

“Newton Geneva” Edition as research programme concerning the relationship physics-mathematics in the history and philosophy of science

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Abstract: The third edition of Newton’s (1642-1727) masterpiece *Principia Mathematica Philosophiae Naturalis* was published in 1726. This edition represented a refinement and – in some respects – an extension of the two previous editions (1687, 1713). It could be therefore surprising that between 1739 and 1742 a further – commented – edition was published in Geneva. This edition was wrongly called Jesuit Edition, but this is a mistake because the two commentators Thomas Le Seur (1703-1770) and François Jacquier (1711-1788) were not Jesuit, but minim friars. The other important personality in this context is the Swiss scientist Jean-Louis Calandrini (1703-1758). The commentators specified every mathematical and physical aspect of Newton’s thought and methodology and referred the the discoveries – connected to Newton’s results – carried out after his work.

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1. Newton’s *Philosophiæ Naturalis Principia Mathematica* Geneva Edition

Newton’s *Philosophiæ Naturalis Principia Mathematica* Geneva Edition (hereafter GE) was edited and commented by Thomas Le Seur and François Jacquier. (Le Seur, Jacquier 1739-1742) The version of the GE we to which we refer is composed of four volumes annotated by the commentators. The notes are longer than Newton’s text itself. *Geneva edition* was divided into three tomes. The *tomus tertius* is divided into two parts. (Bussotti, Pisano 2014b) We remark that, because of editorial reasons, our project of publication with the Oxford University Press will follow the version of the Glasgow edition (1822, by three plus one vol.) Thus we totally divided them into four volumes; because of this, we have used the expression ‘four volume’.

The third edition of the *Principia* had been published only 13 years before the first volume of the GE. An English version of the second edition of the *Principia*¹ (Newton

¹ The book was presented at “The Royal Society of London for Improving Natural Knowledge” (briefly known as “The Royal Society”) in April, 28, 1686, and only in-between May, 19 and June, 30 “The Royal

1713), translated by Motte, appeared in 1729. (Newton 1729) ‘Why was a further edition published then?’ An answer to this question depends on the profound changes occurred in mathematics, in physics and in the application of mathematics to physics between the end of the 17th century and the beginning of the 18th-19th century. (Gillispie, Pisano 2014) The question is also connected with Newton’s personal and geometrical methods, their reception and their replacement with more analytical methods. (Bussotti, Pisano 2014a)

GE is a very treasure concerning Newton’s ideas and his heritage: Newton’s geometry and mathematical physics. Conspicuous sections of history of physics and mathematics can be drawn from it. At this stage, no translations, no critical edition exist about this GE. At first glance, a crucial question arises in history of science: Why only thirteen years after the publication of the 3rd edition of *Principia* was felt the need to publish an annotated edition, which, given its dimensions, was a huge cultural and economic enterprise? (Pisano, Bussotti 2016)

Conspicuous pieces of information as to history of physics, history of mathematics and epistemology can be drawn from GE. It is known that Wallis and Wallis (Wallis, Wallis 1977) worked on that, and their account is crucial text (i.e. for references) up to 1975. After the publication of Newton’s *Principia* many authors (i.e. Varignon, Gregory, Jakob, Johann and Daniel, Euler, etc.) tried to offer a clear and perspicuous transcription into an analytical language of the results Newton presented using his ‘infinitesimal geometry’. On the other hand, because of the mixed geometrical-physical-mathematical-astronomical contents of Newton’s masterpiece (Pisano, Bussotti 2015) a definitive revision is hard and – still nowadays (i.e. *Principia*, Vols. II-III) – far from being complete. Subsequently, in the attempt to offer complete explanations of Newton’s work ‘Geneva edition’ has a set of remarks more extended than Newton’s manuscript itself: e.g., explanations of the results and – above all – of Newton’s methods. Last but not least, a historical question – and under certain aspects philological, as well – raised up: “Why choose a commentary edition of Newton, and not the Newton’s work?”. (Pisano, Bussotti 2016)

2. A Research Programme

Our ‘Newton Geneva Project’ is a research programme that we started several years ago within a more general research statement concerning the relationship between physics and mathematics in the *HPS*. (Pisano 2011; Pisano, Capecchi 2013) In the latest years, we extensively published on the subject. (Pisano, Bussotti 2016) Since 2014 are under contract with the Oxford University Press for the publication of five volumes (expected: 2020): translations from Latin to English, transcription and criticism. We aim to rework the main conceptual scientific frameworks of the whole ‘Newtonian Geneva edition’,

Society” firstly approved and then licensed by Pepys (President of *The Royal Society*) to publish it. Subsequently Edmond Halley (1656-1742) received the Book II and Book III respectively in March, 1, 1687 and in April, 11, 1687. The first edition, composed of the three volumes into Latin language, was published in July, 5, 1687.

taking into account – within historical epistemology of science – the complex share knowledge in context, as well. Particularly we mainly aim to:

1. a clear delineation of the relations between mathematics and physics of the *Philosophiæ Naturalis Principia Mathematica (Principia)*. In other terms: how the particular way in which Newton used geometry and infinitesimal procedures influenced his physics;
2. the comprehension why and how Newton's mathematical methods were progressively, but rapidly, replaced by more analytical methods.

2.1. General and Specific Objective

- Re-examine the present state of art on historical Newtonian Physical-Mathematical understanding, basing extensively on scientific, mathematical, geometrical, epistemological and astronomical considerations: primary and secondary literatures.
- Re-examine critically Newton's mechanical-Astronomical accounts as expounded in Newton's *Principia*.
- Re-thinking of the the relationship between physics and mathematics in Newton's *Principia* by means (acceptation and change) of 'Geneva Edition' annotations.

2.2. Methodology and content of our work

- The general structure of the edition;
- The personalities of the editors;
- The role of the GE among *Principia*'s editions and commentaries published from 1687 – first original edition of Newton's work – to 1833.
- The historical and conceptual meaning of the GE.
- Research and study based on primary sources, as far as possible.
- Re-work Newtonian calculation.
- Re-examination of the literature on the subject.

2.3. Areas of Research and Disciplines

- History of: Physics, Mathematics, Physics-Mathematics, Science in Context.
- Astronomy, Geometry, Mathematics, Physics, Logic.

2.4. Specific Documentary Needs

- We have Newtonian and full ‘Geneva editions’ (in pdf) and necessary materials (at first glance see selected references).

2.5. Main Expected Results and Perspectives

- A new theoretical model of Newtonian science based on the relationship between physics and mathematics along the Scientific revolution.
- A historical scientific account concerning concepts, visualization of knowledge civilization and science in context.
- The results obtained would be of help in re-analysing the birth of the modern science and its heritage in the birth of modern physics.

2.6. Job Process

- Four volumes (Full Transcription and Translation from four-Le Seur and Jacquier volumes) will contain the original Latin text (Newton’s text plus the notes of the commentators) and our critical translations.
- The fifth volume will contain our commentaries, explanations and specifications on Newton’s thought.
- Estimated Manuscript Start Date: 2014-2015.
- Estimated Number of Pages per Volume: ca. 500-600.
- Estimated Number of Images: main facsimile pages if necessary.
- Estimated Manuscript Delivery Date: 2020.

2.7. Originality of Manuscript

- Previously Latin ancient publication.
- New Material: new commentary by the authors.
- New Material: translation from Latin to English and facsimile pages.

2.8. Some Additional Specifications

Volume I containing the book I of the <i>Principia</i>		
Number of pages	Number of words	Figures
The first volume has 435 pages. The dimension of the page is format A4. It is not necessary to insert the figures in the translation. We only let	Each page contains about 500-600 words. The calculation is not easy because there are many figures and mathematical formulas. The	The figures are about 550. The original text and the figures are relatively clear, hence it is possible to think of an <i>anastatic</i> reprint.

them in original Latin text. Maybe we can use image page-image of the Latin original text (from pdf). If necessary, Some figures can be redrawn. Hence, using an A4 format, the first volume will approximately contain 750-800 pages (original text + translation + about 20 introductory pages, also including the figures).	number of words of the volume should be about 375.000 and 480.000 words (text + translation).	
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Volume II containing the book II of the *Principia*

Number of pages	Number of words	Figures
The second volume has 320 pages. Following the same reasoning applied to the first volume, it is reasonable to think that the amount of pages in the edition with Latin text plus translation + introduction is about 580-600.	Following the same calculations as before the global number of words should be between 29.000 and 360.000.	The figures are about 290. The same considerations applied for the first book are valid.

Volume III containing the initial 26 propositions of the book III of the *Principia*

Number of pages	Number of words	Figures
The third volume contains about 370 pages. Following the same reasoning applied to the other volumes the amount of pages in the edition with Latin text plus translation + introduction is about 680-720 pages.	Following the same calculations as before the global number of words should be between 340.000 and 430.000.	The figures are about 180. The same considerations applied for the first book are valid.

Volume IV containing the other propositions of the book III of the *Principia*

Number of pages	Number of words	Figures
The third volume contains about 210 pages. Following the same reasoning applied to the other volumes the amount of pages in the edition with Latin text plus translation + introduction is about 370-390 pages.	Following the same calculations as before the global number of words should be between 185.000 and 235.000.	The figures are about 190. The same considerations applied for the first book are valid.

Volume V

With regard to our volume concerning the introduction to the Jesuit Edition, it is reasonable to think of – more or less – 300/350 pages. Of course, now, it is premature and difficult to be more precise on this question.

2.9. Pertinence and Strategic Character of the Scientific Project Programme

1. No translation exists of the notes-commentaries of the GE. Hence, we propose a product, which is a novelty, from a scientific, historical and editorial point of view.
2. The notes-commentaries of the commentators are added to every single Newton's proposition. They are longer than Newton's text itself. These notes clarify all aspects of Newton way of thinking and working. This was a novelty at that time and even nowadays the GE is the most important document to clarify Newton's scientific thought.
3. The notes-commentaries represent a significant document to point out how physics, mathematics and geometry was developed in the few years between the publication of the third edition of Newton's *Principia* (1723) and the first volume of the GE (1739). Newton's geometrical approach was progressively abandoned in favour of an analytical one. The commentators explain how Newton worked. Furthermore they translated Newton's results into analytical terms. For the first time this was made in a *systematic manner*.
4. Inside the notes-commentaries apparatus, the commentators add treatises, written by themselves or by famous physicians and mathematicians, to clarify how Newton's theory, and more in general physics, was developed along 18th century.
5. The notes of the GE can also be interpreted as a series of lectures in the communication of Newtonian science. These contributions to theoretical science are useful for the needs of both researchers and scholars who wish to understand the bases of Newton's physics and mathematics, in particular, geometry. GE is an edition whose interest goes far beyond the experts of Newton and involves all history of science in the 18th century: how science can change in few years.
6. The volumes-compositions make for absorbing reading for historians of science, philosophers of science, scientists and scientific-Latin language specialists.

3. Concluding Remarks

In our opinion, an extensive rework of this edition GE is necessary to clarify the context in which Newtonian science was developed. This can be a useful means for historians, philosophers and scientist busy with Newton and Newtonian studies. Under this perspective, our project aims at familiarizing and introducing to the tenor of a huge work between physics, mathematics, geometry and science in context.

Finally, the radical way in which the relationships between physics and mathematics changed in relatively few years, so that Newton's geometric methods became almost incomprehensible even to specialists, needs an explanation.

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