

The Institute for Theoretical Physics of the University
of Copenhagen.

by Professor H.M.Hansen.



The Institute for Theoretical Physics of the University of Copenhagen which was founded by the initiative of Professor Niels Bohr and is now under his directorship, is equipped for theoretical and experimental work in atomic physics. Professor Bohr's pioneer work in atomic physics, based on Rutherford's nuclear atom and Planck's quantum theory, was commenced in 1913. The results of the investigations of the intervening ten years, during which time the leadership of Professor Bohr has remained unchallenged in spite of important contributions by others, are generally accepted among physicists and chemists as so far-reaching and significant that future work promises to bring about the greatest advances in physics and chemistry, and, as may also be expected, in astro-physics as well.

Without going into details in this connection the newest result should be emphasized; Professor Bohr's explanation of the natural or periodic system of the elements.

A few years after the commencement of this theoretical work Professor Bohr already saw the necessity for the establishment of an Institute where there should be both space and facilities (library, models, calculating machines, etc.) for theoretical work, and at the same time the possibility of carrying out such experimental work as the theory demanded for control and guidance in its further development. He succeeded in interesting in part a group of private individuals in Copenhagen and in part the Danish government to such an extent that the establishment and maintenance of the Institute on a modest scale was assured, and the Institute was opened in March 1921. The cost of the establishment (grounds, building with installations, machinery, shop, etc. and equipment with scientific instru-

ments) was in all 140,000 Dollars, of which 25,000 Dollars was obtained from private sources and the rest from the government. For the yearly upkeep (purchase of instruments, materials, chemicals etc. as well as heating, lighting and cleaning) there is available a sum of 3,200 Dollars from the government and at present a sum of 4,000 Dollars from private sources as well as from Danish scientific funds.

The arrangement of the Institute is shown by the accompanying plan of the basement and first floor. It shows that besides the library, offices, lecture-room, shops, battery room, etc. there are seven rooms for experimental work of which one is very large. The fixed personnel consists, besides the director, of one associate professor, a secretary, a mechanic, a janitor (half time) and a boy, all of whom are paid by the government (not included in the above mentioned sum for maintenance). The associate professor, however, is in part supported by private funds, and there are also two scientific assistants paid entirely from private sources. (These last salaries are included in the above named sum of 4000 Dollars for maintenance from private sources).

The principal equipment of the Institute is for spectroscopic investigations, both in the visible to the most extreme ultraviolet, and in the X-ray region. For these last investigations, however, high tension equipment is much needed. On the other hand there is a much felt want of equipment for work in the infra-red region of the spectrum. Further, investigations may be carried on in radioactivity, ionization potentials etc. as well as in certain branches of chemical and physico-chemical research. In the fields for which the Institute is equipped the apparatus is completely modern. No elementary instruction is given in the Institute.

In the two years since the founding of the Institute the following numbers of foreign physicists have worked there, besides the scientific personnel and a number of Danish physicists and chemists (only a stay of at least one semester has been counted):

(From) United States 4, Norway 1, Sweden 1, Holland 1, Austria 1, Poland 1, Hungary 1, Japan 2. At present there are on hand urgent requests for permission to work at the Institute from two from the United States, one from India, one from South Africa and one from Austria. While several of the scientists from the United States have obtained scholarships from the Scandinavian-American Foundation, stipends for the scientists from Austria, Poland, Hungary and others have been granted by a foundation established by the Danish state for the support of international science (Rask-Ørsted Fond). From private sources the physicist from Holland has been supported for two semesters.

An idea of the range covered by the work of the Institute up to the present time is provided by the accompanying list of published work. There is here special reason to mention the discovery of the new element Hafnium (atomic number 72) which arose from purely theoretical investigations of the elements of the natural system, but which promises also important practical results.

- N. Bohr, Abhandlungen über Atombau aus den Jahren 1913-1916, (Braunschweig 1921), (Translation of papers in Philosophical Magazine and Nature with an explanatory introduction).
- " On the Quantum Theory of Line Spectra (Copenhagen Academy) Part I and Part II, 1918, Part III, 1922.
- " Über die Quantentheorie der Linienspektren. (Braunschweig 1923) (Translation of the foregoing).
- " Über die Serienspektren der Elemente (Zeitschrift für Physik II, 1920).
- " Zur Frage der Polarisierung der Strahlung ^{im} ~~und~~ der Quantentheorie (Zeitschrift für Physik VI, 1921).
- " Atomic Structure (Nature, March 24. 1921).
- " Atomic Structure (Nature, October 13. 1921).
- " Atomernes Bygning og Stoffernes fysiske og kemiske Egenskaber (Fysisk Tidsskrift 1922).
- " Der Bau der Atome und die physikalischen und chemischen Eigenschaften der Elemente (Zs.für Physik, IX, 1922).
- " Drei Aufsätze über Spektren und Atombau, (Braunschweig 1922).
- " Three Essays on spectra and atomic structure (Cambridge 1923).
- " On the Selection Principle of the Quantum Theory (Philosophical Magazine 43, 1922).
- " Über die Anwendung der Quantentheorie auf den Atombau. I. Die Grundpostulate der Quantentheorie. (Zeitschrift für Physik, XIII, 1923).
- " Linienspektren und Atombau (Heinrich Kayser-Jubiläumsheft) Annalen der Physik 71, 1923.
- " Om Atomernes Bygning (Nobel-prize lecture), Copenhagen 1923. (English and German translation in press).
- " On the effect of electric and magnetic fields on spectral lines. (Guthrie lecture, delivered before the London Physical Society in 1922. (in press)
- " und D.Coster, Röntgenspektren und periodisches System der Elemente, (Zeitschrift für Physik, XII, 1923).
- H.A.Kramers, Intensities of Spectral Lines. (Copenhagen Academy, 1919).
- " On the Application of Einstein's Theory of Gravitation to a stationary Field of Gravitation. (Proceedings Amsterdam Academy, 1920).

- H.A.Kramers, Über den Einfluss eines elektrischen Feldes auf die Feinstruktur der Wasserstofflinien. (Zeitschrift für Physik, III, 1920).
- " Some main features of the modern theory of atomic structure, (Helsingfors Mathematical Congress 1922).
- " Über das Modell des Heliumatoms (Zeitschrift für Physik, XIII, 1923).
- " Über die Quantelung rotierender Moleküle (Zs.für Physik, XIII, 1923).
- " On the theory for absorption of homogeneous X-rays and for the continuous X-ray spectrum. (in press).
- " und W.Pauli, Zur Theorie der Bandenspektren (Zs.für Physik, XIII, 1923).
- " und J.A.Christiansen, Über die Geschwindigkeit chemischer Reaktionen (Zeitschrift f.phys.Chemie 104, 1923).
- O.Klein and S.Rosseland, Über Zusammenstöße zwischen Atomen und freien Elektronen (Zs. für Physik, 1920).
- S.Rosseland, On the theory of ionization by swiftly moving electrical particles and the production of characteristic X-rays (Phil.Mag. XLV, 1923).
- " Zur Quantentheorie des radioaktiven Zerfalls, (Zeitschrift für Physik, XIV, 1923).
- " Origin of radioactive disintegration (Nature, March 17. 1923).
- G. von Hevesy, Über Materietransport an Kristall und Kristallit, (Zeitschrift für Physik, X, 1922).
- " " Über den Zusammenhang zwischen Elektrizitätsleitung und Wärmeleitung elektrolytisch leitender Krystallen (Zs.für Physik, X, 1922).
- " " Über die Auflockerung von Krystallgittern (Zeitschrift für physik.Chemie, 1922).
- " " and D.Coster, On the missing element of atomic number 72, (Nature, January 20, 1923).
- " " " On the new element Hafnium (Nature, February 10. 1923).
- " " " On the new element Hafnium (Nature, February 24. 1923).
- " " " Über das Element der Atomzahl 72 (Die Naturwissenschaften, January 1923).

H.M.Hansen and J.C.Jacobsen, Über die magnetische Zerlegung der Feinstrukturkomponenten der Linien des Heliumfunkenspektrums (Proceedings Copenhagen Academy, 1921).

" , T.Takamine and Sven Werner, On the effect of magnetic and electric fields on the mercury spectrum. (Proceedings Copenhagen Academy, 1923).

" and S.Werner, The optical spectrum of Hafnium (Nature, March 10. 1923).

" " On Urbain's Celtium lines (Nature, April 7.1923).

C.Jacobsen and Johs.Olsen, On the stopping power of lithium for α -rays, (Proceedings Copenhagen Academy, 1922).

V.Thorsen, Über das Bleispektrum (Die Naturwissenschaften, April 1923).

" Seriendarstellung des Gold-bogenspektrums, (Die Naturwissenschaften, Juni 1923).

F.C.Hoyt, The relative intensities of X-ray lines, (Phil.Mag. 46, 1923) (in press).