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Book Review

A Contribution to the Newtonian Scholarship: The “Jesuit Edition” of Isaac Newton’s *Principia*, a research in progress by Paolo Bussotti and Raffaele Pisano

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The *Mathematical Principles of Natural Philosophy* (*Philosophiae Naturalis Principia Mathematica* in Latin), hereafter *Principia*, a three-volume *tour de force* written by Isaac Newton, and published in 1687, is the seminal work in the history of modern physics. American theoretical physicist and Nobel laureate, Steven Weinberg, remarked in his 1972 work on cosmology and gravitation that “all that has happened since 1687 is a gloss on the *Principia*” (*apud* Pask, 2013, 14).

The second edition of the *Principia* was published in 1713, and reprinted and corrected in 1714, incorporating a more comprehensive theory of the Moon, the motions of comets, and the precession of the equinoxes, and, at the end of the whole book, the famous general scholium. The third edition of the *Principia* was published in 1726. Newton made some additions to the third edition, including new explanations for the resistance of fluids in “Book 2” (which resumes “Book 1”, *De motu corporum*, “On the motions of bodies”), as well as a more detailed explanation for the Moon’s orbit and the role of gravitation, and, in “Book 3” (*De mundi systemate*, “On the system of the world”), new observations of Jupiter and the comets. The first translation into English was published in 1729, by Andrew Motte, based on the 1726 third edition of the *Principia*.

The so-called “Jesuit Edition,” which is the focus of Bussotti’s and Pisano’s project, was also based on the third edition of Newton’s *Principia*, published between 1739 and 1742, in four volumes, by the minim friars Thomas Le Seur (1703-1770), François Jacquier (1711-1788), both of whom were French priests, and Jean-Louis Calandrini (1703-1758), a Swiss mathematician. This edition includes several commentaries, explanations and addendums to the *Principia* that did not originate with Newton.

Newton’s masterpiece has ever since been the focus of studies and exegesis, translations and commentaries, interpretations and reformulations. The geometrical procedures of Newton were gradually replaced by analytical procedures. The editors of the “Jesuit Edition”, for instance, made use of the formalism

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developed by Leonhard Euler (1707-1783), outlined in his work *Mechanica* (1736), to rewrite *Principia's* propositions into differential equations. The works by Pierre Varignon (1645-1722), David Gregory (1659-1708), Guillaume François Antoine Marquis de l'Hôpital (1661-1704), Johann Bernoulli (1667-1748), Abraham de Moivre (1667-1754), John Keil (1671-1748), Jacob Hermann (1678-1733) and Willem Jacob's Gravesande (1688-1742) are among the first contributions to physics derived from the exegesis and expansion of the outcomes of the *Principia*.

In addition to the preceding historical editions, there are several modern editions of the *Principia*. The analytic historical exegeses of Newton's third edition by scholars such as Bernard Cohen (1914-2003), known for his works *Introduction to Newton's Principia* (1971) and *The Newtonian Revolution* (1980), and Alexandre Koyré (1892-1964), known for his work *Newtonian Studies* (1965), are among the most outstanding examples in the twentieth century. Peter and Ruth Wallis collected the immense quantities of new material relating to Newton up to the time of Cohen and Koyré in *Newton and Newtoniana 1672-1975, A Bibliography*.

The works by Brackenridge (1995), De Gandt (1995), Densmore (1995) and Dobbs (1976, 1991, 1995) stand out in the contemporary Newtonian historiography in the previous decades. In 2000 physicists and historians of physics, Michael Nauenberg, an expert in Hooke, Newton and Huygens, and Richard Dalitz, well known in the field of particle physics, edited the book *The Foundations of Newtonian Scholarships*. This book was the outcome of a symposium held at the Royal Society in London in 1997 which brought together many of the today's Newtonian scholars.

Newton's biography by Richard Westfall, *Never at Rest* (1980), "based on an extensive study of Newton's manuscripts, does not merely chronicle the events in Newton's life but illuminates almost every aspect of Newton's life and thought, providing a rich and valuable commentary on Newton's scientific achievement" (Buchwald and Cohen, 2001, xiv). In the field of translations and commentaries, the 1999 prominent translation of the *Principia* by Bernard Cohen and Anne Whitman should be highlighted and the study by the Indian physicist S. Chandrasekhar, *Newton's Principia for the Common Reader* (1995), attracts attention as one of the most recent reassessments of Newton's *Principia*.

There has been also a long-lasting tradition of popularization of the *Principia*. Francesco Algarotti's *Newtonianism for Ladies* (1737) was a landmark in the popularization of Newtonian philosophy, as well as Voltaire's *Éléments de la Philosophie de Newton*, first published in 1738 and then again in 1745 in a new edition that included a new section devoted to Newton's metaphysics. *Magnificent Principia: Exploring Isaac Newton's Masterpiece* (2013) by the British mathematician Colin Pask is another contemporary example, and *Reading the Principia* (1999) by the historian of mathematics Niccolò Guicciardi has also become a reference in the field of *Principia's* popularization. The study of the history of science and technology also has among its classic seminal texts exegeses of the *Principia*, such as *The Social and Economic Roots of Newton's Principia* (1931) by the historian and philosopher of science Boris Hessen. It is in the context of this tradition, and these efforts of exegesis of the *Principia*, that one could place the works and the project by Paolo Bussotti, researcher and professor at the University of Udine, and Raffaele Pisano, researcher and professor at the University of Lille 3.

Thomas Le Seur and François Jacquier were Catholic priests of the Order of Friars Minor – founded in the fifteenth century in Italy – but were mistaken for being Jesuits. The so-called "Jesuit Edition" (JE) is an extensively commented version of the third edition of the *Principia*, though not studied enough in this tradition of the *Principia's* exegeses. The historians Bussotti and Pisano have tasked themselves with filling this missing element in the Newtonian scholarship. The JE, after being written between 1739 and 1742, had several editions, such as the 1760 edition in Cologne, the 1780-85 Prague edition (which is a partial reedition of the JE), and a third edition (published first in 1822 and again in 1833) in Glasgow.

Based on the Glasgow edition, mathematician John Martin Frederick Wright corrected several mistakes found in the previous editions of the *Principia's* "Jesuit Edition," and published the corrections in 1833 as "Commentary on Newton's Principia". Bussotti and Pisano have as their starting point for their work this third corrected version of the *Principia's* "Jesuit Edition" which has not yet been translated into English from its Latin original version. Their project includes an English translation of the four volumes of this 1822 corrected JE and an additional introductory fifth volume. This project is to be concluded by 2020.

The authors, clarifying the relevance of the JE, remind their readers that, historically, the commentators of the *Principia* have tried to "1) explain Newton's propositions in a clearer manner than Newton did; 2) translate the properties given by Newton geometrically in more analytical terms; 3)

sometimes explain the development of physics, based on Newton's discoveries, after Newton" (Bussotti and Pisano, 2014a, 35-36). Le Seur, Jacquier and Calandrini accomplished these tasks magnificently.

Firstly, the authors of the JE added clarifying remarks for every single proposition by Newton in the *Principia*. Bussotti and Pisano remind their readers that there is no more meticulously commented edition of the *Principia* than the JE. Secondly, from the first half of the eighteenth century onwards, the work by Euler, *Mechanica* (1736), and the JE became the classic references to the readers of the *Principia* because Newton's formalism as expressed in his *magnum opus* became gradually outmoded and eventually obsolete. Pierre Varignon (1654-1722), Jakob Bernoulli (1654-1705), David Gregory (1659-1708), Johann Bernoulli (1667-1748), John Keil (1671-1721), Jacob Hermann (1678-1744), and Daniel Bernoulli (1700-1982) are among the first authors who translated Newton's results into completely analytical terms. Finally, the editors of the JE offered an encyclopedic summary of the developments obtained throughout the first four decades of the eighteenth century derived from the applications of Newton's calculations in the *Principia*. It is worth noting that, up to the present time, the JE remains very rarely commented by the secondary literature. Therefore, a reassessment of the *Principia's* JE is of enormous relevance to Newtonian scholarship.

According to Bussotti and Pisano the JE provides three fundamental pieces of information useful to "1) Understand Newton's mathematical techniques and physical results, 2) Get a clear idea of the development of physics and mathematical analysis in the 20-25 years after the publication of the third edition of the *Principia*, 3) Fully realize the profound difference between Newton's physical-mathematical approach and the approaches of his successors" (Bussotti and Pisano, 2014a, 37). The work of Bussotti and Pisano advances four areas of research. First, an investigation of the three personalities involved in the production of the JE. Why did the authors of the JE organize the many notes the way they did? Second, they explore the politics of science in the elaboration of the JE. Who conceived and initiated this gigantic project? What are the reasons and motives behind it? Bussotti and Pisano intend to rebuild the social environment inside which the JE was conceived, formulated, and developed, as well as to clarify the nature, purpose, and structure of those notes added by these commentators on Newton's *Principia*. Third, Bussotti and Pisano want to trace the changes and development in mathematics and the physical sciences during the first four decades of the eighteenth century, which led to a growing number of commentators who made Newton's approach and stylistic writing intelligible. Bussotti and Pisano want to verify whether there is a relationship or not between changes in mathematics and the content itself of the physical theories of the period. Finally, they devote part of their research to examine who was the target audience of the JE. "Who might have been the readers of the JE?", ask the historians of science Bussotti and Pisano, who promise to prepare in the coming years a series of papers presenting their results (Bussotti and Pisano, 2014b, 439-440).

The present paper, "*Philosophiae Principia Mathematica* 'Jesuit' Edition: The Tenor of a Huge Work," is divided into two parts. In the first part the authors outline the general structure of the JE, the personalities of the three commentators, and the role played by the JE in comparison with the three editions of the *Principia* between 1687 and 1833. In the second part they layout the ongoing editorial project of the translated and commented edition of the Glasgow version of the JE.

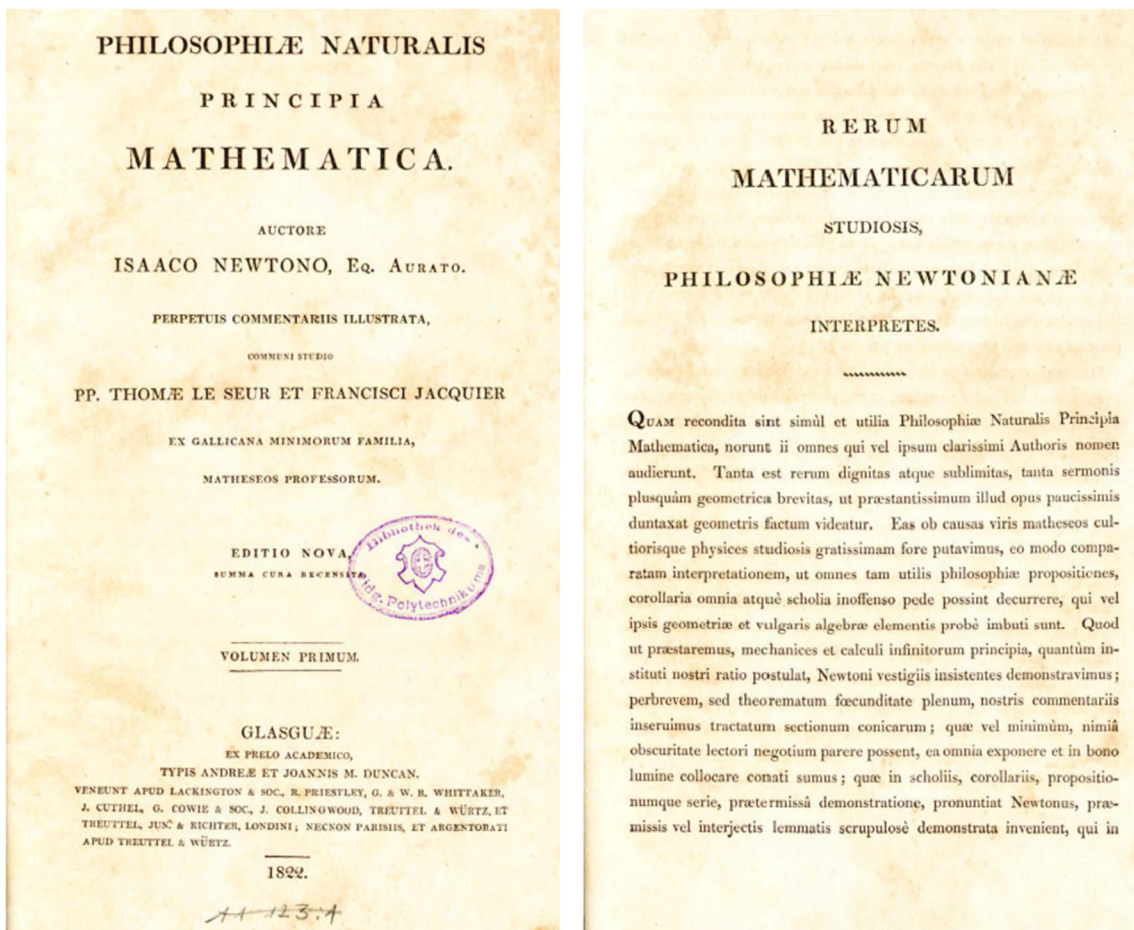
The first volume of the JE was published in 1739 and included the "Book 1" of the *Principia*. The second volume was published in 1740 and included the "Book 2" of the *Principia*. The third and fourth volumes were published in 1742. The third volume includes the first 24 propositions of the "Book 3" of the *Principia* and the fourth volume includes the remaining propositions and the *General Scholium*, a closing essay that Newton inserted into the second edition of the *Principia*.

There are four kinds of interventions, from a typographical point of view, found in the JE: 1) those notes which are directly referred to passages by Newton are specified by a letter within parenthesis, as in (a), 2) those notes which are not interpreted by the commentators as direct explanations of Newton's writing, but which represent either a clarification or an annexation by the commentators are signed by a number, as in 1), 2), 3), and so on, 3) treatises inserted by the commentators to introduce general problems found by readers of Newton's *Principia*, and 4) treatises by different authors about theories first found in Newton's *Principia* and then perfected and developed by them, e.g. works by Daniel Bernoulli and Leonhard Euler.

As it can be seen in the picture below, only the names of the French Catholic priests, Thomas Le Seur and François Jacquier, can be found in the title page. However, Le Seur and Jacquier acknowledged Calandrini's contribution in the end of the first book. The mistaken view that the authors were Jesuits, when in fact Le Seur and Jacquier were Catholic priests of the Order of Friars Minor, was first introduced by the typographer of the Glasgow edition. While they are mostly known for the JE of the *Principia*, they also wrote several other essays. Jean-Louis Calandrini for instance had been a Newtonian since his youth and then

focused on the physics on the colors for his thesis at the Academy of Geneva in 1722. He also studied and wrote about spherical trigonometry and infinite series, as well as maintaining an interest in botany, meteorology, and the problem of the aurora borealis.

Bussotti and Pisano illustrate the potential of the research that they have been doing by presenting in their paper an example that they consider to be paradigmatic in the commentaries introduced by the editors of the JE. The chosen example is found in “Book 1”, “section VII”, “proposition XL”, where Newton presents his solution to the inverse problem of central forces. Bussotti and Pisano argue that the example is a paradigmatic representation of the peculiarity of Newton’s geometric line of thinking and the standard manner by which commentators translate it into its analytical modern expression. Bussotti and Pisano emphasize how this example is important for the history of mathematics as it represents a transition from different thought traditions between that of Newton and his immediate successors. Bussotti and Pisano leave their readers looking forward to both their next results as well as their final editorial project. The coming developments of this important contribution to the Newtonian scholarship are to be eagerly anticipated.



Title page of the 1822 Glasgow “Jesuit Edition”. In: BUSSOTTI; PISANO, 2014, 36.

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