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(*b*. Grüssow, Germany, 19 March 1862; *d*. Breslau, Germany [now Wroclaw, Poland], 24 January 1930)

mathematics.

One of the most distinguished German mathematicians of the years around 1900, Kneser was the son of a Protestant clergyman who died when the boy was one year old. His mother moved to Rostock in order to educate her four sons. There Kneser completed his secondary schooling and studied for a year at the university. As early as this (1880) he published his first paper, on the refraction of sound waves. He then went to Berlin. Of the great Berlin mathematicians Kronecker was above all his teacher, but certainly Kneser was also influenced by Weierstrass. In 1884 he received his doctorate and began his teaching activity. In 1889 he became associate professor, and in 1890 full professor, at Dorpat. In 1900 he went to the Bergakademie at Berlin; and in 1905 he received a professorship at the University of Breslau which he held for the rest of his life. Kneser was "Dr. e. h.". (honorary doctor in engineering) of the Technische Hochschule at Breslau and a corresponding member of the Prussian and Russian Academies of Sciences. In 1894 he married Laura Booth; they had four children. Their son Helmuth was professor at the University of Tübingen, and Helmuth's son Martin became professor at the University of Göttingen. So Kneser may be considered as the founder of a mathematical dynasty.

Although Kneser appears in the history of mathematics primarily as a master of analysis, he was, at first, more concerned with algebra. His dissertation and some subsequent papers are dedicated to algebraic functions and algebraic equations. He next turned to geometry, with a series of interesting works on space curves (1888-1894). Much later Kneser made another important discovery in the theory of curves: the so-called four-vertex theorem (1912). In 1888 he had begun his analytical investigations, the first of which involved elliptic functions, a subject still of interest to him in later years. Soon, however, he turned his attention to one of the two main subjects of his lifework: linear differential equations, and especially the group of ideas associated with the so-called Sturm-Liouville problem (from 1896). Since 1906, integral equations were added, after Fredholm's fundamental works had appeared, the two subjects being closely connected. Kneser's decisive achievement was to bring the theory of developing arbitrary functions into series with respect to the eigenfunctions of a Sturm-Liouville differential equation to the same level of generality that Dirichlet had achieved in the special case of Fourier series. Kneser's treatment of all this, which found final expression in his book on integral equations (1911), is characterized by a very intensive consideration of the theory's applications to mathematical physics, the theory of heat conduction, for instance.

The calculus of variations, the other main subject of Kneser's research (from 1897)—in fact the most important—is also of value to physics. His engagement in this classical topic was not the direct result of his studies with the field's great master, Weierstrass, but, rather, of his teaching experience at Dorpat. Kneser brought the theory of the so-called second variation to a certain conclusion. Especially, he favored one of its geometric aspects, the theory of families of resolution curves and their envelopes, closely connected with the Jacobian theory of conjugate points. But above all, the decisive advances toward the solution of the so-called Mayer Problem, recently introduced to the calculus of variations, are due to Kneser. His textbook on the calculus of variations (1900) had an enduring influence on later research. Many of the

technical terms nowadays usual in calculus of variations were created by Kneser, e. g. “extremal” (for a resolution curve), “field” (for a family of extremals), “transversal,” and “strong” and “weak” extremum.

An example of Kneser’s interest in the history of mathematics is his booklet *Das Prinzip der kleinsten Wirkung von Leibniz bis zur Gegenwart* (1928).

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II. Secondary Literature. See *Zur Erinnerung and Adolf Kneser* (Brunswick, 1930), reprint of the commemorative addresses delivered at Breslau in Feb. 1930; and L. Koschmieder, “Adolf Kneser,” in *Sitzungsberichte der Berliner mathematischen Gesellschaft*, **29** (1930), 78-102, which includes a bibliography of 81 items; and “El profesor Adolfo Kneser,” in *Revista matemática hispano-Americana* 2nd ser., **5** (1930), 281-288.

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