Betti, Enrico | Encyclopedia.com

Complete Dictionary of Scientific Biography COPYRIGHT 2008 Charles Scribner's Sons
6-8 minutes

(*b*. near Pistoia, Italy, 21 October 1823; *d*. Pisa, Italy, 11 August 1892)

mathematics.

Since his father died when Betti was very young, the boy was educated by his mother. At the University of Pisa, from which he received a degree in physical and mathematical sciences, he was a disciple of O. F. Mossotti, under whose leadership he fought in the battle of Curtatone and Montanara during the first war for Italian independence.

After having taught mathematics at a Pistoia high school, in 1865 Betti was offered a professorship at the University of Pisa; he held this post for the rest of his life. He also was rector of the university and director of the teachers college in Pisa. In addition, he was a member of Parliament in 1862 and a senator from 1884. His principal aim, however, was always pure scientific research with a noble philosophical purpose.

In 1874 Betti served for a few months as undersecretary of state for public education. He longed, however, for the academic life, solitary meditation, and discussions with close friends. Among the latter was Riemann, whom Betti had met in Göttingenin 1858, and who subsequently visited him in Pisa.

In algebra, Betti penetrated the ideas of Galois by relating them to the previous research of Ruffini and Abel. He obtained fundamental results on the solubility of algebraic equations by means of radicorational operations. It should be noted that the most important results of Galois's theory are included—without demonstration and in a very concise form—in a letter written in 1832 by Galois to his friend Chevalier on the eve of the duel in which Galois was killed. The letter was published by Liouville in 1846. When Betti was able to demonstrate—on the basis of the theory of substitutions, which he stated anew—the necessary and sufficient conditions for the solution of any algebraic equation through radicorational operations, it was still believed in high mathematical circles that the questions related to Galois's results were obscure and sterile. Among the papers in which Betti sought to demonstrate Galois's statements are "Sulla risoluzione delle equazioni algebriche" (1852) and "Sopra la teorica delle sostituzioni" (1855). They constitute an essential contribution to the development from classical to abstract algebra.

Another area of mathematical thought developed by Betti is that of the theory of functions, particularly of elliptic functions. Betti illustrated—in an original way—the theory of elliptic functions, which is based on the principle of the construction of transcendental entire functions in relation to their zeros by means of infinite products.

Betti published these results in a paper entitled "La teorica delle funzioni ellitiche" (1860–1861). These ideas were further developed by Weierstrass some fifteen years later. However, Betti, who in the meantime had turned to another theory of elliptic functions—thisone inspired by Riemann—did not wish to claim priority. These two methods are linked with the two basic aspects of Betti's mathematical thought: the algebraic mode of thought, which went deep into Galois's research, and the physicomathematical mode of thought, developed under Riemann's influence. Betti, an enthusiastic supporter of theoretical physics, had turned toward the procedures already started in electricity and subsequently applied to analysis.

Among Betti's physicomathematical researches inspired by Riemann are *Teorica della forze newtoniane* (1879) and "Sopra le equazioni di equilibrio dei corpi solidi elastici." A law of reciprocity in elasticity theory, known as Betti's theorem, was demonstrated in 1878. Having mastered the methods by which Green had opened the way to the integration of Laplace's equations, which constitute the basis for the theory of potentials, Betti applied these methods to the study of elasticity and then to the study of heat.

Of particular interest is Betti's research on "analysis situs" in hyperspace, which is discussed in "Sopra gli spazi di un numero qualunque di dimensioni" (1871). This research inspired Poincaré in his studies in this field and originated the term "Betti numbers," which subsequently became common usage for numbers characterizing the connection of a variety.

Betti played an important role in the rebirth of mathematics after the Risorgimento. He loved classical culture, and with Brioschi he championed the return to the teaching of Euclid in secondary schools, for he regarded Euclid's work as a model of discipline and beauty. This led to *Gli elementi d'Euclide* (1889).

His enthusiasm and brilliance made Betti an excellent teacher. At the University of Pisa and at the teachers college, he guided several generations of students toward scientific research, among them the mathematicians U. Dini, L. Bianchi, and V. Volterra.

BIBLIOGRAPHY

I. Original Works. Betti's collected writings are *Opere matemaliche*, R. Accadcmia dei Lincei, ed., 2 vols. (Milan, 1903–1915). Among his works are "Sulla risoluzione delle equazioni algebriche," in *Annali di scienze matematiche e fisiche*, **3** (1852), 49–115; "Sopra la teorica delle sostituzioni," *ibid*., **6** (1855), 5–34; "La teorica delle funzioni ellitiche," in *Annali di matematica pura e appicata*, **3** (1860), 65–159, 298–310; 4 (1861), 26–45, 57–70, 297–336; "Sopra gli spazi di un numero qualunque di dimensioni," *ibid*., 2nd ser., **4** (1871), 140–158; "Sopra le equazioni di equilibrio dei corpi solidi elastici," *ibid*., **6** (1874), 101–111; *Teorica della forze newtoniane* (Pisa, 1879); and *Gli elementi d'Euclide con note aggiunte ed esercizi ad uso dei ginnasi e dei licei* (Florence, 1889), written with Brioschi.

II. Secondary Litrrature. Works on Betti are F. Brioschi, "Enrico Betti," in *Annali di matematica pura e applicata*, 2nd ser., **20** (1892), 256.or his *Opere matematiche*, III (Milan, 1904).41–42: F. Enriques, *Le matematiche nella storia e nella cultura* (Bologna, 1938), pp. 187. 203–204, 222, 224–226: and his article on Betti in *Enciclopediaitaliana Treccani*, VI (1930), 834; G. Loria, *Storia delle matematiche*, III (Turin, 1933), 497, 541. 556–557: and V. Volterra, *Saggi scientifici* (Bologna, 1920), pp. 37, 40–41, 46–50. 52–54.

Ettore Carruccio