Renato Caccioppoli

Renato Caccioppoli (January 20, 1904 – May 8, 1959) may be lesser known than other Italian mathematicians of his era; nevertheless he was an outstanding mathematician, making significant contributions to measure and integration theory, differential equations, calculus of variations, elliptic functions, and surfaces of minimal area. In 1952, he studied the theory of surfaces of "nice" subsets of Euclidean space, namely sets of finite perimeter, which have come to be known as "Caccioppoli sets." He was a professional pianist and violinist, a charming, cultured nonconformist, fluent in five languages, with a passion for the movies.

Caccioppoli was born in Naples in 1925 to a well-to-do family that had made its fortune at the beginning of the 19th century in a successful commercial sea trading business. His mother, Sofia Bakunin, was the daughter of the Russian revolutionary Mikhail Bakunin, a leading exponent of anarchism and founding member of the Russian Populist movement. Caccioppoli was also related to Achille Starace, an important Fascist leader and long-time secretary of the National Fascist Party. In December 1931, Benito Mussolini rewarded Starface's loyalty by appointing him national secretary of the party, a position he held until 1939. One of the latter's first acts in the new position was to proclaim that all meetings and public occasions would begin with the official "salute to the Duce" and that all fascists must wear military uniforms.

To please his father Giuseppe, a famous Neapolitan surgeon, Caccioppoli initially planned to become an engineer, but soon changed to mathematics. He received the Laurea degree (similar to *summa cum laude*) in mathematics from the University of Naples in 1925, under the direction of Ernesto Pascal. He was greatly influenced by Mario Picone, becoming his assistant the same year. In 1931, Caccioppoli was appointed to the Chair of Algebraic Analysis in Padua, but returned to the University of Naples, where he taught group theory and mathematical analysis until his death in 1959. He carried out seminal work on linear and non-linear differential equations, elliptic functions, homological integrations, linear functions and an invention of his own, pseudo-analytic functions.

Caccioppoli extended certain cases of Brouwer's fixed-point theorem and applied his results to existence problems of ordinary and partial differential equations. In 1935, he proved a special case of one of the problems David Hilbert suggested at the 1900 International Congress of Mathematicians. Caccioppoli was cherished and admired by his students, including the writer Luciano De Crescenzo, who begins his passionate portrait of Caccioppoli in his book *Storia della Filosofia Greca* (History of Greek Philosophy) with the sentence: "When I want to be proud of something, I say: I followed the mathematical analysis courses held by Renato Caccioppoli."

In 1933, Adolf Hitler came to power in Germany and formed an alliance with Mussolini. The Fascists imposed racial laws similar to those in Germany against Jews and others. Those who opposed Mussolini were imprisoned or forced into exile. Italy lost many of its most outstanding mathematicians and physicists, including Tullio Levi Civita, Vito Volterra, Guido Fubini, Beniamino Segre and Enrico Fermi, who were forced from their university positions either because they were Jews or antifascists. Caccioppoli felt he had to make some gallant gesture in protest. In May 1938, while Hitler was visiting Mussolini in Naples, Caccioppoli and his fiancée Sara Mancuso (later to be his wife) went to a small open-air restaurant, where he induced the orchestra to play *La Marseillaise*. He followed this with a speech against the two dictators, saying, "What you have heard is the hymn of freedom, the same freedom that in this country is suffocated and denied by Benito Mussolini." He was arrested, and it was expected that his punishment would be severe. However, with the help of his Aunt Maria Bakunin, a professor of chemistry at the University of Naples, who produced a medical certificate asserting that her nephew was not in his right mind, Caccioppoli managed to have himself declared insane and sent to an asylum. While confined he continued his mathematical research, but not wishing to be associated with Italian academic institutions that were then controlled by the Fascists, he published his results in a Vatican State scientific review. Later, to show he had not lost any steam in his opposition to the Fascists, he organized a strike in Naples.

After the war Caccioppoli joined the Italian Communist Party, although he disagreed with it on a number of political and scientific issues. He was a strong supporter of disarmament, becoming a member of the left-wing "peace partisans." His last days were lonely and unhappy. His political hopes were disappointed; his wife left him, and his mathematical inspiration was gone. He shot and killed himself on May 8, 1959. In 1984, the Mathematics Department of the University of Naples was established by merging the former Mathematics Institutes of Science and Engineering and was dedicated to Caccioppoli.

In 1992, a film *Morte di un matematica napoletono* ("Death of a Neapolitan Mathematician") was produced by director Mario Martone. It gave a realistic and amusing picture of Italian university life. It concentrated on the events leading up to Caccioppli's suicide, and won the Jury Prize at the Venice Film Festival that year. Actor Carlo Cecchi gave a brilliant portrayal of Caccioppoli. The film does not stress the mathematical contributions of the Italian genius. Among the limited mathematical content is a classroom scene in which a drunken Caccioppoli gives a complete and correct proof of a calculus theorem. Director Martone presented a dark thriller about the last weeks in the life of Caccioppoli. He was drinking excessively, feeling very isolated and depressed. He struggled to maintain his sanity when he no longer fit in and could find no understanding or compassion from those around him. The film confirms that mathematicians and scientists do not live ideal lives, but have the same affections, weakness, and societal concerns as do others.

Quotation of the Day: "I have no certainties, at most probabilities." – Renato Caccioppoli