Mathématiques et connaissance du monde réel avant Galilée

This book is part of the project “Histoire des savoirs” (History of knowledge) which was carried out between 2003 and 2006 by the “Centre national de la recherche scientifique” (CNRS). It deals with relations between mathematical topics, especially the theory of proportions, and different aspects of the cognition of nature, such as the theory of the continuum and infinity, theories of motion, the science of weights and simple machines. The period treated in this volume runs from the beginning of the 14th to the end of the 16th century, when Galileo started his work. The name of Galileo is connected with the mathematization of physics, especially of motion. But how much was Galileo influenced by the natural philosophy of his forerunners and by their attempts to employ mathematics to measure the world? To give an answer, the articles in this volume are concerned with the question to what extent mathematical and physical, and also philosophical and theological, arguments were associated in the 14th–16th centuries with four different areas: the composition of the continuum by atoms, music, mechanics, and architecture.

The first three contributions deal with the question of the continuum. In his article “Atomisme et géométrie à Oxford au XIVe siècle” (Atomism and geometry in Oxford in the 14th century), Aurélien Robert gives reasons for the reappearance of the concept of atomism, after a long period of oblivion, in the 14th century in discussions about the nature of the continuum, and explains why some authors denied any relation between geometry and physical reality; in order to support their positions, they even rejected certain Euclidean axioms. This denial is especially strong among the 14th-century Oxford atomists (Walter Chatton, John Crathorn, William Wyclif, et al.). It seems that their attitude to geometry was guided by theological principles which led them to deny the existence of a created infinite and to attribute infinity to God alone. In “Le De continuo de Thomas Bradwardine: un traité de philosophie naturelle ou de mathématiques?” (The De continuo of Thomas Bradwardine: a treatise on natural philosophy or on mathematics?) Sabine Rommeveaux raises the question about the status of this text. It was written between 1328 and 1335 and it is fundamental for the study of the continuum in the 14th century. Bradwardine uses mathematical methods as well as physical arguments. By analyzing several propositions, Rommeveaux comes to the conclusion that the object of the treatise, the continuum, is common to natural philosophy and to mathematics and can be treated by the tools of both of them. The contribution of Stephen Clucas (“All the mistery of infinites”: mathematics and the atomism of Thomas Harriot”) treats the work of the late 16th-century mathematician Thomas Harriot. In contrast to Michel Blay and Paolo Mancosu, who argue that the mathematization of the infinite was solely a 17th-century phenomenon, Clucas proves that Harriot’s preoccupation with mathematical problems relating to the representation of motion led him to propound atomistic views in natural philosophy and to embrace the idea of the actual infinity of the universe.

Two articles in this book are concerned with the theory of music. In “Jehan de Meur’s musical theory and the mathematics of the fourteenth century”, Dorit E. Tanay explores the relation between the revolutionary musical theory of John of Murs and the mathematical works of the calculatores in the Merton School tradition. She shows that there
is an unexpected parallel between John of Murs’ new theory of rhythmical notation as presented in his *Notitia artis musicae* of 1321 and the Merton theory to quantify the changes of *intensiones*. Furthermore, in music as well as in the mathematics and philosophy of this time a new attitude towards irrationality and disorder evolved that provided the nucleus of the crucial shift from the medieval notion of music as an image of divine perfection to the early modern notion of music as a dynamic process attuned to human’s affections. Matthieu Husson’s article “La question des consonances chez Jean de Boen” (The question of consonances according to Jean de Boen) discusses the work of a contemporary theoretician of music. John of Murs had extended the space of interaction between natural philosophy and mathematics from the question of consonances to metrical questions. Jean de Boen modified this concept by adding new arguments which were derived from the corpus of natural philosophy. Thus he is an important witness to the gradual transformation of the discipline of music from a quadrivial science to a *scientia media*.

The last section of the book is devoted to mechanics and architecture. The article by Walter Roy Laird (“The scholastic mechanics of Blasius of Parma”) deals with Blasius of Parma (d. 1416) and his treatises on the science of weights. These treatises are in the tradition of Jordanus de Nemore (13th c.) and other writers on the topic, but they differ from them in that Blasius was determined to take into account the resistance of the medium, while Jordanus had tacitly imagined the balances to be hung in a resistance-less medium. Blasius was thus particularly concerned with distinguishing specific from simple gravity and with other physical circumstances. In analyzing effects on the balance, he drew on some of the methods used by 14th-century logicians and natural philosophers, including Bradwardine’s rule. He had the idea that the science of weights is subordinate not only to geometry, but also to natural philosophy. In her article “Quelles mathématiques pour la force de percussion?” (What mathematics [describes] the force of percussion?) Sophie Roux analyzes the use that Galileo and his predecessors made of different mathematical theories to study the phenomenon of percussion. Roux describes the way in which Galileo presented the problem of percussion by setting forth the importance of the theory of proportions for the science of simple machines. Evangelista Torricelli, who followed some suggestions made by Galileo, believed that in the theory of indivisibles he had found a key for understanding the phenomenon of percussion. The final article by Samuel Gessner: “*Salvare la lettera*: mode d’articulation entre mathématiques et questions d’architecture” (*Salvare la lettera*: the connection between mathematics and questions of architecture) presents a case study to show the interrelation between architecture and mathematics in the 16th century. In his commentary on Vitruvius’ book on architecture, Daniele Barbaro (d. 1570) offered an elaborated version of gnomonics which relied on Federico Commandino’s works on the subject. In this context Barbaro maintained that the mathematical treatment of the art of building was desirable. By analyzing these attempts, Gessner clarifies the characteristics of the way in which Barbaro tried to connect architectural questions to the calculation of ratios on the one hand and to geometry on the other hand.

The book ends with a bibliography, summaries of the contributions and an index of proper names.

In this volume different case studies are presented to show the interrelation between mathematical thinking and other disciplines, especially mechanics, music and architecture, from the 14th to the 16th century. Inter alia, the articles make possible a better understanding of the scientific work of Galileo and his contemporaries.
In its crudest and simplest form, the central limit theorem can be stated in the following way. If $X_1, X_2, \ldots, X_n$ form a sequence of independent random variables from a probability distribution with finite mean $E(X_i) = \mu$ and finite variance $E((X_i - \mu)^2) = \sigma^2$, then probabilities about the random variable $Z = (\sum_{i=1}^{n} X_i - n\mu)/(\sqrt{n}\sigma)$ can be approximated by probabilities from a normal distribution with mean 0 and variance 1 usually denoted by $N(0, 1)$. There are two kinds of people who are interested in this theorem or generalizations thereof: those who use it and those who prove it. The “use it” group will be disappointed with Hans Fischer’s book, while the “prove it” group will be very pleased. For the “prove it” group, there is a rich and thorough treatment of the mathematical developments over the span of nearly two centuries as they apply to proving the central limit theorem in its full generality. At one extreme of the “use it” side, there is nothing. Books for data analysts are full of advice about how large a sample size is necessary so that the central limit theorem will reasonably apply in a practical situation. The evolution of how this advice came to be definitely is not the subject of this book. Between the strict “use it” side and the “prove it” side, there is some material in the middle ground. For example, there is a very nice brief discussion about the use of the central limit theorem as a motivating tool in the applied work of Adolphe Quetelet during the 19th century. But to say there is not enough emphasis on the “use it” side is to miss the whole point of Fischer’s book.

Fischer made a conscious decision about what direction to follow with the project. There are two ways to approach the history of Laplace’s approximation or, more formally, his limit theorem: look at all the different areas that were inspired by Laplace’s original result; or look at one end result, the modern mathematical general formulation of the central limit theorem, and then examine the evolutionary path to how we got there. Fischer has chosen the second route. The main theme of the book is the discovery of the evolutionary path that took probability as a mixture of theory and application in the 18th and early 19th centuries to probability as a branch of pure mathematics that resulted in the full flowering of the theory behind the central limit theorem between the First and Second World Wars. Those who are interested in this theme, as I said, will be very pleased.

The development of the mathematical theory behind the central limit theorem can be divided into three general epochs. First there is Laplace’s version of the theorem motivated