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(*b*. Potsdam, Germany, 22 May 1848; *d*. Hamburg, Germany, 20 July 1911)

mathematics.

Schubert, the son of an innkeeper, attended secondary schools in Potsdam adn Spandau. He first studied mathematics and physics in 1867 at the University of Berlin and then went to Halle, where he received the doctorate in 1870. Soon afterward he became a secondary school teacher; his first post was at the Andreanum Gymnasium in Hildesheim (1872–1876). In 1876 he accepted the same post at the Johanneum in Hamburg. He remained there until 1908, having been promoted in 1887 to the rank of professor. Besides this school activity he was engaged by the Hamburg authorities to teach adult courses in which he dealt with various fields of mathematics for teachers already in the profession. In 1905 Schubert began to suffer from circulatory disorders that forced him to retire three years latter. He died after a long illness that, toward the end, left him paralyzed. Schubert married Anna Hamel in 1873; they had four daughters.

Schubert publishe sixty-three works, including several books. His place in the history of mathematics is due chiefly to his work in enumerative geometry. He quicklty established a reputation in that field on the basis of his doctoral disseration, “Zur Theorie der Charakteristiken” (1870), and two earlier papers on the system of sixteen spheres that touch four given spheres. When he was only twenty-six, Schubert won the Gold Medal of the Royal Danish Academy of Sciences for the solution of a prize problem posed by H. G. Zeuthen on the extension of the theory of characteristics in cubic space curves (1874). A member of the Société Mathématique de France and honorary member of the Royal Netherlands Academy of Sciences, Schubert knew and corresponded with such famous geometers as Klein, Loria, and Hurwitz.

Schubert was content to remain in Hamburg, which had no university until 1919. Like Hermann Grassmann, he never became a university teacher and, in fact, declined offers that would have enabled him to do so. Mathematics in Hamburg centered in this period on the Mathematische Gesellschaft (founded in 1690 and still in existence), in the *Mitteilungen* of which Schubert published a number of papers.

In 1879 Schubert was able to present the methods and many individual results of his research in *Kalkül der abzählenden Geometrie*. Many further results were in papers he published until 1903.

Enumerative geometry is concerned with all those problems and theorems of algebraic geometry that involve a finite number of solutions. For example:

1. Bézout’s theorem of the plane: two algebraic curves of orders *a* and *b* with no common elements have no more than *ab* points of intersection in common; this number can be reached.

2. Apollonius’ theorem, according to which there are eight circles that simultaneously touch three given circles in the plane. Schubert’s earliest works dealt with a spatial generalization of this theorem.

3. A somewhat more difficult result of enumerative geometry, Halphen’s theorem: two algebraic linear congruences of P_3, one of order a and class b, and the other of order a' and class b', have in general $aa' + bb'$ straight lines in common.

Algebraically the solution of the problems of enumerative geometry amounts to finding the number of solutions for certain systems of algebraic equations with finitely many solutions. Since the direct algebraic solution of the problems is possible only in the simplest cases, mathematicians sought to transform the system of equations, by continuous variation of the constants involved, into a system for which the number of solutions could be determined more easily. Poncelet devised this process, which he called the principle of continuity; in his day, of course, the method could not be elucidated in exact terms. Schubert’s achievement was to combine this procedure, which he called “the principle of the conservation of the number,” with the Chasles correspondence principle, thus establishing the foundation of a calculus. With the aid of this calculus, which he modeled on Ernst Schröder’s logical calculus. Schubert was able to solve many problems systematically.

In *Kalkül der abzählenden Geometrie* Schubert formulated his fundamental problem as follows: Let C_k be a given set of geometric objects that depend on k parameters. Then, on the model of Bézout’s theorem, formulate theorems on the number of common objects of two subsets C_a and C'_{k-a} of C_k. Here C_a (and analogously C'_{k-a} are designated by certain characteristics, that is numbers $\varrho_1,\ldots,\varrho_s$ of objects that C_a has in common with certain previously designated elementary sets $E^1_{k-a},\ldots,E^s_{k-a}$ of C_k of dimension k—a. The best known of Schubert's investigations are those for the case where C_k is the totally of all subspaces P_d of the projective P_n, where $k = (n-d)(d+1)$. The appropiate elementary sets defined as follows: Let P_{ai} ($i = 0, 1, \ldots, d$) be subsaces of P_n, each of them of dimension a_i with $0 \leq a_0 < a_1 < \ldots < a_d \leq n$ and . Then Schubert designated as $[a_0, a_1, \ldots, a_d]$ the set of those P_d that intersect P'_{ai} in at least i dimensions ($i = 0, 1, \ldots, d$). If the totality of all P_d in P_n is mapped into the points of the Grassman-manifold $G_{n,d}$ there corresponds to $[a_0, a_1, \ldots, a_d]$ a subset of dimension on $G_{n,d}$. Later investigations have shown that the Schubert sets are precisely the basic sets of $G_{n,d}$ in Severi's sense.

Another set that Schubert studied is the totality C_6 of all plane triangles. His results on this set were rederived and confirmed from the modern standpoint by J. G. Semple.

Schubert could not rigoropusly demonstrate the principle of the conservation of numbe with the means available in his time, and E. Study and G. Kohn showed through counterexamples that it could lead to false conclusions. Schubert avoided such errors through his sure instinct. In 1900, in his famous Paris lecture David Hilbert called for an exact proof of Schubert's principle (problem no. 15). In 1912 Severi published a rigorous proof, but it was little known outside a rigorous proof, but it was little known outside Italy. VB. L. van der Waerden independently establsihed the principle in 1930 on the basis of the recently created concepts of modern algebra and topology.

Schubert was known to a broader public as the editor of Sammlung Schubert, a series of textbooks in wide use before World War I. He wrote the first volume of the series, on arithmetic and algebra, and a subsequent volume on lower analysis. He also edited tables of logarithms and collections of problems for schools and published a simple method for computing logarithms.

Schubert was very interested in recreational mathematics and games of all kinds, including chess and skat, and in the mathematical questions that arise in connection with them. In 1897 he published the first edition of his book on recreational mathematics, *Mathematische Mussestunden* the second edition, expanded to three volumes, appeared in 1900; and a thirteenth edition, revised by J. Erlebach, appeared in 1967. Schubert also was the author of the first article to appear in the *Encyklopädie der mathematischen Wissenschaften*; "Grundlagen der Arithmetik." His article, however, was subjected to severe criticism by the great pioneer in this area, Gottlob Frege.

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