

Niels Bohr:

*Politics, Popularization
and People*

A booklet on the occasion of the World Year of Physics

Prepared by Finn Aaserud, General Editor of the Niels Bohr Collected Works

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Coverphotograph: Niels Bohr, Albert Einstein, T. de Donder, O.W. Richardson, P. Langevin, P. Debye, A.F. Joffe and B. Cabrera, gathered to make plans for the 1933 Solvay Conference, Brussels, 1932

Photographer: Queen Elizabeth of Belgium

Preface

The World Year of Physics, which is celebrated in 2005, marks the hundredth anniversary of Albert Einstein's revolutionary publications in the 1905 volume of the German journal "Annalen der Physik". In addition to introducing the special theory of relativity, Einstein here made the radical proposal that the photoelectric effect might be explained by considering light as consisting not of waves, but of particles. The 1905 publications constituted a considerable triumph for the twenty-six year old physicist, who among colleagues and the general public alike came to be regarded as the greatest physicist of the twentieth century, closely followed by the Danish scientist Niels Bohr.

Six years younger than Einstein, Bohr had completed his gymnasium education in 1903 and had started his studies at the University of Copenhagen when Einstein's papers appeared. Bohr made his first fundamental contribution to physics in 1913, when he published his quantum theory of the atom in his so-called trilogy of papers in the British "Philosophical Magazine". When he received the Nobel Prize in physics for this work in 1922, Bohr went out of his way to emphasize that his contribution was part of a tradition in the new quantum physics beginning with Max Planck's introduction of the quantum concept in 1900 and continuing with Einstein's paper on the photoelectric effect as well as Ernest Rutherford's experimental discovery of the nuclear atom in 1911, which served as the empirical basis for Bohr's theory.

The year 2005 celebrates not only the hundredth anniversary of Einstein's breakthrough as a physicist, but also the eightieth anniversary of Werner Heisenberg's original formulation of quantum mechanics, one of the most important contributions to twentieth century physics. Bohr's renowned Institute for Theoretical Physics at the University of Copenhagen was central in the development leading to and arising from Heisenberg's theory, with Bohr himself teaching, advising and binding together a whole new generation of physicists. In particular, Bohr and Heisenberg, together with other younger physicists visiting the institute in Copenhagen, went on to develop what was to become known as the "Copenhagen Interpretation" of quantum mechanics, which still today is accepted by many, possibly most, physicists as the way to understand the new physics. Einstein's refusal to accept the statistical quantum mechanics as final provided an occasion to bring the two giants of physics together. Their famous

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discussions on the matter, with regard to which they were never reconciled, took place in particular at the 1927 and 1930 Solvay Conferences in Brussels. These encounters between Bohr and Einstein have been described in many places, notably Volume 7 of the Niels Bohr Collected Works, which contains Bohr's own detailed and fascinating account.

In the course of their careers Einstein and Bohr became public figures, to which they – again in different ways dictated by personality as well as circumstances – responded actively and conscientiously. In particular, both were genuinely concerned about the social and political responsibility of the physicist, especially in the wake of the atomic bomb, to the origins of which both had contributed in different ways.

After Niels Bohr's published contributions to physics and philosophy have been reproduced and contextualized in the first ten volumes of his Collected Works, the last two volumes of the series document his involvement, broadly speaking, in the political arena (Volume 11) as well as his endeavours towards science popularization and his extensive personal network – including Einstein – inside and outside the field of physics (Volume 12). These writings by Bohr serve to place the great Danish scientist and his contributions in perspective, and we are proud to be able to announce the publication of the last two volumes of the Niels Bohr Collected Works during the World Year of Physics.

Finn Aaserud
Niels Bohr Archive
December 2004

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EARLIER VOLUMES OF THE NIELS BOHR COLLECTED WORKS

In addition to the editor of each individual volume (see below), a General Editor has overseen the preparation of the entire series of the *Niels Bohr Collected Works*. The General Editors have been: Léon Rosenfeld (1904–1974), Volumes 1 to 3; Erik Rüdinger, Volumes 5 to 9 (Volume 7 jointly with Finn Aaserud); and Finn Aaserud, Volume 10. All volumes are published by North-Holland/Elsevier.

Vol. 1, *Early Work (1905–1911)* (ed. J. Rud Nielsen), 1972.

Vol. 2, *Work on Atomic Physics (1912–1917)* (ed. Ulrich Hoyer), 1981.

Vol. 3, *The Correspondence Principle (1918–1923)* (ed. J. Rud Nielsen), 1976.

Vol. 4, *The Periodic System (1920–1923)* (ed. J. Rud Nielsen), 1977.

Vol. 5, *The Emergence of Quantum Mechanics (Mainly 1924–1926)* (ed. Klaus Stolzenburg), 1984.

Vol. 6, *Foundations of Quantum Physics I (1926–1932)* (ed. Jørgen Kalckar), 1985.

Vol. 7, *Foundations of Quantum Physics II (1933–1958)* (ed. Jørgen Kalckar), 1996.

Vol. 8, *The Penetration of Charged Particles Through Matter (1912–1954)* (ed. Jens Thorsen), 1987.

Vol. 9, *Nuclear Physics (1929–1952)* (ed. Sir Rudolf Peierls), 1986.

Vol. 10, *Complementarity Beyond Physics (1928–1962)* (ed. David Favrholdt), 1999.

Introduction

by

Finn Aaserud

The pages following this Introduction contain selected writings from the last two volumes (Volumes 11 and 12) of the Niels Bohr Collected Works, which are currently being prepared for publication. The present Introduction is intended to place these writings in context – both generally and in relation to their appearance in the Collected Works.

The project to publish the Niels Bohr Collected Works was initiated under the leadership of Bohr's younger colleague and close collaborator, the Belgian-born physicist Léon Rosenfeld, the first volume appearing in 1972. Beginning with Volume 5, the general editorship of the series was taken over by Erik Rüdinger, Niels Bohr's last assistant. Rüdinger was in charge of the Niels Bohr Archive in 1985, when it was formally set up as an independent repository for Bohr's papers at the centennial of Bohr's birth. In the process, the institutional responsibility for the publication of the Collected Works was transferred from the Niels Bohr Institute to the Niels Bohr Archive. Therefore, the General Editor of the series changed once more when I succeeded Erik Rüdinger as director of the Niels Bohr Archive in 1989.

The preparation of each individual volume has been carried out by a special editor with expert knowledge of the relevant aspect of Bohr's work. So far ten volumes have been published, covering Bohr's contributions to physics (Volumes 1 to 9) and philosophy (Volume 10). Each volume consists of one or more numbered Parts in which the editor's Introduction to the topic at hand is followed by a main section consisting of Bohr's publications on this topic. While the Collected Works aim at completeness only with regard to Bohr's publications, selections of particularly relevant correspondence and manuscripts, as well as photographs, are also included.

Bohr's remaining publications will take up two more volumes, both of which are edited by the present writer. Volume 11, *The Political Arena*, starts by documenting Bohr's veritable crusade, begun during the Second World War, for what he termed an "open world" between nations. The volume goes on to deal with his various other political involvements, broadly speaking, as these are reflected in his publications. Volume 12, *Popularization and People*, includes a number of unique writings, many of which have not previously been published in English.

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Each of Volumes 11 and 12 is divided into two Parts. The present booklet presents samples from all four of them, as described in the following sections.

1. AN “OPEN WORLD”

Almost as soon as he understood in 1943 that an atomic bomb would likely be built by the end of the Second World War, Bohr developed and promoted his view that the existence of the bomb, as he expressed it, would both facilitate and necessitate an “open world” between nations once the war was over. Bohr has described his ideas and efforts in this regard in his “Open Letter to the United Nations”, published in June 1950. Although there are also other publications from Bohr’s hand on this issue, especially from the period shortly after the Second World War, they are so few and far between as not to stand in any reasonable relation to the extent of Bohr’s effort, which indeed constituted his main concern and occupation for the last twenty years of his life.

In addition to his publications proper, Bohr thus wrote a number of confidential memoranda to statesmen, laying out his ideas and recommending that they be put into practice. This was particularly the case during the Second World War, when Bohr’s endeavours were subject to strict secrecy. Bohr continued to place hopes in his confidential approach even after the war, producing more confidential writings and discussing them with leading politicians. The “Open Letter” contains extensive quotations from those of Bohr’s confidential writings that he considered most important. However, his total output of such writings is considerably larger and they were furthermore written and rewritten and rewritten again just as carefully as any of Bohr’s publications proper. In this Part of the Collected Works it has therefore been deemed appropriate, as an exceptional case, to mix Bohr’s published and unpublished writings.

The documents presented in the main section even include some particularly elaborate letters, into which Bohr put special work and thought. The examples of Bohr’s writings chosen for reproduction below comprise three such letters. The first, addressed to the British Chancellor of the Exchequer and political leader of the British section of the atomic bomb project, Sir John Anderson, represents Bohr’s first formulation in writing of how the existence of the atomic bomb provided an opportunity for the statesmen to improve international relations after the war was over. The other two letters, addressed respectively to Winston Churchill, the British Prime Minister, and Franklin D. Roosevelt, the President of the United States, were responses to the personal meetings Bohr was able to arrange with each of them. All of the letters show Bohr’s strong commitment and how far he was able to bring his cause during the war. After the existence of the atomic bomb became

Niels Bohr Collected Works, Vols. 11 & 12

public knowledge in August 1945, Bohr was allowed to present his views in print. He immediately published an article in *The Times* in London, which is also reproduced below. Here he only presented his general views, without mentioning how he had sought to carry them out during the foregoing two years. In this way, he could continue his confidential approaches to the statesmen even after the war.

Bohr's crusade to achieve an "open world" lasted until his death. In contrast to his scientific publications, his writings on this issue cannot be understood without relation to the general effort of which they were part. Therefore, Volume 11, Part I contains a substantial Appendix of notes and letters further illuminating Bohr's efforts. As another exception in relation to other volumes of the Collected Works, comments between third parties about Bohr's efforts have been included in addition to letters to and from Bohr himself. In order to bring the whole story together, the Introduction is written with an attention to detail that is unusual for the Collected Works. The author is grateful to Aage Bohr, who assisted his father in his political activities and followed them at close hand, for invaluable help in preparing this Part of the Collected Works, and particularly for his help with all aspects of writing the Introduction.

2. OTHER POLITICAL AND SOCIAL INVOLVEMENTS

Throughout his life Bohr involved himself in several political and social activities, in addition to those described in Part I. The purpose of the Niels Bohr Collected Works is to document these activities only in so far as they produced genuine publications. Therefore, some major activities which did not lead to published documents will not be represented. These include, among others, Bohr's involvement in the 1920s in the expansion and relocation of the Danish National Museum and his role in the 1950s in the establishment of the European nuclear research facility of CERN. Yet, several of Bohr's political and social activities did involve publications, and it is these that will constitute Part II of Volume 11 of the Collected Works. These activities range from Bohr's presidency of the Royal Danish Academy of Arts and Sciences between 1939 and 1962 to addresses on various occasions.

The content of several of these publications reflects the political or social context only to a small degree and sometimes not at all. In many instances, Bohr used the opportunity provided by a public address to present some question in physics to non-physicists or to describe the philosophical implications of modern physics. In such cases, the occasion, not the content, of the article has determined its placement in this Part of the Collected Works. The Introduction to Volume 11, Part II will serve to document the context for Bohr's contributions when his pub-

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lications fail to do so. The article chosen for this booklet arose in connection with the twenty-fifth anniversary of Bohr's presentation of his atomic model in 1913, which coincided with a substantial physical expansion of his institute as well as the awarding to Bohr of the Danish Medal of Merit in Gold. The celebration was attended by representatives of the Danish cultural and political elite and received substantial attention in the Danish Press. While the talk (in Danish) that Bohr gave to the invited audience at his institute was not published, a different address (in English) prepared for international radio broadcasting did appear in print. Here Bohr characteristically did not pay particular attention to his institute's past accomplishments or future plans, but presented instead the recent development of physics in general terms. Nevertheless, the occasion constituted in effect not only a celebration of his discovery twenty-five years before, but also of the nearly two decades old Institute for Theoretical Physics at the University of Copenhagen, the establishment and leadership of which must be considered one of Bohr's major accomplishments outside his scientific and intellectual contributions.

3. SCIENCE AND ITS POPULARIZATION

The main content of Volume 12, Part I comprises those of Bohr's popular accounts of modern physics and its epistemological implications that belong neither in Volume 11 nor in earlier volumes (notably Volumes 7 and 10). Bohr's radio address from 1949 to Danish and Norwegian gymnasium students constitutes a particularly instructive example of his concerted mission to make the epistemological lesson of quantum mechanics understandable to the general public. It is reproduced below, both in Danish facsimile and English translation.

4. PEOPLE

In the course of his career, Bohr published articles about several of his predecessors in science, about contemporary physicists as well as about people outside the field of physics. Without in any way exhausting Bohr's considerable social and scientific network, taken together these articles give a better glimpse of it than any other set of his published writings.

Some of Bohr's tributes and obituaries have been published in earlier volumes of his Collected Works, where, as is also the case for many of his popular writings, they were included to illuminate the various topics under discussion there. The remaining ones, numbering more than fifty, are reproduced in Volume 12, Part II of the Collected Works.

In addition to Bohr's writings about other people, this Part of the Collected

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Works includes autobiographical pieces in the form of contributions written on request in connection with honorary distinctions as well as interviews in the media. These writings provide a rare autobiographical element which is invaluable for understanding Bohr and the background for his several publications honouring others.

Bohr's most substantial tributes were written to his revered mentor Ernest Rutherford and to his main intellectual sparring partner Albert Einstein. These contributions have been reproduced in Volumes 10 and 7, respectively. However, Bohr's writings on Rutherford and Einstein are not limited to these two articles. His earliest publication on Rutherford was written for a major Danish newspaper when Rutherford visited the Danish capital for the first time in 1920. Three decades later Bohr gave a radio talk on Einstein in celebration of the latter's seventieth birthday. These two contributions have been chosen for this booklet to represent Bohr's published writings in honour of his colleagues.

Bohr's ties to the Danish society in which he grew up were strong and, with the exception of his forced exile during the last two years of the Second World War, he lived and worked in Denmark throughout his life. Several of his tributes and obituaries were written in honour of members of his Danish circle. The contribution reproduced in this booklet is an article devoted to Kirstine Meyer, one of the first two women (the other was Hanna Adler, Bohr's maternal aunt) to obtain a Master's degree in physics at the University of Copenhagen in 1892. Meyer became a major force in Danish secondary physics education as well as a historian of physics. She was one of Bohr's strong supporters in his quest for a professorship at the University of Copenhagen, and their relationship did not diminish when Bohr was no longer in need of such help. Bohr's article was originally intended to celebrate Meyer's eightieth birthday, but became in effect an obituary when she died shortly before that occasion. Like several other writings in honour of fellow Danes, it illustrates Bohr's closeness to his home milieu.