



7. Gauss: Princeps Mathematicorum.

Ich meine das Wort Beweis nicht im Sinne der Anwälte, die zwei Halb Beweise gleich einer ganzen eins gesetzt, sondern im Sinne eines Mathematikers, wo $\frac{1}{2}$ Beweis = 0 ist, und es für den Nachweis, dass jeder Zweifel unmöglich wird gefordert wird.

I do not mean the word proof in the sense of the lawyers, who set two half proofs equal to a whole one, but in the sense of a mathematician, where $\frac{1}{2}$ proof = 0, and it is required for a proof that every doubt becomes impossible.

Carl Friedrich Gauss (1777-1855)

1. I write about the life and work of famous mathematicians with the greatest respect. Respect that is emphasized when the person we are talking about is Carl Friedrich Gauss. Gauss is considered by many authors the best mathematician in history. Deciding who is the best is always difficult. In general, I do not like to do so, because each one of them has their particular virtues, their genius. But, if we take stock of all the disciplines in which Gauss was colossal,

historians could be right. Approaching the genius of Gauss requires addressing many different paths, in mathematics, physics, astronomy and geodesy. Gauss has had several and very good biographers. There is much literature on this character, that I recommend you reading⁽¹⁾.

Our interest in Gauss arises from him being the first mathematician who sensed and worked intensely on one of the most famous theorems in mathematics, which falls under the main subject of this book. Gauss, after carrying out some very meticulous work, conjectured the so-called *Prime Number Theorem* (PNT), although he did not prove it. This was achieved a century later, after the advances of Dirichlet, Chebyshev and Riemann. The PNT is of enormous relevance, because it presents, for the first time, a clear behavior in the distribution of prime numbers, in addition to linking number theory to analysis, which leads to working with prime numbers using powerful tools. We will devote chapter 8 to this subject, as it constitutes a milestone in the progress on the knowledge of prime numbers.



*Gauss, motif of the former German 10
Deutschmark bill, 1999*

We will make a presentation of the life and achievements, mainly mathematical, of Gauss. A life that must be framed, as always, within the time he lived, which is the end of the eighteenth and first half of the nineteenth centuries. He lived at the dawn of the railroad, he used the telegraph, which he invented, and he was a contemporary of Ludwig van Beethoven, George Washington, Richard Wagner, Thomas Jefferson, Wolfgang Goethe, Friedrich Schiller, Charles Dickens and many others. Therefore, we feel Gauss close to us. He left a monumental mathematical legacy, opening paths to subsequent researchers. In his time, he was called *Princeps Mathematicorum* (The Prince of Mathematics). His personality deserves to be known, and we will do just that.

2. What world did Gauss live in? Gauss was born in the complicated world of pre-revolutionary Europe, which had its epicenter in the French Revolution. This is the most significant event in the late eighteenth century. From 1804 to 1815 almost all of Europe was ruled by Napoleon. In 1814 the Congress of Vienna drew what would be Europe until well into the twentieth century. To explain in a condensed way what happened to this very complicated and important period of history, in which our other protagonist, Bernhard Riemann, also lived, I draw on the work of professor and writer Dietrich Schwanitz, from whom I allow myself to take notes on his historical book "*Bildung. Alles, was man wissen muss*". The historical context in which Gauss and Riemann lived coincides with much of their lives, as Riemann lived between 1826 and 1866, and died only 11 years after Gauss. So, anything we say about the world in which Gauss lived will also be valid for Riemann.

France at the end of the eighteenth century. King Louis XV (1710-1774, Louis the Beloved), who had 24 children from 10 different women, but only 10 with his lawful wife, was the grandfather of Louis XVI. Louis XV planted inadvertently the seed of the subsequent French Revolution. The pageantry, the luxury, the few military successes, the loss of colonies in favor of Great Britain, and his promiscuity, turned him into a hated king at the end of his life. His grandson, Louis XVI (1754-1793), was the straw that broke the camel's back for

the French people. Let us recall that the nobility did not pay taxes, unlike in Great Britain. And, while in Great Britain the nobles would bequeath their titles and lands only to their eldest son, the others having find an occupation or, if lucky, marry a noble heiress, in France the nobility could not mix with other social classes. It was an untouchable, self-absorbed caste, without ties to the bourgeoisie, which in Great Britain was becoming of great importance. Moreover, thanks to Henry VIII, who 250 years earlier had broken the dependence of the Church of England with the Roman Catholic Church, ecclesiastical power had ceased to matter, reducing its presence to the most enlightened circles, and leaving the Church of England as a necessary institution privately. Only the sects defending Puritanism took refuge in it, albeit not at state level, but individually. In France the opposite had happened. The Catholic Church was an institution at the same level as the Monarchy. It owned a third of the land, and additionally it paid no taxes. Worse still, the Church received the tithe from farmers and ranchers, confiscating a tenth of their income for the benefit of bishops, who lived in the greatest luxury possible and encouraged censorship, both political, sociological and cultural.

Louis XVI, who reigned since 1774, married Marie Antoinette, an authentic palatial plotter and symbol of arrogance from absolute power. This couple led France into bankruptcy, which led to the uprising of the people. On July 14, 1789 (currently France's national day), the revolutionary movement seized the fortress-prison of the Bastille with the aim of procuring weapons, and this turned into a bloodbath. This marked the beginning of a struggle to the death between the old powers and the fledgling republic, with Marat as one of its initiators. European reactionary monarchies, especially Prussia and Austria, saw the revolution as a terrible threat if it extended to their territories, so they decided to go against it. Revolutionary France, however, came forward, and declared war in April 1792. Prussia and Austria, under the leadership of King Frederick William II of Prussia, attacked France with their army, under the orders of the Duke of Brunswick, Charles William Ferdinand. After a threat to all the people of Paris, known as the *Brunswick manifesto*, they entered French territory in August of that year and, on September 20, one of the most important battles in history took place: the Battle of Valmy. It was not a bloody battle, because there were few casualties, but France won, surprisingly, and the invading armies were forced to withdraw.



Central Europe in 1789.

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