

Leonhard Euler's Letters to a German Princess: A Milestone in the History of Physics Textbooks and More



by Ronald S. Calinger, Ekaterina (Katya) Denisova, and Elena N. Polyakhova

IOP CONCISE PHYSICS, 2019, 215 PP., \$79.95, ISBN 978-1-64327-189-7

REVIEWED BY JOHAN C.-E. STÉN

Leonhard Euler's well-known epistolary course in physics and philosophy, *Lettres à une Princesse d'Allemagne sur divers sujets de physique et de philosophie*, has since its first publication in 1768–1772 enjoyed an immense success. The charm of the *Lettres* is partly due to the clarity and simplicity characteristic of the author's explanations of difficult issues, without recourse to formulas and equations, and partly due to his gentle mode of persuasion, the letters being addressed to an enlightened young lady of the ruling class, presumably Princess Friederike Charlotte Leopoldine Luise von Brandenburg-Schwedt (1745–1808), who was only 14 when the private course was initiated. Between 1760 and 1762, Euler wrote 234 letters to the Princess, totaling some 1000 pages of high-level science in a palatable form. Among the topics discussed we find, for instance, sound and music, light and color, gravitation and the tides, electricity and magnetism, determination of longitude, logic and syllogisms. Even if the physics involved is in part dated, Euler's letters may captivate even the modern reader by presenting an easily accessible insight into the thoughts of one of the most brilliant mathematicians of all time.

The letters—whose originals are lost—were published in three separate volumes in Saint Petersburg, where Euler famously had returned in 1766 after a 25-year stay in Berlin. Volumes 1 and 2, denoted by E.343 and E.344, respectively, in Gustaf Eneström's *Verzeichnis der Schriften Leonhard Eulers* (1910), were first published in 1768, and volume 3 (E.417) in 1772. A revised version of the letters edited by the Marquis de Condorcet and Sylvestre-François de Lacroix was published in Paris under the slightly different title *Lettres de M. Euler à une Princesse d'Allemagne, sur différentes questions de physique et de philosophie* in 1787 (E.343^A), 1788 (E.344^A), and 1789 (E.417^A). Condorcet's edition, to which I will shortly return, was used as a basis for numerous translations. In his list, Eneström included all 111 editions of the *Lettres* (including translations) known at the time. Here it may be

appropriate to list only the first translated editions of the three volumes up to 1800:

Russian: 1768 (E.343^A), 1772 (E.344^A) and 1774 (E.417^A), German: 1768 (E.343^B), 1769 (E.344^B) and 1773 (E.417^B), Dutch: in 1785 (E.343^C), 1785 (E.344^C) and 1786 (E.417^C), Swedish: in 1786 (E.343^D), 1787 (E.344^D) and 1787 (E.417^D), Italian: in 1787 (E.343^E), 1787 (E.344^E) and 1787 (E.417^E), Danish: in 1792 (E.343^F), 1792 (E.344^F) and 1793 (E.417^F), English: in 1795 (E.343^G), 1795 (E.344^G) and 1795 (E.417^G), Spanish: in 1798 (E.343^H) (no information on the last two volumes was available)

Knowing Professor Calinger as the author of an excellent article about the philosophical background to the *Lettres* (Calinger 1976) and of a monumental biography of Euler (Calinger 2016) (reviewed by myself in the spring 2018 issue of this magazine), I was rather curious about the present book. It consists of a preface, four chapters, and a prologue. Chapter 1 discusses the state of physics and different philosophical schools in the early eighteenth century, and also the origin and development of contemporary physics textbooks in Western Europe, North America, and Russia. Chapter 2 concerns the background of the *Lettres*, their philosophical and religious underpinnings, as well as the long-debated question of the identity of the recipient. Chapter 3 gives a succinct popular account of Euler's life and work, and Chapter 4—the longest one—reproduces a facsimile selection of letters from an 1802 edition translated by Henry Hunter.

The four schools of natural philosophy in the eighteenth century discussed in Chapter 1 are (1) the Cartesian, (2) the Newtonian, (3) the Leibnizian, and (4) the Wolffian. The last-named of these, based on the doctrines of Christian Wolff (1679–1754), is often considered but a branch of the Leibnizian school, but as a matter of fact, there were major differences. Essential in Leibniz's thought was the principle of sufficient reason (*Principium Rationis Sufficientis*), which for him had a limited applicability among contingent facts, but which Wolff elevated into a self-evident truth applicable to all kinds of phenomena, for practical matters as well as theoretical knowledge. There was also a difference regarding monadology, which for Leibniz was a metaphysical issue but which in the hands of Wolff was transformed into a quasi-physical theory of interacting atomlike objects.

Euler's own position can be inferred from his letters, sometimes implicitly, sometimes explicitly. Regarding the laws of motion and the law of gravity, he was definitively a Newtonian, even if he disagreed with Newton when it came to the theory of light (letters 18–19) and color (letters 28–32). Euler also articulated great respect for Descartes, "*le premier des philosophes modernes*," even if he needs to point out that the Cartesian theory of the tides being caused by the Moon's pressure was erroneous (letter n:o 63). Euler borrows Descartes's concept of an all-pervading ether to explain electrical phenomena (letters 138–150) and his

notion of an even finer “magnetic matter” (letters 176–186) to explain magnetism. Despite being a student of Johann I Bernoulli, a firm supporter of Leibnizian calculus, Euler was no admirer of Leibnizian philosophy. The monads were largely irrelevant for him, and in their Wolffian formulation, seriously flawed (letters 125–132). Euler describes Leibniz’s notion of preestablished harmony (*harmonia praestabilita*) as a solution to the mind–body problem but rejects it as absurd (letters 82–83). Wolffianism, at large, was anathema to Euler. He ridicules Wolff (whom he had once met in Marburg) by reporting that he compared humans to machines (letter 79). Euler also refutes both idealism and materialism (letter 96), egoism (letter 97), and skepticism or “pyrrhonism” (letters 117–118). What is there left, then, for Euler’s philosophical standpoint? He was a deeply religious man, a devout Protestant of Baselian stock, and unwilling to commit himself to the teachings of any of the *philosophes* of the day, let alone to recommend any of them to his youthful student. He was remarkably independent in his judgment of philosophical ideas, and totally unimpressed by the French atheists so prominent in Frederick the Great’s court, which he left in 1766.

The panoply of early modern textbooks of physics and philosophy discussed in Chapter 1 is large but neither complete nor flawless. French science is conspicuously absent; for instance, Abbé Nollet’s *Leçons de physique expérimentale* (1743–1748) was certainly a well-known textbook. Other errors and omissions abound. For instance, we read about a posthumous work by Jacques Rohault (1618–1672) entitled *Système de philosophie et philosophie naturelle* that does not even exist, at least not with that wording of the title. Nor can I locate any textbook by Willem Jacob’s Gravesande supposedly entitled *Philosophiae Newtonianae institutianae institutiones*. The title of Leibniz’s *De rerum originatione radicali* has been contracted by forgetting the last word. We also learn that Leibniz wrote *New essays concerning human understanding*, but in what language? Certainly not English. The surname Desauguliers is misspelled many times.

On the brighter side, Chapter 1 discusses several textbooks that may have served to inspire Euler’s *Lettres*, such as *Institutiones philosophiae Wolfianae* (1725/26) by a disciple of Wolff named Ludwig Philipp Thümmig (1697–1728), which was available also in Russian in Mikhail Lomonosov’s translation. The authors also appropriately mention *La belle Wolfienne* (1741–1753), a popular discourse of Wolff’s philosophy for women, written by Euler’s colleague Johann Heinrich Samuel Formey (1711–1797), the permanent secretary of the Prussian Academy of Sciences. Given Euler’s misgivings about Wolffian philosophy, it appears plausible that the *Lettres* were born as Euler’s anti-Wolffian response to *La belle Wolfienne*. Among the many models and sources of inspiration for Euler’s *Lettres*, the authors fail to mention Voltaire’s *Éléments de la philosophie de Neuton* (1738) and the Marquise du Châtelet’s *Institutions de physique* (1741).

Chapter 2 describes the history behind the *Lettres*, whose addressee is never explicitly named. So, who was the princess? Was there a princess at all? These questions have been asked by many a researcher (Grote 2011; Théret 2015; Barilier 2018). At the time the letters were written, 1760–1762, Euler was at the peak of his career as a professor and academician of the Royal Prussian Academy of Sciences in Berlin. From time to time, Euler’s duty was to assist at the dashing court of Frederick the Great, a role that suited him badly, since the sovereign found him an absolute bore. Fortunately, Euler found a like-minded friend in Prince Friedrich Heinrich of Brandenburg-Schwedt (1709–1788), a cousin of Frederick’s father and since 1771 the last bearer of the title margrave of Brandenburg-Schwedt, which was a younger branch of the ruling Hohenzollern dynasty. The prince and Euler, we are told, shared a passion for music. In fact, the whole royal family was musically gifted, including the flute-playing king himself. Indeed, Johann Sebastian Bach had composed his Brandenburg concertos at the request of Margrave Christian Ludwig of Brandenburg-Schwedt, an uncle to Prince Friedrich Heinrich.

Prince Friedrich Heinrich married his cousin Leopoldine Marie, princess of Anhalt-Dessau, but the marriage was quarrelsome and ended tragically (Heese 2006).¹ They had two daughters, Friederike Charlotte Leopoldine Luise, future ruling abbess of Herford, and Luise Henriette Wilhelmine (1750–1811), future princess of Anhalt-Dessau. In the literature about Euler and the *Lettres*, the names of the princesses are spelled slightly differently depending on the source (there are German and French versions). A minor mistake in spelling, once printed, may keep on repeating itself indefinitely.

Presumably at their father’s request, Euler had undertaken the instruction of both princesses, a commission that he seems to have found both pleasant and rewarding. As the Seven Years’ War, which had raged since 1756, turned to Prussia’s disfavor, so much so that in 1759 the royal court had to be evacuated to Magdeburg, the instruction of the two princesses was interrupted. Euler, however, chose to stay in Berlin, witnessing the invasion of the Russian troops that caused considerable damage to his country estate in Charlottenburg. Nevertheless, the instruction of the princesses continued in the form of letters, the first of which is dated in Berlin on April 19, 1760. On that date, Friederike Charlotte was 14, and her sister Luise Henriette merely 9, so surely the letters were mainly addressed to the elder princess.

Even so, for some reason beyond my grasp, Calinger and coauthors insist on challenging this obvious conclusion by referring to the *éloge* of Euler by the Marquis de Condorcet (printed in 1786), which says:

*Madame la Princesse d’Anhalt-Dessau, nièce du Roi de Prusse, voulut recevoir de lui quelques leçons de Physique ...*²

¹The prince finally appealed to his cousin the king, who banished Leopoldine Marie to Kolberg, where she passed the remainder of her life.

²Madame the princess of Anhalt-Dessau, niece of the king of Prussia, wished to receive some lessons from him in physics ...

So, who is the king's niece intended here? Calinger and coauthors wish to identify her as the younger of the princesses, Luise Henriette, who indeed was married in 1767, at age 16, to Prince Leopold III of Anhalt-Dessau. However, the two princesses were not Frederick's nieces, but his second cousins, so there is some confusion about names and titles in the above quotation. For that matter, why should we trust Condorcet, who never met Euler, in regard to this issue?

Much more trustworthy testimony comes from Nicolas Fuss, Euler's personal assistant from 1773, who states in his eulogy of Euler (*Lobrede*, 1783):

Er [Euler] hatte sie beyde unterrichtet und die älteste, izt Aebtissin zu Herforden, ist eben die deutsche Prinzessin, an welche er, zur Fortsetzung seines Unterrichts, während dem Aufenthalte des Hofes zu Magdeburg, die so beliebten Briefe über verschiedne Gegenstände aus der Physik und Philosophie geschrieben hat.

He [Euler] had taught them both, and the elder, currently the abbess of Herford, is the German princess to whom, in order to continue his teaching during the sojournment of the court in Magdeburg, he wrote the greatly admired letters on various subjects in physics and philosophy.

For me, this statement appears to offer a clear-cut solution of the problem, and I wonder why other theories are being ventilated by Calinger et al.

The news of the publication of the *Lettres* in 1768 was received with mixed feelings among Euler's colleagues. The following excerpts from the correspondence between Jean d'Alembert and Joseph Louis Lagrange speak for themselves:

- Lagrange to d'Alembert (June 2, 1769): ... *un [ouvrage] qu'il n'aurait pas dû publier pour son honneur* (a [work] he shouldn't have published if he wished to benefit his reputation).
- D'Alembert to Lagrange (June 16, 1769): *C'est son Commentaire sur l'Apocalypse. Notre ami Euler est un grand analyste, mais un assez mauvais philosophe.* (This is a commentary on the apocalypse. Our friend Euler is a great analyst, but a rather bad philosopher.) This is an ironic allusion to Newton's apocalyptic computations.
- D'Alembert to Lagrange (August 7, 1769): *Il est incroyable qu'un aussi grand génie que lui [Euler] sur la Géométrie et l'Analyse soit en Métaphysique si inférieur au petit écolier, pour ne pas dire si plat et si absurde, et c'est bien le cas de dire: Non omnia eidem Dii dedere.* (It is incredible that such a great genius as he [Euler] is in geometry and analysis is in metaphysics as bad as a little schoolboy, not to mention so flat and so absurd, and indeed one may say: the gods do not grant everything to everyone.)

Both d'Alembert and Lagrange knew that Euler had a history as an ardent defender of Christian faith, a position that did not rank highly among the *philosophes* of the day. When the marquis de Condorcet, a disciple of d'Alembert

and a notorious atheist, edited a new version of Euler's *Lettres* with his young colleague Sylvestre-François Lacroix, he apparently believed to have saved Euler from disgrace by sieving out every sign of personal piety. The damage done was considerable in places, and it propagated to many other editions and translations.

A popular presentation of science addressed to a real or imaginary female reader was a fashionable literary invention of its own. The earliest example that I can think of—but one that the authors fail to mention—is the philosophical letters of Descartes to Princess Elizabeth of Bohemia, which were published by Claude Clerselier in the 1650s. The authors do mention Fontenelle's hugely successful *Entretiens sur la pluralité des mondes* (1686) and Algarotti's *Il Newtonianismo per le dame* (1737); they might have added Maupertuis's *Vénus physique* (1745). The authors mention that the well-known Russian diplomat Antioch Kantemir had translated Fontenelle's *Entretiens* into Russian, but despite the support of Daniel Bernoulli and Euler, did not succeed in getting it through the censors to be printed. It has been aptly remarked by Théret (2015) that Euler, like his predecessors, wrote his letters not just for Princess Friederike, but also, so to speak, “through her” for a wider audience, both male and female.

Chapter 3 presents a short biography of Euler, a topic thoroughly familiar to the principal author. It is therefore a pity that the presentation is marred by so many mistakes in names, dates, and other details that it inspires little confidence. A short and balanced account is sometimes more difficult to write than a complete biography, since every word and fact needs to be carefully gauged in order not to induce misinterpretations. A more critical proofreading might have helped.

In the final chapter, which reprints some excerpts of the *Lettres* in Hunter's translation of 1802, the authors also provide succinct presentations of their contents. This chapter raises questions. Why be content with merely some excerpts of a time-honored classic? Why use a dated translation? Properly translating and editing the whole work would not have necessitated an insurmountable amount of effort. I dare make such an assertion, having myself edited and translated Euler's *Lettres* into yet another new language, Finnish (Stén 2007).

FUNDING

Open access funding provided by University of Helsinki including Helsinki University Central Hospital.

Johan C.-E. Stén
 Department of Mathematics
 University of Helsinki
 P.O. Box 64, (Gustaf Hällströmin katu 2), 00014 Helsinki
 Finland
 e-mail: johan.sten@helsinki.fi

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