

Distribution: limited

SC-85/CONF.811/10
PARIS, 25 November 1985
English only

UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION

Round-table in commemoration of Niels Bohr Centenary

Niels Bohr - A survey of some of his contributions
to science and international co-operation

Unesco House, Room VIII, 28-29 November 1985

INFLUENCE OF NIELS BOHR'S NEW APPROACH TO SCIENTIFIC RESEARCH

by

Ning HU

(The views expressed by the author do not necessarily
reflect the standpoint of Unesco.)

Influence of Niels Bohr's new approach to Scientific Research

Ning Hu

The first time I saw Professor Niels Bohr was in 1937 when he visited Peking.. I was then a second year student in Tsing Hua University. I attended one of his seminars. The only thing I remember now from his talk was a curve drawn on the blackboard. In spring of 1948 I came to Copenhagen from Dublin and stayed in his Institute for half year. I arrived at his institute just at the time when he was leaving for America. He had only half an hour to talk with me before his departure. Being not quite familiar with his accent I hardly understood what he said to me, yet I could not miss his warmth and encouragement. Without Bohr, I still learned very much from other members of the institute, and had very good times with them traveling to Sweden and Norway giving seminars and taking skiing trips. Professor Bohr came back to Copenhagen only about one week before I left the institute and talked with me once again. This time I understood him much better as I was already quite used to the Danish accent. He and Mrs. Bohr also invited me to spend a day in their villa by the sea shore. Both Professor and Mrs. Bohr showed great interest in Chinese history and culture,

and development of science and education in China.

In 1962, Bohr's son Aage Bohr visited Peking. The next day he was to fly back to Copenhagen. We were with him at a farewell dinner, when a telegram was sent to him bearing the sad news that Professor Niels Bohr had just passed away. It was a shock to all of us.

When I was asked to give a presentation for commemorating Niels Bohr Centenary at this meeting, the above was the first recollection coming to my mind. Niels Bohr will always be remembered as a great scientist and teacher. One important contribution of his to the development of physics was the creation of an atmosphere of international cooperation and a tradition of friendly discussions among scientists. During the fruitful years in the development of quantum mechanics, Bohr Institute was the indisputable center of theoretical physics in the whole world. His friendly debates with Einstein on the foundation of quantum mechanics now become legends in the history of science.

Since the time of Newton the notion had been developed that all motions in the universe were predetermined by Newton's law of motion and classical electrodynamics under some initial conditions set at the beginning of the universe. The whole universe is like a huge clock work of which every component moves in a prescribed way. Bohr found out that this was no longer true inside an atom. He therefore introduced the "correspondence principle" which later on developed into the principle of complementarity to replace the classical laws of causality in the microscopic world. This

principle of complementarity represents essentially the probability interpretation of quantum mechanics. This is the first time an important revision had to be introduced into classical laws of motion in order to achieve consistency with the observed facts. Planck and Einstein introduced the concept of quanta into radiation just like Dalton introduced concept of atoms into ponderous matter. They have not gone so far as to doubt the laws of nature. Einstein extended the principle of relativity of Newtonian mechanics to electrodynamics without knowing the famous experiment of Michelson. In this way he unified mechanics and electrodynamics and established special theory of relativity to which the classical mechanics is only the first approximation. Later on he also extended the principle of relativity to include the gravitational field. All this was achieved through the mental power of logical thinking. Surely this is the only way of discovering new laws of nature before discrepancies between theory and experiment have appeared. On the other hand in the case of atoms it was already quite clear that the classical dynamics cannot be applied directly to explain the stability of electron orbits inside atoms. Therefore Bohr had to throw away one part of the classical mechanics and supplemented it by the correspondence principle. Comparing to Einstein, Bohr appeared to be more revolutionary when he proposed the principle of complementarity which defied the "complete description" of the physical world. To defend his view, Bohr pointed out that the influence of observation could not be overlooked in the microscopic world. The

Indeterminacy and the introduction of interference of observation arose great controversy among physicists in early years. Now not many people seem to bother very much about these, indicating that they are now quite used to these new concepts already. This turmoil in mind seemed to arise from the fact that it usually took a long time to adjust ourselves to new concepts of causality.

As mentioned before there exist two lines of approaching the true laws of nature. One line has been followed by Maxwell and Einstein. Maxwell obtained electrodynamics by introducing displacement current in vacuum. Einstein obtained relativistic equations of motion by introducing relativistic principle to electrodynamics. On the other hand quantum theory was obtained not by adding some new concepts or new principles. It came out from the fact that classical dynamics was wrong inside the atom, therefore one had to invent a new theory. This is the first time a new dynamics was obtained in this way. This new line of approach was followed by Niels Bohr when he introduced the correspondence principle leading to quantum theory.

What I really want to stress in this talk is Bohr's new line of approach for promoting scientific researches. Before his time research works on theoretical physics were usually done by people more or less isolated from one another. Bohr's approach can best be explained by his speech at the inauguration of his Institute of theoretical physics in 1921: he said: "It is therefore of the greatest significance not just to depend on the ability and powers of a limited number of scientists; but the task of having to

Introduce a constantly renewed number of younger people into the results and methods of science contributes in the highest degree to continually taking up questions for discussion from new sides; and, not least through the contributions of the young people themselves, new blood and new ideas are constantly introduced into the work." During first few years after the inauguration of Bohr Institute, Bohr invited many most active and talent young research workers to Copenhagen. The institute became not only a place of serious scientific researches, but also a big happy family for all members of the institute. This was how the Copenhagen school was formed. It was the intensive international cooperation and constant personal contact among scientists that was responsible for the growth of quantum mechanics, whose applications to industry and other branches of science produced and are still producing immense benefits to the whole world.

There is a special meaning for this meeting for commemorating Bohr centenary organized by UNESCO. Denmark is not a big country. Yet she took up the responsibility of promoting scientific researches for the benefit of the whole world. The example of Bohr Institute shows that scientific research can be promoted most effectively and most beneficial to mankind only through international cooperations. UNESCO is the proper and suitable organization for promoting this international cooperations and personal contacts among scientists. I hope in the future UNESCO will continuously get supports from all sides in performing this duty.