

Khinchin, Aleksandr Yakovlevich | Encyclopedia.com

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(*b.* Kondrovo, Kaluzhskaya guberniya, Russia, 19 July 1894; *d.* Moscow, U.S.S.R., 18 November 1959)

mathematics.

The son of an engineer, Khinchin graduated from a technical high school in Moscow in 1911 and, from 1911 until 1916, studied at the Faculty of Physics and Mathematics of Moscow University. In 1916 he was retained by the university to prepare for professorship. From 1918 Khinchin taught at various colleges in Moscow and Ivanovo; in 1927 he became a professor at Moscow University. He was elected an associate member of the Soviet Academy of Sciences in 1939 and a member of the Academy of Pedagogical Sciences of the R.S.F.S.R. in 1944. He received the State Prize in 1940 for his scientific achievements. With A. N. Kolmogorov, Khinchin was one of the founders of the Moscow school of probability theory, one of the most influential in the twentieth century.

Khinchin's interest in mathematics was awakened in high school. Other strong interests of his youth were poetry and the theater. At the university Khinchin became an active member of the group of gifted young mathematicians guided by N. N. Luzin, the passionate propagandist of the modern theory of functions. In this group Khinchin began to work on the metric theory of functions. His first paper (1916), on a generalization of the Denjoy integral, began a series of works dealing with the properties of functions which remain after the removal of a set of density 0 at a given point (asymptotic derivative, asymptotic monotonicity).

After 1922 Khinchin turned to the theory of numbers and to probability theory. First he studied metric problems of the theory of Diophantine approximations and of the theory of continuous fractions. These problems, which deal with properties true for almost all real numbers, are naturally connected with the asymptotic properties of functions mentioned above. Later Khinchin studied classical Diophantine approximations, which hold true for all numbers; in particular he established the so-called principle of transposition. Another topic of the theory of numbers was studied in his works on the density of sequences.

In 1923 Khinchin established the so-called law of the iterated logarithm, strengthening the results obtained by G. H. Hardy and John Littlewood on the frequency of zeros in the binary expansion of real numbers. In the probabilistic interpretation this law improves the strengthened law of large numbers established by Borel. Probability theory proved to be an auspicious field for the application of the methods of the metric theory of functions, and Khinchin was drawn more and more into the problems of the summation of independent random variables. During the 1920's and 1930's this classical branch of probability theory assumed its present form in the closely related works of Kolmogorov, P. Lévy, Khinchin, and others. Khinchin's contribution included results on the applicability of the law of large numbers to equally distributed random variables with finite mathematical expectations, on the coincidence of the class of all limit distributions with the class of all infinitely divisible laws, on the convergence of series of random variables (jointly with Kolmogorov), and on the structure of stable laws (jointly with Lévy).

In a series of papers written between 1932 and 1934, Khinchin laid the foundation of the general theory of stationary random processes, revealed the spectral representation of their correlation functions, and generalized G. D. Birkhoff's ergodic theorem, which is a strengthened law of large numbers for such processes.

In other works Khinchin dealt with the convergence of discrete Markov chains to continuous diffusion, with large deviations, with the arithmetic of distribution laws, and with the method of arbitrary functions. In the 1940's Khinchin's interest shifted to [statistical mechanics](#). With the aid of local limit theorems, he substantiated the possibility of replacing means in time by means in the phase space both for classical and quantum statistics. In the last years of his life Khinchin studied [information theory](#) and queuing theory.

Khinchin also wrote several popular books on the theory of numbers and published articles devoted to pedagogic and philosophic questions of mathematics.

BIBLIOGRAPHY

I. Original Works. Khinchin's writings include "über dyadische Brüche," in *Mathematische Zeitschrift*, **18** (1923), 109-116, on the law of the iterated logarithm; "Recherches sur la structure des fonctions mesurables," **9** (1927), 212-279, a summary work on the theory of functions; *Osnovnye zakony teorii veroyatnostey* ("Basic laws of Probability Theory" Moscow, 1927, 2nd ed., rev., 1932), on the summation of independent random variables; *Asymptotische Gesetze der Wahrscheinlichkeitsrechnung* (Berlin, 1933), a monograph on the convergence of Markov chains to diffusion processes; "Korrelationstheorie der stationären stochastischen prozesse," in *Mathematische Annalen*, **109** (1934), 604-615, the principal work on stationary processes; *Predelnye raspredelenia dlya summ nezavisimyykh sluchaynykh velichin* ("Limit Distributions for Sums of Independent Random Variables"; Moscow, 1938); *Matematicheskie osnovania statisticheskoy mekhaniki* ("Mathematical foundations of Statistical Mechanics"; Moscow, 1943), also in English ([New York](#), 1949); *Matematicheskie osnovania kvantgovoy statistiki* ("Mathematical Foundations of Quantum Statistics"; Moscow, 1951); *Pedagogicheskie stati* ("Pedagogical Articles" Moscow, 1963), English trans., *The Teaching of Mathematics* (London, 1968); and *Raboty po matematicheskoy teorii massovogo obsluzhivaniya* ("Works on the mathematical Theory of Queuing"; Moscow, 1963.)

II. Secondary Literature. A biography of Khinchin by B. V. Gnedenko is in *Pedagogicheskie stati* (see above, pp. 180-196); there is also an article by A. I. Markushevich in the same volume (pp. 173-179; both are in the English ed.). See also Gnedenko's article in *Uspekhi matematicheskikh nauk*, **10**, no. 3 (1955), 197-212; and the obituary by Gnedenko and Kolmogorov, *ibid.*, **15**, no. 4 (1960), 97-110. Each of these articles has a full bibliography of Khinchin's works up to the time of publication.

See also *Nauka v SSR za pyatnadtsat let, Matematika* ("Fifteen Years of Science in the U.S.S.R. Mathematics" Moscow-Leningrad, 1932), 150-151, 166-169; *Matematika v SSSR za tridsat let* ("Thirty Years of mathematics in the U.S.S.R."; Moscow-Leningrad, 1948), 57, 60-61, 259-260, 509, 706-713, 724-727; and *Matematika v SSR za sorok let* ("Forty Years of mathematics in the U.S.S.R."), I (Moscow-Leningrad, 1959), 129-130, 789, 795.

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