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Review

Edited by Tom Archibald and Scott Walter

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Die Werke von Jakob Bernoulli. Vol. 5, Differentialgeometrie
Edited by André Weil and Martin Mattmüller. Basel/Boston/Berlin (Birkhäuser Verlag). 1999. xxv + 445 pp. EUR 211

This volume contains the edition of published and unpublished articles on differential geometry by Jacob Bernoulli written or published between 1690 and 1700. The published works include 12 articles from the *Acta Eruditorum*, to which are added four articles by Gottfried Wilhelm Leibniz, including his founding articles of 1684 and 1686 on the calculus, an article of 1692 on lines and angles of contact, and a paper of 1694 in which he constructed a curve by which a body in a gravitational field would move with constant velocity toward a given point (*de curva isochrona paracentrica*) (the latter two articles were already included in Jacob Bernoulli's 1744 *Opera* edited by Gabriel Cramer). The previously unpublished works consist of 29 texts from Bernoulli's research diary, the *Meditationes*. There is also a previously unpublished text on the classification of plane cubic curves, a work that was superseded by Isaac Newton's classification of curves published as an appendix to his *Opticks* in 1704 and so not published with Bernoulli's other posthumous works (*Varia posthuma*) in the 1744 *Opera*.

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When Leibniz published his first article on the algorithm of the calculus in 1684, Johann Bernoulli was 17 years old and still living in Basel, where his brother Jacob, twelve years his elder, tutored him in mathematics. In 1685, Jacob and Johann Bernoulli were jointly responsible for an academic disputation on the parallels between algebraic and logical argument. In December 1687, Jacob Bernoulli, recently named to the chair of mathematics at Basel, first wrote to Leibniz about the new methods of the calculus. Because of his departure from Hanover in October 1687, Leibniz did not receive Jacob's letter or reply until the fall of 1690. In the meanwhile, Jacob had published in the *Acta Eruditorum* the first of his articles on differential geometry included here, in which he solved a problem proposed by Leibniz of finding the curve on which a body under the influence of gravity would descend equal vertical distances in equal times (the problem of the *isochrone*). The curve that meets these conditions is a semicubical parabola. Huygens, Bernoulli wrote, had given the solution of the problem and proved its correctness synthetically, but he proposed to show the analysis using differential calculus, by which the answer could be discovered. In this brief article the word "integral" first appeared in the context of the calculus. At the end Jacob proposed the problem of finding the curve of the catenary or chain hanging freely between two points. In his *Discorsi* Galileo had wrongly supposed that the curve of the catenary was a parabola. Johann Bernoulli, Leibniz, and Huygens all published in the *Acta Eruditorum* of 1691 the correct solution, showing that the curve is a "transcendental" curve in Leibniz's newly introduced terms.

In 1691, Johann Bernoulli had begun to teach the calculus in Geneva. Later in the same year he moved to Paris, where he taught the calculus privately to the marquis de l'Hôpital, his lessons bearing fruit in l'Hôpital's 1696 *Analyse des infiniment petits*. If it would be difficult or impossible to untangle the contributions of the Bernoulli brothers to the development of the calculus up to 1691, seeing that they were in daily contact, after Johann's departure in 1691, their further achievements might be distinguishable. A source of friction between the brothers was that, in Paris, l'Hôpital paid Johann to supply him confidentially with mathematical material, something that Jacob resented when he believed that he had been the first to obtain results which, thanks to Johann's assistance, l'Hôpital published under his own name. Beginning in 1692, Johann and Jacob published mathematical articles in the *Acta Eruditorum* in which they responded to and critiqued each other's work, in the process working out the calculus of variations. These papers were collected and annotated in Bernoulli and Bernoulli [1991]. For a more complete perspective on the development of Jacob Bernoulli's work on the calculus it is necessary to compare articles published in this earlier volume with those in the volume under review here.

This recent addition to *Die gesammelten Werke der Mathematiker und Physiker der Familie Bernoulli* will be of great use to scholars pursuing further research in the history of mathematics and, as such, it is very welcome and significant. The Naturforschende Gesellschaft in Basel and their financial supporters are again to be heartily thanked for their dedication to this work. The 16 previously published articles by Jacob Bernoulli and Leibniz have been relatively easily available to scholars, but they are here beautifully introduced and elegantly annotated by the late André Weil, benefiting from his mathematical mastery. The sections from the *Meditationes* have not been so easily available previously. Moreover, they are here impeccably edited by Martin Matmüller, then Secretary of the Bernoulli edition and the leading scholar of Bernoulli's differential geometry, who also supplies a 50-page commentary, as well as notes on the published works. The editorial principles followed are exemplary, reproducing the texts very nearly as they were first written or published. The commentaries take advantage in a light-handed way of the hindsight that modern mathematics may shed on late 17th-century mathematics, while at the same time letting Jacob Bernoulli's approach to problems reveal itself unobscured. Scholars may now look forward to the publication of Volume 6 of Jacob Bernoulli's works, containing papers on mechanics.

References

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