

The Life and Work of Gustav Lejeune Dirichlet (1805–1859)

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Dedicated to Jens Mennicke, my friend over many years

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Introduction

The great advances of mathematics in Germany during the first half of the nineteenth century are to a predominantly large extent associated with the pioneering work of C.F. Gauß (1777–1855), C.G.J. Jacobi (1804–1851), and G. Lejeune Dirichlet (1805–1859). In fact, virtually all leading German mathematicians of the second half of the nineteenth century were their disciples, or disciples of their disciples. This holds true to a special degree for Jacobi and Dirichlet, who most successfully introduced a new level of teaching strongly oriented to their current research whereas Gauß had “a real dislike” of teaching — at least at the poor level which was predominant when Gauß started his career. The leading role of German mathematics in the second half of the nineteenth century and even up to the fateful year 1933 would have been unthinkable without the foundations laid by Gauß, Jacobi, and Dirichlet. But whereas Gauß and Jacobi have been honoured by detailed biographies (e.g. [Du], [Koe]), a similar account of Dirichlet’s life and work is still a desideratum repeatedly deplored. In particular, there exist in English only a few, mostly rather brief, articles on Dirichlet, some of which are unfortunately marred by erroneous statements. The present account is intended as a first attempt to remedy this situation.

1. Family Background and School Education

Johann Peter Gustav Lejeune Dirichlet, to give him his full name, was born in Düren (approximately halfway between Cologne and Aachen (= Aix-la-Chapelle)) on February 13, 1805. He was the seventh¹ and last child of Johann Arnold Lejeune Dirichlet (1762–1837) and his wife Anna Elisabeth, née Lindner (1768–1868(?)). Dirichlet’s father was a postmaster, merchant, and city councillor in Düren. The official name of his profession was *commissaire de poste*. After 1807 the entire region of the left bank of the Rhine was under French rule as a result of the wars with revolutionary France and of the Napoleonic Wars. Hence the members of the Dirichlet family were French citizens at the time of Dirichlet’s birth. After the final defeat of Napoléon Bonaparte at Waterloo and the ensuing reorganization of Europe at the Congress of Vienna (1814–1815), a large region of the left bank of the Rhine including Bonn, Cologne, Aachen and Düren came under Prussian rule, and the Dirichlet family became Prussian citizens.

Since the name “Lejeune Dirichlet” looks quite unusual for a German family we briefly explain its origin²: Dirichlet’s grandfather Antoine Lejeune Dirichlet (1711–1784) was born in Verviers (near Liège, Belgium) and settled in Düren, where he got married to a daughter of a Düren family. It was his father who first went under the name “Lejeune Dirichlet” (meaning “the young Dirichlet”) in order to differentiate from his father, who had the same first name. The name “Dirichlet” (or “Derichelette”) means “from Richelette” after a little town in Belgium. We mention this since it has been purported erroneously that Dirichlet was a descendant of a

¹Hensel [H.1], vol. 1, p. 349 says that Dirichlet’s parents had 11 children. Possibly this number includes children which died in infancy.

²For many more details on Dirichlet’s ancestors see [BuJZ].

French Huguenot family. This was not the case as the Dirichlet family was Roman Catholic.

The spelling of the name “Lejeune Dirichlet” is not quite uniform: Dirichlet himself wrote his name “Gustav Lejeune Dirichlet” without a hyphen between the two parts of his proper name. The birth-place of Dirichlet in Düren, Weierstraße 11, is marked with a memorial tablet.

Kummer [Ku] and Hensel [H.1], vol. 1 inform us that Dirichlet’s parents gave their highly gifted son a very careful upbringing. This beyond doubt would not have been an easy matter for them, since they were by no means well off. Dirichlet’s school and university education took place during a period of far-reaching reorganization of the Prussian educational system. His school and university education, however, show strong features of the pre-reform era, when formal prescriptions hardly existed. Dirichlet first attended an elementary school, and when this became insufficient, a private school. There he also got instruction in Latin as a preparation for the secondary school (Gymnasium), where the study of the ancient languages constituted an essential part of the training. Dirichlet’s inclination for mathematics became apparent very early. He was not yet 12 years of age when he used his pocket money to buy books on mathematics, and when he was told that he could not understand them, he responded, anyhow that he would read them until he understood them.

At first, Dirichlet’s parents wanted their son to become a merchant. When he uttered a strong dislike of this plan and said he wanted to study, his parents gave in, and sent him to the Gymnasium in Bonn in 1817. There the 12-year-old boy was entrusted to the care and supervision of Peter Joseph Elvenich (1796–1886), a brilliant student of ancient languages and philosophy, who was acquainted with the Dirichlet family ([Sc.1]). Elvenich did not have much to supervise, for Dirichlet was a diligent and good pupil with pleasant manners, who rapidly won the favour of everybody who had something to do with him. For this trait we have lifelong numerous witnesses of renowned contemporaries such as A. von Humboldt (1769–1859), C.F. Gauß, C.G.J. Jacobi, Fanny Hensel née Mendelssohn Bartholdy (1805–1847), Felix Mendelssohn Bartholdy (1809–1847), K.A. Varnhagen von Ense (1785–1858), B. Riemann (1826–1866), R. Dedekind (1831–1916). Without neglecting his other subjects, Dirichlet showed a special interest in mathematics and history, in particular in the then recent history following the French Revolution. It may be assumed that Dirichlet’s later free and liberal political views can be traced back to these early studies and to his later stay in the house of General Foy in Paris (see sect. 3).

After two years Dirichlet changed to the Jesuiter-Gymnasium in Cologne. Elvenich became a philologist at the Gymnasium in Koblenz. Later he was promoted to professorships at the Universities of Bonn and Breslau, and informed Dirichlet during his stay in Bonn about the state of affairs with Dirichlet’s doctor’s diploma. In Cologne, Dirichlet had mathematics lessons with Georg Simon Ohm (1789–1854), well known for his discovery of Ohm’s Law (1826); after him the unit of electric resistance got its name. In 1843 Ohm discovered that pure tones are described by purely sinusoidal oscillations. This finding opened the way for the application of Fourier analysis to acoustics. Dirichlet made rapid progress in mathematics under Ohm’s guidance and by his diligent private study of mathematical treatises, such

that he acquired an unusually broad knowledge even at this early age. He attended the Gymnasium in Cologne for only one year, starting in winter 1820, and then left with a school-leaving certificate. It has been asserted that Dirichlet passed the Abitur examination, but a check of the documents revealed that this was not the case ([Sc.1]). The regulations for the Abitur examination demanded that the candidate must be able to carry on a conversation in Latin, which was the *lingua franca* of the learned world for centuries. Since Dirichlet attended the Gymnasium just for three years, he most probably would have had problems in satisfying this crucial condition. Moreover he did not need the Abitur to study mathematics, which is what he aspired to. Nevertheless, his lacking the ability to speak Latin caused him much trouble during his career as we will see later. In any case, Dirichlet left the Gymnasium at the unusually early age of 16 years with a school-leaving certificate but without an Abitur examination.

His parents now wanted him to study law in order to secure a good living to their son. Dirichlet declared his willingness to devote himself to this bread-and-butter-education during daytime – but then he would study mathematics at night. After this his parents were wise enough to give in and gave their son their permission to study mathematics.

2. Study in Paris

Around 1820 the conditions to study mathematics in Germany were fairly bad for students really deeply interested in the subject ([Lo]). The only world-famous mathematician was C.F. Gauß in Göttingen, but he held a chair for astronomy and was first and foremost Director of the *Sternwarte*, and almost all his courses were devoted to astronomy, geodesy, and applied mathematics (see the list in [Du], p. 405 ff.). Moreover, Gauß did not like teaching – at least not on the low level which was customary at that time. On the contrary, the conditions in France were infinitely better. Eminent scientists such as P.-S. Laplace (1749–1827), A.-M. Legendre (1752–1833), J. Fourier (1768–1830), S.-D. Poisson (1781–1840), A.-L. Cauchy (1789–1857) were active in Paris, making the capital of France the world capital of mathematics. Hensel ([H.1], vol. 1, p. 351) informs us that Dirichlet’s parents still had friendly relations with some families in Paris since the time of the French rule, and they let their son go to Paris in May 1822 to study mathematics. Dirichlet studied at the *Collège de France* and at the *Faculté des Sciences*, where he attended lectures of noted professors such as S.F. Lacroix (1765–1843), J.-B. Biot (1774–1862), J.N.P. Hachette (1769–1834), and L.B. Francœur (1773–1849). He also asked for permission to attend lectures as a guest student at the famous *École Polytechnique*. But the Prussian *chargé d’affaires* in Paris refused to ask for such a permission without the special authorization from the Prussian minister of religious, educational, and medical affairs, Karl Freiherr von Stein zum Altenstein (1770–1840). The 17-year-old student Dirichlet from a little provincial Rhenisch town had no chance to procure such an authorization.

More details about Dirichlet’s courses are apparently not known. We do know that Dirichlet, besides his courses, devoted himself to a deep private study of Gauß’ masterpiece *Disquisitiones arithmeticae*. At Dirichlet’s request his mother had procured a copy of the *Disquisitiones* for him and sent to Paris in November 1822