The final core of uncertainty

We do not know how to predict what would happen in a given circumstance, and we believe now that it is impossible... that this is the way nature really is.

– Richard Feynman

Approaches to the social world that attempt to adopt a scientific method and identify cause and effect to try to solve problems and to predict future outcomes draw on a Newtonian cosmology. This view of the world treats objects as distinct, independent of observation, and existing before they interact, and time and space as an external background to action. It is the framework in which straightforward ideas of cause and effect such as those discussed in the previous chapter make sense. It arose alongside the changes in forms of political community that led to the modern state, individualism and ideas of the independent existence of objects that still underpin much contemporary thinking.

For anyone brought up as a physicist, as I was, such ideas are counter-intuitive: a fantasy that belongs to a particular world. Contemporary cosmologies based on relativity and quantum physics that arose in the early years of the twentieth century take as accepted among other things the impossibility of independent observation, the straightforward existence of objects, or a defined temporality, and this is the picture of the world that makes sense to me. It is also a picture of the world as fundamentally interconnected, a notion expressed perhaps most clearly by Fritjof Capra, whose book, first published in 1975, draws connections between modern physics and Indian and Chinese philosophy. As Karen Barad puts it, much later, ‘Existence is
not an individual affair. Individuals do not pre-exist their interactions; rather, individuals emerge through and as part of their entangled intra-relating.\textsuperscript{34}

Common sense has yet to catch up with early twentieth-century science, and quantum physics in particular.\textsuperscript{5} Current notions of security, for example, still employ notions of the subject or object of security that draw on earlier cosmologies, and scholarship in international relations in particular tends to follow suit. There have been some noteworthy if controversial attempts to address the implications or uptake of quantum physics in other fields by various thinkers, including, for example, Barad, in her *Meeting the Universe Halfway*, Gavin Parkinson’s historical analysis of the uptake by surrealists of relativity and quantum physics in the 1920s and 1930s, and Roger Penrose’s explorations of how quantum entanglement might provide an account of the human mind.\textsuperscript{6} International relations scholars have recently ventured in this direction too.\textsuperscript{7} Often these attempts provoke disputes over who has the ‘correct’ readings of quantum mechanics, and of course challenges to any attempt at what is seen as incorrect analogical thinking or ‘scaling-up’ are common.\textsuperscript{8} Attempts to make social sense of quantum physics are by no means new; Danah Zohar and Ian Marshall’s *The Quantum Society* was first published in 1993.\textsuperscript{9}

This chapter does not attempt to set out a quantum theory of the so-called social world. It has a much more modest purpose. It explores the discontinuities between, on the one hand, the portrayal of security still common in international politics or security studies, and quantum cosmologies on the other, and argues that the idea of security is deeply, and dangerously, embedded in Newtonian thinking. It asks in what way, and with what result, ideas of security and notions of subjectivity and sovereignty would be changed if a cosmology that recognised the ‘final core of uncertainty at the heart of things’ were taken seriously, and it examines why the disjunction persists.\textsuperscript{10} It uses a reading of Michael Frayn’s play *Copenhagen* to explore these issues.\textsuperscript{11} The play juxtaposes competing narratives of a meeting that took place in Copenhagen in 1941 between nuclear physicist Niels Bohr, his former student Werner Heisenberg, and Bohr’s wife, Margrethe. Frayn draws parallels between the impossibility of knowing certain properties of physical particles simultaneously and
the impossibility of knowing people’s thoughts and intentions – even our own. I am not so concerned with the applicability or otherwise of these parallels, or whether Frayn might be read as being too kind to Heisenberg (a question that absorbs many of Frayn’s critics), as with the way the play, as I read it, exposes how the search for certainty, and the corresponding search for security, are untenable, dangerous, and yet powerfully seductive. Bohr himself thought that the implications of quantum physics could best be brought into the wider culture, not by scientists or philosophers, but by creative writers. Frayn’s work seems to prove the point.

Copenhagen, 1941

Niels Bohr was widely recognised as one of the greatest physicists of the century, alongside Einstein, and Werner Heisenberg had been his young collaborator. By 1941, in the middle of the Second World War, it was some time since they had seen each other. Bohr was living in occupied Denmark, and Heisenberg worked as a scientist under the Nazi regime in Germany. Their days of collaboration were over. But in the autumn of 1941, Heisenberg travelled to Copenhagen to give a lecture. He also arranged a meeting with Bohr. The purposes and outcome of this meeting have been the subject of much speculation and curiosity ever since.

Interest focuses on the role each of the protagonists was playing in the development of the bomb. In 1941 both the Allies and the Germans had teams of nuclear and atomic physicists engaged in work that could lead to the development of nuclear weapons. By 1942, both sides were involved in a contest to produce a bomb based on the principles of nuclear fission, a weapon that would give whoever won the race a decisive military advantage. The understanding of the workings of the nucleus had been developed over the previous decade, beginning with the discovery of the neutron in 1932. Bohr and Heisenberg had both contributed to the theoretical development of this area of physics. Experimental work ran in parallel. Crucially, in 1939, it was realised that the splitting of the nucleus by a single neutron – the process called fission – was accompanied by the release of two or more neutrons and huge quantities of energy. These newly
produced neutrons could then go on to interact with – and split – further nuclei of uranium, producing the possibility of a chain reaction since the number of atoms involved doubled each time. However, the free neutrons produced would not fission other nuclei in uranium 238, the isotope that makes up 99 per cent of natural uranium. They will fission only the nuclei of the uranium 235 isotope, which makes up the other 1 per cent. By the time that war broke out, the only remaining questions seemed to be whether, and how, it might be possible to turn the possibility of a self-sustaining chain reaction into practice. What quantity of fissile material would be required? And how difficult would this be to produce?

This was more or less still the context when Heisenberg visited Bohr in the autumn of 1941. Heisenberg was under surveillance by the Gestapo, as was Bohr. Why did they meet? And what was said? Most importantly, what was Heisenberg hoping to achieve by the meeting, and what can be deduced from this about his role in German attempts to build the bomb? Was Germany’s failure the result of deliberate and clever stalling on Heisenberg’s part, an intervention that would have been, on the face of it, more risky than David Kelly’s attempt to expose the Blair government discussed in Chapter 2, or did he not succeed because he just did not understand the physics? Michael Frayn’s imaginary re-enactment of the encounter addresses these questions.

As the action proceeds, the three characters, all now ghosts – the action takes place after they are all dead – re-enact the events of that night in 1941. Three alternative fictional scenarios are presented. They are not separate but weave and interweave into each other. Each begins as Heisenberg approaches the house: ‘I crunch over the familiar gravel to the Bohr’s front door, and tug at the familiar bell pull … The heavy door swings open.’¹⁶ In the first scenario, Heisenberg comes to see Bohr to warn him of the existence of a German nuclear programme, and to find out whether the Americans are doing the same. He asks Bohr ‘if one had the right as a physicist to work on the practical exploitation of atomic energy’.¹⁷ His hope is to persuade the scientists working with the Americans to try to delay the programme by emphasising the difficulty of separating uranium 235. In this scenario, this was what Heisenberg was doing in Germany: keeping control of
the programme, but making sure that it did not succeed. The German project was a reactor that would produce plutonium that could then be used for weapons, in place of uranium $^{235}$. Heisenberg asked for so little money that the project was not taken seriously.

The second re-enactment gives Margrethe’s interpretation of what Heisenberg’s motives were. She sees him as ‘back in triumph – the leading scientist in a nation that’s conquered most of Europe … come to show us how well [he’s] done in life’, and come to let them know he is in charge of a vital secret piece of research – and yet has preserved a lofty moral independence, and has ‘a wonderfully important moral dilemma to face’.19

The final scenario presents Frayn’s own interpretation of the meeting. In this last re-enactment, it is not so much why Heisenberg has come to Copenhagen that matters, but how Bohr responds to his question, ‘Does one as a physicist have the right to work on the practical exploitation of atomic energy?’20 By saying absolutely nothing – he terminates the conversation and the meeting there and then – Bohr avoids prompting Heisenberg to make the calculation about the critical mass required for a chain reaction in uranium $^{235}$: the amount of pure uranium $^{235}$ that would be required to keep a chain reaction going long enough for it to become explosive. If Heisenberg had made the calculation, he would have realised that the task was by no means impossible. The amount required was not around a ton, as Heisenberg thought, but a few kilogrammes. The historical record appears to show that he did not make the calculation until the bomb had been dropped on Hiroshima in 1945.21 He ‘hadn’t consciously realised there was a calculation to be made’, and according to Frayn’s final scenario, Bohr deliberately left him in his state of ignorance.22

Uncertainty and complementarity

The re-enactments are fascinating, and raise challenging questions of motive and morality. But the play leaves us questioning more than what the purposes of the meeting were. In the end Frayn is less concerned with the purpose behind Heisenberg’s visit, or with establishing what happened or who was responsible, than he is with exploring how the answers to any of these inevitable questions could
never be known for certain. This is what the play chooses to focus on, and it is this aspect that is useful for my reading of ideas of security. The play examines whether thoughts and intentions can be precisely established. Frayn draws a parallel between the uncertainty principle in physics – as formulated by Heisenberg – and the interpretation of human actions.

The Copenhagen interpretation of quantum mechanics which Bohr and Heisenberg had worked on together involved two principles – the uncertainty principle and complementarity. In classical Newtonian mechanics the assumption is that if we know the state of a system at some point in time, we can predict what its state will be at some future point. Systems comprise objects or bodies which are independent of each other and interact according to physical laws. Two separate systems will behave completely independently. In quantum mechanics, the new mechanics that was derived from studies of the atom and the nucleus in the early years of the twentieth century, it became clear that there were phenomena which it was ‘impossible, absolutely impossible, to explain in any classical way’. Bohr was one of the first involved in this work. His suggestion that the electrons orbiting the nucleus in an atom moved discontinuously from one state to another, or as is often expressed, ‘jumped’ from one orbit to the next, emitting discrete packages or ‘quanta’ of energy, was the beginning of quantum theory. Bohr realised that ‘this break with the classical scheme – he called it the quantum postulate – implied that the description of atomic systems required a deep readjustment of how we are to understand the classical mechanical “pictures” of particles or waves moving through space and time’.

The uncertainty principle formulated by Heisenberg was a statement of this distinction between classical and quantum mechanics. It reflected the fact that it had proved impossible to devise experiments to measure things on an atomic scale without at the same time influencing the things that the experiment was designed to measure. In particular, it was impossible to measure the position and momentum of a particle at the same time with more than a limited degree of accuracy. In the words Frayn gives to Heisenberg, it was

the strangest truth about the universe that any of us has stumbled on since relativity – that you can never know everything
about the whereabouts of a particle, or anything else ... because we can’t observe it without introducing some new element into the situation ... You have no absolutely determinate situation in the world, which among other things lays waste to the idea of causality, the whole foundation of science – because if you don’t know how things are today you certainly can’t know how they’re going to be tomorrow.\textsuperscript{25}

Bohr’s concept of complementarity added a vital supplement to this principle, or rather, provided an alternative and potentially more challenging and more fundamental formulation of the same thing. The principle is remembered as particle-wave duality. But it was much more than the idea that sometimes an electron, for example, behaves as a wave and sometimes as a particle – which tends to lead to the notion that these two pictures can be used interchangeably. One can choose whichever suits the situation. However, Bohr’s argument was not that we could use whichever of these classical models we liked. He noted (and these are his own words this time) that ‘radiation in free space as well as isolated material particles are abstractions, their properties on the quantum theory being definable and observable only through their interactions with other systems’.\textsuperscript{26} In other words, classical concepts are idealisations: nature is not like that.

Although the uncertainty principle clearly does not apply directly to our observations of thoughts and intentions, Frayn argues that ‘what the uncertainty of thoughts does have in common with the uncertainty of particles is that the difficulty is not just a practical one, but a systematic limitation which cannot be circumvented’.\textsuperscript{27} It is not just a question of not being able to get inside other people’s heads – we cannot even get inside our own. Indeed, our own motivations and thoughts are perhaps the most elusive of all, since we do not see ourselves doing what we do as a result of those thoughts, whilst others do, as Margrethe argues in the play.

**Surveillance, subjectivity, social order**

In Michael Blakemore’s production, the set is minimalist. It consists of a circular stage with three upright chairs, one for each of the three
protagonists: Bohr, Heisenberg, and Bohr’s wife, Margrethe. There is a single entrance to the circle, at the centre back of the stage. The remainder – apart for the side where the audience is sitting – is surrounded by a high, circular backdrop. On the top of this, looking rather like jury benches in a court room, are two semi-circular rows of seats, filled during performances by members of the audience. They are there not only to observe the action but also to enable us to see ourselves watching it: they are our mirror. We become participants in the action. During the course of the dialogue, the actors circle and re-circle the set.

The play is about observation, performance and the uncertain production of self and social order. To take observation first. There are a number of levels of surveillance built in. First of all, there are representatives of the audience on stage. Then there are the frequent references in the dialogue to the possibility of Gestapo microphones: the characters take a turn around the garden when they have anything important to say. Third, there is the figure of Bohr’s wife. She is both protagonist and observer. Regarded by the other two as their audience – ‘We’re going to make the whole thing clear to Margrethe’ – she is ‘watching every step’, and in the end she voices her own scenario.

However, it is not just a question of watching or being watched. We may be being watched, and those watching what we do may find it almost impossible to determine our thoughts or motives. They cannot predict what will happen next because they do not know with any certainty what is happening now. They can hazard a guess, however. But how are we to know what our own thoughts might be when we cannot even see ourselves?

In the final re-enactment at the end of the play, this is brought out clearly. Heisenberg arrives at the Bohrs’ house once more, ‘blinking in the sudden flood of light from the house. Until this instant his thoughts have been everywhere and nowhere, like unobserved particles, through all the slits in the diffraction grating simultaneously. Now they have to be observed and specified.’ Heisenberg reflects on this:

At once the clear purposes inside my head lose all definite shape. The light falls on them and they scatter ... How difficult it is to see even what’s in front of one’s eyes. All we possess is the
present, and the present endlessly dissolves into the past. Bohr has gone even as I turn to see Margrethe … Margrethe slips into history even as I turn back to Bohr. And yet how much more difficult still it is to catch the slightest glimpse of what’s behind one’s eyes. Here I am at the centre of the universe, and yet all I can see are two smiles that don’t belong to me.30

The only solution to this latter conundrum, the only way we can see ourselves if you like, is reflection. There are two forms. One source of reflection is a mirror, of course: in the play Heisenberg catches a glimpse in the mirror of a third smile, and ‘an awkward stranger wearing it’, who he speculates could be him.31 The other source is the gaze of other people. Bohr glances at Margrethe and for a moment he sees what she can see and he can’t, the smile vanishing from his own face as Heisenberg blunders on through the opening civilities. When Heisenberg looks at the two of them looking at him he suddenly sees ‘the third person in the room as clearly’ as he sees them. But this is only a fleeting glimpse, and one he makes no sense of.

The notion that we only exist to ourselves as a person or a subject if we are involved with others, so that we can see ourselves reflected in their gaze, is found in Lacanian approaches to subjectivity. For Lacan, the so-called mirror phase marks the entry of the subject into the imaginary order.32 By catching sight of oneself in the mirror, or in the gaze of another person, one has a glimpse of oneself as a whole, as a separate individual interacting with other separate beings. However, for Lacan – as in Bohr’s quantum mechanics – this is an illusion, or rather, an abstraction. It is a mis-recognition of who or what we are. It is imaginary. Despite the appearance of wholeness and of control, we remain fragmentary creatures subject to all sorts of intersubjective forces rather than complete, self-contained entities in charge of our actions.

In Lacanian thought there is a second stage in the production of subjectivity – which doesn’t displace the imaginary but is added to it – the entry of the subject into the symbolic or social order. It is crucial to mention that this is not in any sense a question of an interaction between a pre-existing subject and a society or social order outside the subject which is always already there. As with the wave/particle
in Bohr’s quantum mechanics, it is only when the process has taken place that the two are produced as apparently separate states. The entry into the symbolic produces both the subject as subject (as ‘I’) and the social order as such. It is a process seen by Lacanians as having a peculiar temporality. The symbolic order does not exist before the subject. It only comes into being when it is posited by the subject as already existing. In other words, the subject produces the social order by behaving as though it were already there. Although this act of presupposition is an act for which there is no firm basis – there was no way in which it was known in advance that it would work – once it has worked it produces the illusion that the subject and the social order have always been there – as separate, distinct entities. Individual subjects and the societies made up of groups of such individuals seem to be separate entities based on firm foundations.

There is one further important thing to note about the production of self and society in the Lacanian view – and this is where the approach is particularly helpful in the analysis of security. Neither the subject nor the social order is complete or closed. There is always a lack or an excess that is produced by the very process of the production of these entities: the world does not neatly fit the socially and linguistically determined categories available. The categories are never sufficient to capture all the complexities and nuances involved. Like the notions of wave and particle, where neither is an adequate description, something is always left out. However, this lack or gap is concealed, hidden by what Lacan calls the master signifier (its masculinity reflecting the patriarchal structure of societies like the modern West). The master signifier is what temporarily holds the symbolic order together in a particular form. It is what makes it meaningful. Like power relations, as we saw in the previous chapter, it is productive as well as controlling. It produces a social field within which subjects can take their place. The master signifier is arbitrary – anything will do, any individual or object can occupy that position in the structure. Examples include divine providence, the invisible hand of the market, the Jew, the objective logic of history, patriarchy. In the contemporary world, the nation and the state take on this role.
Security, trauma, desire

The implications of these ideas of the formation of subjectivity for notions of security are clear. Lacanian approaches teach us that every subject is incomplete, structured around a lack or an antagonism. As such it is *in its very character* insecure. This insecurity, like uncertainty in the case of particle physics, is not something that can be got around, some sort of temporary hindrance that can be overcome. It is something that is inherent in the nature of the world, if one accepts the Lacanian view. Not only is every subject incomplete, so is every particular social or symbolic order. There is always some lack or excess around which that order is constituted, a lack which is concealed by the presence of a master signifier. It has to be concealed for what we call social reality – or what Slavoj Žižek calls social fantasy – to work.

When a security issue arises, what is happening is not that external threats are being recognised or new dangers assessed. It is something quite different that is taking place. The inherent insecurity in the object concerned – generally the state – is being concealed. When something is impossible, one way of concealing that impossibility is to shift the blame somewhere else. During the Cold War, state insecurity in the West was blamed on the Soviet Union. The West would have been secure but for the Soviet threat. The impossibility of security appears contingent. If only we can get rid of the current impediment, we can achieve a secure world. Another example of course is the rush to the discourse of security after September 11. The events of that day made very clear the impossibility of providing complete security for people and state institutions on the US mainland. But rather than admit that impossibility as structural, and work within it, the state moved immediately to declare war. The war is again supposed to produce what has always been and will remain an impossible fiction: security.

In the face of a traumatic event such as September 11 the status of the social or symbolic order – and the fiction of security – becomes apparent. Trauma involves the experience of overwhelming shock, terror or brutality – as in violent events such as a train accident, shell shock in wartime, or a natural disaster – when human beings are faced with the limits to their existence as subjects. It is an encounter with what Lacanians call the real – that which cannot be symbolised, which
simply means the lack or excess that is produced when the symbolic order is put in place. The re-enactments in Frayn’s play are punctuated by flashbacks to the traumatic death of Bohr’s son Christian, who was drowned when he fell from a boat his father was sailing: ‘those short moments on the boat, when the tiller slams over in the heavy sea, and Christian is falling. ... Those long moments in the water ... . When he’s struggling towards the lifebuoy. ... So near to touching it.’ Trauma is an instant when two parallel worlds – like the parallel worlds of quantum physics – are divided by a decision, a moment that cannot be identified, seen, or accounted for. It is a limit point, and it cannot be spoken. It is Derrida’s mystical foundation of authority, or *coup de force.* An encounter with trauma makes the insecurity of existence inescapable.

For Bohr and Heisenberg the ramifications of uncertainty for the physical world are clear. In the end it is Margrethe who takes the implications to their fullest extent at the human level. ‘You want to make everything seem heroically abstract and logical,’ she complains to Bohr, ‘And when you tell the story, yes, it all falls into place, it all has a beginning, a middle and an end. But I was there, and when I remember what it was like, I’m there still, and I look around me and what I see isn’t a story! It’s confusion and rage and jealousy and tears and no one knowing what things mean or which way they’re going to go.’

What happens if there is no longer an audience, either? Again, Margrethe is the one who points out that Heisenberg and Bohr have been working on ‘a more efficient machine for killing people [one that] may yet kill every man, woman, and child in the world’. If this were to happen, then ‘Even the questions that haunt us will at last be extinguished. Even the ghosts will die.’

As we have seen, Frayn has drawn a parallel between the uncertainty principle in physics and the interpretation of human thoughts and actions. I want to draw a parallel here between the search for certainty that drives much human action and the search for security. Why do we need the fiction of security? Like the notion of certainty in science, it leads to possibilities of prediction and control and in that sense can be seen to serve to preserve existing relations of power. Is there more to it than that? What makes it so compelling to us, even as
we glimpse the problems with it in the faces of those whose security is compromised by our own privilege?39

If we return to the play, we see the protagonists circling and re-circling as they formulate and reformulate different possible answers to the question of what exactly happened on that night in 1941 in Copenhagen. It is not an abstract intellectual discussion however. It is a question of the production of each individual as a character in the drama, with a particular role to play: Bohr as ‘a good man from first to last’, for example, Heisenberg as the ‘clever son’.40 And observation has a vital role to play. Without an audience, none of this could happen. It isn’t just that we behave differently if observed, like the sub-atomic particles whose actions are disturbed by an attempted measurement. It’s that we behave to be observed: to produce ourselves as subjects within the social or symbolic order. Without the audience, we are nothing.

The audience is the one to whom the performance is addressed. Reformulating this in Lacanian terms, it is the social or symbolic order that is produced and reinvented in each of the stories of the Copenhagen encounter, and which each of the stories invokes. Like the Archimedian point, the symbolic order is crucial in any conceivable scenario. Without it no story is possible. We have seen in the Lacanian account how the social order is of necessity incomplete, but how this is concealed to enable the social fantasy within which we live to carry on. In the imaginary realm, we have a vision of our completeness as subjects produced at the mirror stage. It is the role of desire that impels us to search endlessly for such impossible wholeness once more. This desire is what lies behind both the desire for certainty and firm, established knowledge built on secure foundations, and the desire for security itself. But it is a desire that both requires and is thwarted by the social or symbolic order.

It requires it, in that the production of a coherent self relies on the production at the same time of a coherent social framework. The two are inseparable. However, we are not all similarly placed as actors in relation to the audience, or as subjects in relation to the symbolic order. As I have noted, the particular structure of the social order in the contemporary West is a patriarchal one, or to use the terminology, it is phallogocentric. As Luce Irigaray argues, ‘from a
feminine locus nothing can be articulated without a questioning of the symbolic itself. For those positioned ‘outside’ by the symbolic order, whether by virtue of gender, race, sexuality, disability or otherwise, the question of subjectivity is from the start more complicated and more ambiguous than in the case of those privileged by it. There is no simple way in which they can take up a subject position outside the symbolic order (there are none). And there is no way in which they can be secure within it in the way some white, heterosexual men may be, for example. For Irigaray, for women to take their place alongside men they would have to ‘challenge the very foundation of our social and cultural order, whose organisation has been prescribed by the patriarchal system’. 

Would it be overwhelming to exist without the shelter of a social fantasy? Such an existence involves facing on a day-to-day basis questions many of us prefer to forget, if we can. What would a world where the impossibility of security was acknowledged be like? Or one where the impossibility of certainty that quantum physics proposes were taken seriously and absorbed into our everyday cosmology? The two questions are very similar: both involve a similar shift in world view. This alternative vision is extensively adopted and explored in popular culture. The events of September 11, for example, were in a sense not completely unexpected, although they were uncanny in that something familiar only in the imagination was taking place in reality. However, for the new cosmology to be adopted and acknowledged in the public sphere would involve a shift away from the notion of state and individual upon which that sphere is currently based. It would entail the development of a new vision of political community, one that was not based on the coming together of discrete particles to produce closed political systems.

Afterlife

The play has had its own afterlife, one that in many ways reinforces Frayn’s arguments. As Matthias Dörries remarks, the play ‘engendered another drama, this one among historians [who] mounted a public spectacle with newspapers, journals and colloquia as their stage’. More importantly, original primary documents emerged as a result of
controversy the play aroused, including unsent letters from Bohr to Heisenberg, released in 2002, and letters from Heisenberg to his wife Elisabeth, made public in 2003. Amidst all the attempts by historians to pin events down and draw conclusions, these letters show yet again the impossibility of doing so.

The Bohr family were the first to respond to the play by the addition of new documents to the historical record. Robert Jungk’s book *Brighter than a Thousand Suns*, an account of the development of atomic weapons during the war published in 1957, contained a letter from Heisenberg to Jungk giving his version of the 1941 conversation with Bohr. In this letter, although Heisenberg admits that ‘I may be wrong after such a long time’, he recalls that the conversation started with his question ‘as to whether or not it was right for physicists to devote themselves in wartime to the uranium problem’. Heisenberg recalls Bohr’s ‘slightly frightened reaction’, and his counter question as to whether Heisenberg thought fission could be used for weapons. Heisenberg goes on:

I may have replied ‘I know that this is in principle possible, but it would require a terrific technical effort, which, one can only hope, cannot be realized in this war.’ Bohr was shocked by my reply, obviously assuming that I had intended to convey to him that Germany had made great progress in the direction of manufacturing atomic weapons.

Heisenberg says he tried to correct this impression, but ‘probably’ did not succeed, and was left ‘very unhappy about the result of this conversation’. His letter to Jungk is carefully phrased, but Jungk chose to reprint only part of the letter in his book.

The appearance of the Dutch translation of the book containing this letter prompted Bohr to attempt to draft a letter to Heisenberg to try to set the record of their meeting straight. Though several drafts were written over the period between 1957, when Jungk’s book was published, and 1962, when Bohr died, the letter was never sent and its contents not made public. The documents were eventually lodged in the Bohr archive and embargoed, with the rest of the papers, until 2012, fifty years after Bohr’s death. The embargo was lifted by the Bohr family in 2002, as a result of the controversy and speculation aroused...
by Frayn’s play. They are published, with introductory comments by Finn Aaserud, in Dörries’s book Michael Frayn’s Copenhagen in Debate.49

The letters are remarkable in many ways. As Dörries observes, the release appeared to have confirmed holders of opposing positions in their views, and, far from settling the historical debate, ‘it has given it wings’.50 His volume documents some responses. Frayn himself responded to the publication of the letters, and the criticisms excited by his play more broadly, in a new post-postscript, a version of which appeared in The New York Review of Books.51

The various drafts that Bohr wrote are a remarkable attempt to put in writing as clear an account of what happened, and his disagreement with Heisenberg’s version, as he could. In the first draft, written around 1957, a sense of his anger is palpable. Bohr writes, ‘I remember every word of our conversations. … In particular, it made a strong impression both on Margrethe and me … that you … expressed your definite conviction that Germany would win.’ He goes on:

I also remember quite clearly our conversation in my room at the Institute, where in vague terms you spoke in a manner that could only give me the firm impression that, under your leadership, everything was being done in Germany to develop atomic weapons. … I listened to this without speaking since [a] great matter for mankind was at issue. … That my silence and gravity, as you write in the letter, could be taken as an expression of shock at your reports that it was possible to make an atomic bomb is a quite peculiar misunderstanding, which must be due to the great tension in your own mind.52

Bohr continues, saying that it was clear from 1939 onwards that he himself realised that an atomic bomb was possible, and that ‘if anything in my behaviour could be interpreted as shock, it did not derive from such reports but rather from the news, as I had to understand it, that Germany was participating vigorously in a race to be first with atomic weapons’. Despite the assertion with which he began, Bohr concludes, ‘All this is of course just a rendition of what I remember clearly from our conversations.’ The letter was never sent.
In draft letters written on the occasion of Heisenberg’s sixtieth birthday in 1961 (but again never sent), Bohr is more circumspect. He notes that he has been asked by many for an account of events during the war, and he writes, ‘I have felt how difficult it is to form an accurate impression of events in which many have taken part.’ He expresses the hope that ‘we shall soon have the opportunity to talk in more detail about such questions, especially in connection with the visit by you … to Copenhagen in 1941, the background and purpose of which I am still being asked about’.53

Although these letters were never sent, the two did talk after the war. Bohr was clearly dissatisfied with these conversations, and resumed his attempt to put something in writing to Heisenberg. He writes in the final unsent draft, dated March 1962, ‘As you know from our conversations in the first years after the war, we here got quite a different impression of what happened during this visit than the one you expressed in Jungk’s book.’ He goes on to say, ‘Naturally, we all understand that it may be difficult for you to keep track of how you thought and expressed yourselves at the various stages of the war, the course of which changed as time passed.’54 However, despite this concession, Bohr is convinced his own recollection is not at fault in the case of the conversation they had at the Institute, ‘during which, because of the subject you raised, I carefully fixed in my mind every word that was uttered’, and he sets out what was said. He concludes the letter, ‘I have written at such length to make the case as clear as I can for you and hope that we can talk in greater detail about this when the opportunity arises.’55 It appears that it never did.

Both Bohr’s drafts and Heisenberg’s communication with Jungk give an account of not only what was said, as they remembered it, but also of what they each thought the other was thinking. Both seem convinced that their own interpretation of events must be correct, though each admits that often memory and perceptions may be misleading. Bohr in particular says he hopes that if only they could meet and talk face to face at length, all could be settled, and a more certain version of events established – whilst at the same time implying that what needs to happen is for Heisenberg to be convinced of his error.

A further release of historical documents followed that by the Bohr archive: the release of letters exchanged between Heisenberg and his
wife Elisabeth, including one written by Heisenberg during his 1941 visit to Copenhagen. These were later edited by Anna Maria Hirsch-Heisenberg and published in English in 2016. She writes in her preface from Feldafing in June 2011:

When my mother died in 1998, I inherited two carefully wrapped bundles of letters: my father’s to her and hers to him. At my mother’s wish, the letters came to me as eldest daughter. Around this time the debate about my father’s role in World War II was rekindled, partly prompted by Michael Frayn’s play Copenhagen; thus I decided to take a closer look at the letters.

The new letter clarifies some of the practical details: where they met and when, and who was at the meetings, but says nothing about the content of the more ‘political’ or scientific conversations. In his account of the journey and his arrival in the familiar city, Heisenberg remarks on how ‘everything has stayed so much the same as if nothing out there in the world had changed’. He appears surprised, though, by ‘how much hatred and fear has been galvanised here’, given that, as he sees it, everyone in Copenhagen ‘is living exceptionally well’.

Cathryn Carson, in her biography of Heisenberg, which focuses on the postwar period, cautions against thinking that we have got ‘a grip on the man’. She argues that Heisenberg ‘did not let himself be easily read in any, particularly public, circumstances. ... More than that, in most things that mattered, he went out of his way to put a layer of distance between what he might think and what he might say.’ She takes Heisenberg’s interpreters to task for ignoring the difficulties they face, and points out the ‘deep-seated irony’ given ‘Heisenberg’s own reflections on epistemology’.

Conclusion

The point of all this – and the point that Frayn, in my reading at least, is at pains to make – is that although we can have no firm grounds for making decisions about intentions, we nevertheless have to make those decisions. Frayn argues that he is unambiguous on this question: his Heisenberg is saying, ‘we do have to make assessments of intention in judging people’s actions’. The ‘final core of uncertainty
at the heart of things’ does not let us off the hook in terms of making judgements of responsibility or anything else. It means that we cannot know whether we are right: that no amount of ‘evidence’ or historical investigation will reveal how things ‘really’ are. This does not mean we should ignore the evidence or forgo investigation: we should find out as much as we can. But that will not give us the answer. We can never be certain. We can never be secure. And attempting to seek certainty and security is more than a waste of time: it is dangerous. In seeking to prove ourselves right, we must assert that the other is wrong. In attempting to ensure our own security, we inevitably make the other (and eventually ourselves) less so.

Ironically, the cosmology that made the bomb possible also leads to the questioning of the very notions of security and certainty in whose name the bomb was being produced. However, we are a long way yet from the shift in episteme where ‘man would be erased, like a face drawn in the sand at the edge of the sea’. Without a recognition of the interconnectedness and inseparability of contemporary life – and indeed all life forms – and its inevitable vulnerability, there is no way in which the desire for an imaginary wholeness, and the certainty and security that go along with it, can be prevented from driving us to ever more horrific feats of invention.

At the end of the play, Margrethe asks, ‘when all our eyes are closed, when even the ghosts have gone, what will be left of our beloved world?’ There is of course, no answer. Heisenberg replies, ‘But in the meanwhile, in this most precious meanwhile, there it is.’

Notes
1 Parts of this chapter draw on a paper presented for discussion at the International Studies Association Annual Convention, New Orleans, 23–27 March 2002, and published in Contemporary Politics 9, no. 4 (September 2003): 361–70.

For an interesting exploration of how much contemporary thinking and culture have ‘caught up’ or not, see Robert P. Crease and Alfred Scharff Goldhaber, The Quantum Moment: How Planck, Bohr, Einstein and Heisenberg Taught Us to Love Uncertainty. New York: W.W. Norton, 2014.


Frayn’s is not the only play to have drawn on quantum physics; another example is Tom Stoppard’s Hapgood. London: Faber & Faber, 1988. For a discussion of that play see chapter 5 of Peggy Phelan, Unmarked: The Politics of Performance. London: Routledge, 1993.

Barad takes Frayn to task for both his analogical thinking and his interpretation of quantum mechanics; see Barad, Meeting the Universe Halfway, 3–25.


An early popular text responsible for much controversy was Robert Jungk’s Brighter Than a Thousand Suns: A Personal History of the Atomic Scientists. Translated by James Cleugh. Harmondsworth: Penguin, 1960. The book that inspired Frayn’s play was Thomas Powers’s Heisenberg’s

For the brief summary given here I draw on ‘Into the Heart of Darkness’, pp. 6–8 of the programme of the Royal National Theatre Production of Copenhagen by Michael Frayn. Poole Arts Centre, Tuesday 20–Saturday 24 November 2001.

Frayn, Copenhagen, 12, and also 54, 88.

Frayn, Copenhagen, 36.

Frayn, Copenhagen, 76.

Frayn, Copenhagen, 77.

Frayn, Copenhagen, 90.

Frayn, Copenhagen, 111.

Frayn, Copenhagen, 91.

Feynman, Six Easy Pieces, 117.


Frayn, Copenhagen, 69–70.


Frayn, Copenhagen, 101.

According to Bohr, terms in our everyday language make no sense in quantum mechanics. ‘Observation’ in particular implies a separation of observer and object of observation that is no longer tenable. But we have no other words to use.

Frayn, Copenhagen, 38; 58.

Frayn, Copenhagen, 88–9.

Frayn, Copenhagen, 89.


Frayn, Copenhagen, 30.


Frayn, Copenhagen, 75.

Frayn, Copenhagen, 81.


Frayn, Copenhagen, 93; 80.

Irigaray, *This Sex Which Is Not One*, 165. Original emphasis.


Powers, ‘A Letter from Copenhagen.’


Frayn, ‘Copenhagen Revisited.’


Frayn, *Copenhagen*, 96.