L'homme au risque de l'infini. Mélanges d'histoire et de philosophie des sciences offerts à Michel Blay edited by Michela Malpangotto, Vincent Jullien, and Efthymios Nicolaidis

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This volume of over 400 pages, containing no fewer than 33 articles, is indeed a set of 'mélanges' in the history and philosophy of science that was presented to the French scholar Michel Blay in celebration of his career after retirement. As the introduction relates, Blay was first trained as a physicist; he then turned to the history of science because he wondered about the adequacy of mathematics to natural phenomena and wanted to understand how physics came to be mathematized in the 17th and 18th centuries. Blay's most important contributions to the history of science lie in two areas that allowed him to deal with this problem: Newton's optics [Blay 1983] and French post-Newtonian analytic mechanics [1992]. In connection to his interest in the mathematization of physics, Blay also devoted part of his research to the topic of infinity, mainly in the cosmological domain [1993, 2010] but also in relation to the invention of infinitesimals [1986, 2001, 2010]. His reflections on the history of science also led him to analyze the ways in which science was organized and financed in the 20th century; and he devoted some of his work to a critical study of contemporary science policies [2003].

The introduction also highlights Blay's ongoing defense of the idea that science and, in particular, early modern science developed mainly as a theory-driven activity and not (as others argue) primarily on an experimental basis. For Blay, the keystone to his interpretative approach is to be found, beyond any *a posteriori* rhetorical reconstruction, in Newton's optics, which Blay sees as a largely theoretical process leading to experimental proofs rather than as an inductive activity. He thus turned traditional interpretations of the prism experiments upside down. From that point of view, Blay aligns with Alexandre Koyré, who considered physics to be first and foremost an *a priori* activity. Blay privileged an internalist reading of the history of

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science and can also be viewed as an heir to the French tradition of historical epistemology.

The diversity of topics addressed in this book reflects the broad range of Blay's research interests—from antiquity to the contemporary period. Some of the articles clearly belong to the history of science; others, to the history of philosophy and science; and still others, to political issues linked to science. Some articles merely relate matter-of-fact historical information based on yet-unexplored archives; others express an interpretative claim that challenges received views about a long period of the history of science. Within such a broad range of approaches, one can hardly find a school of any kind, let alone Michel Blay's school.

Although the length of each article is quite limited—around 10 pages for obvious editorial reasons—some succeed in providing a synthetic and interesting approach to their topic. Since it is not possible here to tackle them all, I will confine myself to a select few.

First, a word on the book's structure. The articles are gathered into three sections:

(1) *La science classique*,
(2) *Science, littérature et art*, and
(3) *Science, philosophie et politique*.

As can be expected for this genre, there is no real unity—either topical, methodological, or historical—to be found in this book. Rather than follow the sections as they were organized by the editors, I will trace lines from some of the authors' contributions to more general issues and, in particular, to the topics investigated by Blay and the methods that he employed. The title, 'L'homme au risque de l'infini', attempts to encompass a diversity of topics. Yet the volume lacks any in-depth study of the notion of mankind or of infinity. Most probably, the editors intended the title to remind us that science must be analyzed as a human activity involving every aspect of human life—not only intellectual, but also artistic, social, and political. Infinity—a topic dear to Blay—refers to the subject matter of scientific practices, and encompasses mathematical as well as cosmological infinity, the infinite as well as infinitesimal entities.

In section 2, several articles explore the relationships between science and the visual arts: see Pierre Caye, 'De la scientificité des arts. Réflexions sur

le rapport entre les arts plastiques et les mathématiques à l'âge humaniste et classique' (mainly on Alberti); or Michèle Gally, 'Points de *vue*. Science et poésie en dialogue (XIII^{e}–XV^{e} siècles)' (science and literature); François Roudaut, 'Quelques remarques sur le Soleil chez un poète encyclopédique du XVI^{e} siècle' (on Guy Le Fèvre de La Boderie); and Frédérique Aït-Touati, 'Le savant et le poète: Hooke lecteur d'Ovide'. These articles intend to show not only that science was integrated into art or literature as a foreign element that would nourish artistic inspiration or as a set of techniques offering new artistic possibilities, but also that, before the 19th century, science and art could form part of a single activity. Art was thus intrinsically scientific or had scientific value. Among those papers, Frédérique Aït-Touati's will certainly present the greatest interest for historians of science. She offers a study of a little-known text by Robert Hooke: his commentary on Ovid's *Metamorphoses*. She shows how Hooke read it as a fictionalized account of historical events related to the formation of the Earth, an account that foreshadowed what Hooke considered to be a hypothesis, namely, universal gravitation. This hermeneutic was a substitute to experience and served as a real proof in natural philosophy. Aït-Touati's paper is particularly valuable because it not only sheds light on a new facet of the curator of experiments at the Royal Society but also presents clearly Hooke's hermeneutical reading of ancient texts as methodologically akin to his experimental and biblical exegetical activities.

In section 3, we find articles that explore the relationships between science and religion, science and philosophy, and science and politics. An article by Philippe Büttgen deals with the relationship between science and dissidence through an analysis of Lessing's interpretation of the behavior of the anti-Trinitarian Adam Neuser ('La raison de sang-froid. Une page de Lessing'). In 'Les condamnations d'idées scientifiques par l'Église orthodoxe', Efthymios Nicolaïdis proposes an overview of how the Orthodox Church reacted to scientific innovation from the fourth century to the 19th, beginning with the Greek Fathers. Counterbalancing the better-known relationships between scientists and the Catholic Church, this article offers a picture in which the debates are mainly internal to the Church itself.

Three articles in this section are more concerned with the philosophy of science. Among them, 'La philosophie des sciences à la Belle Époque' by Anastasios Brenner retraces the historical development of this discipline in

France, from Poincaré and Duhem to Meyerson and Bachelard. He shows that its birth is older and more complex than the traditional view—which traces it back either to the Vienna Circle or to Bachelard's historical epistemology—has led us to think.

Other articles in section 3 deal with the interactions between science and politics from the 17th to the 20th century, including the emergence of science policies after World War II. One article extends to the end of the 21st century! In 'Une histoire des sciences au XXI^{e} siècle', Jean-Marc Lévy-Leblond offers us a pleasant tale of fictional history (supposedly written in 2213) in which he imagines the disastrous consequences of 20th-century science policies based solely on an economy-driven science, without any room for reflection on its concepts and theories.

In the articles that I have mentioned so far, the authors cross disciplinary boundaries and sometimes address the history of science from an externalist point of view. Regarding 'infinity', however, several contributions adopt a more internalist approach. They are to be found in section 1. In 'Gli indistruttibili paradossi di Zenone', Giorgio Israel identifies, in Zeno's paradoxes on the composition of the continuum, one source of the Greeks' reluctance to provide a mathematical treatment of the infinite.

Sabine Rommevaux's article, 'Six inconvénients de la règle du mouvement de Thomas Bradwardine dans un texte anonyme du XIV^{e} siècle', also relates, though not in a straightforward way, to the topic of infinity. In his *Tractatus de proportionibus*, Bradwardine had formulated a rule of motion that allowed for comparing the speeds of motion according to the ratio between the driving forces and the resistance of the object moved. Rommevaux analyzes some objections to this rule formulated in an anonymous manuscript written between the 1330s and the 1340s, which is to be found at the Bibliothèque Nationale de France in Paris (lat. 6559). Even before Nicole Oresme, this writing relied, among other things, on a kind of ingenious thought experiment in which a body falls through void space towards the center of the Earth. When the lower part of the body reaches the center of the world and passes beyond it, an increase of internal resistance and a diminution of speed are induced. Contrary to Aristotle, the author therefore considered this motion as possible without being accomplished at an infinite speed. This article thus illustrates the ability of medieval thought experiments to test theories, to

formulate more precise notions such as internal or external resistance, and even to challenge some dimensions of Aristotle's physics.

Several articles that deal with the history of science in a strict sense, mainly in section 1, are worth mentioning, including those concerned with astronomy and cosmology. In the line of, for example, Michel-Pierre Lerner [1979] but maybe with a bolder interpretative commitment, Michela Malpangotto proposes to interpret the Scientific Revolution as born out of some elements of medieval science freed of Aristotelianism by the humanist rediscovery of mathematical sources, in 'Réévaluer l'humanisme mathématique'. Her argument is convincing, at least as far as astronomy, the field on which she focuses, is concerned. Jean Seidengart insists on the convergence of mathematics with metaphysics and theology in the elaboration of Kepler's cosmology, in 'Mathématique et métaphysique dans les recherches astronomiques de Kepler'.

By opposing Copernicus and Galileo, Maurice Clavelin, in 'Du cosmos aux marées. La justification de l'héliocentrisme chez Copernic et Galilée', seeks to elucidate the relationships between philosophy and science in the early modern period. He provides a step-by-step analysis of Copernicus' arguments in favor of heliocentrism that culminate in the central position of the Sun in a well-organized cosmos. But, whereas Copernicus could still rely on the idea of the world as being a limited and well-organized entity, Galileo had to build new arguments to support heliocentrism in a universe conceived as indefinite. His theory of the tides was precisely intended to provide a physical proof for the new cosmology because Galileo considered it impossible to account for the tides independently of the Earth's motion around the Sun. By this comparison of the two astronomers, Clavelin can subtly distinguish between Copernicus' heliocentric argument and Galileo's geokinetic justification, a distinction that can be accounted for by philosophical reasons and new celestial observations. Yet Clavelin identifies an important shift in which both Copernicus and Galileo play a role: when cosmology begins to be defined not by natural philosophy but by the astronomer.

In 'L'héliocentrisme réfuté par l'alchimie: Pierre Jean Fabre et l'immobilité de la Terre', Bernard Joly proposes an original approach to the topic of the reception of the heliocentric theory in the 17th century. Recent scholarship has indeed rehabilitated alchemy as an experimental science that could have made a contribution to the Scientific Revolution [see Newman 1994, Principe 1987]. Here Joly not only shows how a 17th-century alchemist could take a

stance on contemporary cosmological debates; he also reveals how alchemy, understood as an encyclopedic science, could provide arguments based on a chemical representation of the properties of earth and light *against* heliocentrism and the motion of the Earth.

The focus of Vincent Jullien's article, 'Gassendi à Marseille, qu'allait-il faire dans cette galère?', is an experiment performed by Gassendi in 1640 in which a ball is thrown from the top of the mast of a ship sailing at high speed, thus sustaining the principle of inertia and challenging some objections opposed to the motion of the Earth. In addition to those instances already identified, for example, in Clavius, Bruno, and Froidmont, Jullien mentions some unnoticed early occurrences of this experiment in Ptolemy, Averroes, Nicole Oresme, and Alessandro Piccolomini. But he also adds a report by Isaac Beckman, dated to 1619, of the performance of this experiment in Holland. Siding with Blay's interpretation of early modern science as *a priori*, Jullien concludes by claiming that this experiment, though it had a convincing weight in favor of the principle of inertia and could have contributed to removing one objection against the motion of the Earth, did not in fact demonstrate anything or give crucial support to the argument in favor of heliocentrism.

To conclude, I shall mention three articles that are related to another scholarly domain to which Blay has contributed: Newtonian science. Suzanne Débarbat ('Newton, ses *Principia* de 1687 et les astronomes français') draws links between Newton's 1687 *Principia* and works of French astronomers that might have provided him with relevant information on the shape and dimensions of the Earth. Niccolò Guicciardini's 'Une note sur Newton et la tradition néo-pythagoricienne' is a more synthetic version of another of his works [2013] which downplays Newton's commitment to a form of neo-Pythagoreanism in his examination of possible analogies between light and sound. In 'Euler et la mécanique newtonienne: d'une mécanique géométrique à la mécanique analytique', Marco Panza and Sébastien Maronne offer a study that complements and chronologically extends Blay's interpretation of the reception of Newtonian science in association with the birth of analytic mechanics. They focus on Euler and show how he revived Newtonian mechanics by incorporating competing views from Descartes and Leibniz. But, more importantly, they consider that it was Euler who built the so-called Newtonian analytic mechanics, based on differential calculus and emancipated from the representation of geometrical figures.

As can easily be understood from this account, the interest of this book resides more in the diversity of its contributions than in any form of commitment to a method or in any focus on a period or topic. Most likely, the reader will only be interested in some of the contributions as far as they are related to her or his area of research. But the book as a whole offers an opportunity to stroll along winding paths into the history of science from antiquity to the 20th century.

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