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(*b*. Kalisz, Poland, 23 January 1806; *d*. Dorpat, Russia [now Tartu, Estonian S.S.R.], 13 May 1885)

mathematics.

Minding was a son of the town lawyer in Kalisz. After graduation in 1824 from the Gymnasium at Hirschberg (now Jelenia Góra, Poland), where the family had moved in 1807, Minding studied philology, philosophy, and physics at the universities of Halle and Berlin. In mathematics he was a self-taught amateur. After graduating from Berlin University in 1827, Minding taught mathematics in Gymnasiums for several years. In 1829 he received at Halle the doctorate in philosophy for his thesis on approximating the values of double integrals; from 1831 to 1843 he lectured on mathematics at Berlin University and from 1834 also at the Berlin Bauschule, At the university he lectured in 1831 and 1834 on the history of mathematics and gave a general introduction to the foundations and goals of the mathematical sciences. During these years he published thirty works, including several textbooks. Despite intensive pedagogical and scientific activity, Mhiding's position at Berlin was unsatisfactory; and he eagerly accepted an invitation to the University of Dorpat, where in 1842 the chair of mathematics of the Faculty of Philosophy was divided between one of pure mathematics, which was occupied by K. E. Senff, and one of applied mathematics, which was vacant. From 1843 to 1883 Minding was at the University of Dorpat as a full professor, giving both general and special courses in algebra, analysis, geometry, theory of probability, mechanics, and physics. In 1850 the Faculty of Philosophy was divided into that of physicomathematics and that of history-philology, and in 1851 Minding was elected to a four-year term as dean of the former division. In 1864 Minding and his family became Russian citizens. (In 1838 he had married Augusta Regler, and they had several children.) In the same year he was elected a corresponding member, and in 1879 an honorary member, of the St. Petersburg Academy of Sciences.

Minding's most important discoveries were in the dilierential geometry of surfaces; in these works he brilliantly continued the researches of Gauss, which had been published in 1828. In his first paper (1830), which dealt with the isoperimetric problem of determining on a given surface the shortest closed curve surrounding a given area (on the plane it is the circumference of a circle), he introduced the concept of geodesic curvature. It was independently discovered in 1848 by O. Bonnet, and it was he who named it geodesic curvature. Minding soon proved, as did Bonnet after him, the invariance of the geodesic curvature under bending of the surface. Neither of them knew that the same results had been presented in an earlier, unpublished paper of Gauss's (1825).

Mhiding's studies on the bending or the applicability of surlaces were especially remarkable. He first examined the bending of a particular class of surfaces (1838); incidentally, in the case of surfaces of revolution, he studied an example of the "applicability on a principal basis," which later became a preferred research topic for his disciple K. M. Peterson and for Peterson's followers in Moscow. He then proceeded to the general problem of determining the conditions for applicability of surfaces. Gauss had discovered (1828) that if one surface can be isometrically applied to another (so that the bending does not alter the lengths of curves), then the total curvature will be the same at all corresponding points.

In his article "Wie sich entscheiden lässt, ob zwei gegebene krumme Flächen auf einander abwickelbar sind oder nicht …" (1839), Minding stated the following sufficient condition for applicability: Two given surfaces of equal constant total curvature are applicable to one another isometrically, and this can be done in infinitely many different ways. He also investigated the corresponding problem for surfaces with a variable total curvature. Today "Minding's theorem" is found in all textbooks of differential geometry. Mhiding's papers, as well as Gauss's work of 1828, were great influences on ihc development of this branch of mathematics. In the article "Beiträge zur Theorie der kürzesten Linien auf krummen Flächen," which was published in Crelic's *Journal für die reine und angewandte Mathematik* (1840), Minding pointed out that when the trigonometric functions are replaced by corresponding hyperbolic ones, the trigonometric formulas in spherical trigonometry for the geodesic triangles on the surfaces with constant positive curvature are converted into the hyperbolic formulas for the surfaces with negative curvature. In 1837, Lobachevski showed (in an article that also appeared in Crelle's *Journal*) that the same relation exists between the trigonometric formulas for the sphere and the formulas in his "imaginary" (hyperbolic) geometry. The confrontation of these results might have led to the conclusion that two-dimensional hyperbolic geometry can be (partly) interpreted as the geometrv of geodesics on a surface of constant negative curvature; but it was not until 1868 that Beltrami established this connection.

Starting from Euler's ideas, Minding proposed the method of solving the differential equation $M(x, y)dx + N(x, y)dy = 0$, where M and N are polynomials of some degree, based on determining the integrating factor by means of particular integrals of the equation. Minding's method, expounded in the paper "Beiträge zur Integration der Differential-gleichungen erster Ordnung zwischen zwei Veränderlichen," for which he received in 1861 the Demidov Prize of the St. Petersburg Academy of Sciences, was developed further by A. N. Korkin and others. Darboux (1878) worked independently, followed by E. Picard and others, in the same direction. Minding also published works on algebra (the elimination problem), the theory of continued fractions, the theory of algebraic functions, and analytic mechanics.

BIBLIOGRAPHY

I. Orginal Works. Minding's writings include "Ueber die Curven kürzesten Perimeters auf krummen Flächen," in *Journal für die reine und angewandte Muthematik*, 5 (1830), 297–304; "Bemerkung über die Abwiekclung krummer Linien von Flächen," *ibid*., **6** (1830), 159–161; "De valore integralium duplicum quam proxime inveniendo" (his doctoral diss., in the archives of the University of Halle), pub. with minor modifications as "Ueber die Berechnung des Näherungswertes doppelter Integrale," *ibid*., 91–95; *Anfangsgründe der höheren Arithmetik* (Berlin, 1832); *Handbuch der Differential- und Integralrechnung nebst Anwendung auf die Geometrie* (Berlin, 1836); *Handbuch der Differential- und Integralrechnung und ihrer Anwendungen auf Geometrie und Mechanik. Zweiter Teil, enthaltend die Mechanik* (Berlin, 1838); "Ueber die Biegung gewisser Flächen," in *Journal für die reine und angewandte Mathematik*, **18** (1838), 297–302; "Wie sich entseheiden lässt, ob zwei gegehene krumme Flächen auf einander abwickelbar sind oder nichi; nebst Bemerkungen üher die Flächen von unverändlichem Krümmungsmasse,'" *ibid*., **19** (1839), 370–387; "Beiträge zur Theorie der kürzesten Linien auf krummen Flächen," *ibid*., **20** (1840), 323–327; and "Beiträge zur Integration der Differentialgleichungen erster Ordnung zwischen zwei Veränderlichen," in *Mémoires de l'Académie des sciences de St. Petersbourg*, 7th ser., **5** , no. 1 (1863), 1–95, also pub. separately in Russian trans. (St. Petersburg, 1862).

II. Seconday Literature. See R. I Galchenkova *et al., Ferdinand Minding. 1806–1885*. (Leningrad, 1970), which includes a complete list of Minding's works, pp. 205–210 (nos. 1–72), and extensive secondary literature, pp. 210–220 (nos. 73–289); A. Kneser, "Übersicht der wissenschaftlichen Arbeiten Ferdinand Minding's nebst biographischen Notizien," in *Zeitschrift für Mathematik und Physik*, Hist.-lit. Abt., **45** (1900), 113–128; I Z. Shtokalo, ed., *Istoria otechestvennoy matematiki*, II (Kiev, 1967); A. Voss, "Abbildung und Abwickelung zweier Flächen auf einender abwickelbarer Flächen," in *Encyklopädie der mathematischen Wissenschaften*, III, pt. 6a (Leipzig, 1903), 355–440; and A. P. Youschkevitch, *Istoria matvmatiki v Rossii do 1917 g*. (Moscow, 1968).

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