completely new prospects. This made existing 'planetary' models of the atom, which imagined electrons revolving around the nucleus like planets circling the sun, obsolete overnight, though they still feature in research centres' and energy companies' corporate logos to this day. Only now could atomic models be reconciled with quantum mechanics. Until Chadwick's discovery, Heisenberg too had been unable to imagine a nucleus composed purely of protons and electrons. How could such a nucleus be stable, what held it together? In the summer of 1932, Heisenberg stays in Brotterode, a small spa town in the Thuringian Forest, where he is safe from bouts of hay fever, and he takes his young PhD student along for company. It is here that it occurs to Weizsäcker that the nucleus of an atom is made up exclusively of protons and neutrons, and that this might form the basis for a coherent new theory of nuclear physics. Heisenberg immediately concludes from Weizsäcker's words: 'If neutrons exist, then protons and neutrons, as two elementary particles of approximately equal mass, form an atomic nucleus.' It would presumably be stable. Heisenberg develops this idea in an essay, and it leads him to nuclear physics. At the time, nuclear physics is throwing up surprises on an

almost daily basis, and Weizsäcker, who finds the subject of his own thesis, ferromagnetism, fairly boring, decides to switch to the more interesting field of nuclear physics. In the autumn of 1933 he studies with Niels Bohr in Copenhagen before returning to become Heisenberg's assistant in 1934. From then on he devotes his time mainly to nuclear physics. His first physics paper is entitled 'Determination of the position of an electron' – an application of quantum theory. In 1936 Otto Hahn invites him to his research laboratory, the Kaiser Wilhelm Institute for Chemistry in Berlin, to be his temporary 'in-house theorist' and assistant for six months.

His book on atomic nuclei is published in 1937. For Weizsäcker, the years 1927–29 and 1932–33 are the golden age of physics. And he is soon to witness an event that will determine the course of the rest of his life.

# After the End

## From Haigerloch to Urfeld

Since the beginning of 1945, Hechingen and Haigerloch had provided a safe haven for the Kaiser Wilhelm Institute for Physics in Berlin-Dahlem, whose director was Werner Heisenberg. In the same period, Otto Hahn's Institute for Chemistry relocated to nearby Tailfingen. Here, the leading lights of German physics still strove to get the first German nuclear reactor to work, even as the war drew to its close.

In April 1945, however, even the boldest hopes were dwindling with each passing day. The daily measurements for what was known as 'Major Experiment B[erlin]-VIII' occasionally appeared to indicate that the uranium reactor concealed in the underground vaults of the Swan Inn in Haigerloch might at any moment trigger a chain reaction. Then time ran out.

The scientists could already hear the rattle of French armoured personnel carriers along the Eyach Valley as they sought to erase all trace of their secret project. Heisenberg had the uranium cubes that had been suspended on chains in the heavy water container buried in



a freshly ploughed field, along with the pressed uranium oxide cubes that had just been laboriously transported there from Stadtilm in Thuringia. He also had the heavy water siphoned off into tanks and hidden in an abandoned textile factory. He hoped that these resources would serve as a 'stock' for future research when the war was over. Once all the materials were safely secured, Heisenberg instructed his former student and friend Karl Wirtz to guard the stone cellar and cycled back to Hechingen as usual.

Two days later (Heisenberg had by this time already set out by bike from Hechingen for his home town) Weizsäcker and Wirtz concealed the institute's research documents in a metal canister, soldered it up and sank it in the slurry pit behind Weizsäcker's house – an inglorious fate for a project that had once been at the cutting edge of German research in physics.

The scientists living in Hechingen and its surrounding area could now do nothing but wait for the inevitable. Heisenberg, though, was finally able to set off to join his family in Urfeld, a village with only a couple of dozen inhabitants on Lake Walchensee in Upper Bavaria.

'We wanted, if possible, to spare the children the chaos of the bombing raids,' was Heisenberg's justification for evacuating his family from Leipzig to Walchensee. His wife, who now had five children, was never happy with this arrangement. In Urfeld she was to receive none of the support the physicists' families and technical staff in Hechingen had given each other, and she couldn't get used to the roughness of the local farmers. She felt that the countryside and its people were ill

disposed towards her: 'The soil was rocky and barren, and the little that did grow was predictably eaten by the deer. In addition, the farmers harboured an implacable, distrustful stinginess towards us outsiders. In fact, we had serious difficulties, and we waged a grim battle against hunger and sickness.'

The homemade jams and hand-packed crates of fruit that Heisenberg had sent from Berlin to Urfeld generally either had not arrived or if, after a number of weeks, they had, they were 'rotten, pillaged and crushed'. But now he is able to come to his family's aid. He sets off for Lake Walchensee on his bicycle at half past three on the morning of 20 April 1945. Before leaving Hechingen, he gets hold of a packet of American cigarettes as life insurance.

It is something like 270 kilometres from Hechingen to Urfeld. He travels mainly by night to avoid marauding soldiers and low-flying fighter planes. He spends the daylight hours 'flat on his stomach in a ditch'. Germany is falling apart. Heisenberg sees gangs of lost, starving youths, none of them over 15, camping by the roadside without a clue where to turn; hordes of soldiers of every nationality heading in all directions; rag-clad figures muttering away in foreign tongues who, after their release from camps and forced labour, plunder their way through the countryside.

Danger lurks on all sides and the safest course is to dodge and hide. He runs into a particularly risky situation at a checkpoint. A young soldier waves him to one side and asks for his papers. It is touch and go, as any soldier or officer who has deserted his regiment in a bid

for safety is liable to be sentenced to death or summarily court-martialled and sent to the frontline.

Heisenberg has issued his own travel permit and marching orders, but he doesn't know whether these papers will stand up to close scrutiny. As the young man moves to take these unusual papers to his superior, who is carrying out checks inside a tent, Heisenberg takes a huge gamble.

Cigarettes are much sought-after, and so he asks the young soldier whether he likes smoking too. When the soldier says he does, Heisenberg reaches into his trouser pocket and fishes out his magic packet of *Pall Mall*, pressing it into his young comrade's hand. A glance, and Heisenberg is through. Heisenberg is convinced that his life would have been lost had he run into a non-smoker.

The small county town of Weilheim is in flames when he arrives. No trains are running. Heisenberg sleeps on his bike for a few hours at the station. A goods train unexpectedly starts to move and takes him a few miles down the line.

He covers the next stretch by bike. Three days later he arrives in Urfeld, and his wife Elisabeth describes the sight of her husband as, against all expectation and on the brink of collapse, he comes riding up the hill: 'dirty, dead tired and happy'.

Six years before, Heisenberg had set out from Urfeld for Berlin in anticipation of the gigantic potential of nuclear fission, to test its military applications. Four years before, with the German Reich at the peak of its power, he had remained convinced that there was no

halting the development of nuclear reactors and atomic weapons. 'The road lay open before us.' And now he is dragging himself home, visibly older, like a man returning from the front with his hopes in tatters. His bold dreams have been dashed; the game is up.

In Urfeld it is not neutrons that matter, but food and firewood. They need to make regular treks to Sachembach along the lakeside path to fetch the fresh milk their children need. One day, on his way there, Heisenberg meets the successful Nazi travel writer Colin Ross and his wife, who live a stone's throw away in a shingle-roofed wooden house overlooking the lake. It has been ages since they last met, and Heisenberg voices the hope that they will now see more of each other. It is only later that he recalls how taciturn and withdrawn the much-travelled Colin Ross seemed that day.

To survive one has to hoard supplies or queue for hours in the hope of obtaining this or that. As there is very little to buy in the tiny village of Urfeld, it is often necessary to travel to Kochel. It is there, on 29 April 1945, that he hears of a train standing in the station with people in prison uniforms peering out of the open wagon doors. Heisenberg has only slim pickings in his rucksack to show for his endless wait – only the butcher Pflieger deigned to fetch out a piece of meat. When he arrives back in Urfeld after an exhausting hike over the Kesselberg hill, the daughter of Ernst Brackenhofer, the publican of the 'Zur Post' inn, tells him that Colin Ross and his wife took their lives the previous night.

Heisenberg visits Ross and his wife's house to pay his last respects and gazes upon the dead couple's faces as

they lie there on the floor, wrapped in an African travel blanket. In his shorthand diary of those final days of the war that he spent by Lake Walchensee, he notes that when he entered the room in which the couple had died, he raised his right arm in the Hitler salute for the last time. On 1 May the Heisenbergs learn that Hitler is dead, and Elisabeth Heisenberg remembers how they all felt 'dizzy with relief'. The war couldn't last for much longer!

'We fetched the last bottle of wine – we had actually been saving it for the baptism of our daughter – from the cellar, and drank it with tears of relief and deliverance. There was no thought of going to sleep; once more, hope for the future blossomed before our mind's eye.'

But the war is not over yet. Once, on the lakeside path to Sachenbach, Heisenberg runs into a scattered troop of young SS men who have not yet heard the news of Hitler's suicide. When he tells them that Hitler has named Dönitz as his successor, the name at least rings a bell. This is only a week before Heisenberg's arrest. On 30 April Colonel Boris Pash, the military head of the Alsos Mission, leaves his base in Heidelberg with the goal of tracking down the physicists Gerlach and Diener in Munich and then capturing Heisenberg, his number one target, in Urfeld.

The arrest takes longer than expected. Pash's progress is delayed by the rearguard demolition of bridges. The small vanguard requires reinforcements, as there are still thousands of German soldiers under arms around Kochel. On 2 May the time has come, and a convoy of half-tracks, tanks and jeeps heads for Urfeld.

Elisabeth Heisenberg is initially frightened when Colonel Pash appears in front of her, but she regains her composure when she notices that the troops surrounding her house are American. Number One isn't there; he is down in the village looking after his mother. Pash orders Heisenberg's wife to call her husband back to the house at the top of the hill without letting on why she is ringing.

There is no need for explanations though – the vehicles filling the village street speak for themselves. Pash begins a first session of questioning, which lasts for several hours. Heisenberg later compares the sensation of being arrested by the Americans with feeling like 'an utterly exhausted swimmer setting foot on firm land'.

During questioning, there is a sudden burst of gunfire. 'The two of us are sitting there in our armchairs when a wild gun battle breaks out outside,' writes Heisenberg. 'Colonel Pash races out onto the terrace with his machine pistol at the ready. As for me, I am so shaken by the fact that the thing I expected, feared and hoped for has at last come to pass that I watch the brief gun battle with total calm and in the best of moods. Only the house's remaining residents, especially the children, are hurried down to the cellar. After about ten minutes' shooting (...) everything falls silent. A major informs the Colonel that one SS man has been killed, two wounded and captured, and the others have escaped.'

A young soldier has fallen in the final hours of the war, and it snows that day. Heisenberg can spend one

last night in Urfeld. By the time he steps into the jeep that is to take him with an impressive military escort to Heidelberg the next morning, the weather has turned. The spring sun shines down out of a deep-blue sky, bathing the snow-clad landscape in dazzling light. 'I asked one of my American captors, who had fought in many parts of the world,' Heisenberg's memoirs continue, 'how he liked our mountain lake, and he told me it was the most beautiful spot he had ever seen.' The journey is to take them to Heidelberg, where American specialists have readied themselves for extensive interrogations.

### **Interrogation in Heidelberg**

The Americans know a lot – more than the Germans think they do – but they are also in a race against time, as they try to prevent even the smallest scrap of information about the world's most dangerous technology falling into Soviet or French hands.

The Alsos Mission, with support from agents from the Office of Strategic Services (OSS), the CIA's forerunner, has tried to keep track of Heisenberg's every move. The OSS toyed with the idea of kidnapping him when he gave a lecture at the ETH Swiss Federal Institute of Technology in Zurich in 1944, but the idea of conducting such an operation on neutral Swiss territory was then dropped. However, the friendly young man who asks Heisenberg some clever questions after the public lecture is an experienced agent with a loaded pistol in his pocket. When the unsuspecting Heisenberg accepts Berg's request to walk with him to the post office, Agent

Morris Berg spots that the postcard Heisenberg is buying a stamp for is addressed to his colleague Georg Wentzel in Hechingen. The Americans now have proof that the final act of the German uranium project is being played out in a small town in the Swabian Alps.

The OSS and Alsos have reflected far more on Heisenberg's thinking, motives and character traits than the German general staff. None more so than the man who is due to interrogate him in Heidelberg: the Dutchman Samuel Abraham Goudsmit, a renowned nuclear physicist and the Alsos Mission's scientific chief. The Americans found a framed memorial photo of Goudsmit and Heisenberg on Heisenberg's abandoned desk in Hechingen. It was probably taken in July 1939 in Ann Arbor, Michigan, before they sat down to a farewell dinner with Enrico Fermi and other colleagues. At the time, Goudsmit had been unable to mask his distrust as Heisenberg explained why he had to – and wanted to – return to Germany.

'Germany needs me,' Heisenberg had said back then, and Goudsmit had made a mental note of this remark. He has been planning and preparing the interrogation in Heidelberg for months, and he has readied himself for the moment when the prisoner is led into his room. His nerves are stretched to breaking point. Heisenberg, on the other hand, is not in the least prepared for this meeting. When he is brought in to Goudsmit and the two men stand face to face, it takes him a second to recognise that the senior officer in US Army uniform is an old acquaintance. Heisenberg attempts to make light of Goudsmit's restrained attitude and holds out his hand.



He thinks that his 'My dear Goudsmit' can restore some of the bonhomie between the fellow scientists, but the Dutchman turns away.

The aim of the subsequent questioning goes beyond simply finding out how far the Germans have progressed with the physics of making a bomb; the two men also have a private score to settle. Heisenberg cannot imagine the inner turmoil to which Goudsmit is currently prey. Just a few hours ago, after eight months of uncertainty, he was informed that his parents had been killed at Auschwitz. He is overwhelmed with guilt at not having been able to save them. His parents' last sign of life was a farewell letter from a concentration camp, which he received in March 1943. Since then, he has never given up hope of seeing them again. In early 1943 the Dutch physicist Dirk Coster, who had already helped to arrange the escape of Otto Hahn's colleague Lise Meitner, had written to Heisenberg asking him to intervene on Goudsmit's parents' behalf. Two months later Heisenberg had written a short letter to the German commandant in Brussels, stating how well Goudsmit's parents had treated him on a trip to Holland and that he wished to intercede for them. Whatever the impact this letter might have had, it came too late – the Goudsmits had already been murdered.

Relations are tetchy between the genius on the losing side, who had failed to build an atomic bomb, and his one-time fellow physicist, who was never a first-rank scientist and is now the investigator and prosecutor leading questioning, and it takes quite some time before their anxiety subsides and they come to some

mutual understanding. At one point he asks Heisenberg, 'Would you come to America to work with us now?' For many German physicists facing an uncertain future, the mere offer would have been attractive, but Heisenberg turns it down. 'No, I don't want to leave. Germany needs me.'

Hadn't Heisenberg spoken the same words – 'Germany needs me!' – back then in Ann Arbor when he returned to Germany shortly before the outbreak of war? Goudsmit's question was rhetorical, for America does not need a Heisenberg. The mission was accomplished long ago, whereas the Germans had given up hope while still a long way from their goal. Whether they would ever have managed to lift the veil on the final secrets of the atomic bomb is an open question – and one that is bitterly controversial to this day.

These questions are part of a game of poker, in which Goudsmit holds all the aces. He knows that he can beat Heisenberg with a carefully concealed and utterly devastating trump card at any moment. With one pronouncement he could destroy Heisenberg's arrogant assumption that he and German physics are still the envy of the world. But he maintains his self-control and savours the task of deceiving and misleading this unsuspecting man. Once Heisenberg has been questioned in detail about the achievements of the German uranium research project, he in turn asks his former colleague how far the Americans have got with the atomic bomb. Goudsmit ducks the question, saying that the Americans have been pursuing other, more practical research objectives such as developing radar. Heisenberg eagerly

seizes on this information and his gullibility subsequently makes him the butt of mockery and humiliation. Goudsmit, on the other hand, is amongst those who follow the successful bombing of Hiroshima with great satisfaction and relishes the idea that Heisenberg still believes that this news must be ‘purely propaganda’.

### **Ten physicists on a European odyssey**

A bus pulls up outside a villa on Heidelberg’s Philosophenweg on the morning of 1 May 1945 and six people get in. In the final days of the war, it is striking that they are all meticulously turned out in civilian dress. It is clear that these men of various ages are about to begin a long journey, for it takes a while for all their bags, briefcases, suitcases and coats to be stowed away inside the vehicle. This small group of civilians could easily pass for a gentlemen’s cultural society embarking on an excursion to a Celtic burial site or something similar. Yet the black guards in American uniform surrounding the villa and its grounds, and the olive-green escort vehicles full of GIs with fingers on the triggers of their machine guns do not really fit in with the image of an outing. The six Germans, accompanied by two officers from the British Secret Service, are indeed setting off on a journey through Western Europe, and none of the participants can say where it will lead and how long it will take.

This whole operation is cloaked in the strictest secrecy. The moment the bus pulls away, the six men completely disappear from public view. Their families

are left with nothing but rumours, wishes and hopes; it will be several months before they find out more. The men have received an 'invitation' they cannot turn down. The six Germans find themselves in American custody, but as they are not military personnel they cannot be sent to camps as prisoners of war or war criminals. Instead, they are only ever referred to as 'guests'. The US Army, which has put a discrete organisation with special powers on their case, views these 'guests' as possessing some of the world's deadliest secrets. Their knowledge could cause America enormous, even immeasurable harm. These men boarding the bus are natural scientists, chemists and physicists and, with the exception of one elderly gentleman, they are all members of the 'Uranium Club' set up to build the German atomic bomb. There are no charges against them, but to the Americans they are worth their weight in gold. Their number is not yet complete, however. They were only captured in Hechingen and Tailfingen a few days ago by the Alsos Mission, an advance party of the US Army. Some are still missing, and the search is ongoing for Guest Number One: Werner Heisenberg, the operation's head theorist and mastermind. By the calculations of General Groves, the Alsos Mission's bullish head, Heisenberg alone is worth ten divisions. As the bus and its escort drive towards France, long convoys of vehicles pass them in the opposite direction with French troops on board.

At 32 years of age, Carl Friedrich von Weizsäcker is one of the youngest on the bus. Since the start of the war the Americans have viewed this physicist, whom one could imagine as a philosophy lecturer, as one of their