Bohr, Harald | Encyclopedia.com

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(*b*. Copenhagen, Denmark, 22 April 1887; *d*. Copenhagen, 22 January 1951)

mathematics.

Bohr's father was the distinguished physiologist Christian Bohr; his mother, a daughter of the prominent financier, politician, and philanthropist D. B. Adler. In the home he and his elder brother Niels imbibed a deep love of science. At the age of seventeen Bohr entered the University of Copenhagen. Of his teachers, he felt the closest kinship to H. G. Zeuthen, but the most decisive factor in his development as a mathematician was his study of Jordan's *Cours d'analyse* and Dirichlet's *Vorlesungen über Zahlentheorie* with Dedekind's supplements. In his later student years, his interests centered on analysis. After his master's examination he went to study with Landau in Göttingen. This center of mathematics became like a second home to Bohr, and he returned there often. During the years before World War I, he also came into close contact with Hardy and Littlewood, and he often went to Cambridge and Oxford to study.

After obtaining his doctor's degree in 1910, Bohr joined the faculty of the University of Copenhagen. In 1915 he was appointed professor at the College of Technology, a position he retained until returning in 1930 to the University of Copenhagen, where he headed the newly founded Institute of Mathematics. Bohr was one of the leading analysts of his time, and he exerted an extraordinary influence both in international mathematical circles and in the academic life of his own country. As a teacher he was greatly admired and loved. When the rise of Nazism in Germany in 1933 endangered the academic community, among others, Bohr was among the first to offer help. His close personal relations with colleagues in many countries enabled him to help in finding new homes for those scientists who were either forced to leave Germany or who chose to do so, and he turuned all his energies to this task. He himself did not escape exile in the latter part of World War II, when he was compelled to take refuge in Sweden.

Bohr's contribution to mathematics is one of great unity. His first comprehensive investigation, which formed the subject of his doctor's thesis, was concerned with the application of Cesàro summability to Dirichlet series. In a number of later papers he studied other aspects of the theory of Dirichlet series, in particular the distribution of the values of functions represented by such series. His method consists in a combination of arithmetic, geometric, and function-theoretic considerations. His collaboration with Landau was concentrated mainly on the theory of the Riemann zet-function. It culminated in the so-called Bohr-Landau theorem (1914), concerning the distribution of its zeros. In later papers Bohr gave a detailed study of the distribution of its values in the half plane to the right of the critical line.

The problem of which functions may be represented by Dirichlet series led Bohr to his main achievement, the theory of almost periodic functions, on which the greater part of his later work is concentrated. If a Dirichlet series is considered on a vertical line in the complex plane, it reduces to a trigonometric series. It was therefore natural to consider more generally the problem of which functions if a real variable can be represented by such a series, i.e., can be formed by superposition of pure oscillations. In the special case where the frequencies of the oscillations are integers, the answer is given in the classical theory of Fourier series of periodic functions. Where as hitherto in the theory of Dirchlet serious one had always worked with frequencies forming a monotonic sequence, Bohr discovered that in order to obtain an answer to the problem one would have to consider series with quite arbitrary frequencies. The answer was obtained by introducing the notion of almost periodicity. The theory was published in three papers in *Acta mathematia* (1924–1926), and numerous mathematicians joined in the work on its simplification and extension. Thus Weyl and Wiener connected it with the classical theories of integral equations and Fourier integrals, and Bochner developed a summation method for Bohr-Fourier seris generalizing Fejér's theorem. Stepanoff, Wiener, and Besicovitch studied generalizations depending on the Lebesgue integral. Other aspects of the theory were studied by Favard, Wintner, and many others. In the 1930's Von Neumann succeeded in extending the theory to functions on arbitrary groups, and it thus found a central place in contemporary mathematics.

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