



11. Bernhard Riemann - The shy genius

Wenn, nach meinem Tod wachte ich nach 500 Jahren meine erste Frage wäre, wenn der Riemann-Hypothese bewiesen war.

If, after my death, I woke up 500 years later, my first question would be if the Riemann hypothesis had been proven.

David Hilbert (1862-1943), German mathematician.

1. He lived 39 years, not reaching 40. These were the years that Bernhard Riemann lived. A very short time. He was an essential mathematician, with a superior intelligence and a boundless imagination. His work was multidimensional, because it encompassed mathematics (number theory, analysis and theory of functions and geometry), physics and philosophy, all of his work being first class.

To be able to speak of Bernhard Riemann I have studied the work of several authors. The first is that of his colleague in Göttingen, Richard Dedekind⁽¹⁾ (1831-

1916) which, being friend and disciple, offers the freshest and closest, albeit summarized biography, that I have relied on to write several excerpts of the life of Bernhard, some verbatim. I also leaned on the historical and mathematical works of Detlef Laugwitz⁽²⁾ and Michael Monastyrsky⁽³⁾, which are of great value, because they summarize the work of Riemann in an accessible manner, and I have used them as a guide, in particular those of Laugwitz. I have also relied on the *Riemanniana Selecta*, by José Ferreirós⁽⁴⁾. I have used this because it introduces the reader into his mathematical work, with an excellent explanation about his life and philosophical work. But I have not limited myself thereto, since the biographical and educational sources of information on Riemann are varied. I have skim read the original documents, manuscripts and letters (*Nachlass*⁽⁵⁾), including some article of Riemann's historian and scholar Erwin Neuenschwander⁽⁶⁾: letters and documents that appeared many years after the death of Riemann, which were unknown to Dedekind. And, of course, I became saturated with the manuscripts that I had access to at the University of Göttingen, that I will naturally mention when we discuss the Riemann hypothesis. In contrast to Euler and Gauss, there is not a great documentary base on the biography of Riemann. We must be guided by Dedekind and by the letters he left after his death, as well as by some letters from his teachers and the above mentioned biographers and scholars.



Bernhard Riemann in 1863

Riemann, whom we are used to seeing him through his thick beard, as if to hide from us, marked a new era in mathematics. He had three masters, whom he admired: Euler, Gauss and Dirichlet. And he had many followers of his work. His conclusions on number theory continue to astonish mathematicians, and his contributions to geometry were crucial to developing the mathematical tools used by Albert Einstein (1879-1955) in his General Theory of Relativity. He led a life full of work, devoted to it continuously, without rest. He went through discomfort and great economic hardship. He saw the death of most of his family, which he was very close to. His health was not good, and his shyness prevented him from teaching with ease. Shyness that made it difficult for him to be sociable, or to assert his intelligence and his discoveries. We do not know how far Riemann

would have reached, had he been an expressive person. Or, perhaps, he would not have reached too far. He left a fresh and modern work, which his friend Dedekind helped organize and publish: the so-called *Gesammelte mathematische Werke und Wissenschaftlicher Nachlass* (Collection of mathematical works and scientific work), 1876. He left us a hypothesis, to which I devote this book, which still puzzles mathematicians in 2020 as the greatest unsolved problem.

2. Riemann's childhood. Georg Friedrich Bernhard Riemann, to be precise, was born on September 17, 1826, in Breselenz, a small town west of the Elbe, today in the district of Jameln, near Dannenberg. It was situated in the Kingdom of Hannover, which in those days, and until 1837, was one of the dependencies of the British crown, as we have seen in previous chapters. His father, Friedrich Bernhard Riemann, was the local Lutheran pastor, who had participated as a lieutenant in the Napoleonic wars from 1812 to 1814, the so-called Wars of Liberation. He had served in the army of the Austrian Count Ludwig Wallmoden, who distinguished himself in the siege of Hamburg. The troops formed by Russians, Prussians and their allies crushed the French general Davout units in Mecklemburg, which, among other factors, hastened the subsequent battle of Leipzig. At a certain age, he married Charlotte Ebell, daughter of a private adviser of the court of Hannover. Bernhard



Lutheran Parish Church of Breselenz
Photo: H. H. Oldman

was the second of six children that the couple had: two sons and four daughters. The family's health was poor. His mother died when he was 20, and his brother and three sisters also died young.



Monument and plaque in memory of Riemann in Breselenz, on his birth's 150th anniversary.

Photo: Adam Walanus

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