memories of

NIELS BOHR

By ***J. Rud Nielson***

WHEN I saw Niels Bohr for the last time, a few weeks before his death, he gave me a reprint of his Rutherford Memorial Lecture and inscribed it "With the thought of many common memories".

I shall try to share with you some of my memories of the great scientist and thinker, to whom all of us are indebted for his leadership in physics during half a century, and whom many of us had the good fortune to know as the wisest and most lovable of men.

Let me first mention a few facts about his family background and early life. His home was one of culture and learning. His father was professor of physiology at the University of Copenhagen. Among his father's closest friends were the physicist Christiansen, the philosopher Höffding, and the philologist Thomsen. These four distinguished colleagues dined together every other Friday night, and after the meal would talk about all sorts of problems. The young Niels Bohr learned much from listening to these conversations. He enjoyed the close friendships of Christiansen and Höffding until their deaths.

Niels Bohr began high school in the year that Planck initiated the quantum theory. He entered the University of Copenhagen in 1903. As a student he, and even more his younger brother, Harald, later a famous mathematician, were outstanding soccer players. At the age of 21, while still a student, he won the gold medal of the Royal Danish Academy of Sciences for an experimental and theoretical investigation of ripples on liquid jets. In 1911 he obtained the doctor's degree for a brilliant dissertation on the electron theory of metals. In the fall of that year he went to J. J. Thomson in Cambridge and in the early spring of 1912 to Rutherford in Manchester. He made a trip back to Denmark that summer to marry Margrethe Nørlund but otherwise spent most of his time in Manchester until the fall of 1913, when he returned to take a position as docent at the University of Copenhagen, with the duty of lecturing to premedical students. The first of his epoch-making papers on the constitution of atoms and molecules had appeared that summer.

I do not recall if I had heard of Bohr before I entered the University of Copenhagen as a freshman in the fall of 1913. However, I saw him several times that first semester. Once was when H. M. Hansen, who later served for many years as rector of the University of Copenhagen, defended his dissertation on the inverse Zeeman effect. I remember Bohr pointing out that Hansen's theoretical analysis was out of date.

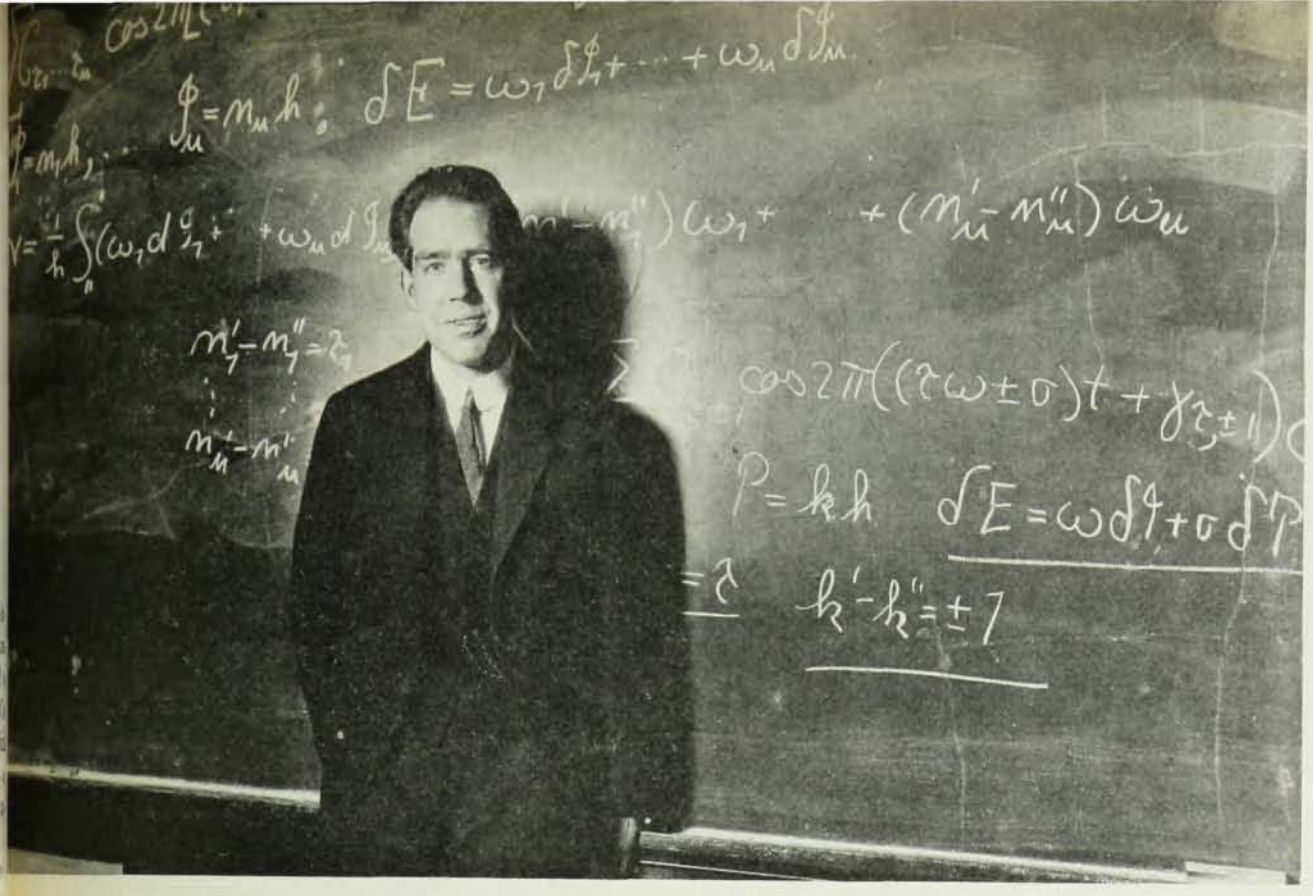
On another occasion, out of curiosity, I attended one of Bohr's lectures to the premedical students. Teaching these students was hardly a satisfying experience for Bohr. However, when I was put in charge of lecture demonstrations a few years later, I learned that he had designed several good demonstration experiments that year.

My first personal contact with Bohr came the following semester when he gave a series of lectures on the electron theory of metals. I later wondered why he chose to lecture on this subject rather than on his atomic theory.

In the fall of 1914 Bohr went back to Manchester as reader of mathematical physics. During the next two years we students in Copenhagen heard little about his work. The Danish physics journal had several articles about relativity but none about the atomic theory.

At that time I lived in the home of a schoolmate of Professor Martin Knudsen, noted for his experimental verifications of the kinetic theory of gases. Once, when they met, my landlord asked Knudsen what Bohr's theory was all about. "I don't know," Knudsen answered, "I haven't read his papers."

J. Rud Nielsen is professor of physics at the University of Oklahoma where he has been a faculty member since 1924. Born in Copenhagen, he taught physics there from 1916 to 1922. All quotations in the article have been translated from Danish by the author.



Bohr in the early days: ". . . always friendly and less remote and dignified than most Danish professors. . . ."

In 1916 a professorship in theoretical physics was created for Bohr at Copenhagen. Before this time the study of theoretical physics there had been limited largely to Christiansen's *Elements of Theoretical Physics* and Drude's *Optics*. When Bohr took over there was a great improvement, both in quality and scope. The first semester he lectured on the theory of elasticity, and I remember in particular being impressed by his treatment of the torsion of prisms and by his free use of vector and tensor analysis.

At the beginning of one semester two of Knudsen's assistants and I decided to meet together and study Jeans' *Dynamical Theory of Gases*. When Bohr heard about it he asked if he might join us. The upshot was that his two weekly lectures came to deal with the kinetic theory that semester.

Later, Bohr's lectures were devoted more and more to topics related to his atomic theory, and they were attended not only by the six or eight advanced students of physics but also by staff members from both physics and chemistry.

Around 1918 Bohr lectured on the dynamics of conditionally periodic systems and described the method that came to be known as the correspondence principle. Although a detailed account of this was published in a *Memoir* of the Danish Academy in 1918, it did not become generally known for several years. Even today several recent books give 1923 as the year this principle was first put forth.

In the fall of 1916 Bohr invited me to his home and talked to me about the possibility of working on one of his problems. Unfortunately, I had spent eight weeks in the hospital with scarlet fever that year and had had to postpone taking the first part of the examinations for the MS degree. I therefore told him that I would have to wait until I had passed these examinations. When I had done so in the spring of 1917, I chose a special field of study after consulting Bohr. However, Knudsen insisted on supervising my work; and he offered me a job, which I needed.

At that time Bohr had only a small room next to what is now the Oersted Memorial Room and was then the Physics Library. He had a secretary, but no paid assistant, and did practically all of his work at home.

When I think of Bohr as he appeared nearly fifty years ago, the speed with which he moved comes to mind. He would come into the yard, pushing his bicycle, faster than anybody else. He was an incessant worker and seemed always to be in a hurry. Serenity and pipe-smoking came much later. He was always friendly and less remote and dignified than most Danish professors in those days.

I met him often in the Library, and he would talk about what he was working on at the moment. Once he told me quite excitedly that he now un-

1917 snapshot of Bohr and Sommerfeld was taken in Lund, Sweden, where they were attending a joint meeting of the Copenhagen and Lund Physical Societies.

derstood why the lowest orthohelium state was metastable. Although he was always modest about his own achievements, he was well aware of their importance. A couple of times he remarked, "I believe that the working out of these ideas will be the history of physics for the next twenty years."

I remember vividly the lecture on the structure of atoms and the physical and chemical properties of the elements that Bohr gave before the Danish Physical Society in October 1921. Before he started he said that he had gotten some new ideas during the night, so the lecture would be somewhat different than he had originally planned. He talked for more than two hours, developing the new ideas as he went along, almost oblivious of his audience.

You will recall that this work led to the prompt discovery of element number 72, which Hevesy and Coster called hafnium after the Latin name for Copenhagen.

By this time my work for Knudsen had become intolerable. I was helping him write a textbook. When I tried to bring it into accord with modern physics, he would grumble: "If we have to use quantum theory to explain this we may as well not explain it." In the fall of 1922 I went to Pasadena and resigned from my position in Copenhagen. Epstein spoke at the first colloquium I attended at Caltech, and his topic was the lecture of Bohr's that I had heard a year previously in Copenhagen.

As early as 1917 Bohr proposed the building of a small institute for theoretical physics. About the same time Knudsen made detailed plans for a new physics building with facilities mainly for experimental work. Helped by a donation from a group of industrialists, Bohr's proposal was approved, and on March 3, 1921, the Institute for Theoretical Physics was dedicated.

In the speech he made on that occasion, Bohr took pains to explain why it was desirable to do experimental research in an institute for theoretical physics. He also emphasized the desirability of having some teaching done at the Institute: "In scientific work," he said, "no one can make definite promises for the future; for obstacles can occur that can be overcome only by quite new ideas. It is important, therefore, not to depend on the abilities and powers of a fixed group of scientists. The task of continually having to initiate new young people in the results and methods of science leads to discussions of the problems from new angles, and through the contributions of the young people themselves new blood and new ideas enter the work."

Even before the Institute for Theoretical Physics was built, a few foreign physicists had come to Copenhagen to work under Bohr's inspiration and guidance—notably Kramers from the Netherlands and Klein from Sweden. Bohr's Institute soon became a mecca for theoretical physicists from all parts of the world.

I did not see Bohr during the most exciting years when the new quantum mechanics was developed and interpreted. However, in 1931 I went to Copenhagen and spent two years in his Institute. During the first months of my stay Bohr was busy getting his Faraday lecture on "Chemistry and the Quantum Theory of Atomic Constitution" ready for publication. He spent an enormous effort on this paper, discussing each paragraph with several physicists and revising it repeatedly until he was satisfied. It was finally published in February 1932, some two years after it was delivered.

Bohr usually worked on two or three things at a time. He would work with one of the younger physicists in the morning, with another in the afternoon, and with a third in the evening. In spite of his great kindness, he demanded much of his collaborators, and they would be exhausted at the end of the day.

As an example, I may mention the following: One evening Bohr phoned Dr. Jacobsen and asked him to go to London to see an exhibit. "There is a train for Esbjerg leaving in an hour and a half," he said, "do you think you could get ready that soon?" Jacobsen answered that his passport would need to be renewed. Bohr then called the chief of

police, but he happened to be sick, so Jacobsen did not take off that night. But he left the next day.

Bohr's most important work during the two years I was at the Institute was the famous investigation of the measurability of electromagnetic field strengths carried out in collaboration with Rosenfeld and published in December 1933. Bohr and Rosenfeld worked hectically for more than a year, and as late as two or three weeks before the work was completed Bohr feared it was all wrong.

In August 1932, Bohr delivered an address ("Light and Life") to an international congress on light therapy. The paper was printed in English in the proceedings of the congress, but Bohr was not satisfied with it. He had promised a translation for a Danish journal and asked me to help him with it. When the first page proof came from the printer we went over it sentence for sentence, discussed each statement at length, and made a number of changes. This repeated itself with the second page proof, and altogether we had nine proofs before Bohr was satisfied.

This was not a record. Some years later Bohr wrote a nine-page introduction to a three-volume work on Danish culture, and when he had the twelfth proof he decided to rewrite one of the pages.

I remember the last night of the work on the Danish version of "Light and Life". Bohr was overworked and nervous and paced back and forth, while his secretary and I sat at a table with the proofs and a typewriter. When the last corrections were finally made and Bohr had to indicate to the frantic publisher whether the proof was OK or another proof was needed, his pen wouldn't write. His secretary gave him another pen—and he signed in the wrong place.

Between 10 and 11 one night during this work, Bohr changed to evening clothes. He and Mrs. Bohr had to attend an affair for a foreign bigwig. Their taxi took me home first, and as we parted Bohr asked me to be at the Institute at 8:30 the next morning. He was there on time, and we started going over the proof. When we came to a place that had bothered him the night before, he said: "Yes, we must change that. I have been thinking of it all night." I learned from Mrs. Bohr that they had gotten home at 2 a.m.!

After the Danish version of "Light and Life" was printed, Bohr said: "Now, let us make this the original," and asked me to translate it back into English.

As you know, Bohr's style is somewhat heavy. Each word is carefully chosen and each sentence written and rewritten until it conveys the precise meaning intended. Although Bohr's Danish papers are flawlessly written, he said once: "It is more difficult to write in one's own language; for there one knows precisely what the words mean. In a foreign language one doesn't know it quite so well, and so one can let the words mean just what one wants them to mean."

Perhaps I should say a word about Bohr's command of foreign languages. Once, when someone had hinted that his knowledge of English left something to be desired, he told me, mildly offended: "Why, I have lived several years in England and I can even think in English." Nevertheless, he did not have a fine ear for pronunciation. One time I heard one of his sons criticize him for saying "bøt" rather than "but". He answered: "But, that is the way my teacher, Miss Hansen, taught us to pronounce it." Bohr's spoken German was less perfect, especially in the early days, and he persisted, for example, in using "müssen" for "dürfen".

Most of Bohr's papers written during the last thirty years are of a philosophical nature. He has expounded the concept of complementarity over and over again. "Each time," he would say, "I find a little better way of expressing it." Many of these papers are based on lectures given on particular occasions. When I once called one of these papers an "occasional poem" he was pleased and said that he did not like to write like so many authors, especially Germans, who boast of having treated their topic as completely as possible. "I don't want to be complete, and I like to smuggle new ideas in," he said.

In 1932 the Bohrs moved from the villa at the Institute to the mansion which the brewer Carl Jacobsen had donated as the life-time residence of the most distinguished Danish scholar. They could now give parties for very large groups. During such a party Bohr would often disappear to a room with a blackboard together with one or another of the physicists present.

In April 1933, the Bohrs came to the United States. Bohr asked me to join them in Chicago where he was to lecture at meetings held in connection with the World's Fair. He wanted me to help him with a paper and, with his usual optimism, even talked about starting a book. He was tired and overworked when he left Denmark, but he was confident that a few weeks in this country, and in particular a month in Southern California, would be a good rest for him. He was to be a different man in Chicago.

Unfortunately, it didn't turn out that way. Bohr was still tired in Chicago, and for the first time I

saw him almost depressed. The stay in Pasadena had not been happy for the Bohrs, and Millikan had gotten on Bohr's nerves. "I don't think they liked me in Pasadena," he said, "they wanted all the time to have me make statements to the newspapers; but I refused, for if journalists get hold of one he is lost. . . . They did get me to talk to a gathering of the Trustees and I gave my impressions of Caltech. I said many nice things, . . . but I didn't say anything I didn't mean, and it was not what they wanted to hear."

Bohr spoke highly of some of the physicists he met in California. He mentioned Oppenheimer, in particular.

Bohr didn't even begin to do any writing in Chicago. I served mainly as a safety valve by giving him a chance to talk about his experiences in California and get the irritation out of his system. He was in better shape when the week or ten days were over.

Early during the Chicago meeting Bohr made a speech on behalf of the visiting foreign scientists in which he praised American science. Afterwards a prominent Danish-American remarked to him: "You are not only a great scientist but also a good politician when you say that this country will be leading in science in a few years." Bohr got quite upset over this remark. He was, in fact, greatly impressed by the contributions of many of the American physicists. "There is probably no one in Europe," he said, "who knows as much about the atomic problems as Slater." He mentioned other names and ended by saying: "Who knows where science will flourish most highly a hundred years from now? Perhaps in Japan; perhaps in China. We know nothing about such things."

Although this was in the midst of the depression, Bohr felt that the main trouble with the United States was that people had too much money. "You see that especially in Southern California," he said, "but also here in Chicago. We were in a magnificent house yesterday. Wonderfully built of the best materials in the world. A swimming pool with illumination from below. . . . These people have had so much money that they didn't know what to do with it. But fine it was. I should like to have met the architect who built it." Another day Bohr commented on the depression: "When I tell people here that in Denmark the burdens of the depression are fairly evenly distributed over all layers of the population, they are very surprised. . . . Of course, one cannot improve conditions for all layers of society without renunciation on the part of some. . . . It is sheer folly to believe that one can achieve anything in this world without renunciation. . . ."

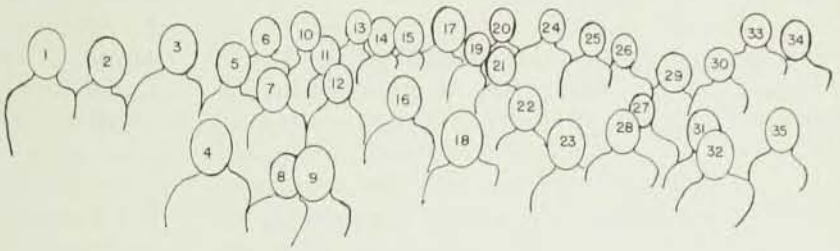
Bohr's main assignment in Chicago was to give a lecture on space and time in atomic theory. When the big hall was filled, Bohr and I were still busy putting figures and formulas on a blackboard, and the lecture was considerably delayed—to the embarrassment of A. H. Compton, who served as chairman.

The next day Bohr said: "I hope that one or

This group photograph was taken during a conference at Bohr's Institute in the spring of 1932. The names of those identified are keyed to the drawing below.

1. Werner Heisenberg
2. Piet Hein
3. Niels Bohr
4. Léon Brillouin
5. Léon Rosenfeld
6. Max Delbrück
7. Walter Heitler
8. Lise Meitner
9. Paul Ehrenfest
10. Felix Bloch
11. Ivar Waller
12. J. Solomon
13. Erwin Fues
14. Bengt Strømgren
15. R. de L. Kronig
18. Hendrik A. Kramers
19. C. F. von Weizsäcker
20. J. Ambrosen
21. Guido Beck
23. H. H. Nielsen
24. Buch Andersen
25. G. Kalckar
26. J. Rud Nielsen
27. R. H. Fowler
28. Egil A. Hylleraas
31. P. A. M. Dirac
33. Charles G. Darwin
34. Charles Manneback

(No positive identification has been made of Nos. 16, 17, 22, 29, 30, 32, and 35.)



two got something out of my lecture, as Heisenberg did a few years ago." Bohr spoke highly of Compton as a physicist and a man, but he felt that Compton's philosophy was too primitive: "Compton would like to say that for God there is no uncertainty principle. That is nonsense. In physics we do not talk about God but about what we can know. If we are to speak of God we must do so in an entirely different manner."

Bohr was at this time much interested in the positive electron and in Dirac's theory, and he talked in particular about the difficulties connected with the possibility that certain observations might result in the creation of electron pairs.

However, Bohr's interests have never been limited to physics, and in Chicago he talked about a variety of things. He related the experiences of a Danish physician at an international meeting and said, "This is the way it goes with international meetings as long as we have independent countries. The aim of most delegates to such meetings seems to be to obtain as many advantages as possible for their own country and to cheat and deceive the others as much as possible. . . . We must be internationalists, and in science we succeed fairly well. . . . All peoples and races are essentially alike; the differences are in their traditions and backgrounds. . . . Every valuable human being must be a radical and a rebel, for what he must aim at is to make things better than they are. . . ."

When the conversation turned to economics, Bohr said, "Economics is not a science at all, but largely propaganda." But then he added: "Of course, even in physics we carry out propaganda. When we believe we have seen something more clearly than others, we try to spread our new insight, and that is propaganda. . . . I had to argue for two years with Heisenberg and Bloch before I could convince them that the new quantum theory depends altogether on correspondence. . . . It was also hard to make them and others accept the notion of complementarity."

Bohr talked a good deal about his plans for future publications. "I believe that I have come to a certain stage of completion in my work," he said, "I believe that my conclusions have wide application also outside physics. . . . I should like to write a book that could be used as a text. I would show that it is possible to reach all important results with very little mathematics. In fact, in this manner one would in some respects achieve greater clarity." This book, which Bohr referred to as his testament, was never written.

Knowing Bohr's interest in Kierkegaard, I mentioned to him the translations made by Prof. Hollander of the University of Texas, and Bohr began to talk about Kierkegaard: "He made a powerful impression upon me when I wrote my dissertation in a parsonage in Funen, and I read his works night and day," he told me. "His honesty and willingness to think the problems through to their very limit is what is great. And his language is wonderful, often sublime. There is of course much in Kierkegaard that I cannot accept. I ascribe that to

the time in which he lived. But I admire his intensity and perseverance, his analysis to the utmost limit, and the fact that through these qualities he turned misfortune and suffering into something good. . . ."

In February 1937, the Bohrs stopped over at Norman on their way to Japan, and Bohr gave two lectures at the University of Oklahoma, on causality and on his drop model of nuclear structure. He talked again about his desire to write a textbook on atomic theory; and he talked about complementarity and argued in particular that this concept in a sense makes room for life or the existence of living organisms.

In the summer of 1939, I had to go to Denmark because of the death of my mother. I saw Bohr two or three times at the Institute and spent a day with the Bohrs at their straw-thatched summer house. I was again impressed by Bohr's tremendous vitality and optimism in spite of many disappointments: "My views on the quantum theory are not accepted by many physicists," he said. "I gave a lecture on the epistemology of physics and human cultures before an international congress of anthropologists, but they did not like it. I spoke on biology and atomic physics in Bologna last year at the second centennial of Galvani's birth, but the geneticists, in particular, did not approve of it."

I mentioned that on my way home I was planning to attend a meeting at Harvard on the unity of science; hence, I got Bohr's comments on some of the leaders of this movement. "Neurath gave a lecture in Copenhagen," Bohr said, "in which he claimed that if one would only analyze language all difficulties would disappear. When I had to say something after his lecture, I said: 'An expert is a man who knows all the difficulties in a certain field. However, after this lecture it is hard for me to decide what Neurath's field is.' "

Although the logical positivists have always tried to enlist Bohr's support for their views, he has never been able to take them, or for that matter any other school philosophers, quite seriously. Thus, when a logical positivist once denounced the fallacies of metaphysics at great length Bohr stood up and said: "A very apt definition has been proposed of a specialist in some branch of learning as a man who has worked so long in that branch that he has come to know all the errors that can be made in it. I think we may say that Professor X has shown us, in his most interesting lecture, that he truly deserves the name of metaphysician."

In a somewhat related vein, he once began a lecture to the student body at Copenhagen something like this: "A specialist is a man who knows very much about a limited field, and a philosopher is a man who knows a little about very many things. Thus, the ideal specialist knows everything about nothing and the ideal philosopher knows nothing about everything. Now, we scientists claim to know something about something."

In 1950 I spent some three weeks in Denmark. I met most of the Danish physicists and talked at length with Bohr. He talked mostly about his efforts in this country during the second world war to convince Presidents Roosevelt and Truman that

This family portrait of Professor and Mrs. Bohr, their sons, daughters-in-law, and grandchildren was taken on Niels Bohr's seventieth birthday. Standing are sons Erik, Hans, Aage, and Ernest. Mrs. Hans Bohr is seated at far left. Next to her is the late Mrs. Erik Bohr. Mrs. Aage Bohr stands with her husband, and Mrs. Ernest Bohr is seated at far right.

plans must be made to forestall a nuclear arms race. "That is why I went to America," he said. "They didn't need my help in making the atom bomb."

Bohr gave me copies of his open letter to the United Nations, dated June 9, 1950. As you know, this is a passionate plea for permitting an open flow of information as the first prerequisite for the establishment of the mutual confidence required for effective measures to prevent a nuclear arms race and bring about common security and cooperation between nations. The impact of this letter was undoubtedly greatly reduced by the outbreak of the Korean war.

In July 1951, I attended a conference on quantum physics at Bohr's Institute. At the opening meeting Bohr gave a two-hour lecture in which he traced the major steps in the development of the quantum theory. He did not cover all that he had planned and ended by saying: "I had hoped, with a very bad kind of optimism, to give you my ideas about the theories of particles and fields, but the time was too short."

During the five-day conference, which dealt mainly with elementary particles and nuclear structure, Bohr was present all the time and frequently made pertinent remarks. More than once he said, "Let us keep an open mind."

In the summer of 1957, I visited Bohr at the Institute and spent a Sunday with the Bohrs at their summer place. When I arrived at the Institute I first met Miss Schultz, who had been Bohr's secretary since 1916. I asked how he was. "He is a little heavier, his hair is a little thinner; but he works as hard as ever," she said. The last statement was confirmed by Professor Jacobsen, who added, "But, as you know, Bohr is never quite happy unless he has a little more to do than he can manage." Bohr was now 72. He had retired from his professorship, being succeeded by his son, Aage, but he was still director of the Institute and also chairman of the Danish Atomic Energy Commission.

Bohr was closeted with a Russian. When Miss Schultz phoned him that I was there, he asked her to invite me to see a Russian film on atomic energy that would be shown in a few minutes, and he told her that he would see me afterwards. The film was excellent. By the time the showing was over an official from the ministry of finance had come to see Bohr, but Bohr sent him away in order to talk with me.

He first commented on the film: "The Russians got the first nuclear power plant, and they have the largest cyclotron. Of course, in such a film they don't say that the first reactor was built elsewhere. . . . It was perfectly absurd to believe that the Russians cannot do what others can. . . . There never was any secret about nuclear energy. . . . It is also absurd to expect that the Russians will put up with everything and give up any position of power that they may possess. . . ."

Bohr then began to talk about the problem of peace and mentioned again his open letter to the United Nations. "The quantum theory does not present any problem to me anymore," he said, "The all-important problem now is to find a way to prevent nuclear war. . . ." He mentioned Roosevelt and Truman several times: "It was terrible that no one over there had worked on the solution of the problems that would arise when it became possible to release nuclear energy; they were completely unprepared . . . ," he said.

On the Sunday at Bohr's summer house I felt for the first time that he was beginning to get old. At the mid-day dinner he said hardly a word. At coffee time, taken outdoors, he was more lively. However, while the rest of us went on the traditional afternoon walk, he had to lie down and rest. Later in the afternoon, however, he seemed to be his old self, and during and after the late afternoon tea he was in very good form. The conversation dealt largely with pedagogy, and Bohr related many funny experiences from his school days.

I left around 7 p.m. and in Hillerød, on my way back to Copenhagen, I looked up a cousin of mine and found her ready to go to an organ concert at Frederiksborg Castle. I went with her, and that gave me an opportunity to see Bohr's coat of arms hanging there a few feet from that of the King. As you know, it represents the principle of complementarity by the ancient Chinese Yang and Yin symbol.

In December 1957, Bohr spoke on atoms and human knowledge to an audience of 2500 at the University of Oklahoma. Although Bohr mentioned that he had recently been interested in superconductivity, most of our conversations during his stay in Norman dealt with his efforts to arouse men of influence and power to do something effective to promote peace. "We must do something for mankind," he said several times. He had not had much chance to talk to Eisenhower in Washington when he received the Atoms for Peace Award, but he had talked with many leaders inside and outside government circles. Not all of these talks had been encouraging. The one who understood the problems best, he felt, was J. J. McCloy. "Politics is extremely complicated," Bohr said, "and we must be

patient. But something must be done before it is too late. . . . We are in a completely new situation that cannot be resolved by war."

Bohr talked about the Oppenheimer case, which, he said, had damaged the reputation of the United States very much in Europe: "There must be something wrong with the American sense of justice if you can forgive a man and then ten years later treat him as Oppenheimer was treated."

He told me what Teller's contribution to the design of the hydrogen bomb was. When I asked him how great a contribution this was, he answered: "Old physicists who have turned administrators might not think of this solution. However, if you had asked a good class of physics students, two or three of them would have suggested this solution. Anyway, the Russians did the very same thing."

The most interesting part of my conversations with Bohr at this time dealt with his efforts in England and the United States during the second world war to convince the governments that some great moral act would be needed to forestall a nuclear arms race. He told me that he had come to this country with a plan, in the execution of which he himself would play an essential part. This plan was supported by prominent members of the British government, but was rejected by Roosevelt and Churchill at the Quebec Conference.

On my arrival in Copenhagen in August of last year, I had a letter from Mrs. Bohr telling me that her husband had been ill in June because of overwork. He had stayed in bed for only a week, but the doctor had ordered a complete rest for several months. Hence, they were staying in the country until the third of September.

On the fourth of September, I had lunch with them at their home at Carlsberg. Niels Bohr looked much as he had in 1957. He began almost immediately to tell me about a conference to be held at the Institute in July 1963 on the fiftieth anniversary of the publication of his first paper on atomic structure. He evidently looked forward to this occasion.

He also talked about his recent Rutherford Memorial Lecture. He mentioned a trip to Germany in honor of Heisenberg's sixtieth birthday. If I heard right, he had, in addition, made two trips to England and trips to both the United States and Russia during the past year or so.

While Bohr went to get some reprints for me, his wife told me that he would soon have to go back to the hospital for tests.

The next day I visited the Institute and talked with Prof. Jacobsen. He had not seen Bohr for three months and was worried about his health. He commented on Bohr's remarkable endurance. They had attended meetings together in Geneva about CERN. These meetings had lasted all day and been very tiresome; but while the younger people were groggy, Bohr was always fresh the next morning.

We talked about Bohr's fantastic ability to direct an Institute with fifty or sixty foreign physicists in attendance most of the time, and about his remarkable capacity for grasping the essence of a new piece of research very quickly, which enabled him to follow, in his own way, nearly all that was being done at the Institute. "In addition to having the ability," Jacobsen said, "one must like to do such an arduous thing, and Bohr likes it."

As you know, Niels Bohr died of a heart attack on the 18th of November last year. His private life was harmonious and happy, although he knew sorrow. His scientific achievements were unexcelled. His efforts to promote an open world were less successful. We may hope that some of the seeds he sowed may yet bear fruit.

Niels Bohr, shortly before his 75th birthday, seated outside the family's summer house with two of his grandchildren. They are daughters of his son Ernest.