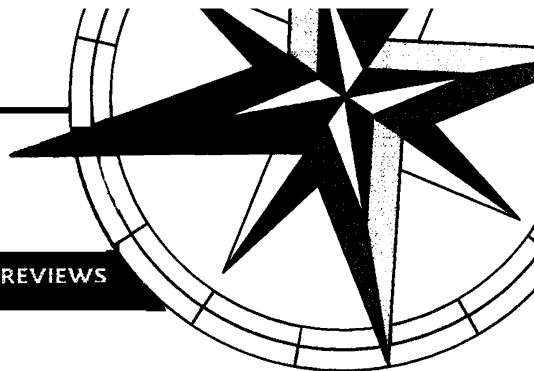




Heisenberg and Bohr— Another View

IN HIS ARTICLE "LETTERS AVER PHYSICIST supported Nazi bomb" (News of the Week, 15 Feb., p. 1211), Adrian Cho repeats erroneous statements that have been cast into doubt by several writers (1). Werner Heisenberg never said that "he intended to subvert the Nazi bomb program from within." Nor is it true that "the Dane [Niels Bohr] abruptly ended ... their long friendship." This can be seen from the warm tone used by Bohr in his unsent letters to Heisenberg (2). Also, after the war, the Bohr and Heisenberg families visited each other in their homes and spent their vacations together in Greece, and Bohr contributed an article to the *Festschrift* (i.e., a volume of essays to honor a scholar on a special anniversary) for Heisenberg's 60th birthday in 1961.

In 1939, German Army Ordnance had drafted Heisenberg to study the feasibility of atomic bombs so that the Allies would not be able to surprise Germany with them. By 1941, Heisenberg had found that such bombs would be feasible but technically so difficult to make that their construction would take many years. It seemed to him, therefore, that the then small international community of nuclear scientists might have time to reach an agreement not to build these weapons. Heisenberg decided that he should discuss the critical situation with his old friend Bohr, with whom he had solved so many tricky issues in the past. He risked his neck in doing so, because the nuclear project was secret. Heisenberg told me this when I asked him, in 1969, about his visit to Bohr in Copenhagen in 1941. I was then working under Heisenberg at the Max Planck Institute for Physics. Heisenberg said that he had not realized that the war had changed their formerly close relationship. In fact, Bohr was suspicious of the motives behind Heisenberg's unexpected visit (2). When Heisenberg mentioned the technical feasibility of nuclear weapons (still doubted at that point by Bohr), adding that he knew what he was talking about, Bohr apparently assumed, according to Bohr's unsent letters, that Heisenberg was working on the construction of bombs. He ended the conversation before Heisenberg could explain the true purpose of his visit.

In Germany, bomb construction was not attempted because it would have taken too

much time and resources. A reactor for power production was given official support. Robert Jungk, in his book *Brighter Than a Thousand Suns*, which Cho mentions in his article, gave the erroneous impression that Heisenberg refrained, for moral reasons, from bomb-making. Heisenberg and his closest associate, Carl Friedrich von Weizsäcker, wrote letters (3) to Jungk criticizing his exaggerations



Heisenberg (left) and Bohr in 1934.

while appreciating his engaged research. Jungk published only the laudatory part of Heisenberg's letters. It seems clear that Bohr's drafted letters to Heisenberg do not aver Heisenberg's support for a Nazi bomb.

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References and Notes

1. See the postscript by Michael Frayn to his play *Copenhagen* [M. Frayn, *Copenhagen* (Anchor, New York, 2000)]; articles by T. Powers, C. Carson, and H. Reichenberg in a supplement to the German edition of *Copenhagen* [Copenhagen (Wallstein, Göttingen, Germany, 2001)]; and T. Powers, *Heisenberg's War* (Knopf, New York, 1993).
2. See drafts of unsent letters written by Borg to Heisenberg, which were recently released by the Niels Bohr Archive (www.nbi.dk/NBA/papers/introduction.htm).
3. See the article by Carson in the supplement to the German edition of *Copenhagen* (1).

Response

GOTTSTEIN WRITES THAT HEISENBERG KNEW that atomic weapons might be built, albeit with great difficulty, and that he realized that "the then small international community of nuclear scientists might have time to reach an agreement not to build these weapons." If Heisenberg intended to forswear work on

atomic weapons while maintaining his position as leader of German nuclear research, did he not perforce intend to subvert Nazi ambitions to achieve such weapons?

Concerning the effect of the 1941 meeting on Bohr and Heisenberg's friendship, Gerald Holton, a physicist and historian of science at Harvard says, "It's a non-story in a way. Nothing happened except a friendship was broken." Holton may be mistaken, however. If Bohr and Heisenberg remained truly close after the war and until Bohr's death in 1962, then one can only wonder how the two failed to hash out their differences over the encounter that clearly meant so much to both of them.

Regardless of these considerations, one thing is clear: Bohr's letters explicitly and peremptorily state that in 1941 Heisenberg said that he had been working in earnest on atomic weapons for 2 years. Bohr may have misunderstood Heisenberg, but his letters speak for themselves and they certainly aver that Heisenberg supported the German bomb effort—precisely as the article says.

ADRIAN CHO

Survey of Foreign Recipients of U.S. Ph.D.'s

IN THE WAKE OF THE EVENTS OF SEPTEMBER 11, proposals have been made to regulate or restrict the number of students studying in the United States on temporary visas. In the interest of informing debate, we provide descriptive statistics on the number of temporary residents who received U.S. doctorates in science and engineering (S&E) between 1981 and 1999 (1). For the 1990s, we explore in more detail the country of citizenship of doctorate recipients. The data come from the Survey of Earned Doctorates (SED), a census of all doctoral recipients in the United States (2).

During the past 19 years, temporary residents have accounted for more than 50% of the growth in Ph.D. production in the United States. Permanent residents have provided for another 10%. A dramatic increase in the number of Ph.D. recipients holding temporary visas occurred from 1981 to 1992, followed by a decline during the next 7 years.