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Professor Otto Hahn (left) as he was taken into custody by "Alsos," an Allied mission to collect German physicists and their research.

DECLASSIFIED FILES REOPEN "NAZI BOMB" DEBATE

By STANLEY GOLDBERG and THOMAS POWERS

Did leading German physicists choose not to "know" how to build an A-bomb?

In the race to build an atomic bomb, Germany had some strong advantages—a year's head start, some of the world's leading scientists, and access to critical materials. But when World War II ended, the Germans had come up empty. All that remained of their efforts were a five-foot shelf of basic research materials and an empty re-

Stanley Goldberg, a historian of science in Washington, D.C., is writing a biography of Gen. Leslie R. Groves. Thomas Powers is the author of Heisenberg's War: The Secret History of the German Bomb (forthcoming).

actor vessel. By July 1945, with the war in Europe over, ten German scientists (see pages 36–37) had been incarcerated by the Allies in Farm Hall, a stately British home. They were captured and interned as part of "Alsos," a special mission to uncover the state of German uranium research.

On the evening of August 6, 1945, the German scientists were astounded by a short report on the news. The United States had obliterated the Japanese city of Hiroshima with an atomic bomb. For a time that night, Werner Heisenberg, the chief theoretician of the German bomb program, believed that reports of a

bomb were a hoax. But as further details convinced the imprisoned Germans that the news was true, they began to speak of how their own program had gone wrong. Even now, after nearly 50 years of acrimony and muddled debate, there is still no answer to the fundamental question: **Why was there no German bomb?**

The post-bomb arguments of Samuel Goudsmit and Heisenberg represent the heart of this debate. **Goudsmit, a Dutch-born physicist, was scientific director of the Alsos mission that seized the German scientists and research reports near the end of the war.** Allied scientists and intelligence authorities considered Heisenberg “the most dangerous possible German in the field because of his brain power.”¹

Goudsmit had known and respected Heisenberg before the war, but later his judgment turned harsh. He said he had seen secret reports proving that Heisenberg had bungled important scientific questions and had lied about his wartime role in the project. Indeed, in books, articles, and private correspondence, Goudsmit **insisted that Heisenberg had concocted phony claims of moral compunction as an explanation for the humiliating German failure to produce the bomb.**²

The dispute centers on Heisenberg. The Germans thought of Heisenberg as first among equals, though he never commanded anything like the line authority that J. Robert Oppenheimer had at Los Alamos. Albert Speer, Germany’s economic czar, remembered Heisenberg’s technical pessimism as decisive at a June 1942 meeting in Berlin that more or less ended serious German hope of a bomb. If Heisenberg said it couldn’t be done in a war-torn economy, that was the end of it.

Historians have long sought one particular batch of classified files—the 270-odd pages of reports from **Farm Hall**, the British home where Heisenberg and nine other German scientists were held from July 3, 1945, through the end of the year. **The weekly reports, compiled by British intelligence officers, were based on transcripts of the scientists’ secretly recorded conversations** via microphones concealed in every room. Goudsmit hinted at the files’ existence in his 1947 book, *Alsos*, and Gen. Leslie Groves, director of the Manhattan Project, dipped into them freely for his own 1962 memoir, *Now It Can Be Told*. But British authorities sealed the files for the next 30 years. Last fall the physicist Nicholas Kurti orchestrated a noisy public campaign for their release.

Declassified in February, the Farm Hall re-

ports—the American copy still bearing Goudsmit’s marginal notes in pencil—provide a vivid, intimate portrait of the German scientists who failed to build a bomb for Hitler.³ Whatever triggered Goudsmit’s angry charges against Heisenberg is there on paper—in the conversations reflecting deep ambivalence by Heisenberg and three friends regarding building a bomb. The reports are not the whispers of conspirators who figuratively poured sugar into gas tanks while colleagues slept; but neither do they reflect second thoughts or special pleadings from men who tried but failed to build a bomb. The Farm Hall reports expand and illuminate the history of the German bomb program, and no future attempt to explain that history can ignore them.

The two most significant reports, numbers four and five, **cover the period bracketing Hiroshima, from the first terse BBC announcement at 6 p.m. on August 6, through Heisenberg’s full-scale bomb physics lecture delivered to the assembled company on August 14.**

The information from those reports illuminates what Heisenberg knew or quickly managed to deduce about bomb design. From a historical viewpoint, the information is important because it confronts Goudsmit’s charge that Heisenberg failed to build a bomb because he simply didn’t know how. But for the general reader, most striking is the attitude of the German scientists—their instinctive emotional response at hearing the news of the U.S. success. (This response helps to explain Heisenberg’s pessimistic report in 1942 to Speer and other German officials on the prospects—or lack of them—for a successful German bomb. Was Heisenberg giving his honest opinion in 1942—or deliberately pricking the official balloon?)

There can be little question that **the recorded responses are authentic.** The Farm Hall “guests” believed that they were talking only to each other, not for the benefit of some unseen eavesdropper. On July 6, hidden microphones picked up the following conversation:

Kurt Diebner: “I wonder whether there are microphones installed here?”

Heisenberg: “Microphones installed? (laughing) Oh no, they’re not as cute as all that. I don’t think they know the real Gestapo methods; they’re a bit old-fashioned in that respect.”

On the evening of August 6, the first question in the minds of all ten scientists was, is it true? Have the Americans really built a bomb? “If the Americans have a uranium bomb then you’re all second-raters,” said Otto Hahn. “Poor old Heisenberg.”

The question of morality arose. Carl Friedrich von Weizsäcker, Heisenberg’s close friend and protégé, said in the first few minutes, “I think its dreadful of the Americans to have

“If the Americans have a uranium bomb, you’re all second-raters.”



The German physicists were detained at Farm Hall, a country house near Cambridge, England, that was seeded with microphones.

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done it. I think it is madness on their part.”

Heisenberg did not let the remark go unchallenged. “One can’t say that,” he responded. “One could equally well say, ‘That’s the quickest way of ending the war.’”

“That’s what consoles me,” said Hahn.

Hahn needed consoling. He had contemplated suicide in 1939 when he first realized that his December 1938 discovery of fission might lead to bombs, and he spoke of suicide again on August 6. Hahn’s friends and the British officer in charge, Maj. T. H. Rittner, kept watch over him that night until he was safely asleep.

The titular chief of the German program, Walther Gerlach, responded differently, acting (in Max von Laue’s words) “like a defeated general.”

Later that first night, Hahn visited Gerlach in his bedroom to cheer him up. “Are you upset because we did not make the uranium bomb?” Hahn asked, and added, “I thank God on my bended knees that we did not make a uranium bomb.”

Hahn had been on the periphery of the German project, busy with basic research at the Kaiser Wilhelm Gesellschaft in Berlin. His passionate disavowal of the bomb, then and later, was incidental to the German failure. Hahn’s conversation with Heisenberg later that night came closer to the heart of the matter. Here is Major Rittner’s paraphrase of that discussion:

“Hahn explained to Heisenberg that he was himself very upset about the whole thing. He said he could not really understand why Gerlach had taken it so badly. Heisenberg said he could understand it because Gerlach was the only one of them who had really wanted a German victory, because although he realized the crimes of the Nazis and disapproved of them,

he could not get away from the fact that he was working for Germany. Hahn replied that he too loved his country and that, strange as it might appear, it was for this reason that he had hoped for her defeat. . . . They continued to discuss the same theme as before, that they had never wanted to work on a bomb and had been pleased when it was decided to concentrate everything on the engine [reactor]. Heisenberg . . . feels himself that had they been in the same moral position as the Americans and had said to themselves that nothing mattered except that Hitler should win the war, they might have succeeded, whereas in fact they did not want him to win. . . . They then went on to discuss the feelings of the British and American scientists who had perfected the bomb and Heisenberg said he felt it was a different matter in their case as they considered Hitler a criminal.”

In later years, sometimes in nearly identical words, Heisenberg often repeated these remarks—save one. So far as we know, he never again said, “they might have succeeded” if they had wanted Hitler to win the war.

Two others discussed the moral issues as well—Weizsäcker and Karl Wirtz, who had been a student of Heisenberg’s at Leipzig. Heisenberg, Weizsäcker, and Wirtz, in fact, had been in charge of the principal German effort to build a working reactor. “I believe the reason we didn’t do it,” said Weizsäcker the first evening, “was because all the physicists didn’t want to do it, on principle. If we had all wanted Germany to win the war we would have succeeded.” Later he and Wirtz both remarked on the irony of the situation—the Allies built the bomb with all of its terrors, while the scientists in Hitler’s Germany worked only on a reactor.

Goudsmit extracted two elements from these conversations—talk of the morality of the bomb and discussions of how it was designed and built—and concluded that the Germans didn’t know how to build a bomb and had concocted a phony story of moral reservations to explain their failure. Reconsidered 45 years later with the full reports at hand, his interpretation rests very uncomfortably with the facts. In the Farm Hall conversations, Heisenberg, Hahn, and the others were not expressing their doubts and reservations for the historical record; they were speaking with intimate friends in what they took to be privacy.

As to German incompetence, in 1946 Goudsmit was absolutely certain that the rigid imposition of dictated truth by incompetent administrators constrained and confined those German scientists working in the laboratory

and prevented the free exercise of scientific inquiry. In a March 1946 *Bulletin* article, "How the Germans Lost the Race," Goudsmit claimed that German scientists believed that only thermal neutrons (neutrons that had been slowed down by repeated collisions with a non-absorbing moderator such as carbon or heavy water) could be used to fission uranium 235 and therefore, they never understood the concept of a bomb. They all believed, he argued, that a bomb was a reactor out of control. And furthermore, they did not even understand the possibility of using a reactor to produce plutonium; their vision was confined to developing a power-producing reactor.

Goudsmit believed that because of experimental errors and stupid reasoning, German scientists had rejected the possibility of using carbon as a moderator, and he concluded that because they were forced to use scarce heavy water as a moderator, it was unlikely that German scientists would have been able to produce a self-sustaining fission reaction even if the war had lasted much longer.

Contradicting Goudsmit's conclusions, a little over a year later in the August 16, 1947 issue of *Nature*, Heisenberg pointed out that as early as 1940, Weizsäcker had suggested a way to use a reactor to produce a new element which, Weizsäcker suggested, should be fissionable. In the *Nature* article, Heisenberg rejected the suggestion that the German decision not to try to build a bomb had been the result of incompetence or ignorance. Rather it had been both a political decision and a realistic response to circumstances. "The project could not have succeeded under German war conditions," said Heisenberg, but then he said much more:

"From the very beginning German physicists had consciously striven to keep control of the project and had used their influence as experts to direct the work into the channels which have been mapped [in this paper]. . . . In the upshot they were spared the decision as to whether or not they should aim at producing atomic bombs. The circumstances shaping policy in the critical year 1942 guided their work automatically towards the problem of the utilization of nuclear energy in prime movers. To a German physicist, this task seemed important enough. . . . We could feel satisfied . . . with a peace-time application which [like the discovery of fission] . . . would likewise find . . . [its] beginning in Germany, and in the course of time bear fruit."

But even as Heisenberg wrote, Goudsmit's book, *Alsos*, was in the final stages of production. Not only did Goudsmit repeat his claims that Heisenberg and his colleagues had been incompetent bunglers, he expressed deep disappointment that his old colleague would have

Alsos: Tracking the German bomb

In the spring of 1944, Dutch-born physicist Samuel A. Goudsmit was appointed to lead the scientific team of Project Alsos, the intelligence mission to discover the extent of German progress in the manufacture of an atomic bomb. The military commander of the team was Col. Boris A. Pash, formerly head of G-2, the military intelligence section for the Western Command. The name Alsos, derived from the Greek word for "grove," was an allusion to the head of the American atom bomb program, Gen. Leslie R. Groves. Groves was irritated by the name, but hesitated to draw attention to it by demanding a change. In order to mask the true purpose of the project, the mission was expanded to include operations concerning chemical and biological warfare as well as innovations in conventional explosives. Alsos was organized to follow directly behind front-line elements of Allied forces in Europe.

Between April 1944 and May 1945, the Alsos unit hoppedscotched through France, Belgium, the Netherlands, and Germany, investigating significant physics laboratories, seizing and assessing documents and apparatus, and capturing and interrogating scientists—especially physicists and chemists thought likely to be working on problems of nuclear physics and nuclear engineering. When Goudsmit arrived at the University of Strasbourg in November, 1944, he found what he considered incontrovertible evidence in the files of the physicist Carl Friedrich von Weizsäcker that German work on an atomic bomb was not far advanced. He also discovered that his old colleague and friend Werner Heisenberg and his laboratory had been evacuated from Berlin to the small Bavarian town of Hechingen. Goudsmit believed that Heisenberg was in overall charge of the German atomic bomb, but in fact Heisenberg directed only the project's theoretical work. Later, in the spring of 1945, elements of the Alsos team captured the Hechingen laboratory and uncovered the German heavy water reactor, which had been under construction in a camouflaged cave in the nearby village of Haigerloch. Soon thereafter Heisenberg was seized at his family's summer home in Urfeld.

—S.G., T.P.

allowed himself to be used by the Nazis, and he was made indignant by Heisenberg's appeal to moral reticence, which he judged to be dishonest. And so the battle was joined. Philip Morrison's remarks typify the attitudes of American scientists. In a December 1947 *Bulletin* review of Goudsmit's book, Morrison wrote:

"He [Heisenberg] has lately tried to claim that the motivation for the German work was a peaceful one, since they wanted not bombs but merely a pile. . . ."

"The careful story put together by Goudsmit demonstrates this account to be . . . a rationalization invented while some of the participating physicists were interned in England. The documents cited in *Alsos* prove amply that, no different from their Allied counterparts, the German scientists worked for the military as best their circumstances allowed. But the dif-

(continued on page 38)

The "guests" at Farm Hall

The German scientists interned at Farm Hall were described by their British overseers as follows:

Professor Otto Hahn, a radio-chemist from the Kaiser-Wilhelm Institute of Chemistry in Berlin-Dahlem (ultimately the Max Planck Institute), who received the 1944 Nobel Prize for Chemistry:

"The most friendly of the detained professors. Has a very keen sense of humor and is full of common sense. He is definitely disposed to England and America. Has been very shattered by the announcement of the use of the atomic bomb as he feels responsible."

Professor Max von Laue, a nuclear physicist at the Kaiser-Wilhelm Institute, and the 1914 recipient of the Nobel Prize for Physics:

"A shy, mild-mannered man. He cannot understand the reason for his detention as he professes to have had nothing whatever to do with uranium or the experiments at the Kaiser-Wilhelm Institute. . . . He is extremely friendly and is very well disposed to England and America."

Professor Walter Gerlach, a professor from the Institute of Physics in Munich with a background in German torpedo work, who was appointed to the physics section of the Reich Research Council:

"Has always been very cheerful and friendly but from his monitored conversations is open to suspicion because of his connections with the Gestapo. As the man appointed by the German government to organize the research work on uranium, he considers himself in the position of a defeated general and appeared to be contemplating suicide when the announcement [of the bombing of Hiroshima] was made."

Professor Werner Heisenberg, a physics professor and director of the Kaiser-Wilhelm Institute; recipient of the 1932 Nobel Prize for Physics:

"Has been very friendly and helpful ever since his detention. He has taken the announcement of the atomic bomb very well indeed and seems to be genuinely anxious to cooperate with British and American scientists."

Professor Paul Hartek, a physical chemist from Hamburg and the driving force behind much of German atomic research:

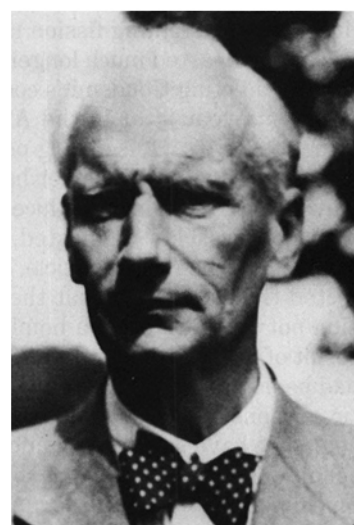
"A very charming personality. Appears to be interested only in his research. He has taken the announcement of the atomic bomb very philosophically and has put forward a number of theories as to how it has been done."



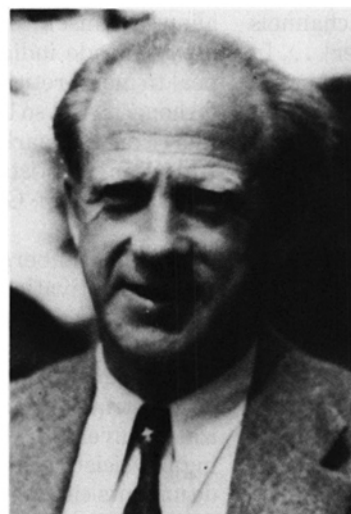
Professor Otto Hahn



Professor Max von Laue



Professor Walter Gerlach



Professor Werner Heisenberg



Professor Paul Hartek



Professor Carl F. von Weizsäcker

Professor Carl F. von Weizsäcker, a theoretical physicist at the Kaiser-Wilhelm Institute:

"Outwardly very friendly and appears to be genuinely cooperative. He has stated, both directly and in monitored conversations, that he was sincerely opposed to the Nazi regime and anxious not to work on an atomic bomb. Being the son of a diplomat, he is something of one himself. It is difficult to say whether he is genuinely prepared to work with England and America."

Dr. Karl Wirtz, a physicist at the Berlin-Dahlem Institute:

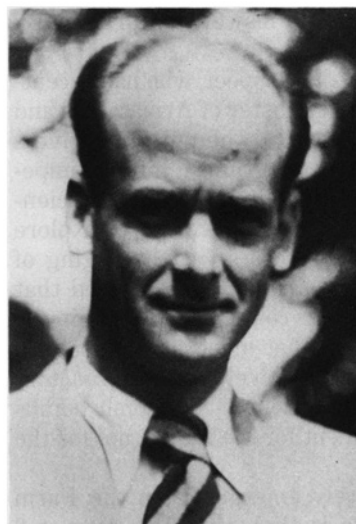
"A clever egoist. Very friendly on the surface, but cannot be trusted. He will cooperate only if it is made worth his while."

Dr. Eric Bagge, a physicist at the Leipzig Institute of Theoretical Physics:

"A serious and very hard-working young man. He is completely German and unlikely to cooperate."

Dr. Horst Korsching, a physicist and uranium separation expert working in Berlin:

"A complete enigma. On the announcement of the use of the atomic bomb he passed remarks on the lack of courage among his colleagues which nearly drove Gerlach to suicide."



Dr. Karl Wirtz



Dr. Eric Bagge

Dr. Kurt Diebner, the German army's expert on nuclear physics, commissioner for Norwegian heavy water production, and deputy head of the German atomic project:
 "Outwardly friendly but has an unpleasant personality and cannot be trusted."

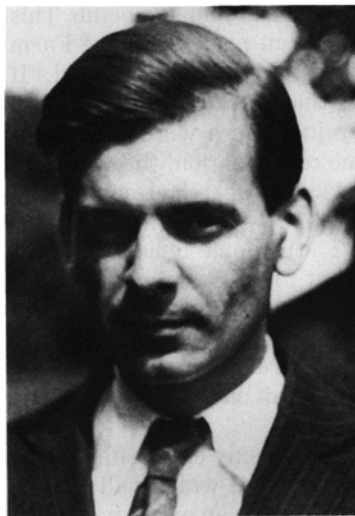
All of the Farm Hall detainees were released; none was charged with anything. Professors Max von Laue and Otto Hahn became fast friends during their internment and each continued long and respected academic careers. Von Laue died in 1960; Hahn in 1968.

Karl Wirtz became involved with the German nuclear power industry and lives outside Karlsruhe. Walter Gerlach and Kurt Diebner faded into obscurity, at least from a historian's perspective.

Carl Friedrich von Weizsäcker, who developed a theory of the origin of the solar system, has shifted his academic interest to philosophy and continues his association with the Max Planck Institute. He lives outside Munich and his brother is president of Germany.

Werner Heisenberg, considered one of the world's handful of genuinely great physicists, is assured a place in history for his work with quantum mechanics and for the Heisenberg uncertainty principle. Throughout the remainder of his life, he was always well-regarded by his peers, although a kind of coolness lingered. Heisenberg was director of the Max Planck Institute until his death in 1976.

—S.G., T.P.

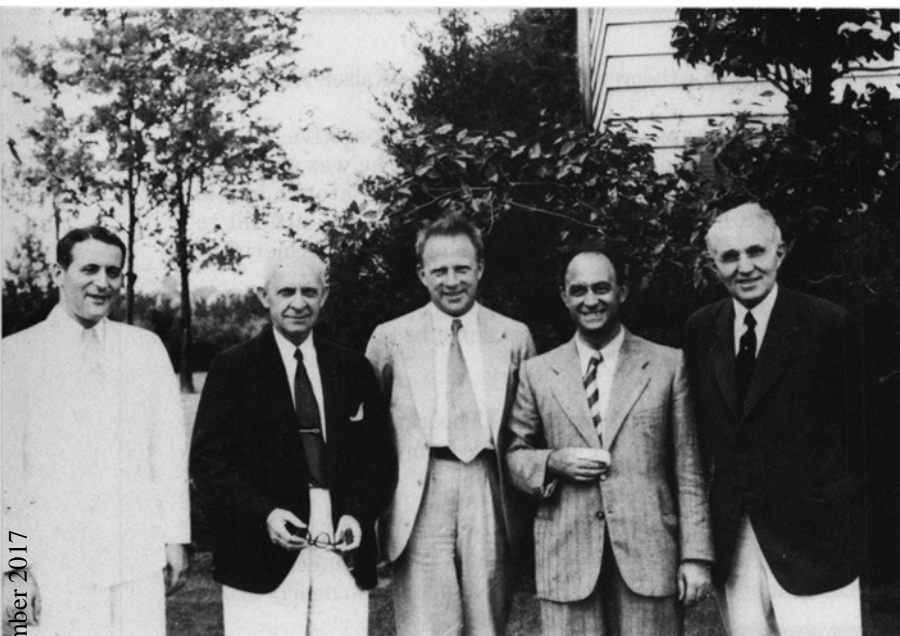


Dr. Horst Korsching



Dr. Kurt Diebner

PHOTOS: NATIONAL ARCHIVES



Before World War II, Samuel Goudsmit (far left) and Werner Heisenberg (center), were friends. With them at the 1937 University of Michigan annual summer physics conference are Clarence Yokum, Enrico Fermi, and Edward Kraus.

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ference, which it will never be possible to forgive, is that they worked for the cause of Himmler and Auschwitz, for the burners of books and the takers of hostages.”

Now that the summaries and partial transcripts of the Farm Hall tapes have been made public, it is difficult to understand why Goudsmit, Groves, Morrison and other Allied scientists believed Heisenberg and the others all tried or wanted to build a bomb. The Farm Hall words point to another conclusion and the complete absence of any serious German program confirms what Heisenberg and some of the others expressed.

The documentary record shows that in the autumn of 1941, the German and Allied fission programs were at essentially similar crossroads—would pursuing fission technology development result in important weapons for this war? Among scientists on both sides, there was no consensus.

In the United States, the political decision to proceed was based, in part, on the belief that the Germans had been making progress in the development of a fission bomb. But a letter written in April 1941 (recently discovered in the National Archives) from Princeton physicist Rudolph Ladenburg, a German emigré, to Lyman Briggs, Director of the National Bureau of Standards and head of the American uranium fission program, contradicts this belief. In it, Ladenburg informs Briggs that colleagues close to Heisenberg had gotten word to Ladenburg that Heisenberg's group was working on a uranium bomb, but that Heisenberg had delayed as much as possible,

fearing the consequences of succeeding. In the end, the letter said, he would have to follow orders. If such a bomb was possible, it would be developed soon.⁴

Eight months later, by the end of the year, the Germans had decided not to go ahead. This verdict was rendered as the tide began to turn against Germany on the Eastern Front. Among the scientists, Kurt Diebner's group was convinced that a bomb made of uranium 235 or plutonium might be built with destructive potential a million times greater than the equivalent amount of dynamite. Diebner estimated that between 10 and 100 kilograms of fissile material would be required. Heisenberg, head adviser for the project, was much more circumspect. He waffled on just how much active material would be needed. He was vague when he noted that neutrons of any speed would fission uranium 235. And in early 1942, when asked outright by military authorities if results could be obtained within the next nine months, his answer was an unequivocal “no.”

In June 1942, Albert Speer, who had recently been appointed Minister of Armaments and Munitions and who had the power to give a bomb development program significant impetus, met with a number of military and scientific leaders, including Heisenberg, to explore the question. Speer did so at the urging of some of those who remained convinced that nuclear technologies could be exploited in the service of war. At that meeting, Heisenberg chose to focus on the development of reactors and cyclotrons and pronounced atomic bombs to be a development for the future, not for the war.⁵

What ultimately emerges from the Farm Hall transcripts is that after the August 6 atomic bomb announcement, Heisenberg seems to have had two different versions of what would be required to build a bomb. This is reflected in different portions of the Farm Hall reports. First from Gerlach, who said, “If they want to get that [sufficient quantities of plutonium] they just use a whole ton.” But later in the same conversation, the following exchange took place between Heisenberg and Hahn:

Heisenberg: “I still don't believe a word about the bomb but I may be wrong. I consider it perfectly possible that they have about 10 tons of enriched uranium, but not that they can have 10 tons of pure uranium 235.”

Hahn: “I thought that one needed only very little 235.”

Heisenberg: “If they only enrich it slightly, they can build an engine which will go but with that they can't make an explosive which will—”

Hahn: “But if they have, let us say 30 kilo-

2^{10} is about 10^3 , so that 10^{24} is 2^{80} , namely requires 80 reactions

grams of pure 235, couldn't they make a bomb with it?"

Heisenberg: "But it still wouldn't go off, as the mean free path is still too big."

Hahn: "But tell me why you used to tell me that one needed 50 kilograms of 235 in order to do anything. Now you say one needs two tons."

At the June 1942 meeting with Albert Speer and the military experts in Berlin, Heisenberg described the amount of fissionable material required to level a city as "about the size of a pineapple."

Later on the night of August 6, when Hahn and Heisenberg were alone, Hahn again asked, "Do you think they would need as much as 30 kilograms?" Heisenberg replied, "I think so certainly, but quite honestly I have never worked it out as I never believed one could get pure 235." He continued:

"I always knew it could be done with 235 with fast neutrons. That's why 235 only can be used as an explosive. One can never make an explosive with slow neutrons, not even with the heavy water machine, as then the neutrons only go with thermal speed, with the result that the reaction is so slow that the thing explodes sooner before the reaction is complete."

In response to Hahn's next question, "How does the bomb explode?" Heisenberg, without hesitation, replied as follows:

"In the case of the bomb it can only be done with the very fast neutrons. . . . in order to make 10^{24} neutrons I need 80 reactions one after the other. . . . The mean free path is about six centimeters. In order to make 80 collisions, I must have a lump of a radius of about 54 centimeters and that would be about a ton. . . . It is conceivable they could do it with less in the following manner. They would take on a quarter of the quantity but cover it with a reflector [at Los Alamos this was referred to as a "tamper"] which would turn back the fast neutrons."

Hahn asked, "How can they take it in an aircraft and make sure that it explodes at the right moment?" Again Heisenberg was not hesitant:

"One way would be to make the bomb in two halves, each one of which would be too small to produce the explosion because of the mean free path. The two halves would be joined together at the moment of dropping when the reaction would start."

Heisenberg was able to reconstruct the process within a few hours after hearing that Hiroshima had been destroyed by an atomic bomb. A week later, he had honed and refined these ideas, which he presented in a formal lecture to his colleagues. The general discussion that followed the lecture makes clear that only some of the scientists really understood bomb physics. Besides Heisenberg, this group

space grows as the jump (6 cm) times the square root of the number of jumps (reactions)

square root of 80 is about 9 and 6 times 9 is 54 cm: a sphere of this diameter is about 80 400 cubic cm's

U density is about 19 g for cubic cm: the sphere should then be 1.5 Tons ...

In a 1942 Berlin meeting with military leaders, Heisenberg's pessimism ended serious German bomb hopes.



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“The fact that Heisenberg reached these conclusions in one evening is remarkable.”

included Harteck, Weizsäcker, and Wirtz. The others were evidently hearing much that was new to them.

When Hans Bethe, who was chief of the theoretical division at Los Alamos during the Manhattan Project, read the Farm Hall transcripts 47 years later, he was immediately struck by Heisenberg’s sophistication. “My first reaction,” he said, “is that Heisenberg knew a lot more than I have always thought—the fact that he reached many of these conclusions in one evening is most remarkable. In his lecture it was clear he was talking to people who were quite ignorant. Heisenberg put everything on quite a low level, even going back to fundamentals. Apparently the other people didn’t know very much about fission—even including Max von Laue, who was a great physicist. But especially Walter Gerlach [the head of the German uranium project]—he knew very, very little—everything had to be explained to him as for the first time.”⁶

The Farm Hall transcripts reveal Heisenberg’s sophisticated understanding of bomb physics and that he had kept much of this understanding to himself during the war. The transcripts also provide evidence that the relationships between scientists and the military in Germany was very different from those relationships in the United States or England—and contrary to Morrison’s assumptions. As Heisenberg remarked to his colleagues on the evening of August 6, 1945:

“The point is that the whole structure of the relationship between the scientist and the state in Germany was such that although we were not 100 percent anxious to do it [produce nuclear weapons], on the other hand we were so little trusted by the state that even if we had wanted to do it, it would not have been easy to get it through.” Many of the German scientists at Farm Hall understood which World War II governments had been wearing the white hats and which had been wearing the black.

As Heisenberg noted in his 1947 *Nature* article, in 1942 the state of research and

knowledge concerning nuclear fission in Germany and in the United States was comparable. But knowledge is not sufficient to build a bomb. A very large, expensive, and far-flung industrial complex must be mounted and managed. The United States decided to make that transition, a decision motivated in part by concern for Germany’s progress toward a bomb. Of necessity, U.S. scientists gave up control of the products of their labors and control of how such products would be employed.

In Germany, the authorities decided against the huge effort that an industrial enterprise would require. First, it was inconceivable to the Germans that anyone else would contemplate developing a fission bomb. Second, there is evidence that Werner Heisenberg and possibly other scientists purposely reported bleak prospects to German leadership concerning near-term nuclear technology for war. These scientists also kept information from (and even lied to) colleagues who they knew would have been eager to cooperate with the Nazi leadership. Heisenberg’s words from the Farm Hall tapes, “From the very beginning, German physicists had consciously striven to keep control of the project,” ring true.

None of this, of course, gives general absolution to Heisenberg and his colleagues nor is it a general defense of their actions or statements before, during, or after the war. The fact remains that Heisenberg and most of his colleagues at Farm Hall never claimed a superior ethical and moral stance during the war. Perhaps the specter of such claims drove Goudsmit, Morrison, and Groves to lash out with such vehemence, with such absolute moral certainty.

As Heisenberg had often said, the situations in America and Germany were not comparable. Suppose, for instance, that the United States had worn the black hat. And suppose that American scientists, for one reason or another, had decided they could not emigrate from a fascist regime. We think there is little doubt that many of them would have chosen to walk the same kind of knife-edge that Heisenberg chose—and in such a way as to minimize the damage to themselves and to others. ■

1. Robert Furman, memo to file (March 7, 1944), Record Group 77, Army Corps of Engineers, entry 21, box 171, National Archives and Records Administration, Washington, D.C.

2. Samuel Goudsmit, “How the Germans Lost the Race,” *Bulletin of the Atomic Scientists* (March 15, 1946), pp. 4-5; Samuel Goudsmit, *Alsos* (New York: Henry Schuman, 1947); cf., correspondence with Victor Weisskopf, Hans Bethe, Rudolf Peierls, et al., Goudsmit Papers, Niels Bohr Library, American Institute of Physics, New York, N.Y.

3. Farm Hall Transcripts, National Archives, Record Group 77, entry 22, box 163. (We are indebted to Ed Reese and Will Mahoney in the Archives Military

Reference division for their generous cooperation and assistance.)

4. For the effects of this letter on the American program see Stanley Goldberg, “Inventing a Climate of Opinion,” *Isis* (forthcoming); for the provenance of the letter, see Thomas Powers, *Heisenberg’s War* (New York: Alfred A. Knopf [forthcoming]), chapter 10.

5. See David Irving, *Virus House* (London; William Kimber, 1967); Mark Walker, *German National Socialism and the Quest for Nuclear Power, 1939-1949* (Cambridge; Cambridge University Press, 1988) chapters 2-3; Powers, *Heisenberg’s War*, chapters 13-14.

6. Hans Bethe. Interview by Thomas Powers, March 19, 1992.