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The Unanswered Question

Thomas Powers
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Copenhagen

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Something happened—some terrible offense was given which could never be recalled—during the wartime visit of the German physicist Werner Heisenberg to the man who probably meant most to him in the world, the Danish physicist Niels Bohr. It would be forgotten now, certainly Michael Frayn never would have written a play about it, if the offense had not somehow involved Heisenberg's role as a leader of the German effort to invent atomic bombs. But the bomb was part of it and scientists and historians have been arguing about what happened ever since.

Here is what is known: in September 1941 Heisenberg traveled to Copenhagen, where he told Bohr that in Germany a research effort was underway to develop bombs using the principle of atomic fission. Some kind of misunderstanding ensued. In despair Heisenberg told his wife and close friends that the conversation had gone astray, Bohr became too angry to continue, the meeting ended abruptly. Bohr's wife and friends later confirmed that indeed he was angry, so angry that the old friendship and intimate working relationship could never be restored. They did not see each other for many years, until Heisenberg came again to Denmark in 1947. There, in Tisvilde, where Bohr had a house in the country, they tried to sort out the earlier conversation but could agree on little—not even where it took place: on an evening walk, as Heisenberg remembered, or in Bohr's study in his home? "After a while," Heisenberg wrote in a memoir, "we both came to feel that it would be better to stop disturbing the spirits of the past."

There is no evidence that the two men ever broached the subject again during the remaining fifteen years of Bohr's life, but plenty of other people did, then and later. The 1941 meeting was minutely analyzed by American and British intelligence authorities after Bohr's escape to Sweden in 1943, one jump ahead of the Germans. Rumor of Heisenberg's visit spread through the scientific grapevine even before the war was over, and its meaning was hotly debated afterward. Why had Heisenberg come to Copenhagen? What made Bohr so angry?

The interest in these questions wasn't idle. The German military had placed Heisenberg in charge of theoretical work on the feasibility of atomic bombs during the first weeks of the war and he remained a principal director of uranium research until the last shots were fired. When the war ended he was in southern Germany working on a small experimental nuclear reactor which never achieved a self-sustaining chain reaction. It was a tiny program without scientific or military significance. Bohr, meanwhile, had gone on from Sweden to Britain and the secret American laboratory at Los Alamos in the high desert of New Mexico. There he had alarmed officials with reports of Heisenberg's progress toward a bomb, had established an intimate friendship and excellent working relationship with J. Robert Oppenheimer, director of the American laboratory, and had even made a small theoretical contribution to the design of the triggering device for the plutonium bomb that destroyed Nagasaki.

That's roughly it. Heisenberg came, they talked, it went badly. Frayn has solid reasons for his version of how the conversation might have gone, but the fact of it is the only point universally accepted. On almost every detail there is more than one opinion; long books have been written trying to sort it all out. Frayn is not trying to establish what really happened; it is what might, could, or should have happened that interests him and gives the play its power as a work of ideas. When Heisenberg in the first year or two after the war tried to explain how he and his closest colleagues approached the bomb-making project he was angrily slapped down by scientists involved with the American effort. Critics said Heisenberg had bungled the physics and then tried to disguise his failure with a fable about moral reservations. But interest in the visit never quite died. After all, Heisenberg came to see Bohr in 1941 in German-occupied Denmark; he risked prison or worse by telling his old friend that Germany had a bomb program. Why did he come? What made Bohr so angry? In the absence of accepted answers to these questions the British playwright Michael Frayn has in effect invited three figures of history—Heisenberg, Bohr, and Bohr's wife, Margrethe—to do

now in his play *Copenhagen* what they never managed to do in life: to question each other about the famous visit, to answer forthrightly, and to listen.

Frayn has been a hard-working author and playwright for decades, but his previous eight novels and fifteen plays offer nothing quite like the intellectual dazzle and moral seriousness of *Copenhagen*. Despite the successful eighteen-month run of the play in Britain, first at the Royal National Theatre and later in the West End, American producers were long skittish about bringing the play to Broadway. *Copenhagen* is not only short on laugh lines (there are a few, all rueful) but it focuses on two subjects which are difficult under any circumstances—knowing who we are and what we mean, and knowing when we have reached the frontier separating right from wrong. No play has considered moral issues of such depth and complexity since Rolf Hochhuth's 1963 play *The Deputy*, but where Hochhuth launched an accusation against Pope Pius XII for his silence during the Holocaust, Frayn simply asks a question—indeed he asks it twice, as we shall see. I expect no rush from historians and the community of scientists to answer it.

But Frayn begins with characters, not ideas. Perhaps no collaboration in the history of science was closer than Heisenberg's with Bohr and certainly none was more fruitful. For three years in the 1920s, while Heisenberg was an assistant in Bohr's institute, they more or less invented modern quantum physics. But to call what they did "working together" is a bit of a stretch. They tackled problems very differently. Bohr was slow, careful, even ponderous as he took physical ideas and reduced them to plain language anyone could understand—even his nonmathematical wife, Margrethe, a practical, skeptical woman who did not grant her trust to all of the brilliant students who passed through Bohr's world. For Heisenberg in particular she seemed to feel some reservation; why, exactly, she never said. Perhaps it was nothing more complicated than a feeling of being excluded from the extraordinary intimacy that Bohr and Heisenberg established on their long walks together. For a time it must have seemed that no one could drive a wedge between those two.

Margrethe wasn't the only one to find something a little chilly and dismissive about Heisenberg's genius. He raced ahead intellectually in the same way he plunged downhill skiing. He did not like to wait, even for Bohr, and the idea for which Heisenberg is best remembered—the uncertainty principle, which Frayn exploits with great imagination and subtlety—was conceived and defended almost in the teeth of Bohr. The arguments were so fierce that the two men sometimes burst asunder, disappearing for days or weeks to think and work alone. "You're a lot better off apart, you two," says Frayn's fictional Margrethe. The real Margrethe probably thought much the same. In the end Heisenberg and Bohr agreed to look at physical phenomena in two ways simultaneously, as both wave and particle, an insight (both men insisted it was not a compromise) thereafter called "the Copenhagen interpretation."

The play opens at an unspecified time. The characters have all died but are restless and questing in afterlife. The conversation takes place in the Bohrs' house in Carlsberg—the "House of Honor" given to Bohr as Denmark's greatest scientist—but the stage is almost bare. Three chairs are the only furnishings. One has arms and it is Bohr who mostly sits there. A hallway leads away to a door at the left rear. Through that door Heisenberg will arrive for his visit—not just once, but three times, as they parse and re-parse all the possible ways of answering Margrethe's opening question: "But why?... Why did he come to Copenhagen?"

There is no action to speak of, just Heisenberg's repeated arrival and departure, Bohr and Heisenberg setting off on their walks—the long walk after they first met (when Bohr's newest son, as Margrethe reminds him, was one week old), the too-short walk that ended so badly the night Heisenberg tried to talk about bombs. The triangle created by the three characters is repeatedly broken and redrawn. Sometimes the governing alliance is Bohr and his wife, sometimes Bohr and Heisenberg, then back again. As played by Philip Bosco at New York City's Royale Theater, Bohr is a little uncertain with age but very much the man of science, dropping everything for the pursuit of an idea, quite unaware that his pride is sometimes involved, and his pride can be like iron. Mercifully Bosco makes no attempt to reproduce the speech of the Bohr of history, who famously mumbled and garbled his words in a volume ever dwindling till his listeners were crowded around in a breathless knot, straining to hear. Blair Brown is Margrethe: sensible shoes, a plain suit, hair gray at the temples, nothing that could possibly be mistaken for a genuine smile crossing her face. She didn't like Heisenberg's sudden intrusion at the time and she doesn't like it now, that is clear.

But Heisenberg is the great question in this play, as he was in life. He is played by Michael Cumpsty as a figure of astonishing power, confidence, clarity of desire, self-knowledge—until it all slips suddenly away and he becomes as baffled by the difficulty of understanding what he was up to as the bewildered Bohr. The Heisenberg who opened in London in May 1998 was crisper in speech, cooler, subtler, sometimes hurt by what was said to him, but the play's British director, Michael Blakemore, has evidently encouraged, certainly allowed, Cumpsty to play a stronger, more positive, altogether more passionate figure in the American production—not at all the Heisenberg of history any more than Bosco plays the real Bohr. This Heisenberg, apart from initial moments of diffidence, is a man with ready access

to a fund of strong emotion. He laughs, he grows excited, he becomes angry and expresses his anger. He even shouts and what's more, he shouts at Bohr. He all but roars.

Frayn never strays far from the known; the histories of these people have been minutely recorded on just about every subject imaginable except, of course, the blank pages of Heisenberg's visit. Frayn draws on the rest of their lives to coax out a portrait of their relations that might explain what went wrong. They have plenty to talk about—their initial walks together through the Danish countryside, the intellectual struggle that culminated in the Copenhagen interpretation, Heisenberg's difficulties with the Gestapo after Hitler's rise to power, the terrible day when the Bohrs' oldest son, Christian, was swept overboard in a heavy sea and drowned. There are three sound effects in this play: the ring of the bell pull when Heisenberg arrives (the Bohrs turn expectantly, almost fearfully—they are not at all eager, in this play, to find out at last why Heisenberg came); the sound of sea gulls as they remember once again the awful moment when Bohr, standing in the doorway, turns his head away and cannot say what Margrethe understands immediately; and one other sound, shocking and unexpected, to which I will return.

Copenhagen is an imaginative reworking of the true and the known, but the character of the characters, the kind of people they are, has been changed—in the case of Heisenberg, changed a lot. They are now people who might actually thrash out a complex personal misunderstanding—not the tongue-tied, easily hurt, too considerate, and sometimes guilt-bedeviled figures of history who decided to quit talking about the biggest thing ever to come between them.

The history of this event can be stunningly complex but Frayn manages to sketch in the basics. You don't have to do any homework to understand what they are arguing about and why it matters. Bohr wonders if Heisenberg has come to borrow the Danish cyclotron. (Germany has none.) Has he lost his chair at Leipzig? (His reward, Margrethe points out, for the uncertainty paper.) Is it conceivable (now Bosco's Bohr expresses rising anger of Old Testament intensity) that Heisenberg has come thinking that Bohr—who is half-Jewish—would accept sanctuary in the German embassy when the inevitable happens and the Jews are deported?

But none of those is the answer. Nor are the guesses Bohr made after the war. "You told Rozental that I'd tried to pick your brains about fission," says Frayn's frustrated Heisenberg.

You told Weisskopf that I'd asked you what you knew about the Allied nuclear program. Chadwick thought I was hoping to persuade you that there was no German program. But then you seem to have told some people that I'd tried to recruit you to work on it.

In *Copenhagen* Heisenberg does want to know if there's an Allied bomb program ("my dear Heisenberg...I've no idea...") but it's not the reason he's come. What he intends is immeasurably bolder—to tell Bohr that now, in the very early stages of fission research, scientists can still tell officials that bombs are too difficult and expensive, and he wants Bohr to press this point upon the Americans—"to tell them we can stop it together." The plan is of course preposterous and seems to collapse as soon as it's put into words.

But crazy as it is, Frayn suggests, this really was the reason Heisenberg came to Copenhagen. The response is predictable. Bohr is angry, Margrethe, says,

because he *is* beginning to understand! The Germans drive out most of their best physicists because they're Jews. America and Britain give them sanctuary. Now it turns out that this might offer the Allies a hope of salvation. And at once you come howling to Niels begging him to persuade them to give it up... The gall of it! The sheer, breathtaking gall of it!

All this is argued with great spirit and feeling, but after Heisenberg's scheme collapses, as it was bound to do in wartime, the play turns inward and backward, ranging through the lives of these three for the seeds of their angry encounter—Margrethe's resentment of Heisenberg as an unwanted son, Bohr's conviction that in science as in life Heisenberg always needed slowing down, the death of Christian too painful to discuss, the awful complicity in crime which attached like a port wine stain to every German who remained in Germany during the war. "Everyone understands uncertainty. Or thinks he does," says Frayn's Heisenberg—the principle that in the subatomic world you can never know both the position and the velocity of a particle. One or the other, not both. As this notion is explored Frayn deepens human mysteries as well—why people do what they do ("Because I never thought of it," says Heisenberg of his failure to perform an important calculation; "Because it didn't occur to me!"), the tricks played by memory, the difficulty of seeing into other minds. We know other people as we know particles passing through a cloud chamber, not of themselves, but by the droplets of water vapor left by their passage. With people it is the same: we catch glimpses, as of walkers at night, passing from time to time beneath the light of a street lamp. If Bohr is right, and the Copenhagen interpretation restores humankind to the center of the universe, then the observer determines what can

be observed; and, Margrethe continues, “If it’s Heisenberg at the center of the universe, then the one bit of the universe that he can’t see is Heisenberg.”

Heisenberg: So...

Margrethe: So it’s no good asking him why he came to Copenhagen in 1941. He doesn’t know!

This back and forth plays well and reads well, but it’s not what gives the play its genuine tension, and it’s not why scientists and historians have been arguing for sixty years about why Heisenberg came, and what his visit had to do, if anything, with the Allied discovery at war’s end of the startling and, at first, inexplicable absence of a big German effort to build atomic bombs. Things need not and might not have turned out that way. “Let’s suppose for a moment,” says Bohr, “that...I stop, and control my anger, and turn to him, and ask him why.... Why are you so confident that it’s going to be reassuringly difficult to build a bomb with 235? Is it because you’ve done the calculation?... No. It’s because you haven’t calculated it....”

Heisenberg: And of course now I have realised. In fact it wouldn’t be all that difficult. Let’s see...

He begins to talk numbers.

It’s not in the script but it’s very much in the theater—the evening’s third sound effect, a roar and rumbling that shakes the gut of every playgoer with stunning intensity and lasts long enough for the thought to sink in: if Bohr had responded purely as a scientist, nosing out the absent calculation, pushing the problem forward, helping Heisenberg to see he couldn’t slip out the back door after all... Tons of uranium 235 were not required for a bomb, only kilograms. Germany could have done it.

Heisenberg: Almost certainly not.

Bohr: Just possibly, though.

Heisenberg: Just possibly.

It’s wonderful theater, and it tells us what a vast chasm separates Hitler with no bomb from Hitler with a bomb in time to use it. But in fact the passage amounts to a remark by the playwright: damn good thing Bohr was thinking like an aggrieved Dane, Frayn says in effect, and treated Heisenberg like a man with a hidden agenda... But this is not where the play has been leading.

Whatever it was that Heisenberg said or did in Copenhagen in 1941, Margrethe never forgave him for it. At a service for Bohr in 1963, standing with the physicist Sam Goudsmit, who was scientific director of a wartime inquiry into German atomic research, she pointed to Heisenberg nearby and said, “Goudsmit, that wartime visit... was a hostile visit, no matter what people say or write about it.” In *Copenhagen* Frayn gives her anger free rein.

Margrethe: You’ve come to show us how well you’ve done in life... He’s burning to let us know that he’s in charge of some vital piece of secret research. And that even so he’s preserved a lofty moral independence... Preserved it so successfully that he’s now also got a wonderfully important moral dilemma to face...

Heisenberg: All the same, I don’t tell Speer that the reactor...

Margrethe: ...will produce plutonium, no, because you’re afraid of what will happen if...you fail... Please don’t tell us you’re a hero of the resistance.

Heisenberg: I’ve never claimed to be a hero.

Bohr takes it all in good stride, but death has done nothing to soothe Margrethe’s fury. It seems odd at first. What has Heisenberg done really? His visit to Copenhagen in 1941, the play Frayn has written about it, and Margrethe’s anger at its core, all make sense only after we know how the story turned out. Heisenberg returned to Berlin where German officials were persuaded early in 1942 by Heisenberg and others that building a bomb was too expensive and uncertain for Germany in wartime. In June the German czar in charge of economic mobilization for the war, Albert Speer, met with Heisenberg and other leading scientists to argue one final time the wisdom of an all-out bomb program. German generals had pressed Speer to take the possibility seriously but Heisenberg stressed the difficulties and unknowns, requested only modest sums of money for reactor research, and convinced Speer that the bomb project offered no hope of success before the end of the war. The record of the German effort reveals nothing we might describe as a counter-history—no glimpses in documents or memoirs, or even anecdotes of Heisenberg beneath a succession of street lamps,

caught urging a bomb program on officials. Indeed, the few glimpses we do get are of just the opposite—the meeting with Speer and the visit to Bohr are only two examples.

What is startling and even subversive about Frayn's play is the question that slips in through the door with Heisenberg's arrival, a question that eventually stirs Margrethe to lash out in protective fury. But at first you hardly notice. How did the famous conversation begin? "I simply asked you," says Heisenberg, "if as a physicist one had the moral right to work on the practical exploitation of atomic energy. Yes?"

Bohr does not recall, the discussion veers elsewhere, the question goes unanswered. Frayn did not invent this question; it is a close paraphrase of what Heisenberg in a memoir says he asked, and Heisenberg used roughly similar words on half a dozen other occasions. Whether Bohr would have remembered it that way, I don't know; he never described the evening in print, or in detail to anyone who has left a clear record of what he said. But in the play Margrethe understands all too well where this question will lead. In point of fact Heisenberg did not build a bomb, whereas Bohr, in some small but not quite inconsequential way, helped to do so. "You're not suggesting that Niels did anything wrong in working at Los Alamos?" demands Margrethe.

Heisenberg: Of course not. Bohr has never done anything wrong...

Margrethe: You're not implying that there's anything that *Niels* needs to explain or defend?

Heisenberg: No one has ever expected him to explain or defend anything. He's a profoundly good man.

A branding iron could not make the point more painfully. But Frayn is not venting some crazy animus against Bohr; *Copenhagen* isn't an attempt to turn the tables, invite Heisenberg back into the family of science, and drive Bohr out. Frayn is restoring to the scientists of all sides something denied to them by the historians: moral autonomy—the capacity to question what they have been asked to do. Heisenberg is not a hero of the resistance, but something more disturbing—a scientist asked to build a bomb who raised the question whether it was right. Margrethe recognizes the challenge in this fact. If Heisenberg didn't come to borrow the cyclotron, show himself off, announce some personal setback like the loss of his professorial chair, spy on the Allies, probe Bohr for thoughts on how to make a bomb, or invite him to throw in his lot with the Germans, then possibly—just possibly—his goal was "very simple, when you come right down to it," as Bohr tells his wife in the opening scene: "He wanted to have a talk." And possibly—just possibly—what he wanted to talk about was the one question posed twice, at the beginning and the end of Frayn's remarkable play: "Does one as a physicist have the moral right to work on the practical exploitation of atomic energy?"

For the scientists who succeeded where Heisenberg failed, and for the historians who have recounted their efforts, answering Heisenberg's question is no simple matter. But once the question is posed there are only two possible responses—to ignore the question and to dismiss his visit to Copenhagen as somehow safe and self-serving, or to grant him the courtesy of an attempt to reply.