

Talk at the Niels Bohr Archive
June 2011

I'm flattered and honored by the invitation to speak at this first jubilee of the Niels Bohr Archive and almost speechless at that thought that I am now the same age that Bohr was when I met him almost fifty years ago. That was in connection with the work of a project to preserve documents and reminiscences having to do with the early history of quantum physics. My participation in this project is the reason that Finn Aaserud has inflicted me on you today, for the project, which was called Sources for History of Quantum Physics, played a part in the pre-history of the NBA.

The prehistory of archives in general is an instructive subject. I'll say a few words about it before turning to my main topics, which are, first, the archiving of papers of scientists, and, second, the development of the NBA.

As for the prehistory of archives, it dates back five millennia. That is too long to review here. Fortunately, for my purposes it can be reduced to a single episode, its grandest moment, as recorded by the prophet Ezra. According to this unimpeachable source, the efficient functioning of a well organized archive enabled the Jews to rebuild their temple in Jerusalem without molestation. It happened that a Persian official in Jerusalem doubted that King Cyrus, who had freed the Jews from their Babylonian captivity, had also granted them permission to rebuild the Temple. The official wrote to Babylon for confirmation. Ezra recorded what happened on receipt of the inquiry: "a search was made in the House of the Rolls...And there was found a roll, and therein was...a decree concerning the house of God in Jerusalem." The decree, from Cyrus, included permission to rebuild, specified dimensions, authorized payment from the King's purse, and ordered restitution of gold ornaments stolen by his evil predecessor Nebuchadnazzar.¹

All of which goes to show that archives are important to civilized life and have been for at least three millennia. So have archivists, who not only collect but sometimes, as in the case recorded by Ezra, also can find the documents in their care. Like their modern counterparts,

¹ Ezra, 6:1-5.

ancient archivists had to face and resolve problems of storage, preservation, and retrieval. Records came in many media – in Cyrus’ time on stone, baked clay, unbaked clay, papyrus, leather, wood, and wax. Archivists filed them wherever they could, in jars, baskets, boxes, cupboards, and, what has proved a treasure trove for modern historians, mummified crocodiles.²

Some say that Moses was the first archivist. If so, archival practices have improved a lot since his time. For one thing, Moses received most of his information orally, from a dark cloud. A modern archivist gives preference to written documents from known informants. Moses did have two authentic documents, inscribed on stone by their author, but he broke them because their intended audience showed greater interest in a golden calf. After obtaining a copy of the tablets and writing his histories and commandments, Moses disposed of his research materials and placed the finished final version alone in a portable archive of ark encrusted with gold.³

The keepers of the Niels Bohr Archives also take down information orally, that is, they interview relevant people, but, in contrast to Moses, they know whom they are talking to. They prize the original and authentic and would not think of disposing of documents because someone had incorporated them in an official history, or of destroying them out of annoyance at their potential users. The NBA preserves its holdings carefully, knowing that later scholars will find important things in them that earlier ones missed. The Bohr archivists do not keep the paper, film, fiche, photographs, punched cards, magnetic tape, CDs, flash drives, and sound recordings entrusted to them in a jealously guarded gilded ark, but in accessible acid-free containers. No doubt, however, they could make good use of a little gold.

Knowledge is power. Archivists are very knowledgeable. They know the whereabouts of the buried bodies. When Galileo’s anti-Roman friend Paolo Sarpi was granted the rare privilege of free access to the Venetian Archives, he became one of the most powerful men in the state;

² Ernst Posner, *Archives of the ancient world* (Cambridge: Harvard University Press, 1972), 44, 57-8, 88, 138, 159.

³ Exodus, 19:9-34:4.

so powerful that an admiring Vatican tried to assassinate him, several times.⁴ The archives made him a far greater threat to papal pretensions than Galileo's missionary efforts on behalf of the sun-centered universe. Not all archivists exercise their power so as to become lawgivers like Moses or political forces like Sarpi. Most of them deploy their might gently, easing the way of others to the authentic records of the past, opening paths to constructive confrontation with the documents without which we do not have a chance of civilizing ourselves.

1. Archives of Scientists

The archiving of the papers of scientists takes place in many different sorts of establishments. Most common is the general-purpose state or university library. Typically, these institutions handle the *Nachlass* of a scientist as they would the literary remains of an ordinary person. Depending on its size and circumstances, a general library may engage an archivist especially to develop collections in the history of science; sometimes, although I think not often, this archivist has a doctorate in the history of science and publishes in the field. In the U.S., the libraries of the universities of California-Berkeley, Caltech, Oklahoma, and Wisconsin, and of Harvard, Stanford, and Yale have, or until recently have had, such a person on their staffs. No doubt there are more but ten is probably the right order of magnitude. The number in Europe is hardly greater. In any case, scholar-archivists are becoming rare as libraries rearrange their operations in response to tightening budgets and enlarging demands for electronic assets.

A more secure habitat for the scholar-archivist of scientific papers is the learned society. The old academies of science are treasure houses of unpublished material for histories of science.⁵ Among scientific societies with particularly active scholar-archivists now or in the recent past are the academies of Stockholm, Göttingen, London, and Paris, and the American Philosophical Society. Museums of the history of science, which collect papers as well as

⁴ Micanzio, Fulgenzio, *The life of the most learned Father Paul* (London: H. Moseley and R. Marrot, 1651), 114-13, 138-44, 142-3[bis] (*recte* 162-3).

⁵ J.L. Heilbron, "Historical pointers to the future of academies," in Edoardo Vesentini and Leopoldo Mazzaroli, eds., *L'esperienze delle accademie e la vita morale e civile dell'Europa* (Venice: Istituto veneto di scienze, lettere ed arti, 2006), 123-36.

instruments and other artifacts, employ scholar-curators, as in Cambridge, Florence, Harvard, Leyden, London, Munich, Oxford, and Washington. The same can be said of old observatories that play the role of museums: the Yerkes in Chicago, the Observatoire of Paris, the Specola of Bologna. I suppose that keepers of herbaria may belong here too. In these cases, however, as with scholar-archivists in university libraries, increasing pressure to serve the public in the teeth of budget cuts has reduced the number, or changed the assignments, of scholar-curators. This is a deplorable trend.

There are of course many papers of first importance to the history of science in private hands. These virtual archives can be dangerous places for investigators as well as for manuscripts. I once discovered a cache of letters relevant to Bohr's early work on atomic structure in a haunted house. The house, which dates from Saxon times, belonged to the brother-in-law of Henry Moseley, who worked in Rutherford's laboratory in Manchester before World War I when Bohr too was there. The second floor of this ancient house was reached by an external staircase, which passed by a room that few people had entered for 200 years. That was because a ghost lived there. Walled up, where only a ghost could get at them, were letters from Bohr, Hevesy, and Rutherford to Moseley, as well as letters from Moseley to his mother and sister about work and workers in the laboratory. And that was far from all. The ghostly archivist also had stewardship of the papers of Moseley's father, a naturalist who corresponded with Darwin and Huxley, and of Moseley's grandfather, a physicist in contact with Joule, Kelvin, and Maxwell.

These papers were unusually difficult of access and vulnerable to loss or damage. With great generosity, their owner, Moseley's brother-in-law, made a gift of them to the Oxford Museum for the History of Science, where they joined other documents under the control of a flesh-and-blood archivist. Unfortunately, she too may well become a ghost as a consequence of cost cutting in the British government's support of universities and museums.

Hair-raising as this story might be, it does not compete with the rescue of the manuscripts of Galileo. A collector of these manuscripts, a scholar named Giovanni Battista Nelli,

unexpectedly encountered a sheet in Galileo's hand as a wrapping for a piece of mortadella.⁶ He ran to the butcher. "Where do you buy your paper?" The answer led Nelli to the house once occupied by Galileo's last disciple and first biographer, Vincenzo Viviani. Nelli discovered that Viviani's descendents were selling off the precious documents as waste paper. He bought the lot, which eventually found its way to safety at the Biblioteca Nazionale in Florence. A similar tale is told about the papers of James Boswell, the biographer of Samuel Johnson, with a grocer in place of the butcher and a ham sandwich in place of the mortadella.⁷

Once archived, a document can easily be lost or, if its location be known, unappreciated. Archives are places of discovery. A Danish professor, Johann Ludwig Heiberg, made perhaps the greatest single archival discovery in the history of the history of science. He identified an unknown letter from Archimedes under the text of a Greek prayer book. The letter contained what is now called the "method of Archimedes," a precious and unique account of techniques he used not to prove, but to invent, his theorems. The discovery, made in 1906, required not only the existence of the palimpsest and the archive in which it had long rested, but also the work of an informed archivist whose ample catalogue transcribed enough of the half effaced Archimedean text to enable Heiberg to identify it.⁸

Sources for History of Quantum Physics

The arrival of threatened papers in a well-conducted archive is like the saving of a vessel in danger of shipwreck. In the early 1960s, the manuscript remains of many of the creators of quantum physics were in imminent danger of dispersal or destruction. Many holdings, notably Max Planck's, had been obliterated during the war. Aging quantum physicists were retiring from their posts, leaving their universities, and facing the problem of disposing of papers to which neither they nor their institutions attached much historical value. Lest the papers of, say, Werner Heisenberg, suffer as did some of Galileo's and end up around a bratwurst, the American Physical Society and the American Philosophical Society obtained

⁶ Antonio Favaro, "Intorno ad una nova edizione delle opere di Galileo," in Favaro, *Galileo Galilei e lo Studio di Padova* (2nd edn, 2 vols, Padua: Antenori, 1966), 2, 211-31, on 317.

⁷ Peter Martin, *A life of Samuel Johnson* (New haven: Yale University Press, 2000), 4.

⁸ Reviel Netz and William Noel, *The Archimedes codex* (Da Capo Press, 2007), 131-2.

funds from the U.S. National Science Foundation to record the reminiscences of the main actors in quantum physics, and to try to insure the preservation of relevant documents.

Although the initiative and funding were American, and although the original intention was to deposit the interviews and documents in the archives of the Philosophical Society in Philadelphia and of the University of California at Berkeley, the project was necessarily international in scope. It had its headquarters here in Copenhagen. Its strategy was to interview the main historical actors, gain their confidence, borrow their relevant papers and correspondence for microfilming, and return the material with a recommendation that it be offered for deposit to one or another archive.⁹

I fear that what I have just said is what historians call a rational reconstruction. The project did borrow, film, and return manuscripts, and ended with hundreds of miles of microfilm, arranged for copying by Paul Forman. But we had not intended to put our major effort into preservation. We began giving greater weight to conducting interviews and located in Europe primarily to have easy access to our older interviewees. With great generosity and interest, Bohr allotted the project office space in converted stables adjacent to his villa in the Carlsberg Brewery. Léon Rosenfeld was the energetic intermediary between Bohr and the project's director Thomas Kuhn, and in the fall of 1962 the project's staff of five were at work in the brewery. Unfortunately we were not able to schedule many interviews with Bohr before his sudden death that November. This cruel reminder of mortality caused us to accelerate our program of interviews, which, however, soon foundered on the discovery that the memories of quantum physicists were no better than those of other mortals. I'll give you two examples of this fallibility, one from the quantum and one from the other world.

The first concerns James Franck, who, together with Gustav Hertz, received the Nobel Prize in physics in 1925 for experiments that confirmed the existence of atomic energy levels by means of electron impact. Due diligence by the project staff showed that Franck and Hertz began their experiments before they knew Bohr's work and that, when they discovered it, they insisted that their experiments disproved it. Bohr managed to reinterpret their results in

⁹ J.A. Wheeler, "Preface," in T.S. Kuhn et al., *Sources for History of Quantum Physics. An inventory and report* (Philadelphia: American Philosophical Society, 1967), v-ix.

his favor; Franck and Hertz continued in their original opinion; and the disagreement persisted until a few years before they received the Nobel Prize. (It was rather like that cardinal who became a priest just before he entered the conclave from which he emerged as Pope). When Kuhn asked Franck what had changed his mind about the bearing of his experiments on Bohr's theory, Franck did not understand the question. In his recollection, he and Hertz had begun their work in the expectation of confirming Bohr; happily they did so; and the Nobel Prize rewarded their efforts. When Franck saw the published record disproving the recollections he had based on the citation of his Nobel Prize, he broke off the interview in great distress.¹⁰

My second example has to do with the recollection of young mothers of landmark events in the development of their infants, such as the onset of teething, crawling, and toilet-training. The mothers' memories did not agree with the dates of these events as recorded by a clinic that had monitored the children. The point of interest is that their memories were all off in the same direction, by fourteen weeks in the pressing matter of toilet training.¹¹ Just as Franck had reworked his recollections to agree with the long-term significance of his work, so these mothers had tidied up theirs to agree with the development of the normal child as set down by Dr. Spock.

It does not follow from these stories that interviews are worthless. Reminiscences can supply reliable information and important leads not otherwise available. But they persuaded us to rebalance our project to give greater emphasis to the discovery and preservation of documents. The change of emphasis helped create the background to the establishment of the Niels Bohr Archive.

Rosenfeld's initiatives

It appears from the correspondence of Rosenfeld kindly transcribed for me by Dr Anja Skaar Jacobsen that by January 1962, more than six months before the project arrived in

¹⁰ Kuhn et al. (ref. 9), 3-8, 100. The cardinal in question was Giovanni Francesco Albani, Pope Clement XI (1700-21).

¹¹ L.C. Robbins, somewhere.

Copenhagen, Rosenfeld had almost convinced Bohr to establish an archive, presumably of documents related to quantum physics, with his scientific papers and correspondence as its nest egg. After Bohr's death and while the project still inhabited the stables, Kuhn, Rosenfeld, and Aage Bohr discussed the characteristics needed for such an archive and the ways in which it might be realized. By May 1963 plans had matured to the point that Aage Bohr could write Kuhn as follows:

My father always had a keen interest in the historical aspects of science, and especially in his later years devoted considerable effort to studies relating the early phases of quantum theory. After his death, his scientific correspondence, his papers and books are being collected in a special archive in the Institute. It is contemplated to collect in this archive material related not only to his own work, but generally to the development of modern physics so as to create the basis for a research center.¹²

Under Rosenfeld, the project's microfilming went forward with the copying of Bohr's manuscripts – a job that fell to Eric Rüdinger, whose death a few years ago was a great loss to everyone who knew him. As Bohr's assistant, Erik had an office in the stables and, together with Aage Pedersen, joined the project's staff for lunch made additionally convivial by a daily reenactment of the miracle at the marriage at Cana. This took place in a refrigerator, which kept itself full of Carlsberg beer.

The archive began to yield fruit immediately with Rosenfeld's discovery of a memorandum that Bohr had drawn up for discussion with Rutherford in the summer of 1912. It documents the earliest conception of the idea that nine months later became the nucleus of Bohr's atomic model. The memorandum and some correspondence of the period furnished Rosenfeld with the ingredients of the pioneering account of the development and early reception of the model that he prefaced to a reprint of Bohr's famous trilogy on the constitution of atoms and molecules published in 1963.¹³ Rosenfeld extended his treatment of Bohr's prewar physics in collaboration with Rüdinger in an article in the memorial volume edited by Stefan Rozentel

¹² A. Bohr to Kuhn, 27 May 1963, copy in Rosenfeld Papers.

¹³ Léon Rosenfeld, "Introduction," in Niels Bohr, *On the constitution of atoms and molecules* (Copenhagen: Munksgaard, 1963), xi-liii.

and published in Danish in 1964. Among the article's interesting features is an apology by its authors for having to rely exclusively on the written record, whereas the other contributors wrote from reminiscence.¹⁴ Apparently the ethic of the archive had not yet penetrated their souls.

Pursuing the opening made by Rosenfeld, and unapologetically reliant on documents, Kuhn and I tried to follow Bohr's course from his doctoral thesis on the electron theory of metals through the writing of the trilogy. To fill in gaps we were allowed to see, through Rosenfeld's good offices, some of the personal correspondence between Bohr and his family. This proved to be most valuable historical material. I am delighted to learn that more of it will be made available soon. Passages from the new material already made public show that Bohr pursued his literary interests while working out the basis of his quantized atom just as had when writing his doctoral dissertation.¹⁵ Bohr's choice of literature no doubt reflected his unusual sort of creativity and perhaps contributed something to it.

Another early user of the archives was Robert Oppenheimer, who came to our stables regularly for a week or so to obtain material for an obituary notice he was writing on Bohr for the U.S. National Academy of Sciences. It was an inspiration and a warning to listen to Oppenheimer relate the passages from Dante or the Baghavad Gita stimulated by his morning's ride on the S-tog. Like Franck, but more so, he had fallen for his own mythology.¹⁶

The most important publication from the archive was of course Bohr's *Collected Works*. His papers and correspondence were already in some order owing to the efforts of Betty Schultz and Sophie Hellmann. That lightened the labors of the volume editors engaged by Rosenfeld, who served as general editor. Each volume has its own chronological and thematic unity and also introductions placing the material in its scientific-historical context. The contract for the

¹⁴ Léon Rosenfeld and Erik Rüdinger, "The decisive years 1911-1918," in Stefan Rozental, ed., *Niels Bohr* (Amsterdam: North Holland, 1968), 38-73, on 38.

¹⁵ Niels to Harald Bohr, 20 April 1909, in *CW*, 1, 500, mentioning Kierkegaard's *Stadier paa livets vej*.

¹⁶ J.L. Heilbron, "Oppenheimer's guru," in Cathryn Carson and David Hollinger, eds., *Reappraising Oppenheimer. Centennial studies and reflections* (Berkeley: University of California Press, 2005), 275-291 (Berkeley Papers in the History of Science, vol. 21.).

edition, signed in 1969, provided for six or seven volumes to be issued over ten years.¹⁷ When Rosenfeld died halfway through the decade, in 1974, Rud Nielsen, the most prolific of the volume editors, had brought out one volume and had two more almost ready for the press.

Meanwhile, Rüdinger had returned from a teaching stint in Nigeria to assume the task of moving the edition on with the help of the Carlsberg Foundation. It was not easy. He found that “interest in the historical and philosophical aspects” of the *Collected Works* had died with Rosenfeld.¹⁸ I have this information from a letter of 1974 from Rüdinger to Forman, one of two-dozen wonderful letters on philosophical and historical aspects that Forman has just donated to the NBA. In 1977, Rüdinger became general editor and began to plan the remaining volumes of the series. Although still paid on soft money, he had adequate help and, by the centennial of Bohr’s birth in 1985, six volumes had been published and two more were about to be printed.

2. The Niels Bohr Archive

The Bohr centennial brought a very welcome promotion of the proto-archive into the NBA. Becoming official brought hard-money support, from the Ministry of Education, and a Board of Directors representing the University of Copenhagen, the Bohr Institute, the Danske Videnskabernes Selskab, and the Bohr family, which generously gave Bohr’s scientific papers and correspondence to the new institution. Its mission was to preserve and increase the collections, to encourage their study by the Archive’s staff and visiting scholars, and to complete the *Collected Works*.¹⁹

Rüdinger returned to international development work in 1989. He had an idea how to fill the vacuum he would leave. “We may have a happy solution at hand [he wrote Forman] since it may enable us to acquire the services of Finn Aaserud, whom we had planned in any case to secure as editor of the final volume of the *Collected Works*.”²⁰ Finn was appointed general editor and director of the archives in 1989. He brought the project to a close in 2007, with the

¹⁷ Finn Aaserud, Talk at NBA, 6 June 2008, on the completion of the *Collected Works* (hereafter *CW*).

¹⁸ Rüdinger to Forman, 21 May 1974.

¹⁹ Aaserud (ref. 17).

²⁰ Rüdinger to Forman, 7 April 1989.

publication of volume 12. Thus the enterprise begun by Rosenfeld ended in twice the number of volumes, and four times the time, called for by the contract with North Holland.

The publication of a scientist's collected works in twelve large volumes in 45 years is not unusually long by international standards. In the pathological case of Leonhard Euler, whose works have been in the works for over a century, it already has taken scholars many more lifetimes to edit and publish them than it took him to compose them. More commonly, such projects require 20 to 50 years. Among the largest recent projects, the Joseph Henry Papers at the Smithsonian were published in 11 volumes in exactly the same period, 1972 to 2007, as Bohr's *Collected Works*. The Einstein Papers, now edited from Caltech, has just published its 12th volume after almost 30 years of existence, and has 18 left to go.

Among the classical nineteenth-century editions, which, in general, are re-editions of text with few if any samples of correspondence, the *Oeuvres* of Lavoisier took 6 volumes and over 30 years (1862-93), those of Lagrange 14 volumes in 25 years (1867-92), of Laplace 14 volumes in 35 years (1878-1912), and of Gauss 12 volumes in 70 years (1863-1933). Closer to the *Collected Works* in scope and conception are Huygens' *Oeuvres complètes* (22 volumes in 30 years, 1880-1910) and the "national edition" of Galileo's *Opere* (20 volumes in 20 years, 1890-1910), which contain previously unpublished manuscripts and correspondence.

Pride

There was a frank element of national pride in the creation of these old editions. The connection was made with particular force by Antonio Favaro in his appeal to the patriotic sentiments of the newly unified Italy for money to support his new edition of Galileo's *Opere*:

When I was making my first inquiries [for government funds] the complete works of Lagrange [a native of Turin] were published under such auspices in France; and I remember how painful it was to me to see that without bothering itself in the least our country let slip this opportunity to affirm the Italian origin of the great Torinese before the entire scientific world. And not long ago, again in France, the works of Leonardo da

Vinci were printed with almost unparalleled magnificence. Oh! How much better it would have been for us to have provided for our own glory by using the money spent on monuments to these great men to collect and publish their work ourselves!...Let us go vigorously to work: or, mark my words, we will not be spared the supreme disgrace of seeing a complete edition of the writings of Galileo done by a foreigner.²¹

There is and should be an element of national pride in Bohr -- Denmark's towering representative of the high European culture that killed itself off in World War I. From this point of view, the *Collected Works* does not do justice to Bohr or the culture that produced him. This culture combined science, philosophy, literature, and poetry with a sense of social responsibility integral to the liberal Judaism on his mother's side of the family, and to the service to education prominent on his father's side.²² This potent mixture worked its effect on many people, lastly, perhaps, on Rüdinger, who late in his editing career and following on his public service read or re-read *Wilhelm Meister* and some of Goethe's poetry, and urged them on Forman with the same fervor that Bohr read them to his friends and colleagues.²³ This poetic fervor does not come through the *Collected Works*.

Notwithstanding the great collaborative achievement that the *Collected Works* represents, and its importance in establishing the NBA, it is lacking by modern standards. The correspondence it includes is sparse and selective, as each editor chose documents on the reasonable criterion that they should elucidate the scientific themes of the papers published in his volume. Perhaps at the time when Rosenfeld designed the *Collected Works* no wider view of the edition was possible if it were to be published at all. But now there are many attractive and realizable possibilities ranging from additional thematic volumes to a full web-based edition of everything the Bohr family has released.

An indication of the possible interest of and in the documents not yet released is the reaction to the material made available in 2002 concerning the famous visit Heisenberg paid Bohr sixty years before. Apart from drafts of a congratulatory message to Heisenberg on his 61st

²¹ Favaro (ref. 6), 331.

²² Abraham Pais, *Niels Bohrs times* (New York: Oxford University Press, 1991), 32-9.

²³ Rüdinger to Forman, 4 Jan 1986; Rüdinger singled out the phrase "Lebens labyrinthisch irren Lauf" from "Zueignung" as especially important for him.

birthday in 1961, the documents present Bohr's version of his conversation with Heisenberg during the German occupation. Whatever Heisenberg said, it made Bohr very angry, as did a report of Heisenberg's version of their meeting as published by a Swiss journalist, Robert Jungk, in 1957. Most of the drafts are not dated. The earliest probably was written in 1957 or 1958, the others in 1961 and 1962. Bohr sent none of them. Although all the drafts were intended to set the record straight, and although the addressee was always Heisenberg, that make best sense when read as directed to different audiences and different purposes.

For example, the last sentence in the earliest draft reads: "This letter is essentially between the two of us, but because of the stir [Jungk's] book already caused in the Danish newspapers, I have thought it appropriate to relate the contents of this letter in confidence to the head of the Danish Foreign Office and to Ambassador Duckwitz."²⁴ Bohr must have worried that Heisenberg's intimation that they had discussed the German uranium project might suggest that Bohr had been open to some sort of collaboration. That would help explain the reference to Georg Ferdinand Duckwitz, the West German ambassador, a personal friend of the Bohrs and of all of Denmark for his part in saving Danish Jewry during the war.²⁵

These considerations suggest that the Ministry and Duckwitz, not Heisenberg, were the readers Bohr had in mind. For if his primary concern was to erase a possible smudge on his public reputation, what good would it do to write a private letter to Heisenberg? I would not be surprised to find that Bohr had discussed the offending parts of Jungk's book with Duckwitz and also informed the Danish Foreign Ministry even though he did not send Heisenberg the letter in which he mentioned them as confidants. A search in the relevant archives might be rewarding.²⁶

²⁴ Finn Aaserud, "Bohr documents in facsimile, original, and translation," in Matthias Dörries, ed., *Michael Frayn's Copenhagen* (OHST, 2005), 105-79, on 113.

²⁵ Pais (ref. 22), 478; Bo Lidegaard, *A short history of Denmark in the 20th century* (Copenhagen: Gyldendal, 2009), 172-7. A downward revision of Duckwitz's role is in progress; Vilhjálmur Örn Vilhjálmsón, "'Ich weiss, was ich tun habe.' En kildekritisk belysning af Georg Ferdinand Duckwitz' rolle i redningen af jøderne i 1943," *Rambam*, no. 15 (2006), 72-93.

²⁶ Bohr mentions debriefings in England in his drafts to Heisenberg, n.d., and 26 Mar 1962, in Aaserud (ref. 24), 143, 157, 169. Cf. F.H. Hinsley et al., *British Intelligence in the Second World War*, vol. 3:2 (London: HMSO, 1988), 584-5, 589, 936.

Bohr was particularly upset by Jungk's report that Heisenberg had proposed a "gentleman's agreement" whereby physicists on both sides would foreswear pursuit of an atomic bomb. This proposal, if made, was by no means then the benign naive gesture it might now seem. In 1941 Heisenberg believed that the Germans would win the war unless, unexpectedly, their opponents managed to bring nuclear weapons to bear. Even to have listened to his proposal might smack of collaborationism.²⁷

The drafts dating from 1961 and 1962 attempt to explain Heisenberg's behavior and recollections by the changing circumstances of war and the humiliation of defeat. The psychology is sound and the audience is posterity. Some of the drafts mention Bohr's new deep involvement with history and the stimulus given it by SHQP.²⁸ If Bohr had not wasted his time at physics he might have made a good historian.

Opportunity

In 1971 Rüdinger wrote, "people in Denmark hardly realize Bohr's significance."²⁹ From a desultory search through Danish histories of the twentieth century, I gather that the situation might still prevail. Elsewhere Bohr's name is scarcely known although "quantum jump" has become a part of everyone's vocabulary. Bram Pais concluded the introduction to his biography of Bohr with the question why even physicists now do not know what Bohr did for their discipline.³⁰ Judging from my recent experience teaching at Caltech, physics students know nothing of Bohr except that he invented a quirky old-fashioned silly contradictory atomic model of interest only for a museum of scientific curiosities. When I reply to friends who ask whose biography I will attempt next that the victim is Niels Bohr, they look, and are, completely blank.

²⁷ Undated memo in Margrethe Bohr's hand, "Samtalerne med tyske fysikere i efteråret 1942 [!]," in Aaserud (ref. 24), 131.

²⁸ Bohr to Heisenberg, 30 Nov and 27 Dec 1961, and n.d., in Aaserud (ref. 24), 119, 125, 135, 139, 141, 145, 149, 153.

²⁹ Rüdinger to Forman, 12 Sep 1971.

³⁰ Pais (ref. 22), 14, 29.

The NBA should be able to change this deplorable situation. It is one of the few archives for the history of science that has a dedicated scholar-archivist. It still has unfinished business in the *Collected Works* and in fully establishing the international study center that, according to Rosenfeld and Aage Bohr, Bohr intended to set up around archival material with his own collections as its nucleus.

This was not a whim. As I mentioned, Bohr became increasingly interested in the history of physics as he aged – illustrating the complementarity he liked to draw between performing an act and analyzing a completed action. By the time he came to write up his Rutherford Memorial Lecture, which was published in 1961, he had so far absorbed the historian’s ethos as to invoke it against suggestions for revision proposed by the physicists to whom he sent the draft. His exchange with Charles Galton Darwin, who had been a coworker in Rutherford’s laboratory when he worked out the basis of his atom model there, is particularly instructive.

Darwin urged that Bohr simplify his account of the considerations that had led him to the model by reducing them to the ultimately decisive one. This was, as Darwin remembered it, the interpretation of the Balmer formula for the spectrum of hydrogen. Bohr refused on the ground that the simplification would destroy the “factual and detached” approach he had taken and rewrite history as pedagogy. As he knew well, the logical is seldom the chronological; history is often messy and sometimes foggy; the opposite of truth, as Bohr liked to say, is not falsehood but clarity.³¹

The upcoming hundredth anniversary of the quirky contradictory model that founded the quantum theory of matter offers a splendid opportunity to make Bohr better known to the world – not only Bohr the physicist and philosopher, but also Bohr the man of “uncommon power and earnestness of purpose,” to quote from Rosenfeld’s general introduction to the *Collected Works*³², and Bohr the representative of that old high European culture that bound the *Bildung* of the individual with a strong sense of social responsibility. As Bohr wrote of Hans Christian Ørsted, in words that apply equally to himself, “to [our] picture of Ørsted as a

³¹ *CW*, 10, 330-2; cf. *ibid.*, 392-3.

³² *CW*, 1, ix.

scientist and thinker belongs intrinsically his attitude towards his fellow human beings, which characterized his activity in the society he served so well.”³³

³³ *CW, 10, 364.*