The Mathematical Theses Defended at collège de Clermont (1637-1682): How to Guard a Fortress in Times of War

Domenico Collacciani, Sophie Roux

Chapter 4

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Domenico Collacciani and Sophie Roux[1]

I. Introduction

Early modern theses that were defended in colleges and universities have recently attracted historical attention. They were first studied by historians of art and of the book: the illustrations that some theses included allowed scholars to reconstruct their material and social production as well as the ceremonies associated with their public defense.[2] More recently, among other documents, their doctrinal content has been of interest for intellectual historians studying the transition from the so-called "philosophy of the Schools" to the modern philosophy, especially, but not only, in Jesuit colleges.[3] An impressive book has thus been devoted to theses in logic, natural philosophy, metaphysics, ethics, and politics that were defended between 1555 and 1648

[1] Mathesis, République des Savoirs, ENS, Collège de France, CNRS, PSL Research University, 75005, Paris, France. This article took a very long time to complete. Above all, we would like to thank Dan Garber and Susanna Berger for their patience with us; Susanna deserves special thanks for the care with which she revised our article and helped us improve our English. We would also like to thank our colleagues in Berlin, Bologna, Brussels, Groningen, Paris, Princeton and Rome who, by their questions and comments, gave us new impetus when we were stuck in the middle of the ford.

[2] Meyer, 1993, 2003, 2017; and Rice, 1999, 2004, 2007.

[3] Brockliss, 1981, 2002, 2006; Gatto, 1994; Ariew, 1999; Hellyer, 2005; Klein, 2017; Raphael, 2017.

at the University of Dilingen, the first Jesuit University north of the Alps.[4] Yet theses in mathematics defended in Jesuit colleges remain understudied. Often only a few printed mathematics theses remain—we do not know if the other mathematics theses were never printed or they were printed but then lost.[5]

This chapter studies mathematics theses defended during a period of fifty years at the *collège de Clermont* in Paris, the most important French Jesuit college. It begins at the end of the thirties, around the time when Descartes's *Discourse on method* and *Essays* (1637) appeared; this moment also corresponds to when these theses began to be defended or at least to be published. The chapter ends in 1682, when the *collège de Clermont*, having received the patronage of Louis XIV, became Louis-Le-Grand.[6] Our first objective, which belongs to social history, is to capture some of the teaching practices of the early modern period. Our second objective, which falls within intellectual history, is to explain how the ancient and the new doctrines interacted, more specifically how French Jesuits reacted to Descartes and to other *novatores*. To reach these two aims without writing an excessively long paper, we will focus on optics and leave aside other disciplines tackled in these theses, including military architecture, mechanics, and cosmology.[7]

[4] Leinsle, 2006.

[5] On mathematics theses defended in Antwerp and Louvain, see Vanpaemel, 2008; De Bruycker, 2009; Dhombres, and Radelet de Grave, 2009. According to the *Ratio studiorum*, the printing of theses was not compulsory. Lukács, 1986, 375.

[6] The list of these theses is given in Bibliography, section 2. Most of them were for the first time identified in Le Dividich, 1996, xxxiii–xxxvi; see also Dupont-Ferrier, 1921–1925, vol. III, Appendix I, 273–85.

[7] Military architecture, especially Bourdin's, is studied in d'Orgeix, 2005, 91-105; Romano, 2006; De Lucca, 2012, 96–104, 118, 189, 217, 229, and 332. Topics in cosmology and natural philosophy in theses defended in the sixties are studied in Roux, 2017. The discipline of mechanics in these theses has not yet been studied.

We begin with a general presentation of the corpus, which is exceptional insofar as there is almost one thesis per year, so that one can identify structural features common to all of the theses, but also variations from professor to professor and changes over time (II). Then, we focus on the optics theses that were defended during the long period in which Pierre Bourdin was the professor of mathematics at *collège de Clermont* (III). The brief time when Ignace-Gaston Pardies held the same chair some twenty years later on gives us the occasion to discuss an optics that fully incorporated the lessons of the *novatores*, even if it claims to respect the doctrine of the Ancients (IV).

II. An overview of the mathematics theses defended at the *collège de Clermont*

Before coming to the optical doctrines defended in these theses, we will explain why our focus is on mathematics theses rather than on philosophy theses, give some indications about what is meant by "theses," and, finally, enumerate the professors who were teaching mathematics at the *collège de Clermont*. Our corpus itself will give us many clues, but we will not hesitate to complete them by information known from other contexts.

1/ French Jesuit philosophy theses are typically 2 to 3 feet high posters printed on paper, canvas, or silk; they are sometimes richly illustrated and often dedicated to great figures.[8] By contrast, the Jesuit theses in mathematics examined in this chapter are *quarto* format books ranging from 2 to 20 pages in length, rarely preceded by a dedication, more rarely still by a letter

[8] On the dedications and on the illustrations of theses, and on their material production, see Meyer, 1993, 2003, 2017.

developing this dedication.[9] The physical differences between philosophy and mathematics theses produced by Jesuits in France are striking when the same student successively defended theses in philosophy and mathematics, as was the case of Chrétien-François de Lamoignon on 14 and 15 June, 1663, or of Jean-Baptiste Colbert on 29 and 30 August, 1668. The mathematics thesis booklet of Jean-Baptiste Colbert (1651–1690), the eldest son of the Minister of the same name, is a small treatise of mixed mathematics that does not include fancy figures (Fig. 1). His philosophy thesis print is a magnificent poster engraved by François de Poilly (Fig. 2).

In terms of their theoretical content, Jesuit philosophy thesis prints generally present "Conclusions (*conclusiones*)" that reiterate the Aristotelian orthodoxy established by Francisco Suárez, Francisco de Toledo, and the Coimbrans without providing any explanation, objection, discussion, or comment. During the period examined here, they assert for example that natural philosophy is the speculative science of the natural body inasmuch as it is natural; that the three principles of natural bodies are matter, privation, and form; that motion is the actualization of the potential, insofar as it is potential; that quantity is an accident really distinct from matter, etc.[10] They do not present much textual content that would be of interest to intellectual historians, except insofar as they confirm the received view according to which the professors of the Schools belonged to a distant and immobile landscape with respect to which the *novatores* moved forward.

[9] Exceptions include the thesis that Charles Potier dedicates to Claude Lestandart, holder of the *abbaye du Val Secret* near Château-Thierry where Potier came from (1640), the thesis that Jacques Truel de Cohon dedicates to Timoleon Le Roy, *premier commis* to the War Minister Michel Le Tellier (1648), and the thesis that Jules Louis Bolé de Champlay dedicates to François Michel Le Tellier, who succeeded his father as War Minister (1668).

[10] Ariew, 2014, 15–17.

By contrast, the mathematics thesis booklets introduced here discuss various subjects, occasionally of pure mathematics (elementary arithmetic and geometry), but usually of mixed mathematics (optics, astronomy, mechanics, fortifications, and military architecture), or, as an additional handwritten title indicates in 1676, of "physico-mathematics."[11] The questions that are tackled involve the latest scientific developments, or at least, events that were discussed in the learned circles. For example, the book *Epistolae duae de motu impresso a motore translato* (Two letters on the motion impressed by a moving mover), in which Gassendi associated Copernican cosmology with a demonstration of Galileo's law of falling bodies having recourse to indivisibles, launched in 1642 what has been called "the second Galileo affair." [12] Dominique de Vic defended a thesis entitled *Dissertationes contra Galilæum* (Dissertations against Galileo) in 1643. Torricelli's experiment having been reproduced and amplified in France for the first time in October 1646 by Pierre Petit and Pascal father and son, Blaise Bouthier defended a thesis giving a significant place to Torricelli's experiment in July 1647, which means that he had been taught on these issues during the preceding winter.[13] In 1651, Pierre de la Villette takes up verbatim the first nine paragraphs of Cavalieri's *Exercitationes Geometricae Sex* (Six geometrical dissertations), which four years beforehand outlined the notion of indivisibles and set out the principles of the two methods that today's historians of science call the distributive

[11] On the Sorbonne copy of Anonyme 1676, the title is completed by the following manuscript annotation: "Theses mathematicae seu potius physicomathematicae" (mathematics, or rather physic-mathematics theses).

[12] Galluzzi, 1993.

[13] When Pascal published his *Expériences nouvelles touchant le vide* in October 1647, the only writings to mention the Rouen experiment before were Pierius 1646 and Petit's letter to Chanut of November 1646, which was published one year later in Petit and Magni 1647.

method and the collective method.[14] Last, but not least, in 1665 some theses were devoted to the comets that enlightened the European skies that very year.[15] Of course, this does not mean that the Jesuit professors accepted scientific novelties. De Vic lists the absurd consequences that follow from Galileo's law of falling bodies and from his explanation of the tides.[16] Thierry argues that the space at the top of Torricelli's tube, far from being a vacuum, is filled with an "aerial spirit, distinct, by its most powerful part, from the common air and from other airs."[17] De la Villette refuses to label Cavalieri's doctrine as science because of the paradoxes that it generates.[18] The theses on comets were followed by a series of theses condemning not only Descartes' opinion on comets, but his natural philosophy more generally.[19] Such discussions deserve our attention. Much more than philosophy theses, mathematics theses are an indicator of the demarcation that the Jesuits made between the novelties that could be accepted, because they did not challenge the Aristotelian framework, and the novelties that could not, because they endangered this framework.

To account for the difference between philosophy and mathematics theses, it is helpful to turn to the *Ratio studiorum*. While the doctrine to be taught and the textbooks to be used were

[14] Compare de la Villette 1651, 13–4, § 37–41 and Cavalieri 1647, 3–4, § 1–5, 6, § 9. Cavalieri published his method in Cavalieri 1635; Cavalieri 1647 is an answer to the objections formulated in Guldin 1635–1641.

[15] Tarteron 1665; Prou 1665a; and Ragayne de la Picotière 1665a.

[16] De Vic 1643, 14, § 2. Gedoin 1644, 4.

[17] For the quotation, see Thierry 1648, 11, § 29, and 12, § 33: "Vocetur aut a potiori parte Spiritus aërius, a communi tamen aëre distinctus." See also de Cohon 1648, 11, § 33–4. Both defend the position of Étienne Noël (1581–1659), who was then rector of the *collège of Clermont*, and who is now remembered for having been mocked by Pascal.

[18] De la Villette 1651,14–5, § 43–6.

[19] Prou 1665b and c; Ragayne de la Picotière 1665b; Decombes 1665; and de la Bletonniere 1665.

determined in philosophy and theology, there were no specifications concerning mathematics. Similarly, the rules for the various disputations in philosophy and in theology are detailed, whether they concern the times and places of the events, their number and their rhythm, the pomp with which they were to be organized, or the functions of the different protagonists (the prefect, the rector, the teachers, the examiners, the defendants, the objectors, etc.), but nothing is said about the public exercises in mathematics, except that every month, or at least every second month, the professor "should have one of the students solve a famous mathematical problem in the presence of many students of philosophy and theology.[20] Being less controlled than philosophy disputations, mathematics disputations allowed for more variety and for more original developments.

Another explanation for the difference between philosophy and mathematics theses lay in the bitter and long-lasting rivalry that developed between the Jesuits and the Sorbonne. [21] Since the Parisian Jesuits were denied the authorization to award diplomas, they tried to push their advantages into the educational market by demonstrating their supremacy in mathematics, a field

[20] Lukács 1986, 374–7, 402. The monthly disputation in mathematics was introduced in 1599. According to Cosentino (1970, 212) if no rules were formulated to regulate mathematics disputations, contrary to what Clavius had wished, it was because the enactment of rules would have obliged all colleges to create a chair of mathematics, whereas only the most important colleges could afford one. On Clavius' fight for the teaching of mathematics through the different versions of the *Ratio*, see Romano 1999, 111–32; on the first chairs of mathematics in France, see *ibid.,* 393–414.

[21] On the rivalry between the Jesuits of Paris and the Sorbonne, see Jourdain 1862–1866, 60–7, 83–7, 94–9, 107–9, and 150–8; Dupont-Ferrier 1921–1925, vol. I, 26–28. Compère and Julia 1984–2002, vol. III, 359–407 argue that the monarchy stimulated this rivalry both for emulating the two institutions and for being granted the role of an arbitrator between them.

in which the Sorbonne professors were incompetent and over which they had no control.[22] Moreover, the Jesuits used disputations to spread what they considered to be scientific orthodoxy throughout France. Today, the philosophy thesis prints defended at the *collège de Clermont* are found only in the *bibliothèque de la Sorbonne*, in two collections of theology and philosophy theses defended mainly at the University, and occasionally at external colleges.[23] As evidenced by the collections held today by libraries outside of Paris and by correspondences of the time, mathematics thesis booklets of the *collège de Clermont* were by contrast circulated throughout France, and sometimes even beyond. The two most striking examples of such a widespread dissemination are the thesis booklet defended in 1663 by Chrétien-François de Lamoignon, the eldest son of the President of the *Parlement* of Paris, which is now to be found in many libraries all over Europe and even in America, and the anti-Cartesian thesis booklet defended in July 1665 that was sent by Parisian scientists to their correspondents abroad.[24]

2/ For simplicity, we speak generically of "theses" in this chapter. It is however only at the end of the period under consideration that this term is systematically used in the titles of our

[22] For a similar situation in Antwerp and Louvain, see De Bruycker 2009, 139.

[23] Bibliothèque interuniversitaire Sorbonne (Paris), OBL 32–1 (105, 130 bis); VCM 6=6680 (1–2). For an exception, see the thesis print of Coret (1661), now to be found in many European libraries. On 12 December 1661, in the midst of the Jansenist crisis, this thesis print defended the infallibility of the Pope, including on questions of fact.

[24] Petit to Huygens, 7 August 1665, in Huygens 1888–1950, vol. V, 433; Oldenburg to Boyle, 14 July 1665, in Oldenburg, 1965–1973, vol. II, 431–2. For some mathematics thesis booklets, there remain however only one copy preserved in the library of the Conservatoire des arts et métiers, where, after the Revolution, treatises on applied mathematics and on fortifications coming from the libraries of the religious orders were deposited. Romano (2006, 362–5) discusses on the circulation of manuscripts, especially those of Bourdin's.

documents, even if beforehand they were sometimes referred to as such.[25] In the years 1643–1655, they are almost always entitled *agones panegyrici* or *agones mathematici*, "panegyric (or mathematical) jousting."[26] After the interruption following Bourdin's death, the privileged term is *positiones* in the years 1663–1669. Finally, from 1669 onwards, our documents are dubbed *theses mathematicae*.[27] Beyond the use of the word *theses*, the nature of these documents should be clarified.

First, early modern theses were not supposed to introduce new results, methods or interpretations, but were the occasion for students to establish their competence in a given academic field by defending a set of established positions. Second, a distinction existed between *theses pro gradu*, that led to the awarding of diplomas, and *theses sub preside*, that were more or less formalized exercises through which the students who had acquired some skills had an opportunity to demonstrate them in front of an audience.[28] Since the Jesuits never obtained the right to award diplomas, which remained a privilege of the Sorbonne, the theses defended at the

[25] Bourdin himself uses the term *theses* only in the title of the 1640 thesis defended by Pierre Gaillard, but Paul Le Mercier introduced his manuscript transcriptions of the 1638 thesis and of the 1639 thesis respectively as "Theses mathematicae seu Musaeum mathematicum" and as "Aliae theses mathematicae … seu conclusiones mathematicae" (BNF, Ms. Lat. 17862, resp. f. 906 and 966) and Descartes speaks of the "Jesuit optical theses" (to Mersenne, 9 February 1639, in Descartes, 1964–1974, vol. II, 499). Oldenburg to Boyle, 14 July 1665, in Oldenburg (1965–1973, vol. II, 432–3) uses the terms "thesis" and "disputation" interchangeably.

[26] The Greek term from which *panegyricu*s derives refers to an eulogy, to the assembly in which this eulogy is pronounced, and, finally, to the festive event itself.

[27] Similar terminological variations are noted in Leinsle 2006, 41.

[28] On this difference and the exercises in Jesuit establishments, see Leinsle 2006, 26–9.

collège de Clermont were at best *theses sub preside*.[29] Nevertheless, in the context of their rivalry with the Sorbonne, the Parisian Jesuits used to mimic the ceremonies surrounding the defense of *theses pro gradu* to capture the symbolic benefits normally reserved for the intellectual magisterium of the Sorbonne.

Jesuits organized magnificent public celebrations in June or July to mark the end of each school-year. In our documents, the use of the word *agones* in the titles during the period 1643–55 is an allusion to this ceremonial context. Considering what we know of previous periods and of other colleges, the significant phenomenon at the *collège de Clermont* is that, from the late 1630s onwards, these ceremonies included festivities totally devoted to mathematics.[30] The front page of each thesis booklet mentions the place and date of the defense, but also the name and origin of the defendant. It is almost always followed by a program written in the future announcing the various events scheduled for these mathematical festivities, which took place at the end of the week, including on Sunday afternoons.[31] The celebrations were opened by a solemn speech

[29] Jourdain 1862–1866, 150–8, Compère and Julia 1984–2002, vol. III, 364.

[30] For a description of the annual celebrations at the *collège de Clermont* and at college of *La Flèche*, see resp. Dupont-Ferrier 1921–5, vol. I, 245–6; and Rochemonteix 1889, vol. IV, 149–56. For a description of the public, see Meyer 2002, 38–42; and Dhombres and Radelet 2009, 27; it should be noted, however, that the testimonies of ceremonies available to us concern the defenses of important people, like the eldest sons of a Minister and of the President of the *Parlement de Paris*, and that we do not know how an ordinary defense was conducted. For the place of mathematics in these celebrations during the late sixteenth and early seventeenth century, see Romano, 1999, 491–511.

[31] In our corpus, there are several exceptions to this rule. First, there were Sunday exercises; as we argued in Collacciani and Roux (2017b, 92–93), they probably corresponded to monthly disputations that were not public, but involved only the small group of mathematics students gathered in the *aula mathematica*. Second, there were theses

(*solemnis prolusio*) delivered by the professor of mathematics; students then performed mathematical exercises for two or three consecutive days. Such programs likely functioned as advertising leaflets that were distributed beforehand, to make the public know of the event, but also, possibly, to allow the *virtuosi* to prepare comments, questions, and objections.[32]

The authors of the theses were not the defendants, but their teachers, whose names are not mentioned on our documents. The professors could submit the same set of problems to a number of students and the same thesis could be defended on the same day by several students, who sometimes were rich enough to print their own volume in their own name (this is, for example, the case of Louis Ragayne de la Picottière and Louis Prou in 1665). Sometimes students shared the costs by printing a single thesis booklet that mentions their respective names (for example Pierre de Cornouaille and Jacques Manchon in 1638 or Hyacinthe de Ruffec and Jean Richomme in 1655).[33] In the last years of the period under scrutiny, in 1668, 1669, and 1671, thesis booklets were also produced that did not mention the names of all of the defendants; as for the 1672 thesis, which was defended by Louis Le Mazier on 24 June, by "two of the

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that were defended in unusual times of the year because of extraordinary events such as the passage of a comet (Tarteron and Prou, 29 January 1665; Vernon to Oldenburg, 10 April 1672, in Oldenburg, 1965–1973, vol. IX, 14). Last, for some unknown reasons, some defenses took place during the week, such as Guillaume Benard de Rezay's defense on Thursday 29 July 1666, Jean-Baptiste and Pierre-Antoine de Castagnere de Chasteauneuf's defense on Wednesday 13 July 1667, Jean-Baptiste Colbert de Seignelay's defense on Thursday 30 August 1668, or Alexandre Milon's defense on Monday 6 July 1671.

[32] Le Dividich 2003, 56–61 for leaflets announcing courses in mathematics; Rochemonteix 1889, vol. IV, 153; Meyer 2002, 38–9; and Meyer 2017, 36–8 for leaflets announcing the defense of theses.

[33] The strategy of sharing the costs of printing is noted by Leinsle 2006, 37; Dhombres and Radelet de Grave 2009, 26; Meyer 2017, 20. How the time was shared when there were several defendants is not known.

Society of Jesus" on 25 June, and by "one of the Society of Jesus" on 26 June. Because theses were written by teachers, the same paragraph, the same set of paragraphs, or even the same set of theses altogether, can be found in theses defended one or several years apart from one another: for example, a thesis entitled *De corporum caelestium motibus* (On the motions of celestial bodies) was defended in July 1667 by Jean-Baptiste and Pierre-Antoine de Castagnère de Chasteauneuf and in March 1668 by Jean-Baptiste Colbert de Segnelay.

3/ Most of the professors who held the chair of mathematics at the *collège de Clermont* are known through the Jesuit archives:

1634–1653: Pierre Bourdin (1595–1653)

1653–1658: ?

1658–1661: Georges Fautrel (?–1687)

1661–1664: Nicolas d'Harouys (1622–1698)

1664–1669: Michel Beaussier (?–?)

1670–1673: Ignace-Gaston Pardies (1636–1673)

1673–1676: Claude-François Millet de Chales (1621–1678)

1676–1685: Jean de Fontaney (1643–1710).[34]

The temporal distribution of thesis booklets allows us to distinguish periods, which correspond to the activity of some teachers and to the inactivity of others, or even to the fact that the chair of mathematics may have been vacant in the mid-fifties. Sixteen theses in mathematics produced between 1638 and 1651 survive, that is, almost one for every year during the fifteen years (1638–1653) in which Pierre Bourdin taught at the *collège de Clermont*. In the ensuing

[34] We follow the indications given in Dainville 1954, 110–11.

decade or so, only one thesis was defended in 1655, a year in which we do not know who was the mathematics teacher, assuming there was one. During the eight years (1661–1669) when Nicolas d'Harouys and Michel Beaussier were professors, there are twenty-one theses; this frenzy of thetic activity is explained by the extraordinary passing of two comets in a row in 1664–65, but mostly by the antagonism that developed between the Jesuits and the Cartesians. Under the impulse of Ignace-Gaston Pardies, the normal rhythm of one thesis per year was reintroduced.

As a quick glance at these thesis booklets shows the disciplines favored in the thirties and forties, when Bourdin was the mathematics teacher, were optics and military architecture. In the sixties, because of the comets, the establishment of an observatory, and the interests of those who were then mathematics teachers, most of the theses were devoted to astronomy and cosmology, the main task, but not the only one, being to compare the different systems of the world.[35] Finally, in the few theses that were defended when Pardies was a professor, the place of optics is again important. In what follows, we will focus on optics to contrast Bourdin's teaching and Pardies' teaching.

[35] On the 1664–65 comets, see Roux 2017. On the observatory of the *collège de Clermont*, see Bigourdan 1918; Dupont-Ferrier 1921–1925, vol. I, 189–90; and Dainville 1960, 44. Nicolas d'Harouys built machines for teaching the different astronomical systems that are alluded to in Ragayne de la Picottière 1665b, 4, § 7. Garnier (1678, 118) describes these machines and explains that, because of their number and magnitude, they could not be stored in the rooms of the Library, but had to be kept in a large room of their own. They were to be seen by eminent travelers, see for example Huygens' *Journal*, in Huygens (1888–1950, vol. XXII, 545), André de Graindorge to Huet, 9 May 1665 and 5 August 1665, in Graindorge 1942, resp. 267 and 303; and Brice 1685, vol. II, 51.

III. Pierre Bourdin's collections of optical problems: spectacular devices enlisted to defend a traditional theory of sight

Pierre Bourdin (1595–1653) began his career by teaching grammar and humanities at the college of La Flèche (1618–1623). He was then professor of rhetoric at Rennes (1627), Rouen (1628), and Bourges (1629–1632). Two years after his return to La Flèche as a professor of mathematics (1633), he was transferred to the same position at the *collège de Clermont*. Since he held this title for almost twenty years, from 1634 to his death in 1653, and organized a defense almost every year, we have an impressive number of his thesis booklets at our disposal.[36] To capture their gist, we will first approach them from a formal perspective; we will then show that they had recourse to engravings and optical devices; finally, we will ask ourselves what was the place of the ancients and the moderns in Bourdin's optical theory.

1/ From a formal perspective, Bourdin's thesis booklets belong to a "genre" that can be easily characterized. They are often presented as encyclopedias ordered according to disciplines (*Philosophica, Optica, Acoustica, Historica, Cosmographica, Theologica, Astronomica, Arithmetica*, or *Ex philosophia*, *Ex optica*, etc.).[37] Bourdin, who had been a professor of rhetoric and who probably knew the art of memory, did not confine himself to the order of disciplines:

[36] On Bourdin, see Sommervogel 1890-1900, vol. II, 29–30,; on his career, see Dainville 1954, 110; and Romano 1999, 563–4. On his relations with Descartes, see Ariew 1995, 1997 and 1999, 5, 24–9, 156, 173, 193–6, and 203–4; and Collacciani and Roux, 2017a. On his treatise on fortifications, see d'Orgeix 2005, 91–105; Romano 2006; De Lucca 2012, 96–104, 118, 189, 217, 229, and 332. On his theses and more generally his teaching at the *collège de Clermont*, see Le Dividich 1996, 39–44, 47–8, 180–8, 234–43, and 272–6; and Collacciani and Roux, 2017b.

[37] Leinsle (2006, 20) notes that some theses are a series of exercises independent of each other, while others constitute small treatises on a given subject.

the 1638 thesis enumerates the different collections of a cabinet of curiosities, the 1639 thesis, the rooms of a palace, the 1646 thesis, the accomplishments of mathematics. Each of these headings includes, rather than a series of continued propositions on a given theme, a collection of problems that are independent from one another. For example, in the 1640 thesis, a problem under the heading *Militaris* asks to show that straight lines are more suitable than curved lines for building defense walls; a problem under the heading *Sacra* asks to compute the speed of the skies, knowing that during the time to say "Pater," the stars travel 800 leagues; or a problem under the heading *Philosophica* asks to demonstrate geometrically that quantity is infinitely divisible in actually finite parts, and, this, in two ways, the Aristotelian and the Euclidean.[38] The "collection of questions" aspect was also present, albeit less markedly, in the theses defended under Jean Leurochon in Pont-à-Mousson in the twenties and it was part of the genre of mathematical recreations that appears in Leurochon*'s Récréations mathématiques* or in Marin Mersenne*'s Questions inouies*.[39] Bourdin's emphasis on problem solving, that appears when paragraphs begin with expressions such as *explicare* (or *aperire, indicare) qua possit* (or *quo fit, cur, quo pacto, unde, qua arte fiat*), is however typical for him.

Bourdin's thesis booklets present yet another specificity that is not found in the thesis booklets of any other Jesuit professor of the *collège de Clermont*: some of them include pictures. In the thesis booklet of Jacques Pallu and Jacques Touchelée, whom Bourdin made defend a mathematics thesis in 1635 when he was a professor at La Flèche, there are no illustrations; in

[38] Potier, 1640, 3, § 4, and 7, § 1–2.

[39] Leurochon 1622; and Leurochon 1629. On the diversity of these theses, see Romano 1999, 501–3. See also (ibid., 618–21) on the reproduction of mathematics thesis booklets defended in Paris in 1622. Concerning mathematical recreations, see Chabaud 1994.

1638, Pierre de Cornouaille and Jacques Manchon's included two engravings in their thesis booklet (one representing the Copernican hypothesis, the other a reinforced fortification); and from 1639 onward, Bourdin developed a collaboration with engravers to illustrate his thesis booklets. Figure 3 reproduces copper-plate engravings made by Alexandre Boudan that appear in a 1640 thesis booklet. While the plate on the right illustrates various topics, the plate on the left is entirely devoted to optical phenomena, optics being indeed the discipline that most interested Bourdin. These illustrations raise unanswered questions. We do not know why some thesis booklets feature printed images, whereas other impressions of the same sets of theses that were supposedly defended at the same dates contain fewer images, drawings rather than engravings, or no images. We also do not know what shares the engravers and Bourdin had in the production of these images, nor what type of contract bound them. Some things are known however. The signature inscribed on some of the engravings identifies his main—and possibly his only—collaborator as Alexandre Boudan (1600–71), an illuminator, copper-plate engraver, and dealer of etchings established in rue Saint-Jacques at the *Corne de cerf* around 1633, then at the *Image Saint-Maur* from 1643 onward, who also worked with other Jesuits.[40] Second, some of these engravings are also included in the manuscript notes taken from Bourdin's teaching, which indicates that they were likely also distributed in class.[41] Moreover, they resurface in various editions of his *Cours de mathématique*, which is presented as a "figured mathematics" (*figurata*

[40] Jones (1947, 119–20) and Ariew (1995, 212; 2014, 21), date back to 1631 Boudan's engravings that are in Bourdin's thesis booklets, but Collacciani and Roux (2017b, 110–11) prove that they were made in 1637, at the time when Bourdin was beginning to teach mathematics in Paris.

[41] Petit 1639, in BNF, Ms. Lat. 17861, p. 879; de Culant 1639, in BNF, Ms. Lat. 17861, p. 881; Bourdin 1641, 1645, 1661. Le Dividich (1996, 41; and 2003, 61–3) mention the use of these engravings in Bourdin's classes.

mathesis) and organized according to a "map" (*ichnographia*). Bourdin's textbook was a visual encyclopedia of mathematics where, in accordance with a more general pedagogical tendency of the Jesuits, pictures were used as mnemonic support for students.[42] It is therefore no exaggeration to conclude that images were essential in Bourdin's pedagogical practice.

Another particularity of Bourdin's thesis booklets is that some paragraphs begin with "*exhibere (or proferre) experimenta*," (to exhibit or to show experiments). One wonders if the experiments in question were carried out during the defense or if they were only presented with engravings. It is possible, that, as some of the theses ask, the defendants had to trace ellipses or to explain the functioning of a book wheel, which was able to open several books at the right page.[43] But it is unlikely that they could, as other theses demand, display fountains and machines capable of lifting enormous burdens.[44] Unambiguous evidence that real experiments were performed comes from the program of 1639, which distinguishes between the time devoted to discourses and to experiments.[45] Thus, Bourdin's thesis booklets displayed a science that was literally spectacular: there were spectators around and they were attending spectacular performances. This is unsurprising in the context of public ceremonies that were intended to convince the public of the magnificence of Jesuit science.

[42] Collacciani and Roux 2017b, 106–11.

[43] Henri 1639, 6 § 3, 7 § 1, and 6 § 1. The machine to display books is certainly a book wheel similar to the one presented in Ramelli 1588.

[44] Henri 1639, 7 § 1–4; and Manchon 1638, 7 § 4–5.

[45] Henri 1639, 2. The programs of 1640, 1648 and 1651 also mention real experiments.

2/ Relevant here is an optical device called the Lens of Faith (*Specillum Fidei*) that is presented as new and unexpected in several theses. The most precise indications about it appear in the 1639 thesis, which describes the marvelous effects of this device without explaining how it works (Fig. 4).

These effects were the following: when seen with the naked eye, a given plate would depicts the Host surrounded by angels; however, when seen through the Lens of Faith, the same picture revealed, not the Host, but the Lord of the angels, that is Jesus Christ. The Lens of Faith showed a representation of transubstantiation.[46]

Bourdin was already interested in anamorphoses when he arrived in Paris, but it is probably through Jean-François Niceron that he first heard of this dioptrical device.[47] Although it was invented as early as 1628 by Charles du Lieu, a Jesuit from Lyon (1609–1678), it was not described in a publication before Niceron's *Perspective curieuse* (1638).[48] It appeared in Jesuit works of the mid-seventeenth century, from Jean du Breuil (1649) to Nicolas Forest Duchesne (1650) to Gaspar Schott (1659); a century later, it was still known: it was used by Charles-Amédée van Loo to paint a portrait of Louis XV in 1742.[49] The Museo Galileo in Florence and the Teyler Museum in Harlem having preserved different pieces of the whole apparatus—a painting in Florence, an optical tube in Harlem—, it is possible to get an idea of its functioning

[46] Henri 1639, 6. It is also mentioned in Foucquet 1646, 6 and Anonymous 1675, 11 § 4.

[47] Collacciani and Roux 2017b, 99–100. The most complete article on this device is Malcolm 2002; concerning Niceron, see Truci 1976; and Bessot 2005; concerning Bourdin, see Collacciani and Roux 2017b, 95–100.

[48] Niceron 1638, 101 and du Breuil, 1649, "Instruction sur le traite VII," sigs. Zz1v–2r. On Charles du Lieu, see Malcolm, 2002, 219–21.

[49] Du Breuil 1649, 161–2; Forest Duchesne 1650, 226–7; Schott 1658, 470–1 and pl. 23, fig. 7, 453.

and to construct a replica.[50] The *specillum* was a tube that included faceted mirrors: each of these facets refracting a fragment of the picture that was seen with the naked eye. What was seen through the *specillum* was a new picture composed from several fragments of the initial picture (Figs. 5 and 6).

The skill of the artist consisted in painting two pictures that were not only coherent, but also associated through a symbolic relation, so that the picture seen through the lens revealed the meaning of the picture seen with the naked eye. According to the examples mentioned in the literature of the day, the *specillum* allowed one to see Urban VIII as a substitute of several popes, Ferdinando II de' Medici (or Louis XIII) rather than several Mohammedan sultans, Louis XIV in the place of his parents, a New Testament truth instead of several Old Testament prophecies.[51] As for the *Specillum Fidei* mentioned in Bourdin's theses, as we have seen, it made one see Jesus Christ in the place of the Host (Fig. 7). To look at these pictures through the appropriate lens revealed the truths hidden behind the painted appearances; it was not only a scientific device, but a moral device, even an apologetic one when the truth in question was that of the Eucharist.

3/ If Bourdin displayed a spectacular device at the cutting edge of his time, his optical theory was inspired by Jesuits of the previous generation like François de Aguilón (1567–1617)

[50] For a photograph of the Florentine apparatus, see Bonelli 1959, 38; the optical tube was lost in the 1966 Arno flood, see Righini-Bonelli 1976, 197–96; for its present state, see https://catalogue.museogalileo.it/object/OpticalToy.html. Only the optical tube remains in the Teyler Museum, see https://www.teylersmuseum.nl/en/collection/instruments/fk-0316-1-5-anamorphoscopes-5. Hunt and Sharp (2011) propose a reconstruction of the apparatus.

[51] Niceron 1638, 106, 115–8; and Du Breuil 1649, 162 and 165.

and especially Christoph Scheiner (1575–1650), who accepted Kepler's discovery that vision is made on the retina, rather than on the crystalline lens, but refused to give up the existence of *species* transporting the resemblance of things to the brain. From the analogy between the eye and the *camera obscura*, the pupil being the hole through which the light is transmitted, the crystalline lens being the lens by which a picture is formed, and the retina being the screen on which it is painted, Kepler had deduced in the *Paralipomena ad Vitellionem* that opticians had to study the geometric transmission of light rays without resorting to *species*, while natural philosophers had to devote themselves to the investigation of what was happening beyond the retina, in the dark caverns of the brain.[52] In his *Oculus hoc est fundamentum opticum* (The Eye, that is the optical principle), Scheiner, who is Bourdin's main source of inspiration, took up Kepler's analysis of the different functions of the parts of the eye and argued that the retina is the formal instrument of vision.[53] He went even further thanks to delicate anatomical observations and established that the optic nerve is not in the axis of the eye, but also that some pictures can be seen in the eyes of dead men and animals.[54] But, unlike Kepler, to ensure that we know things as they actually are, he kept the notion of *species*, which he applied equally to images emanating from objects, to visual rays, to retinal images, and to brain images.[55] Although he admitted that all rays joining the visible object to the eye are to be considered visual rays, he asserted that only

[52] Kepler 1604, 37–56, 168. On Kepler's optics, see Lindberg 1976, 178–208; Simon 1988 and 2019; Smith 2015, 322–75.

[53] Scheiner 1619, 124–5, 137–8, and 197–9. See also Scheiner 1630, 106a$_{30}$–116b$_{9}$. On Scheiner's compromise, see Pantin 2008, 263–7; Chen-Morris and Gal 2010, 203–6; and Smith 2015, 374–5.

[54] Scheiner 1619, 17–18; and Scheiner 1630, 110b$_{39}$–112a$_{3}$.

[55] Scheiner 1619, 128–38; Pantin 2008, 263–7.

one of them is sensed by the eye and deserves as such to be called the "principal, primary, and immediate or formal ray."[56]

Bourdin's thesis booklets take up the division of parts and functions of the eye proposed by Scheiner in the wake of Kepler.[57] The crystalline lens is established by nature to gather the visible *species* on the retina: vision is distinct when each point on the retina corresponds to a point of the object; it is confused when the crystalline lens is damaged and there is no one-to-one correspondence between the points of the object and the points of the retinal image. As for the retina, it is the formal organ of vision: it is the place where the visible *species* of the objects (*species objectorum*) that have passed through the cornea and have been collected by the crystalline lens are joined to the visual spirits (*spiritus visorii*) that come from the brain through the optic nerve.[58] This stresses a point that was already noted by Ibn al-Haytham but had been reinforced by Kepler: while visual rays coming out of the eye (*radii emissi*) are imaginary, incoming rays carrying the images of the objects (*radii immissi*) are real.[59] But for all that, Bourdin's optics, exactly like Scheiner's, did not abandon the notion of *species*. Like Scheiner,

[56] Scheiner 1619, 73–4.

[57] Aguilón and Scheiner are among the very few authors to be named, see Bouthier 1647, 12 § 1–2.

[58] Cornouaille and Manchon 1638, 15 § 2, 4–5; Henri 1639, 14 § 1; de Culant 1639, [1] § 2; Potier 1640, 9 § 1–2 et 4; Gaillard 1640, [1] § 1–2; de Vic 1643, 11 § 4–5; Gedoin 1644, 13 § 29; Bouthier 1647, 12 § 2; Thierry 1648, 8 § 19–20; and de Bourneuf, 1650, 10–11 § 27, and § 30. See also BNF, Ms. Lat. 17861, f. 900 and 905 and Ms. Lat. 17862, f. 906–9.

[59] De Culant 1639, [3] § 1; Henry 1639, 14 § 2; Potier 1640, 7 § 5; Gaillard [1640], [1] § 6; Bouthier 1647, 12 § 2. On the arguments against the emission of visual rays, see Lindberg 1976, 66–7, 178-85; Smith 2015, 185–8, 256–75; and Simon 2019, 43–4, and 127–8.

Bourdin states that *species*, light (*lux*), illumination (*lumen*), and color are the same albeit in different respects.[60] The most developed argument on *species* is given in the 1642 thesis:

> I. To explain vision, *species* are needed in the medium. These are not (except perhaps metonymically), as is commonly believed, images of objects, but a very simple entity of the same kind for absolutely all visible things, whose function is to join what is looked at to the agent when these powers are distant. Likewise, the Peripateticians believe that, by light, as by a vehicle, celestial things produce various effects on sublunar things.… II. The *species* of visible things impressed by powers and expressed by them are really similar to objects and are their natural images, and outside of them there are no other images of things, or formal *species*, not even in mirrors, but neither when, through an opening, external objects appear on a screen in a closed room.[61]

Scheiner is not Bourdin's only source: it is likely that he learned from Fortunatus Vospicus Plempius the strange fact reported by Platerus (Felix Platter), Rungius (Johannes Runge), Smetius (Henrich Smet), Vagerus (Matthaeus Wagger), Kepler, and Plempius, that "while they were deprived of the use of their eyes, they were able to see by their nose and to

[60] De Bourneuf 1650, 10 § 15–16.

[61] Despont 1642, 10 § 1–2: "Ad explicandam visionem necessariæ sunt species in medio. Hæ non sunt, ut vulgo creditor, (nisi forte metonymice) imagines obiectorum, sed entitas quædam simplicissima, et uniusmodi respectu omnium omnino visilium, cuius sit munus Aspectabilia potentiis distantibus coniugere ad agendum, ut de lumine censent Peripatetici, quo veluti vehiculo, cœlestia in sublunaribus varios producunt effectus... II Species rerum visilium impressæ potentiis et ab iisdem expressæ sunt vere similes obiectis, et illorum imagines naturales, ac præter eas nullæ sunt aliæ rerum imagines, aut species formales, ne in speculis quidem, sed nec in charta dum clauso in conclavi per foramen externa obiecta apparent." For other mentions of species, see Thierry 1648, 8 § 17–18; and de Bourneuf 1650, 10 § 25–6. De Vic (1643, 10 § 1) is discussed *infra*, p. XXX.

distinguish correctly colored objects through their nostrils."[62] However, Scheiner's importance is revealed by the engraving "Oculus" that was first used in the years 1638–1640 during Bourdin's classes as well as in his thesis booklets and then regularly republished in his books until the 1661 edition of the *Cours de mathématique* (Fig. 8). In the lecture notes taken by Paul Le Mercier, part of this engraving was copied, which indicates that copying figures by hand constituted a significant part of Bourdin's teaching (Fig. 9). Even leaving aside Bourdin's appetite for pedagogy through images, using engravings and drawing pictures was relevant in anatomy: visualizing the spatial structure of the eye and the relationship among its parts was more efficient than describing it through words. The images labeled 4 and 15 in the "Oculus" engraving might have been inspired by Felix Platter's anatomical images, but, since these images had already been reproduced in Kepler's *Ad Vitellionem paralipomena*, it is impossible to know if Bourdin was inspired by Platter or by Kepler (see Figs. 8 and 10).[63] Moreover, other images in the "Oculus" print are borrowed from Scheiner: this is the case for the image labeled 3 as well as images 5 to 9, in which the optic nerve is inclined with respect to the central axis of the eyeball, or for image 16, in which the aqueous humor appears isolated from its neighboring parts, which is a rare representation since it could not be obtained by dissection (Fig. 11).[64]

[62] Potier 1640, 5 § 5: "… cùm essent privati oculorum usu, naso viderent, et obiectos colores naribus aptè discernerent, ut referunt probatae fidei Platerus, Rungius, Smetius, Vagerus, Keplerus, et Fortunatus Vopiscus Plempius." This is the last problem discussed in Plempius (1632, 310–12), who refers exactly to the same group of authors.

[63] We would like to thank Tawrin Baker for the clues on anatomical representations of the eye that he shared with us. For more, see Baker 2016.

[64] Scheiner 1619, 17–18. The inclination of the optic nerve with respect to the central axis of the eyeball is also taken into account in Descartes' *Dioptrique*, see Descartes 1964–1974, vol. VI, 106.

As engravings begin to appear in the lecture notes of Bourdin's students in 1637–1638 and in his thesis booklets in 1638, one wonders whether the pictures of Descartes' *Dioptrique* inspired him. Some of Bourdin's and Descartes' pictures have a family resemblance, because they use the same graphic conventions: they combine anatomical and optical elements on a single picture, so that the path of rays is traced not only in the medium between the object and the eye, but in the eye itself; they represent not a singular ray, but pencils of rays that form double cones (from each point of the visible body, many rays issue forth, which are recombined after their passage through the tunics of the eye to form a single point on the retina); they use oriented objects such as arrows, daggers or swords to make the inversion of the image on the retina sensible. But it cannot be concluded that Bourdin and the artist(s) with whom he collaborated borrowed these conventions directly from Descartes, since they already existed in Kepler and Scheiner.[65] Moreover, it is unlikely that Bourdin and his collaborator(s) developed overnight an image-based pedagogy from scratch in reaction to Descartes' pictures. Nevertheless, it is not impossible that the seduction exerted by Cartesian pictures prompted Bourdin and Boudan to invest in their own pictures (Figs. 12 and 13).

Bourdin's reaction to the doctrine contained in the *Dioptrique* was unknown before Charles Potier's thesis (1640). In this work Bourdin criticizes Descartes' law of refraction, but also his use of subtle matter to explain light and colors.[66] His first argument against subtle matter

[65] On these conventions, see Shapiro 2008, 282–6. Concerning pictures in Descartes' natural philosophy, see Lüthy 2006; Zittel 2009 and 2011.

[66] Collacciani and Roux 2017a, 59–65. According to Bourdin, the law of reflection and the law of refraction are the same, insofar as the less inclined a light ray is, the less reflected or refracted it is, see Pallu and Touchelée 1635, 10

is that it is only an imaginary entity.[67] Moreover, far from making the explanations more simple, it makes them more complex:

> To explain the action of light and colors on the eyes by the motion of some subtle matter diffused through the pores of the air and of transparent bodies, which luminous bodies set in motion and through which they affect the eyes in different ways, which is quite different than by intentional *species*, amounts to healing a scar with a new injury, and to bothering for nothing with the same difficulties, and with some new ones on top of that. To show this and to demonstrate the inanity of subtle matter.[68]

Bourdin presents explicitly as two rival explanations of light and color the Cartesian explanation, which uses subtle matter, and the Aristotelian explanation, which uses intentional *species*. We hope that it is not an over interpretation to attribute to Bourdin the idea that the mechanization of light made possible by Descartes' subtle matter made vanish into thin air scholastic entities such as intentional *species*. Bourdin was attacking subtle matter to defend scholastic entities. Without examining the transformation of Bourdin's and Descartes' optical dispute into a metaphysical controversy and their reconciliation thanks to Jacques Dinet, it can be noted that in 1643, while their reconciliation was in progress, Dominique de Vic defended a thesis that included subtle matter among the entities that could explain vision:

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§ 7; Potier 1640, 9 § 6; and BNF, Ms. Lat. 17861, f. 908. His conflict with Descartes was linked to the fact that they were not referring to the same angles by the terms "angle of incidence" and "angle of refraction."

[67] Potier 1640, 11 § 3.

[68] Potier 1640, 15 § 3: "Lucis et colorum actionem in oculos explicare per motum materiæ cuiusdam subtilis fusæ per aëris, et transparentium corporum poros, quàm lucida corpora moveant, eáque tangant oculos modis variis, atque omnino aliter, quam per species intentionales, est cicatricem curare novo vulnere, et gratis implicare sese iisdem, et insuper novis difficultatibus. Has afferre, et inanitatem subtilis illius materiæ demonstrare."

> For vision, it is necessary that something is produced by the visible object in the transparent medium: whether it is a *species*, as Peripateticians want, a motion of a subtle medium that acts like a stick, according to the opinion that Simplicius attributes to Aristotle, or something that is transmitted through pores or voids as Democritus says.[69]

This does not mean that Bourdin believed in the existence of subtle matter and in his capacity to explain light and colors: it is only one hypothesis among others. In the last two theses Bourdin had Jean de Bourneuf (1650) and Pierre de la Villette (1651) defend, he challenged the atomist and Cartesian hypotheses concerning the nature of light, returning to what he called the "common and royal way," namely the Aristotelian way of explaining the light:

> Different [philosophers] explain the nature of light in different ways: some by a perpetual flow and emission of corpuscles from the luminous body, others by the motion produced by the luminous or colored body on corpuscles placed in the transparent medium. Both explanations are ingenious, but not at all appropriate, if you look at the details. Hence, we have still the common and royal way. This is why we say that light is a form in a suitable subject, but without penetration of the subject. This subject is the transparent and another

[69] De Vic 1643, 10 § 1: "Ad visionem necesse est ut à visili in medio diaphano producatur aliquid, sive illud sit species, ut placet Peripateticis; sive motio medii subtilis ad instar baculi, ut Aristoteli affingit Simplicius; sive aliquid aliud transmissum per poros, aut vacuum, ut innuit Democritus." Matton (2018) argued against Collacciani and Roux (2017a, 71–2) that this passage does not contain any allusion to Descartes, but is only an allusion to Simplicius' exposition of Aristotle's doctrine, that Bourdin might have known through Gassendi (1642, 173–4). This seems improbable to us, because Bourdin never discusses Gassendi, while he had been involved in a long controversy with Descartes. In 1644, Bourdin's and Descartes' reconciliation was so complete that Bourdin was entrusted with the task of distributing copies of *Principia philosophiae* to the French Jesuits (Descartes 1964–1974, vol. IV, 143 and 160).

would be suitable for another thing. The nature (*indoles*) of light, which is sufficiently perceived by the one who sees, is not perceived at all by the one who was born blind.[70]

To summarize, Bourdin's thesis booklets were encyclopedic collections of problems taken from different parts of mixed mathematics, the resolution of which sometimes required the manipulation of engravings or even the performance of real experiments. Bourdin's optical teaching was founded on Scheiner's *Oculus* (1619), but that did not prevent him from making his students produce extraordinary effects such as the appearance of a picture of Christ thanks to the *Specillum Fidei*. More generally, two levels can be distinguished in Bourdin's theses and in his teaching: on the one hand, a stable structure of knowledge corresponding to the Jesuit science of the years 1610–1620, on the other, new experimental elements coming from the scientific actuality that added a touch of novelty and excitement to this structure of knowledge without contradicting it. As for Descartes, Bourdin perceived him as a *novator* among many others, who had to be corrected when he went astray—that is what Bourdin did concerning subtle matter –, but who did not pose a real threat to the traditional ways of teaching nor induce a transformation of the Aristotelian structure of knowledge.

IV. Ignace-Gaston Pardies: a new theory of light claiming to be true to the Ancients

[70] De Bourneuf 1650, 8, § 17–8: "Luminis naturam varii vario modo exponunt: alii per corpusculorum perpetuum fluxum et eiaculationem à lucido: alii per corpusculorum perspicuo in medio positorum motum factum à lucido, vel colorato. Ingeniosè quidem utrique; at minus commodè, singula si spectes. Nobis igitur via restat, communis et regia. Quare lumen dicimus esse formam in subiecto apto, sine tamen subiecti penetratione. Subiectum illud perspicuum est, et aliud quidem alio magis. Lumine vero indoles ea quæ percipitur satis ab oculato, à cæco nato minimé." See also De la Villette 1651, 12 § 34–5. The mention of a blind person is probably an allusion to *Dioptrique*, in Descartes 1964–1974, vol. VI, 85–6.

Ignace-Gaston Pardies (1636–1673) was educated in the Jesuit colleges of Pau and Toulouse. He began his career as a preceptor of humanities at the *collège de la Madeleine* in Bordeaux (1656–1660), where he studied theology (1660–1663). He then spent one year as a professor of humanities in Bordeaux (1664) and one year of probation in Pau (1665); at this point he had already some reputation as a mathematician: he was in correspondence with Athanasius Kircher (1602–1680) and he was a friend of Emmanuel Maignan (1601–1676), he offered his expertise on a project to make the river that passes through Pau navigable and published two books on comets.[71] After spending a few years as professor of philosophy and mathematics in La Rochelle (1666–1668) and in Bordeaux (1668–1670), he was appointed professor of mathematics at the *collège de Clermont* at the age of thirty-four. Only three years after his arrival in Paris, he died prematurely from a fever, contracted while tending the poor.[72]

Due to his short life and career, Pardies only authored a few thesis booklets. At the *collège de la Madeleine* in Bordeaux, Étienne Roux and André Duhamel defended in 1669 theses devoted to mechanics. At the *collège de Clermont*, Alexandre Milon and another student defended in 1671 theses on optics, while Louis Le Mazier and other students defended in 1672 theses on cosmology.[73] Jean-Baptiste Joseph-Ignace de Mesgrigny and Charles-Bénigne Hervé defended theses devoted to different parts of mathematics in 1670; the sections on optics and on military architecture in their thesis booklets were borrowed from thesis booklets printed in 1666,

[71] Pardies 1665a and 1665b.

[72] On Pardies's life and works, see Trévoux 1726, 664–93; Sommervogel 1890–1900, vol. VI, 201–8; and Ziggelaar 1971.

[73] The thesis booklets on military architecture that the catalogue of the Bibliothèque municipale de Lyon dates from 1671 without giving any reason for such a date are left aside.

1668, and 1669, that is, when Pardies was not in Paris. The sections on optics and military architecture were likely written by his predecessor and Pardies probably arrived in Paris shortly before the start of the school-year in October 1671.[74] The only thesis booklet devoted to optics at the *collège de Clermont* under Pardies is the booklet dated 1671. We will first show that it differs from those defended under Bourdin because of its presentation, but also because of the intellectual context in which it was defended; we will then make explicit the principles of Pardies' optics that surface in it; finally we will insist that it is not without reason that Pardies was accused of Cartesianism.

1/ Theses of the kind that Bourdin developed disappeared after him. Mathematics thesis booklets defended at the *collège de Clermont* in the second half of the century resemble more standard *disputationes*, *dissertationes,* or *theses* that feature a set of propositions to be debated: they do not ask the defendant to solve elementary problems belonging to different parts of mixed mathematics using engravings or performing real experiments. Whereas Bourdin's thesis booklets present collections of questions and propositions that jump from one topic to another unrelated one, the mathematical thesis booklets produced later in the seventeenth century by Pardies and others present more coherent progressions from one topic to another that in certain cases appear as mini-treatises specialized in one domain. The only trace of the type of thesis booklet developed by Bourdin that remains in the second half of the seventeenth century is that

[74] The section on optics of Mesrigny 1670, 7–14 is borrowed from Anonymous 1666, 3–13; Lamoignon de Basville 1666, 3–13; or Benard de Rezay 1666, 3–13; its section on military architecture is borrowed from Bolé de Champlay 1668, 10–11 or from Anonymous 1669, 14–15 § 3–6. We were not able to see Hervé 1670 but our guess is that it is identical to Mesrigny 1670.

paradoxes are often formulated, sometimes at the end of each paragraph or of each page, as is the case in the thesis that Chrétien François de Lamoignon defended in 1663, sometimes gathered at the end of the thesis, as exemplified by the list of "Paradoxes that follow from the principles of Descartes' philosophy" at the end of the thesis booklet defended by Louis Ragayne de la Picottiere and others in 1665.[75] Here, paradoxes are not logically unacceptable or self-contradictory statements; rather, they are statements that run counter to received opinions and that, as such, are supposed to arouse astonishment, admiration, or repulsion in an audience—recall that these theses were defended during ceremonies that brought together a public that expected something spectacular, at least rhetorically.[76]

These formal differences are however slight compared to the difference in intellectual context between the first and the second half of the seventeenth century. As we have seen, Bourdin considered Descartes as a *novator* among many others; if Descartes did not succeed in making the Jesuits adopt his *Principia philosophiae* in their classrooms, he succeeded at least in being considered by them as a kind of fellow traveler with whom they could exchange polite letters and honest words. In the sixties however, while the Cartesians were busy publishing the works of Descartes that he had not published, writing Cartesian works on subjects he had not dealt with, and giving lessons in Cartesian philosophy to anyone who wanted to listen to them,

[75] Concerning paradoxes in De Lamoignon (1663) and Ragayne de la Picottiere (1665b, 15–16), see Roux 2017 114–5. The 1665 theses were defended by many students, see Ragayne de la Picottiere 1665a; Prou 1665b; Ragayne de la Picottiere 1665b; Prou 1665c; Decombes 1665; and de la Bletonniere 1665: in what follows, we only give reference to Ragayne de la Picottiere.

[76] For a study of Renaissance paradoxes, see Colie 1966. That thesis booklets presented paradoxes is noted in Leinsle 2006, 40, 45–6; and Dhombres and Radelet de Grave 2009, 173.

the Jesuits and more generally the partisans of the philosophy of the Schools judged that, as far as natural philosophy was concerned, the main challenge that they had to face was to prevent the Cartesian party from continuing to spread a natural philosophy that was perceived as a threat to the old philosophy. This polarization of the field between the new philosophy advocated by the Cartesians and the old philosophy defended by the Jesuits affects all of France, but manifests itself particularly vividly at the *collège de Clermont*, as is evident from the thesis booklets devoted to cosmology.[77]

Throughout our period, the comparison of hypotheses concerning the structure of the world was a *topos* for those who taught cosmology. In his lectures, Bourdin said for example that Ptolemy's hypothesis was irreconcilable with new observations, Frascator's hypothesis, too complex, Copernicus' hypothesis, ingenious but implausible, and moreover contrary to Scripture, so much so that he came to favor a combination of Tycho Brahe's and Ptolemy's hypotheses.[78] There was then no mention of Descartes, which is only natural since he had not yet published his *Principia philosophiae*. It is still the case in 1663: Chrétien François de Lamoignon's thesis print is devoted to a criticism of Copernicus' hypothesis, presented as a fortress that should be taken by assault, while Joseph Le Meilleur's thesis print compares the hypothesis of the concentric circles ("ridiculous"), the Ptolemaic hypothesis ("intolerable"), the Copernican hypothesis ("unlikely"), the Tychonian ("almost chimeric in practice"), and the semi-Copernican ("combining all the disadvantages of the Copernican and the Tychonian hypotheses") before introducing "the new mathematical hypothesis of Clermont," which is supposed to take the best

[77] On this polarization of the French natural philosophy, see Roux 2013a.

[78] BNF, Ms. Lat. 17862, f. 501–13.

of all the previous ones without any of their defaults.[79] In 1664, an anonymous defendant criticized, but only in passing and without naming its author, the Cartesian explanation of magnetism for being ingenious, but too poetic and too mechanical: "insofar as it is poetic, it is rejected by philosophy, which is the enemy of all fiction; since it is too mechanical, it is not accepted by nature, to which it is up to command the laws of human art, not to obey them."[80] This corresponds exactly to two fundamental methodological criticism that will be addressed to Descartes in the 1665 thesis booklet: he mistakes his fictitious mathematical hypotheses for true theses explaining the reality of things and he confuses the analysis of artificial and natural things. In both cases, the problem is that the traditional division of labor between mathematics and natural philosophy is not respected.[81] But in 1664 this is only a criticism made in passing; the passage of two comets in 1664–1665 occasioned a confrontation between the Cartesians and the Jesuits that quickly led to an unprecedented attack of Cartesian natural philosophy.

This confrontation, along with Descartes' works placement on the Index of Prohibited Books *donec corrigantur* on November 20, 1663, precipitated a change of intellectual context: not only was Descartes now explicitly mentioned, but his system of the world was condemned more harshly than any other. In 1666, Lamoignon de Basville noted:

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[79] De Lamoignon 1663; Le Meilleur 1663, 12–13 § 3–8. On the political context of Lamoignon's thesis, see Lerner 2001, 534–7. Nicolas d'Harouys was the author of the "new mathematical hypothesis of Clermont" which is also presented in Lamoignon de Basville 1666, 19 but not in Benard de Rezay 1666.

[80] Anonymous 1664, 6 § 4: "Nimium tamen et poetica videtur esse et mechanica; quatenus est poetica, reiicitur a philosophia omnis inimica figmenti; ut mechanica nimius est, non admittitur a natura, cuius est artis humanæ legibus imperare, non subiici."

[81] Ragayne de la Picottière 1665a, 3 § 3, 4 § 4, 11 § 39; and Ragayne de la Picottière 1665b, 5–6 § 14–15, § 19; commented in Roux 2017, 114.

> If it [the Cartesian hypothesis] differs in anything from the Copernican one, it adds to it a lot of absurd things of its own making and it shakes up an otherwise ingenious hypothesis. Certainly the Copernican hypothesis sins against the laws of Wisdom, but the Cartesian hypothesis sins much more seriously [against them], since it attributes everything to the power of God, so that it seems to leave nothing to his wisdom; the former depicts a world much greater by its mass than it was before, the latter makes it immense; the former forbids the graves to go down in a straight line, the latter orders them to go up, or at least to endeavor to do so. The Copernican glories in the simplicity of its motions, the Cartesian in their multiplicity, since it imparts an infinity of motions to infinitely infinite parts.... The Copernican, though not true, is nevertheless possible; the Cartesian is neither true nor possible.[82]

Similarly, the theses defended in 1667 and 1669 criticized Descartes' hypothesis for adding its own vices to those of the Copernican hypothesis.[83] In addition, for reasons that we will

[82] Lamoignon de Basville 1666, 17: "Si quid a Copernicæa differt, maxime quam absurda de suo multa conferat, et hypothesym cæteroquin ingeniosam labefacet. Peccat quidem contra Sapientiæ leges Copernicæa, sed multo gravius Cartesiana, quæ sic Dei potentiæ tribuit omnia, nihil ut sapientiæ videatur relinquere: mundum illa jam mole quam par era longe maiorem expresserat, hæc immensum exhibet: prohibet prima ne recta deorsum ferantur gravia; eadem sursum ire certe jubet altera. Gloriatur Copernicæa motuum simplicitate, multiplicitatem consectatur Cartesiana dum infinities infinitis partibus motus pariter infinitos imprimit…. Denique Copernicæa quamvis non vera, possibilis tamen est: Cartesiana nec vera, nec possibilis." See also Anonymous,1666, 15 § 6.

[83] Castagnere de Chasteauneuf 1667 (or Bolé de Champlay 1668), 4 § 3. For other criticisms, see idem, 5 § 5, 8 § 11, 9 § 11, and 11, § 16; Anonymous 1669, 8 § 5. While the other theses present one system after another, Castagnere de Chasteauneuf (1669) and Bolé de Champlay (1668) present one celestial phenomenon after another and, for each of them, compare the different systems.

not detail here, Louis XIV decided in 1671 to ban the public teaching of Descartes's philosophy, which resulted in what was sometimes called the persecution of Cartesianism.[84] In short, while Descartes and the Jesuits were playing a subtle game of intellectual seduction and mutual manipulation when Bourdin was professor at the *collège de Clermont*, Pardies made his students present his optics publicly at a time when there was an all-out-war between his order and the Cartesians.

2/ Pardies was not entirely unattuned to the Jesuit's wonderful optics that we were able to glimpse in the Lens of Faith. In 1665, Pardies wrote to Kircher that he admired his *Ars magna lucis et umbrae* (1645) so much that he had hung his portrait in his room and that, inspired by his anacamptic clocks, he had built a marvelous clock (*horologium thaumaticum*), which produced a rainbow while indicating the time in different places.[85] In 1666, he described for the *Journal des sçavans* two beautiful rainbows that he observed while traveling in the south of France.[86] Still, his main contribution was theoretical and, as we will now explain, his theory was a theory of light rather than a theory of sight. From the very first paragraph, Pardies' optics appears as a post-Keplerian optics: the light propagates in straight rays, which do not obstruct one another; when these rays reflect on opaque bodies, they detach the colors and transport them to the eye, which functions as a *camera obscura*, so that pictures of the bodies are reproduced upside down

[84] On the official condemnations of Cartesianism in France, see Roux 2019.

[85] Pardies to Kircher, 20 August 1665 and Pardies 1673a; and Ziggelaar 1971, 30–6.

[86] Pardies to Payen, 27 October 1666, in *Journal des sçavans*, 7 February 1667, 45–8.

on the retina, which is itself compared to a cloth.[87] Like Scheiner and Bourdin before him, Pardies adopts this Keplerian optics without sacrificing *species*:

> Certainly, there are *species* emitted by objects, but these cannot be distinguished from the rays themselves that reflect, intersect, and attain their term... Vision occurs through reception, not transmission. The *species*, once they have attained their term on the retina, determine the faculty of seeing by means of the small filaments of the optic nerve. Objects appear all the larger that their images on the retina are larger; vision is all the stronger that more rays penetrate the eye; it is all the more distinct that the rays coming from one point gather in a narrower area of the retina.[88]

While Jean-Baptiste Joseph-Ignace de Mesgrigny and Charles-Bénigne Hervé still devoted most of the sections on optics to vision a year earlier, Milon does not expand any further on vision, but focuses instead on the nature of light. He begins by refuting both the Epicureans' opinion that light is a body and Descartes' opinion that light is explained by a pressure (*contensio*) of the celestial matter which, from the sun and luminous bodies, would endeavor to move (*conari ad motum*) and, compressing the eye, determine the faculty of seeing to produce

[87] Milon 1671, 3 § 1–2.

[88] Milon 1671, 4 § 3: "[E]sse aliquas Species emissas ex objectis, quæ tamen non distinguantur ab ipsiis radiis reflexis, decussatis, terminatis.... Visionem fieri per receptionem, nullatenus per emissionem. Species terminatas in Retina determinare videndi facultatem ope tenuium nervi optici capillamentorum. Objecta tanto majora apparere quanto major est eorum in Retina imago: visionem eo fortiorem quo plures radii ad oculum penetrant: eo distinctiorem quo radii ex uno procedentes puncto magis ad se se accedentes colliguntur ad Retinam in angustiori loco."

sensation.[89] To attack the opinion of the Epicureans, whic include Gassendi, Pardies notes that Aristotle never approved of it. To counter the opinion of Descartes, he points out two of its unfortunate consequences: "According to this hypothesis, we would see the sun and luminous bodies even when we turn our backs to them or when we are locked in a room, and a ray of sunlight transmitted through a pore in a sheet of paper placed obliquely would refract towards the perpendicular."[90]

The first objection is that if, as the *Principia philosophiae* wants, light was a pressure propagating through an omnipresent subtle matter, this pressure would be transmitted through the corpuscles of subtle matter in the interstices of the walls or in the space behind us, so that we would see through the walls and behind our backs. The Cartesian hypothesis cannot account for the difference between opaque and transparent bodies, nor for the difference between what is in our field of vision and what is not.[91] The second objection is that, if, as the *Dioptrique* says, the propagation of light was comparable to the transmission of a ball, the refraction of a ray of light that passes from a less dense medium to a denser one, as is the case when it passes from air to a cloth, would cause its deviation towards the perpendicular (*ad perpendicularem*). However, it is the opposite which is actually true: the refraction of a ray of light passing from a less dense

[89] Pardies neatly summarizes the explanation of light proposed in Descartes 1964–1974, vol. VIII-1, 108 sqq. By comparison Lamoignon de Basville (1666) and Anonymous (1666, 3 § 2) are vague.

[90] Milon 1671, 4 § 4: "In ea hypothesi, solem lucidáque corpora etiam aversi aut intra cubiculum occlusi videremus; et radius solaris per foramen obliquè jacentis chartæ transmissus ad perpendicularem infringeretur."

[91] Other similar objections appear in Paradoxes 2 and 3, in Milon 1671, 7: light would be reflected as well by the earth or by a rough piece of wood, as by a mirror; the light of the Sun or of a burning torch would be as intense at large distances as at small ones.

medium to a denser medium does not cause its deviation towards the perpendicular, but its deviation away from the perpendicular (*a perpendiculari*).[92]

The hypothesis that light is a body being rejected, whether in its Cartesian version or in its Epicurean version, Milon puts forward with his own thesis, which is that light, being not a body, is a quality:

> We can perhaps form a conjecture about its production and propagation by comparison with sound: it is indeed quite rightly that the Sound has been called the Monkey of Light. It is evident that sound is produced, formed, and propagated by certain vibrations of the undulating air or of some other equivalent body; so that, the waves advancing from different places, when they make contact, go further and cross each other without hindering each other, and then, penetrating the organ of hearing, they excite sensations of sound which vary with the variety of the commotions or tremors of the air. Thus, it may be that light is excited, that it is propagated and that it affects the organ of vision by the numerous waves and frequent vibrations, not of the air, but of a more subtle substance.[93]

[92] This objection is also at the root of Paradox 12, in Milon 1671, 8. This is at the time a common criticism of Descartes 1964–1974, vol. VI, 93–105; it is for example to be found in Grimaldi 1665, prop. 19, 173–6. There might be an echo of this criticism in Anonymous (or Benard de Rezay) (1666, 6 § 10), which is identical to Lamoignon de Basville (1666, 6 § 11). Later on, it will be found in Pardies (1670, 86–7 § 37) and Ango (1682, book I, prop. 72, 85–8).

[93] Milon 1671, 5 § 5–6: "[C]onjecturam aliquam facere fortasse possumus ex comparatione ad sonum: jure enim optimo Luminis Simius appellatus Sonus est. Manifestum autem est sonum produci et formari et propagari per certas quasdam aëris undulantis aut alterius æquivalentis corporis vibrationes: adeo ut variæ ejusmodi undulationes ex varii locis procedentes contagione quodam ulterius procedentes, se se impunè trajiciant, ac deinde in aurem illapsæ organum auditus verberent, excitentque varios sonorum sensus pro varietate commotionum seu tremorum aëris. Ita

The four arguments given in favor of this conjecture are that: 1. Manifest experiments have shown the existence of a tenuous substance called ether.[94] 2. The reason why the Sun, fire and other luminous bodies excite the vibrations of this substance can be found.[95] 3. This conjecture can explain the phenomena of light, colors, and vision.[96] 4. Objections can be answered by referring to the example of sound.

The thesis booklet that André Duhamel and Étienne Roux defended in Bordeaux in 1669 ended with a section on pneumatics presenting the waves of sound caused by the vibrations of the air.[97] In Milon's Parisian thesis booklet, the notion of waves is extended to the analysis of light. This extension is introduced by the image of sound as the monkey of light, coming from Kircher's *Ars magna lucis et umbrae*, which, as was noted, Pardies read when he was in Bordeaux.[98] The analogy between sound and light being however frequent in the seventeenth century, one must compare Pardies with other authors to catch the twist that he gave to this

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fortasse posset ut lumen excitaretur et propagaretur organumque visus afficeret, per certas quasdam et crebras, non quidem aëris, sed subtilioris alicujus substantiæ undulationes et frequentes successiones."

[94] This is an allusion to the interpretation of the barometric experiments that were given in Jesuit colleges. In the case of the *collège de Clermont*, see Thierry 1648, 10–15 § 26–33; Truel de Cohon 1648, 10–15 § 33–44; and De Bourneuf 1650, 13 §§ 37–38. These are commented on by Collacciani and Roux 2017b, 103.

[95] This is what Milon (1671, 6 § 7) is about.

[96] This is what Milon, (1671, 6–7 § 8–9) is about. The theory of colors advanced here by Pardies is similar to the one that he developed in his teaching in Bordeaux, on which see Ziggelaar 1671, 177–9.

[97] Roux 1669, 9–10 § 53–60.

[98] This image first appears in Kircher 1671, lib. II, pars I, chap, Exp. 3, p. 102. Kircher (1673, lib. I, sect. I, cap. 1) begins with a whole section entitled "Praelusio I. Sonus lucis simia est."

analogy. [99] Mersenne uses it at the beginning of the *Harmonie universelle* (1636–1637), but he adopts the opposite intellectual approach to that of Pardies by assuming that light and its properties are known, to infer from this knowledge several statements about sound.[100] Like Mersenne, Bourdin goes from light to sound, not the other way around.[101] Last, but not least, Kircher's image means that sound imitates light, not the reverse, and it emerges in a part of the *Ars magna lucis et umbra* that intends to derive the radiation of sound from the radiation of light and to establish the new discipline of *echologia* or *photocamptica* that would extend the laws of reflection and refraction from light to sound.[102] In short, whereas Pardies' predecessors explained sound by light, Pardies' intention was to explain light by sound.

His key concept for that was the wave that, in all likelihood, he took up from Francesco-Maria Grimaldi, whom he mentioned in several occasions.[103] In his *Physico-mathesis de lumine, coloribus et iride* (Physico-mathematics on light, colors and rainbow, 1665), Grimaldi explained the phenomenon of diffraction, which he was the first to observe and to describe systematically, by the undulation (*undulatio*) of a fluid matter. For him, light is a fluid animated by a very fast motion, the undulation of light, an accidental phenomenon that occurs occasionally.[104] When

[99] On the analogy between light and sound in general, see Darrigol 2010.

[100] Mersenne 1636, book I prop. 1, p. 1–5. The main limitation of this analogy is that, for Mersenne, intentional species are necessary in the case of light, but not in the case of sound. See as well book I, prop. 25, p. 44–8.

[101] Potier 1640, 11 § 1, Villette 1651, 12 § 36.

[102] Kircher 1671, lib. II, pars I, cap. 6–7, p. 96–102.

[103] Pardies to Payen, 27 October 1666, in *Journal des sçavans*, 7 February 1667, p. 45; Bibliothèque municipale de Bordeaux, mss 934, f. 236v, Pardies to Newton, 21 May 1672, in Newton 1958, p. 97. Moreover, while it is known that Pardies, if he is not the author, at least got his hands on Rochon 1672, this work mentions Grimaldi (1665, 181).

[104] Grimaldi, 1665, prop. 2, p. 12.

light encounters the borders of a small aperture, it refracts and moves with a certain fluctuation (*flutuatio*); similarly, the modification of light that makes both real and permanent colors appear is determined by "a very subtly wrinkled undulation, like a tremor of diffusion, with a very subtle fluctuation" (*undulatio minutissime crispata, et quidam velut tremor diffusionis, cum certa fluitatione subtilissima*).[105] In the lengthy proposition that follows his explanation of colors, Grimaldi goes like Pardies from sound to light since he wishes to confirm his explanation by an analogy with sound.[106] But what was an accidental phenomenon for Grimaldi became in its elaboration by Pardies the unique hypothesis which explains all optical phenomena, sound constituting an operative analogy to understand light and the existence of subtle matter being established by the reinterpretation of barometric experiments that had been proposed in some of Bourdin's theses twenty years beforehand. Insofar as our aim is to stick to the 1671 thesis booklet, we will not reconstruct the wave optics of Pardies.[107] Rather, we would like to conclude our analysis of the 1671 thesis booklet with two remarks.

First, Pardies did not envision disputations only as occasions in which to make his students perform in front of an audience some exercises on elementary questions, but rather he saw them as opportunities to make known his own theories and to claim his identity as a member of the Republic of Letters. The scientific sophistication of his thesis booklets attests to this novel mode of employing theses. This transpires also from Pardies' references to his thesis booklets as if they were what we would today call his scientific publications, where the new concepts,

[105] Grimaldi 1665, prop. 22 and 43, p. 187–90 and p. 341–70.

[106] Grimaldi 1665, prop. 44, p. 370–95.

[107] Shapiro 1973, 209–44.

results, or methods that he formulated were for the first time made public.[108] Such use of thesis booklets as an exchange currency between scholars became even more pronounced when the *collège de Clermont* passed under royal patronage and became the *collège Louis-Le-Grand*: the mathematical thesis booklet of 1686 opens with a dedication of the mathematicians of *the collège de Clermont* to the members of the *Académie des Sciences*.

Secondly, this new way of putting thesis booklets to use makes it all the more surprising that, after having advanced his theory of light, Pardies took up an Aristotelian thread and tried to confirm this new conception of light by invoking Aristotle's authority.[109] Pardies recalled the two approaches to light that can be found in the Aristotelian corpus. On the one hand, *De Caelo* gives a physical explanation of the generation of light by making it the effect of the friction of the moving sun and the moving stars with a subtle air.[110] On the other hand, *De anima* presents qualitatively light as the *energeia*, that is to say, the effective act, of the transparent medium as such.[111] Without seeking to resolve the tensions that exist between these two approaches, Pardies sees in the first one a confirmation that the ether is the vehicle of light and in the second one the affirmation that light is not fire, but a fire endowed with efficient energy. Presumably, this amounts to identifying Aristotle's ether with subtle matter and the fire endowed with efficient

[108] Duhamel (1669) was sent to the *Académie des sciences* and examined by Huygens (Ziggelaar,1971, 17). In Pardies (1670, Preface, Sig. A4v), Pardies claimed: "… il y a déja trois ans que j'ai donné publiquement tout ce que je mets dans ce discours"; in his letter to Oldenburg, 13 January 1672, in Oldenburg 1965–1973, vol. VIII, 455, he wrote: "Il y a deja plusieurs années que j'ay enseigné publiquement tout cecy et mesme je l'ay imprimé dans des theses."

[109] Milon 1671, 6 § 7.

[110] *De Caelo* II, chap. 7, 289 a19.

[111] *De anima* II, chap. 7, 418b9-10.

energy with its undulating motion. This interpretation of Aristotle fully accepts the fundamental notions of Cartesian mechanics. Thus, if Pardies defends, against the Epicureans and against Descartes, the thesis that light is a quality, he understands by "quality" a motion of matter. If this interpretation is true, the objections that Pardies addresses to the Cartesian explanation of light assume a different meaning: for Pardies, Descartes failed to explain light according to the principles of his own mechanics because he limited himself to making it an *endeavor* to motion; only an undulating motion of subtle matter can give a proper mechanical explanation of light, that is, an explanation of light in terms of *motion*. Pardies criticizes Descartes for not having been Cartesian enough.

3/ Now it is clear why Pardies was accused of Cartesianism by his fellows Jesuits. Recall that this accusation, which began in 1670 while Pardies was still in Bordeaux, led him successively, and each time in vain, to protest of his innocence, that is, that he was not a Cartesian, first by adding some remarks to his *Discours du mouvement local* (1670), then by publishing a *Discours de la connaissance des bêtes* (1672), and, finally, by helping Antoine Rochon, another Jesuit who was also suspected of holding Cartesian opinions, to write the *Lettre d'un philosophe à un cartésien de ses amis* (1672).[112] In the biography they give of Pardies, the *Mémoires de Trévoux* summarize the situation very aptly: "He used to say, when he was accused

[112] See Ziggelaar (1971, 79–85) about the remarks that were added to the *Discours du mouvement local*, idem (95–7) about the contemporary perception of *Discours de la connaissance des bêtes* as a Cartesian work, idem (113–4) about the letters concerning Rochon and Pardies that the General of Jesuits Giovanni Paolo Oliva sent, and idem (118–20) about the contribution of Pardies to the *Lettre d'un philosophe*. Beaude (1976) criticized Ziggelaar (1971) for not having confronted more directly the problem of Pardies' crypto-cartesianism.

of being Cartesian, that no one had refuted Descartes more than he had; he was indeed telling the truth; but he was nevertheless suspected, and the suspicion was no less well-founded; for he was in fact following what everyone today takes from Cartesian physics...."[113]

The suspicion was well-founded from a social perspective in terms of how Pardies communicated his doctrines: just as Cartesians like Jean-Baptiste Denis or Jacques Rohault held open conferences for the public, so he invited his readers to attend his classes at the *collège de Clermont* to clarify the points of his books that remained obscure.[114] The suspicion was also well-founded from an intellectual perspective with regard to Pardies' doctrines. From his first published book on comets to his book on the souls of beasts, he had an ambivalent attitude: on the one hand, he was indeed criticizing some of Descartes' theses; on the other hand, he had so totally assimilated the fundamental lessons of the new philosophers that he was moving in a space of knowledge structured by their principles.[115] As we have shown, this was also the case in

[113] Trévoux 1726, 670.

[114] Le Gallois 1672, 59 and 66. Pardies 1670, "Avis à ceux qui veulent apprendre la geometrie," 1st ed. (1671), Sig. a13v: "Si l'on veut se donner la peine de venir au College de Clairmont, l'Auteur de ces Elemens les y expliquera publiquement après la S. Remy," 2nd ed. (1673), Sig. A18: "Si l'on veut se donner la peine de venir au College de Clermont, l'Auteur de ces Elemens continuera de les y expliquer publiquement les Lundis et les Vendredis." Denis 1682, 81: "ceux qui y trouveront quelque difficulté, pourront s'en éclaircir faciclement, en allant au College de Clermont; car le R.P. Pardies, qui y professe les mathematiques, prend la peine d'en expliquer toutes les Propositions, et de répondre aux objections qu'on luy forme sur cette Matiere [motion and the rules of percussion]." Pardies 1673a, Sig. A5r: "Ceux qui auront la curiosité d'apprendre à fond la Théorie et l'usage de ces Machines, pourront le faire aisément, s'ils veulent se donner la peine de venir au College de Clermont, où l'on en fera des entretiens publics, une fois la semaine, pendant quelque temps."

[115] Pardies (1672) analyzed in Roux (2013) and Pardies (1665a) analyzed in Roux (2017, 117–8).

the thesis booklet of 1671. He underlines certain weaknesses or inadequacies of the Cartesian explanation of light, but he does not question the Cartesian enterprise as such: optics being part of mechanics, to explain light is to show what motion of what matter accounts for it. While Bourdin preserved the structure of Aristotelian knowledge, Pardies overturned this structure by considering mechanics as the science of motion in general and this science of motion as the key to all physics.

There is a fundamental point here. As early as the theses of 1669, Pardies defined mechanics as "the science, which demonstrates by the first principles the production, conservation, communication, pressure, impulse, acceleration and extinction of local motion."[116] The definition of mechanics as a science of motion in general also opens the Preface of the *Discours du mouvement local*: "All the productions that come either from the industry of men or from the causes of nature, are made only by motion. Therefore, it is not possible to penetrate into the secrets of physics, nor to succeed in the invention and practice of the arts, without the help of mechanics, that is, without knowing the laws of motion."[117] But the most significant passage is the praise of mechanics that opens *La statique*:

> This treatise is a continuation of a *Discours du mouvement local*, which had already been published, with the intention of writing a whole mechanics and of putting in order all the science of motion. Those who know the way in which we proceed today in the

[116] Duhamel 1669, 3: "Mechanica vocetur scientia, quae motûs localis productionem, conservationem, communicationem, contensionem, impulsionem, accelerationem, extinctionem per prima principia demonstrat." Gabbey (1992, 311–4; and 2004, 22–3) emphasized this new definition of mechanics, that they found in Wallis (1670-1); in France, Poisson first made it explicit in his Preface to Descartes (1668, Sig. A2).

[117] Pardies 1670, Sig. A2.

consideration of nature, and in the practice of the arts, also know the advantages to be found in the knowledge of the laws of motion. And since it is certain that nothing is done in the arts without using mechanics, it must also be recognized that nothing can be explained in the particular effects of nature unless the demonstrations of this science are used. It is mechanics that prescribes the rules of ... architecture ... both civil and military. It is mechanics that builds ships and governs them. It constructs machines to lift the heaviest loads with ease. It regulates the conduct of the waters.... It animates the organs.... It makes rocks talk in artificial grottos where it imitates the singing of birds.... This is part of what mechanics does when it is employed by the artifice of men: but what does it not do, when it is employed by the industry of nature itself? Is it not mechanics which steadfastly consolidates the earth beneath our feet? Yes, it is it that rounds the surface of the sea and filters its waters through underground pipes, to bring out fountains and rivers; it is it that suspends the clouds in the air, that pushes them in various places by the wind and expresses the rain…; it is it that brings down heavy bodies, with that doubling of speed and that proportion which philosophers cannot sufficiently admire; it is it that gives the heavens a jolt and maintains them in such a regulated motion, it is it again that makes birds fly in the air, that makes fish swim in the water, and animals walk on the earth; it is by its means that the heartbeat, the circulation of blood, the distribution of spirits and breathing are performed, it is it that carries light and sound in circles on all sides.... In a word, nothing is done without it, neither in art nor in nature.[118]

[118] Pardies 1673b, Sig. a2r-a3v. This preface then continues to offer a history of mechanics which evokes Descartes' letter to Plempius for Fromondus, 3 October 1637, in Descartes (1964–1974, 420-1), and finally ends with a presentation of the mechanics in six books that Pardies had projected. While in 1669 he divided mechanics into

To paraphrase what Leibniz said of Honoré Fabri, with such a definition of mechanics, Pardies abandoned the heart of the Aristotelian citadel to the enemy even if he defended a few bastions.[119] The most direct proof of this is the return to the tradition carried out in the *Optique divisée en trois livres* that Pierre Ango (1640-1694), one of Pardies' successors at the *collège de Clermont*, published in 1682, the year when the *collège de Clermont* received the patronage of Louis XIV. While the body of *Optique divisée* relies heavily on the manuscripts that Pardies had left to develop an optical theory, Ango's introductory words are for re-establishing the traditional structure of knowledge. According to the conventional order of disciplines, Ango recalls a theory of light like that of Pardies is the work of a geometrician, not of a philosopher.[120] This reminder goes hand in hand with a criticism of the Cartesians that implies a recapture of the citadel: whereas Aristotle had distinguished between physics and mechanics, things and principles of things, "the so-called philosophers who have recently written about physics" have wrongly called "physics" these writings, whereas they are only "a heap of various treatises on natural mechanics." Moreover, they have been completely mistaken in reducing the real qualities to "a heap of different dusts variously stirred, depending on how their whim made them think they should be stirred."[121] Also in 1682, Antoine-Louis de la Forest defended a thesis which,

kinetics, statics, barytonics, ballistics, hydraulics and pneumatics (Roux, 1669), here he merged barytonics and ballistics on the one hand, hydraulics and pneumatics on the other, but added a part on librations and vibrations of pendulums and another part on waves of light and sound (Pardies 1673b, Sig. a6– 11r which is rehearsed in his letter to Oldenburg, 13 January 1672, in Oldenburg 1965–1973, vol. VIII, 452–5).

[119] Leibniz to Des Bosses, 2 February 1706, in Leibniz 1875–1890, vol. II, p294.

[120] Ango 1682, 2.

[121] Ango 1682, 3–4.

forgetting Pardies' new definition of mechanics, opened instead with the traditional definition of mechanics as the science of machines that make us lift great weights with small forces.[122]

Conclusion

We have chosen to focus on optics in order to study as systematically as possible the thesis booklets defended at the *collège de Clermont* from 1637 to 1682. The general conclusions we have reached are the following.

1/ Mathematics disputations, which were far from being supervised as strictly as philosophical disputations, vary greatly, whether in their form, in the subjects treated, in the capacity of the professors, or even in the doctrines that they defended. They constitute a richer material for social and intellectual history than had been assumed until now.

2/ As far as the Jesuits' relationship to the Cartesian natural philosophy is concerned, the mid-1660s brought about a rupture: before 1665, Descartes' natural philosophy could indeed be criticized, but this criticism remained moderate; after 1665, the Cartesian natural philosophers became the main enemies of the Jesuits, those with whom one should not make a pact under any circumstances. This rupture can be explained in various ways. From a political perspective, one cannot ignore the fact that Descartes's works were put on the Index of Prohibited Books in 1663, but there were also more local factors, like the confrontation that comets occasioned in 1665. From an intellectual perspective, the Jesuits blamed the Cartesians for not respecting the traditional division of disciplines: mathematical hypotheses and fictions should not be confused with physical theses that explain the true nature of things. Ironically enough, about twenty years later, this is what *mutatis mutandis* the Cartesians would blame the Newtonians for. The division

[122] La Forest 1682, 3 § 1.

of disciplines is obviously an important part of what we have called the Aristotelian structure of knowledge: it is not something that can be changed lightly in an educational or research institution.

3/ It was inevitable that some Jesuits would find themselves in a singular conundrum, as happened to Pardies. The paradox of Jesuit science was indeed that it aimed at defending tradition—the uniformity and solidity of doctrine—, while placing itself at the forefront of the new sciences. Seen from a little distance, there were two comfortable positions: the first one, illustrated by the Dominicans, was to reject completely the new sciences and to stick to the scholastic tradition; the second one, exemplified by the Royal Society and the *Académie des sciences*, was to reject the scholastic tradition and to move forward with the new sciences. Jesuits wanted to have their cake and eat it too: they placed themselves at the forefront of the new sciences, but they did so to control the sciences according to the requirements of tradition. As the case of Pardies shows, this might have turned into something like an impossible mission: to be on the forefront of scientific research implies, at one time or another, in one way or another, for one reason or another to stop being a scholastic.

Bibliography

1 Manuscripts

Cours de mathématiques, précédé d'un cours de théologie, 2 vols. [BnF (Paris), Latin 17861-17862].[123]

[123] Lecture notes by Paul Mercier of Bourdin's mathematics course at the Collège de Clermont in 1636–1638.

Cursus mathematicus : breviter, et clare figuris explicatus in gratiam eorum, qui mathesim volunt addiscere cito, ac facile [Bibliothek des Max-Planck-Instituts für Wissenschaftsgeschichte (Berlin), Rara B769c].[124]
Scientiæ contemplatricis thomus unus, quae est physiologia, sive de natura rerum corporearum... sub reverendo admodum Patre Pardies, illustrissimi Palensis senatus consiliarii filio, [Bibliothèque municipale (Bordeaux) Ms. 934].[125]

2 Mathematics theses defended at the Collège de Clermont (1637–1682)

1634–1653: Pierre Bourdin (1595–1653)[126]

Pallu and Touchelée 1635
4–5 June 1635, Jacques Pallu and Jacques Touchelée, *Deo hominique Jesu Christo eiusque matri Virgini Mariæ deiparæ Encyclopædiam mathematicam D.D.V. [sic] Jacobus Pallu. Jacobus Touchelée Turonenses*. *Iidem sedebunt propugnatores sua illius Encyclopedia pro annua celebritate Academiæ Regii Collegii Flexiensis Societatis Jesu*, La Flèche: Georges Griveau [Bibliothèque municipale (Lyon), Bibliothèque Mazarine (Paris)].[127]

Cornouaille and Manchon 1638
19–20 June 1638, Pierre de Cornouaille and Jacques Manchon, *Deo hominique Jesu Christo eiusque matri Virgini Mariæ deiparæ Musæum mathematicum, D.D.C. [Dicant, dedicant, consecrant] Petrus de Cornouaille, Sylvanectensis, Jacobus Manchon, Parisinus, pro annua celebritate literaria collegii Claromontani Societatis Jesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon), Bibliothèque Mazarine (Paris), BL (London)].

Bussey 1638
20 June 1638, Claude Bussey, *Encyclopædia mathematica Collegii Claromontani Parisiensis Societatis Jesu. Propugnator, Claudius Bussey* [Public Library (New York)]

Culant 1639
27 February 1639, Jacques de Culant, *Deiparæ Virgini Mariæ Propositiones ex optica et geometria militari, D.D.C. [Dicat, dedicat, consecrat] Jacobus de Cullant Molinensis…. Disputabuntur in aula mathematica collegii Claromontani Societatis Jesu*, s.l.s.n. [BnF (Paris),

[124] Lecture notes by an anonymous hand of Bourdin's course in mathematics.

[125] Lecture notes by doctor Raymond Dufour of a philosophy course held by Ignace–Gaston Pardies in Bordeaux in 1669.

[126] The names of the professors of mathematics who wrote the theses are not mentioned in the thesis booklets, but are known through the Jesuit archives. We follow the list given in Dainville 1954, p. 110–111.

[127] According to the dates we know, Bourdin had already left La Flèche for Paris when Pallu and Touchelée 1635 was defended, we include it as the earliest existing thesis booklet written by Bourdin.

Bibliothèque municipale (Lyon), Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].

Petit 1639
22 May 1639, Antoine Petit, *Deo Optimo Maximo mathematicæ Positiones. D.D.C. [Dicat, dedicat, consecrat] Antonius Petit, Meldensis…. Disputabuntur in aula mathematica collegii Claromontani Societatis Jesu*, s.l.s.n. [BnF (Paris)].

Henri 1639
9–10 July 1639, Yves Henri, *Augustæ cœli reginæ Mariæ Virgini Deiparæ ejusque integerrimo sponso D. Josepho Palatium mathematicum D.D.C. [Dicat, dedicat, consecrat] Yvo Henri Briocensis, pro annua celebritate literaria collegii Claromontani Societatis Jesu*, s.l.s.n [BnF (Paris), Bibliothèque municipale (Lyon), Bibliothèque Mazarine (Paris)].[128]

Potier 1640
30 June–1 July 1640, Charles Potier, *D.O.M. [Deo Optimo Maximo] Encyclopædia mathematica, ad agones panegyricos in Claromontano Parisiensis Societatis Jesu collegio. Agonista Carolus Potier Castrotheodoricus*, s.l.s.n. [Bibliothèque municipale (Auxerre), Bibliothèque municipale (Lyon), BSG (Paris), Bibliothèque centrale du conservatoire national des arts et métiers (Paris), Biblioteca nazionale centrale (Roma), BL (London)].

Gaillard 1640
25 November [1640], Pierre Gaillard, *Soli iustitiæ omnia intuenti oculo Theses mathematicæ de optica deque mirabili oculi oeconomia D.D.C. [Dicat, dedicat, consecrat] Petrus Gaillard disputabuntur in aula mathematica collegii Claromontani Societatis Jesu*, s.l.s.n. [BnF (Paris), Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].[129]

Despont 1642
5–6 July 1642, Philippe Despont, *A.M.D.G. [Ad maiorem Dei gloriam] Encyclopædia mathematica, ad agones panegyricos in Claromontano Parisiensis Societatis Jesu collegio.*

[128] Yves Henri is mentioned only in the BNF copy, which begins with a frontispiece in which the rectangles and circles are printed while the images inside them are drawn by hand. The Lyon copy includes printed figures of the three cosmological systems at the section "Stadium cosmographiæ," of optics and the physiology of the eye at the section "Gymnasium opticæ," and of military fortifications with the manuscript annotation "propugnaculum Le Bastion" at the section "Ænigma geometricomilitare."

[129] The BNF copy does not mention the year of the defense, the CNAM copy mentions neither the year nor the day. We argued that this exercise dates from 1640 in Collacciani and Roux 2017a, 55–6.

Agonista Philippus Despont Parisinus, s.l.s.n. [BnF (Paris), Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].[130]

de Vic 1643

20–21 June 1643, Dominique de Vic, *Agones mathematici in Claromontano Parisiensis Societatis Jesu collegio celebrandi. Dissertationes singulis agonibus præmittentur contra Galilæum*. *Agonista Dominicus de Vic Parisinus*, s.l.s.n. [Bibliothèque municipale (Lyon), BnF (Paris), BSG (Paris), Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].[131]

Gedoin 1644

2–3 July 1644, Louis Gedoin, *Agones mathematici in Claromontano Parisiensis Societatis Jesu collegio celebrandi cum Deo et B[eata] Virgini. Physico–mathematicæ prolusiones habebuntur…. Agonista Ludovicus Gedoin Parisinus*, s.l.s.n. [Bibliothèque centrale du conservatoire national des arts et métiers (Paris), Bibliothèque Mazarine (Paris)].

Foucquet 1646

9 and 11 June 1646, Yves Foucquet, *Exercitatio mathematica ad agones panegyricos. Cum Deo et Beata Virgini propugnator Yvo Foucquet, Parisinus, in Claromontano Parisiensis Societatis Jesu collegio*, s.l.s.n. [Bibliothèque centrale du conservatoire national des arts et métiers (Paris), Bibliothèque municipale (Lyon)].

Bouthier 1647

20–21 July 1647, Blaise Bouthier, *Æternæ memorie serenissimo Principis Henrici Bordoni Condæi Agones annuas D.D.C. [Dicat, dedicat, consecrat] mathematica Parisiensis collegii Claromontani Societatis Jesu. Propugnabit Deo duce et Virgine Blasius Bouthier, Parisinus*, s.l.s.n. [Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].

Thierry 1648

20–21 June 1648, Pierre Thierry, *Exercitatio mathematica ad agones panegyricos*. *Cum Deo et Virgine propugnator Petrus Thierry Parisinus, in Claromontano Parisiensis Societatis Jesu collegio*, s.l.s.n. [BnF (Paris), Bibliothèque centrale du conservatoire national des arts et métiers (Paris), Bibliothèque Mazarine (Paris)].[132]

Truel de Cohon 1648

[?] July 1648, Jacques Truel de Cohon, *Positiones ex universa mathematica selectæ. Has mathematicæ positiones cum Deo et B[eata] Virgine propugnabit Jacobus Truel de Cohon,*

[130] There are two copies at the Bibliothèque centrale du conservatoire national des arts et métiers, one of which does not mention the name of the defendant.

[131] The BSG copy does not mention the name of the defendant.

[132] According to the title-page, the disputation took place on 20 June only, but, according to the program, it took place on 20 and 21 June.

Alenconius in aula Claromontana Parisiensis, s.l.s.n. [Bibliothèque de l'Arsenal (Paris), BnF (Paris)].

de Bourneuf 1650

26–27 June 1650, Jean de Bourneuf, *Agones mathematici in Claromontano Parisiensis Societatis Jesu collegio celebrandi. Cum Deo et B[eata] Virgini propugnabit Johannes de Bourneuf, Juliodunensis*, s.l.s.n. [Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].

de la Villette 1651

1–2 July 1651, Pierre de la Villette, *Agones mathematici in Claromontano Parisiensis Societatis Jesu collegio celebrandi. Cum Deo et B[eata] Virgini propugnabit Petrus de la Villette, Mondiderinus*, s.l.s.n. [BSG (Paris), BL (London)].[133]

d'Herbelot 1651

1651, Edmond d'Herbelot, *Agones mathematici in Claromontano Collegio... propugnabit Edmundus d'Herbelot, Parisinus*, s.l.s.n. [Bibliothèque municipale (Grenoble)].[134]

1658–1661: Georges Faultrel (?–1687)

de Ruffec and Richomme 1655

3 July 1655, Hyacinthe de Ruffec and Jean Richomme, *Exercitatio mathematica ad agones panegyricos, Cum Deo et B[eata] Virgine propugnabunt Hyacinthus de Ruffec, Parisinus, Ioannes Richomme, Rothomagœus, in Collegio Claromontano Societatis Iesu,* s.l.s.n. [Bibliothèque municipale (Toulouse), Bibliothèque Mazarine (Paris), Bodleian Library (Oxford)].

1661–1664: Nicolas d'Harouys (1622–1698)

Lamoignon 1663

15 June 1663, Chrétien François de Lamoignon, *Agones mathematici ad arcem copernicani systematis, Expugnatam in Collegio Claromontano Societatis Iesu,* Paris, Antoine Vitré [Bibliothèque interuniversitaire de Santé (Paris), BnF (Paris), Bibliothèque municipale (Coutances), Bibliothèque municipale (Lyon), BSG (Paris), Bibliothèque Mazarine (Paris), BM

[133] De Bourneuf 1650 and de la Villette 1651 have an identical introductory page introduced by the title "Dissertatio generalis."

[134] Due to the Covid-19 pandemic we were not able to compare De la Villette 1651 and d'Herbelot 1651, but our suspicion is that they are identical..

Library (London), ETH Bibliothek (Zürich), HAB (Wolfenbüttel), Legion of Honor Museum (San Francisco), Stanford University Library (Stanford)].[135]

Le Meilleur 1663
30 June 1663, Joseph Le Meilleur, *Positiones mathematicæ de triplici sphæra, armillari, terrestri, cælesti, propugnabuntur in Collegio Claromontano societatis Iesu a Iosepho le Meilleur Venetensi,* Paris, Edmond Martin [Bibliothèque municipale (Amiens), Bibliothèque municipale (Lyon), Bibliothèque municipale (Toulouse)].

Anonymous 1664
4 July and 6 July 1664, *Positiones physico–mathematicæ, de magnetis subiecto, effectu, et usu, propugnabuntur in Collegio Claromontano Societatis Iesu,* Paris, Edmond Martin, [Bibliothèque municipale (Amiens), Bibliothèque municipale (Lyon), Bibliothèque municipale (Toulouse), Bibliothèque Mazarine (Paris), Biblioteca Nacional de Portugal (Lisboa), Houghton Library (Harvard)].

1665–1669: Michel Beaussier (?– ?)

Tarteron 1665
29 January 1665, Jérôme Tarteron, *De cometa ann. 1664 et 1665 observationes mathematicæ propugnabuntur ab Hyeronymo Tarteron, Parisino, in aula Collegi Claromontani Societatis Iesu*, Paris: Edmond Martin [BnF (Paris), Universiteitsbibliotheek (Ghent)].

Prou 1665a[136]
29 January 1665, Louis Prou, *De cometa ann. 1664 et 1665 observationes mathematicæ propugnabuntur a Ludovico Prou, Parisino, in aula Collegi Claromontani Societatis Iesu*, s.l.s.n. [Bibliothèque d'Amiens métropole (Amiens), Bibliothèque de l'observatoire (Paris)].

Ragayne de la Picottiere 1665a
12 June 1665, Louis Ragayne de la Picottiere, *De duplici cometa vero et ficto positiones mathematicæ, propugnabuntur a Ludovico Ragayne de la Picottière, Sagiensi, in Collegio Claromontano Societatis Iesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon), Biblioteca nazionale centrale (Roma), BL (London), Herzog–August–Bibliothek (Wolfenbüttel)].

Prou 1665b
12 June 1665, Louis Prou, *De duplici cometa vero et ficto positiones mathematicæ, propugnabuntur a Ludovico Prou, Parisino, in Collegio Claromontano Societatis Iesu*, s.l.s.n. [Bibliothèque municipale (Toulouse), BSG (Paris), Bibliothèque de l'observatoire (Paris)].[137]

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[135] According to the title-page, the disputation took place on 8 June 1663, but according to handwritten annotations in some copies, it took place on 15 June.

[136] Tarteron 1665 and Prou 1665a are identical.

[137] Ragayne de la Picottiere 1665a and Prou 1665b are identical.

Ragayne de la Picottiere 1665b
13–14 June 1665, Louis Ragayne de la Picottiere, *De hypothesi cartesiana positiones physicomathematicæ, propugnabuntur a Ludovico Ragayne de la Picottiere, Sagiensi, in Collegio Claromontano Societatis Jesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon), Bibliothèque du Centre Sèvres (Paris), Det Kongelige Bibliotek (Copenhagen)].

Prou 1665c
13–14 June 1665, Louis Prou, *De hypothesi cartesiana positiones physicomathematicæ, propugnabuntur a Ludovico Prou, Parisino, in Collegio Claromontano Societatis Jesu*, s.l.s.n. [BnF (Paris), BL (London), Biblioteca nazionale universitaria (Torino)].

Decombes 1665
[13–14 June] 1665, Jean Decombes, *De hypothesi cartesiana positiones physicomathematicæ, propugnabuntur a Joanne Decombes, in Collegio Claromontano Societatis Jesu*, s.l.s.n. [HAB (Wolfenbüttel)].

de la Bletonniere 1665
13–14 June 1665, Louis de la Bletonniere, *De hypothesi cartesiana positiones physicomathematicæ, propugnabuntur a Ludovico de La Bletonniere Burgundo, in Collegio Claromontano Societatis Jesu*, s.l.s.n. [BSG (Paris)].[138]

Anonymous 1666
2, 3 and 4 July 1666, *Ex optica selecta mathemata, cum Deo et B. Virgine explicabuntur ac propugnabuntur in Collegio Claromontano Societ. Iesu,* s.l.s.n. [Bibliothèque municipale (Lyon)].

Lamoignon de Basville 1666
10 July 1666, Nicolas de Lamoignon de Basville, *Ex optica et astronomia selecta mathemata, cum Deo et B. Virgine, explicabit ac propugnabit Nicolaus* de *Lamoignon de Basville, Parisinus in Collegio Claromont. Societat. Iesu,* s.l.s.n. [Bibliothèque d'Amiens métropole (Amiens), Bibliothèque municipale (Toulouse), BSG (Paris)].

de Maupeou 1666
23 July 1666, Pierre de Maupeou, *Ex optica et astronomia selecta mathemata cum Deo et B. Virgine, explicabit ac propugnabit Petrus de Maupeou parisinus, in Collegio Claromont. Societ. Jesu* [BnF (Paris), Bibliothèque d'Amiens métropole (Amiens), Bibliothèque Mazarine (Paris)].[139]

Benard de Rezay 1666

[138] Ragayne de la Picottiere 1665b, Prou 1665c, Decombes 1665, and de la Bletonniere 1665 are identical.

[139] Due to the Covid-19 pandemic we were not able to compare Anonymous 1666 and de Maupeou 1666, but our suspicion is that they are identical..

29 July 1666, Guillaume Benard de Rezay, *Ex optica et astronomia selecta mathemata, cum Deo et B. Virgine, explicabit ac propugnabit Guillelmus Benard de Rezay Parisinus, in Collegio Claromont. Societat. Iesu,* s.l.s.n. [Bibliothèque interuniversitaire de Santé (Paris), Bibliothèque centrale du conservatoire national des arts et métiers (Paris)].[140]

Castagnere de Chasteauneuf 1667

13 July 1667, Jean–Baptiste and Pierre–Antoine de Castagnere de Chasteauneuf, *De corporum cælestium motibus ac phænomenis iuxta varias hypotheses astronomicas et de architectura militari propositiones mathematicæ, Deo duce, favente Deipara, propugnabunt Ioannes Baptista, et Petrus Antonius de Castagnere de Chasteauneuf, Camberienses, in Collegio Claromontano Societatis Iesu*, s.l.s.n. [Bibliothèque municipale (Lyon), BSG (Paris)].

Anonymous 1667

July 1667, *De corporum cælestium motibus ac phænomenis iuxta varias hypotheses astronomicas et de architectura militari Propositiones mathematicæ,... propugnabuntur in Collegio Claromontano Societatis Jesu* [Bibliothèque municipale (Toulouse)]

Bolé de Champlay 1668

20 March 1668, Jules–Louis Bolé de Champlay, *De corporum cælestium motibus ac phænomenis iuxta varias hypotheses astronomicas et de architectura militari Propositiones mathematicæ, Deo duce, favente Deipara, propugnabit, Iulius Ludovicus Bolé de Champlay, Parisinus, in Collegio Claromontano Societatis Iesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon)].[141]

Anonymous 1668

16–17 June 1668, *Propositiones mathematicæ ex statica mechanica et architectura militari, Deo duce, favente Deipara, propugnabuntur in Collegio Claromontano Societatis Iesu*, s.l.s.n. [Bibliothèque municipale (Lyon)].

Colbert de Seignelay 1668

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[140] The section on optics is identical in Benard de Rezay 1666 and Lamoignon de Basville 1666, but the latter adds § 8. The section on optics in Anomymous 1666 and Lamoignon de Basville 1666 are identical, except that the latter omits § 8 and § 22, but adds § 29. The section on astronomy which is mentioned in the titles (*ex astronomica*) of Benard de Rezay 1666 and Lamoignon de Basville 1666 includes fairly similar comparisons of the systems of the world, but the later adds a section on eclipses [or: "on the eclipse"]. Anomymous 1666 does not include the comparison of the systems of the world present in Benard de Rezay 1666 and Lamoignon de Basville 1666, but includes the section on eclipses of Lamoignon de Basville 1666.

[141] Castagnere de Chasteauneuf 1667, Bole de Champlay 1668, and perhaps Anonymous 1667 are identical. Bole de Champlay originally bore the date “20 January” but this is corrected by hand to “20 March.”

30 August 1668, Jean–Baptiste Colbert de Seignelay, *Regi armis omnia expugnanti architecturam militarem sapientia omnia constituenti totius mundi constitutionem bellis pacisque arbitro bellatricem pacificamque mathesin consecrat Joannes Bapt[iste] Colbert de Seignelay, Parisinus,* s.l.s.n. [Sorbonne, BnF (Paris), Bibliothèque municipale (Lyon), Bibliothèque Mazarine (Paris)].[142]

Anonymous 1669
1–2 June 1669, *Positiones mathematicæ de calendario Romano, mundi systemate, antiquis ac novis sideribus et architectura militari, Deo duce, favente Deipara, propugnabuntur in Collegio Claromontano Societatis Iesu*, s.l.s.n. [Bibliothèque municipale (Lyon)].

de Mesgrigny 1670
14 June 1670, Jean–Baptiste Joseph–Ignace de Mesgrigny, *Positiones ex variis matheseos partibus, Deo duce, favente deipara propugnabit Johannes Baptista Josephius Ignatius de Mesgrigny, Aquensis, in Collegio Claromontano Societ. Jesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon)].[143]

Hervé 1670
27 June 1670, Charles–Bénigne Hervé, *Positiones ex variis matheseos partibus propugnabit Car. Benig. Hervé*, s.l.s.n. [Bibliothèque d'Amiens métropole (Amiens)].[144]

1670–1673: Ignace–Gaston Pardies (1636–1673)

Roux 1669
1669, Étienne Roux, *Theses mathematicæ et mechanicæ*, Bordeaux. [Universitaire Bibliotheken (Leiden)].[145]

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[142] The last page indicates that the thesis booklet was defended in August 1668: Renaudot, "Gazette du 1 Septembre 1668," in Renaudot 1669, 914, gives the precision that it was on 30 August, Colbert having defended his philosophy thesis on 29 August.

[143] The section on optics in Mesrigny (1670, p. 7–14) is borrowed from Anonymous (1666), its section on military architecture is borrowed from Anonymous (1668, 10–11, § 21–4), and from Anonymous (1669,14–15, § 3–6). The problems to be solved at the end of each paragraph are sometimes, but not always, different. A few developments of Anonymous (1666) do not figure in Mesrigny (1670), for example the condemnation of Descartes' subtle matter expressed in Anonymous (1666, 4, § 6).

[144] Due to the Covid-19 pandemic we were not able to compare De Mesgrigny 1670 and Hervé 1670, but our suspicion is that they are identical.

[145] As a manuscript note indicates, this copy was sent by Pardies to Huygens, through the intermediary of Galois.

Duhamel 1669
August 1669, André Duhamel, *Clarissimmo Viro Domino D.[omino] Carolo Duhamel […] Burdegalensis Societatis Jesu primitias offert et consecrat Andreas Duhamel, Burdegalensis. Theses mathematicæ. Has theses Deo duce atque auspice Maria propugnabit Andreas Duhamel in aula Collegii Burdegalis*, Bordeaux: s.n. [Bibliothèque municipale (Lyon)].[146]

Anonymous 1671a
19–20 June 1671, *Theses mathematicæ de optica propugnabuntur in Collegio Claromontano Societatis Iesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon)].

Milon 1671
6 July 1671, Alexandre Milon, *Theses mathematicæ de optica, propugnabuntur in Collegio Claromontano Societatis Iesu ab Alexandro Milon, Turonensi,* s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon), Bibliothèque Mazarine (Paris), King's College Library (London)].[147]

Anonymous 1671b
[1671 ?] *Theses de re militari*, s.l.s.n. [Bibliothèque municipale (Lyon), King's College Library (London)].[148]

Le Mazier 1672
24–26 June 1672, Louis le Mazier and al., *Theses mathematicæ de vario mundi systemate, Propugnabuntur in Collegio Claromonatno Societatis Jesu, Propugnatores Die XXIV Ludovicus le Mazier, Die XXV, Due e Societate Jesu, Die XXVI, unus a Societate Jesu*, s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon)].

1673–1676: Claude–François Millet de Chales (1621–1678)

Godley 1674
15–17 June 1674, Jean Godley and al., *Theses mathematicæ de hydrostatica, architectura militari, et astronomia, Has theses, Deo duce, et auspice Deipara, propugnabuntur in Collegio Claromontano Societatis Jesu*. (*Propugnatores : diebus Veneris XV et Sabbati XVI, duo e Societate Jesu, Die Dominica XVII Joannes Godley, Londinensis*) s.l.s.n. [BnF (Paris), Bibliothèque municipale (Lyon), Gottfried Wilhelm Leibniz Bibliothek (Hannover)].

de Geldrop 1674

[146] Roux 1669 and Duhamel 1669 are identical. According to the dates we know, Pardies was still in Bordeaux when these theses were defended. We include them here as the earliest known theses written by Pardies.

[147] Anonymous 1671a and Milon 1670 are identical.

[148] Anonymous 1671b has no title-page. The King's college copy is bound with Milon 1671. The same printing matrices were used.

20 July 1674, Embert de Geldrop, *Theses mathematicæ de hydrostatica, architectura militari, et astronomia, Has theses, Deo duce, et auspice Deipara, propugnabit Embertus de Geldrop, Mechliniensis, in Collegio Claromontano Societatis Jesu*, s.l.s.n. [Bibliothèque municipale (Lyon)].[149]

Anonymous 1675
5, 6 and 7 July 1675, *Theses mathematicæ de geometria practica, mechanica, statica, geographia, optica, Deo duce, et auspice Deipara, propugnabuntur In Collegio Claromontano Societatis Jesu,* Paris: Veuve Edmond Martin [BnF (Paris)].

Anonymous 1676
19, 20 and 21 June 1676, *Theses mathematicæ de hydrostatica, architectura militari, et astronomia propugnabuntur in Collegio Claromontano*. [Bibliothèque interuniversitaire Sorbonne (Paris), Bodleian Library (Oxford), BL (London)].[150]

1677–1682: Jean de Fontaney (1643–1710)

de La Hillière 1680
1680, François–Joseph de La Hillière, *Theses mathematicæ de architectura militari. Has theses tuebitur in Collegio Claromontano La Hillière.* [Public Library (New York)].

La Forest 1682
21 June 1682, Antoine–Louis de la Forest, *Theses mathematicæ de mechanica et hydrostatica, Propugnabuntur in Collegio Claromontano Societatis Jesu,* (*Has theses, Deo duce, et auspice Virgine, tuebitur Antonius Ludovicus de La Forest Constantinopolitanus*)*,* Paris: Gabriel Martin [BnF (Paris), Public Library (New York)].

3 Printed sources

Ango, Pierre 1682. *L'optique divisée en trois livres*. Paris: Michallet.

Bourdin, Pierre 1661. *Le Cours de mathématique contenant en cent figures une idée generale de toutes les parties de cette Science*. Paris: Sébastien Bernard.

[149] Godley 1674 and de Geldrop 1674 are identical.

[150] Anonymous 1676 and de Geldrop 1674 are identical except for one page added in the former (p. 6, "de meteororum æquilibrium").

———. 1641. *Le Cours de mathématique, representé par figures, et cartes, et clairement expliqué dans toutes ses parties, avec quantité de connoissances et pratiques nouvelles, Le tout en faveur de ceux qui veulent apprendre les mathematiques en peu de temps*. Paris: François Pelican.

———. 1645. *Le Cours de mathématique, representé par figures, et clairement expliqué, avec quantité de connoissances et pratiques nouvelles. Le tout en faveur de la Noblesse, et de ceux qui veulent apprendre en bref la Mathematique du temps rapportée à la Milice*. Paris: François Pelican.

Du Breuil, Jacques 1649. *Troisième et dernière partie de la perspective pratique où se voient les beautez et les Raretez de cette Science […] et les effets admirables des trois rayons. Droit, reflechi et brisé*. Paris: V^ve^ F. Langlois.

Brice, Germain 1685. *Description nouvelle de ce qu'il y a de plus remarquable dans la ville de Paris*. 2 vols., La Haye: Abraham Arondeus.

Cavalieri, Bonaventura 1635. *Geometria indivisibilibus continuorum nova quadam ratione promota*. Bologna: de Ducis.

———. 1647. *Exercitationes Geometricæ Sex*. Bologna: J. Monti.

Coret, Jacques 1662. *Theses propugnatæ a jesuitis, die 12. decembris an. 1661. In Collegio Claromontano Parisiens. In quarum decimâ nonâ appendice manifesta continetur hæresis qua fidei catholicæ fundamentum & Ecclesiæ gallicanæ doctrina concutiuntur*. [Paris]: s.n.

Denis, Jean–Baptiste 1682. *Mémoires, conférences et observations sur les arts et les sciences présentées à Monseigneur Le Dauphin*. 2nd ed., Paris: Laurent d'Houry.

a mis en forme : Italien

Descartes, René 1668. *Œuvres de Descartes*, Edited by Charles Adam and Paul Tannery, new presentation by Bernard Rochot and Pierre Costabel, 11 vols. Paris: Vrin, 1964–1974.

———. *Traité de la Mécanique, composé par Monsieur Descartes: de plus l'Abrégé de Musique du même auteur, mis en français avec les éclaircissements nécessaires par N. P. P. D. L.* [Nicolas Poisson], Paris: Charles Angot.

Forest–Duchesne, Nicolas 1650. *Florilegium universale liberalium artium et scientiarum, philologicum, mathematicum, philosophicum ac theologicum*. Paris: Lesselin.

Le Gallois, Pierre 1672. *Conversations de l'Académie de Monsieur l'abbé Bourdelot, contenant diverses recherches, observations, expériences et raisonnements de physique, médecine, chymie et mathématique. Le tout recueilli par le Sr Le Gallois. Et le parallèle de la physique d'Aristote et de celle de Mons. Descartes, leu dans ladite Académie*. Paris: Thomas Moette.

Garnier, Jean 1678. *Systema bibliothecae collegii parisiensis Societatis Jesu*. Paris: Sébastien Marbre-Cramoisy.

Gassendi, Pierre 1642. *De apparente magnitudine solis humilis et sublimis epistolæ quatuor, in quibus complura physica, opticaque problemata proponuntur, et explicantur*. Paris: Louis de Heuqueville.

Graindorge, André 1942. "Une page d'histoire des sciences. Vingt-deux lettres inédites d'André de Graindorge à P.-D. Huet," in Léon Tolmer (ed.), *Mémoires de l'Académie nationale des sciences, arts et belles-lettres de Caen. Nouvelle série. Tome X*. Caen: Charles Le Tendre, pp. 245–337.

Grimaldi, Francesco Maria 1665. *Physico-mathesis de lumine, coloribus et iride*. Bologna: V. Benatiis.

a mis en forme : Anglais (E.U.)

Guldin, Paul 1635–1641. De *centro gravitatis trium specierum quantitatis continuae*. Vienna: Formis Gregorii Gelbhaar.

Huygens, Christiaan 1888–1950. *Œuvres complètes de Christian Huygens*, ed. by Société Hollandaise des Sciences, 22 vols. La Haye: Martinus Nijhoff.

Niceron, Jean-François 1638. *Perspective curieuse ou Magie artificielle des effets merveilleux de l'Optique par la vision directe, de la Catoptrique, par la réflexion des miroirs plats, Cylindriques et Coniques, de la Dioptrique, par la refraction des Crystaux*, Paris: P. Billaine.

Kepler, Johannes 1604. *Ad Vitellionem Paralipomena Quibus Astronomiae Pars Optica Traditur*, Frankfurt: Claudius Manius et Haeredes Joanni Aubri.

Kircher, Athanasius 1671. *Ars Magna Lucis et Umbræ in decem libros digesta quibus admirandæ Lucis et Umbrae in mundo, atque adeo universa natura, vir effectusque uti nova, ita varia novorum reconditiorumque spcciminum exhibitione, ad varios mortalium usus, panduntur*, 2nd ed., Amsterdam: Janssonius a Waesberge Weyerstraet, (1st ed. 1645).

———. 1673 *Phonurgia nova sive Conjugium mechanico-physicum Artis et naturae Paranympha Phonosophia Concinnatum qua universa sonorum natura, proprietas, vires effectuumq prodigiosorum Causae.... Describitur*. Campidoniae: per Rudolphum Dreherr.

Leibniz, Gottfried Wilhelm1875–1890. *Die philosophischen Schriften*. Edited by Carl Immanuel Gerhardt, 7 vols. Berlin: A. Asher & Comp..

a mis en forme : Anglais (E.U.)

a mis en forme : Anglais (E.U.)

Leurochon, Jean 1622. *Selectæ propositiones in tota sparsim mathematica pulcherrimæ. Quas in solemni festo sanctorum Ignatii et Xaverii et anniversaria colegii Mussipontani celebritate literaria propugnabunt Mathematicarum auditores*. Pont-à-Moussson: S. Cramoisy.

———. 1629. *Selectæ propositiones in tota sparsim mathematica pulcherrimæ ad usum et exercitationem cerebrium academiarum. Propositiones arithmeticæ*, *Geometricae, Mechanicae, Cosmographicae, Musicae, Opticae*. Pont-à-Moussson: G. Bernard.

Lukács, Ladislao ed. 1986 *Ratio atque institutio sudiorum Societatis Iesu (1586 1591 1599)*, *Monumenta paedagogica Societatis Iesu*. Edited by Ladislao Lukács, vol. 5, Roma: Institutum historicum Societatis Iesu.

Mersenne, Marin 1634. *Questions inouyes, ou, Récréation des scavans : qui contiennent beaucoup de choses concernant la théologie, la philosophie, & les mathématiques*. Paris: Chez Iaques Villery.

Oldenburg, Henry 1965–1973. *The Correspondence of Henry Oldenburg*. Edited and translated by Alfred Rupert Hall and Marie Boas Hall, 9 vols. Madison–Wisconsin–London: University of Wisconsin Press.

Pardies, Ignace-Gaston 1665a. *Dissertatio de motu et natura cometarum*. Bordeaux: Pierre du Coq.

———. 1665b. *Remarques sur les comètes et autres phaenomènes extraordinaires de ce temps*. Bordeaux: G. de la Court.

———. 1670. *Discours sur le mouvement local*. Paris: Edme Martin.

a mis en forme : Français

a mis en forme : Anglais (E.U.)

———.1671. *Éléments de géométrie ou par une méthode courte et aisée l'on peut apprendre ce qu'il faut sçavoir d'Euclide, d'Archimede, d'Appollonius, et les plus belles inventions des anciens et des nouveaux géomètres*. Paris: Sebastien Mabre-Cramoisy.

———. 1672.*Discours de la connaissance des bêtes*. Paris: Sebastien Mabre-Cramoisy.

———. 1673a. *Deux machines propres à faire les cadrans avec très grande facilité decrites et expliquées par le P. Ignace Gaston Pardies de la Compagnie de Jésus*. Paris: Sebastien Mabre-Cramoisy.

———. 1673b. *La Statique ou la science des forces mouvantes*. Paris: Sebastien Mabre-Cramoisy.

Pascal, Blaise 1647. *Expériences nouvelles touchant le vuide : faites dans des tuyaux, syringues, soufflets & siphons de plusieurs longueurs & figures, avec diverses liqueurs, comme vif–argent, eau, vin, huyle, air, etc. avec un discours sur le mesme sujet*. Paris: Margat.

Petit, Pierre and Magni, Valeriano 1647. *Observation touchant le vuide, faite pour la première fois en France, contenue en une lettre écrite à Monsieur Chanut [...]Par Monsieur Petit intendant des fortifications, le 10 novembre 1646. Avec le discours qui en a esté imprimé Pologne sur le mesme sujet, en juillet 1647*. Paris: Sebastien Cramoisy et Gabriel Cramoisy.

Pierius, Jacques [1648]. *An detur vacuum in rerum natura*. Paris: n.d.

Platter, Felix 1583. *De corporis humani structura et usu.* [Basel]: Frober.

Plempius, Fortunatus Vospicus 1632. *Ophtalmographia, sive Tractatio De Oculi fabrica, actione, et usu praeter vulgatas hactenus Philosophorum ac Medicorum Opiniones*. Amsterdam: Henri Laurent.

Ramelli, Agostino 1588. *Le diverse et artificiose machine del Capitano Agostino Ramelli*. Paris: in casa de l'autore.

Renaudot, Théophraste 1669. *Recüeil des gazettes nouvelles ordinaires et extraordinaires. Relations et recits des choses avenues tant en ce Royaume qu'ailleurs, pendant l'année mil six cent soixante–huit*. Paris: Bureau d'Adresse.

Rochon, Antoine 1672. *Lettre d'un philosophe à un cartésien de ses amis*. Paris: Thomas Jolly.

Scheiner, Christoph 1619. *Oculus, hoc est: Fundamentum opticum: in quo ex accurata oculi anatome, abstrusarum experientiarum sedula pervestigatione, ex invisis specierum visibilium tam everso quam erecto situ spectaculis, nec non solidis rationum momentis, radius visualis eruitur.* Innsbruck: apud Danielem Agricolam.

Schott, Gaspar 1657. *Magia universalis naturae et artis*, *sive recondita naturalium & artificalium rerum scientia*. Würzburg: Henricus Pigrin.

Trévoux 1726. *Journal de Trévoux ou Mémoires pour l'histoire des sciences et des beaux–arts*. Trévoux: de l'imprimerie de S. A. S., Avril.

4 Secondary literature

Ariew, Roger 1995. *Pierre Bourdin and the Seventh Objections*. In Roger Ariew and Marjorie Greene eds. *Descartes and His Contemporaries: Meditations, Objections, and Replies*. . Chicago: University of Chicago Press, 208–225.

———. 1997. Critiques scolastiques de Descartes: le *cogito*. *Laval théologique et philosophique*, 53-3, 587–603.

———. 1999. *Descartes and the Last Scholastics*. Ithaca, N.Y: Cornell University Press.

———., 2013. *Censorship, Condemnations and the Spread of Cartesianism*. In Mihnea Dobre and Tammy Nyden eds., *Cartesian Empiricism*, Dordrecht-Heidelberg-New York-London: Springer, 25–46.

———. 2014.*Descartes and the First Cartesians*. Oxford: Oxford University Press.

Armogathe, Jean-Robert 1969. Dom Desgabets et Port–Royal. *Chroniques de Port–Royal*, 17, no. 18, 68–87.

———. 1977.*Theologia cartesiana: L'explication physique de l'eucharistie chez Descartes et Dom Robert Desgabets*. The Hague: Martinus Nijhoff.

Baker, Tawrin 2016. *Why All This Jelly? Jacopo Zabarella and Hieronymus Fabricius ab Aquapendente on the Usefulness of the Vitreous Humor.* In Peter Distelzweig, Benjamin Goldberg, Evan Ragland eds., *Early Modern Medicine and Natural Philosophy,* Dordrecht: Springer, 59–90.

Beaude, Joseph 1976. Sur le cartésianisme d'Ignace-Gaston Pardies. A propos de l'ouvrage du Père A. Ziggelaar. *Revue d'histoire des sciences*, 29-3, 261–67.

Bessot, Didier 2005. Synthèse et développement de techniques d'anamorphoses au XVII^{e} siècle: les traités du père Jean-François Niceron. *Mélanges de l'École française de Rome. Italie et Méditerranée*, 117-1, 91–129.

Bigourdan, Guillaume 1918. La station astronomique du Collège de Clermont (première période) et la mission astronomique de Siam. *Comptes rendus hebdomadaires des séances de l'Académie des sciences,* 166, 833–40 and 871–5.

Bonelli, Maria Luisa 1959. *Una lettera di Evangelista Torricelli a Jean-François Niceron.* In *Convegno di studi Torricelliani in occasione del 350o anniversario della nascita di Evangelista Torricelli (19–20 ottobre 1958)*. Faenza: Fratelli Lega, 37–41.

Brockliss, Laurence 1981. Aristotle, Descartes and the New Science: Natural Philosophy at the University of Paris 1600–1740. *Annals of Science* 38, 33–69.

———. 2002. *Harvey, Torricelli and the institutionalization of new ideas in seventeenth–century France*. In Wolfgang Detel and Claus Zittel eds., *Wissensideale und Wissenskulturen in der Frühen Neuzeit Ideals and Cultures of Knowledge in Early Modern Europe*. Berlin: Walter de Gruyter, 115–34.

———. 2006. The Moment of No Return: The University of Paris and the Death of Aristotelianism. *Science and Education* 15, 259–78.

Chabaud, Gilles 1994. *Sciences en jeux: les récréations mathématiques et physiques en France du XVII^e^ au XVIII^e^ siècle*. Unpublished PhD, EHESS,.

Colie, Rosalie L. 1966. *Paradoxia epidemica. The Renaissance tradition of Paradox*. Princeton: Princeton University Press,.

Collacciani, Domenico and Roux, Sophie 2017a. *La querelle optique de Bourdin et de Descartes à la lumière des thèses mathématiques soutenues au collège de Clermont*. In Antonella Del Prete and Raffaele Carbone eds. *Chemins du cartésianisme*. Paris: Garnier.

———. 2017b. Pierre Bourdin, anti–cartésien ou jésuite ordinaire?. *Historia Philosophica*, pp. 89–113.

Compère, Marie-Madeleine and Julia, Dominique 1984–2002. *Les collèges français (XVII^e^—XVII^e^ siècles), Répertoire*, 3 vols. Paris: INRP/Éditions du CNRS.

Cosentino, Giuseppe 1970. Le matematiche nella *Ratio studiorum* della Compagnia di Gesù. *Miscellanea storica ligure*, 169–213.

De Dainville, François 1954. L'enseignement des mathématiques dans les Collèges jésuites de France du XVI^e^ au XVIII^e^ siècle. *Revue d'histoire des sciences*, 7–1, 6–21 and 7–2, 109–123.

Darrigol, Olivier 2010a. The Analogy between Light and Sound in the History of Optics from the ancient Greeks to Isaac Newton. *Centaurus*, 52-2, 117–155.

———. 2010b. The Analogy between Light and Sound in the History of Optics from the ancient Greeks to Isaac Newton. Part 2. *Centaurus*, 52-3, 206–57.

De Bruycker, Angelo 2009. To the adornment and honour of the city': the mathematics course of the Flemish Jesuits in the seventeenth century. *British Society for the History of Mathematics Bulletin* 24,135–46.

De Lucca, Denis 2012. *Jesuits and Fortifications: The Contribution of the Jesuits to Military Architecture in the Baroque Age*. Leiden-Boston: Brill Academic Publishers.

Dhombres, Jean and Radelet deGrave, Patricia 2009. *Une mécanique donnée à voir. Les thèses illustrées défendues à Louvain en juillet 1624 par Grégoire de Saint-Vincent S.J.* Turnhout: Brepols.

Le Dividich, Aude 1996. *L'enseignement des mathématiques en France (1600–1670)*, *Unpublished PhD.* École des Chartes.

———. 2003 Afficher, distribuer : usages éphémères de l'imprimé dans l'enseignement des sciences mathématiques en France au XVII^e^ siècle. *Revue de la Bibiothèque nationale de France* 14, 56–63.

Dupont-Ferrier, Gustave 1921–1925. *Du collège de Clermont au lycée Louis-le-Grand,* 2 vols. Paris: De Boccard.

Gabbey, Alan 1992. *Newton's Mathematical Principles of Natural Philosophy: A Treatise in Mechanics?* In Peter M. Harman and Alan E. Shapiro eds., *The Investigation of Difficult Things: Essays on Newton and the History of Exact Sciences in Honour of D.T. Whiteside*. Cambridge: Cambridge University Press, 305–22.

———. 2004. *What was 'Mechanical' about 'The Mechanical Philosophy'?* In Carla Rita Palmerino and J.M.M.H. Thijssen eds., *The Reception of the Galilean Science of Motion in Seventeenth-Century Europe*. Dordrecht: Springer, 11–24.

Gal, Ofer and Chen-Morris, Raz 2010. Baroque Optics and the Disappearance of the Observer: From Kepler's *Optics* to Descartes' Doubt. *Journal of the History of Ideas*, 71-2, 191–217.

Galluzzi, Paolo 1993. "Gassendi e l'affaire Galilée delle leggi del moto." *Giornale Critico Della Filosofia Italiana* 72, 86–119.

Gatto, Romano 1994. *Tra scienza e immaginazione. Le matematiche presso il collegio gesuitico napoletano (1552–1670 ca.)*. Florence: Olschki.

Hellyer, Marcus 2005. *Catholic Physics: Jesuit Natural Philosophy in Early Modern Germany*. Notre-Dame: University of Notre Dame Press.

Hunt, James L. and Sharp, John 2011. The refractive anamorphic viewer of J.-F. Niceron: Reconstructing a 17th century optical toy. *American Journal of Physics* 79, 2023–9.

Jones, Phillip S 1947. The Identity of the Author of a Hitherto Anonymous Work." *Scripta Mathematica*, 13, 119–20.

Jourdain, Charles 1862–1866. *Histoire de l'université de Paris aux XVII^e^ et XVIII^e^ siècles*. Paris: Hachette.

Klein, Boris 2017. *Les chaires et l'esprit. Organisation et transmission des savoirs au sein d'une université germanique au XVII^e^ siècle*. Lyon: Presses universitaires de Lyon.

Leinsle, Ulrich 2006. *Dilinganae Disputationes. Der Lehrinhalt der gedruckten Disputationen an der Philosophischen Fakultät der Universität Dillingen 1555–1648*. Regensburg: Schnell & Steiner.

Lerner, Michel-Pierre 2001. *La réception de la condamnation de Galilée en France au XVII^e^ siècle*. In José Montesinos and Carlos Solís Santos eds*. Largo Campo di Filosofare. Eurosymposium Galileo 2001*. La Orotava: Fundación Canaria Orotava de Historia de la Ciencia, 513–48.

Lüthy, Christoph 2006. *Where Logical Necessity Becomes Visual Persuasion: Descartes' Clear and Distinct Illustrations.* In Ian Maclean and Sachiko Kusukawa eds. *Transmitting Knowledge: Words, Images and Instruments in Early Modern Europe*. Oxford: Oxford University Press, 97–133.

Malcolm, Noel 1998. The Title Page of *Leviathan* Seen in a Curious Perspective. *The Seventeenth Century*, 13, 124–55.

Matton, Sylvain 2018. De Pierre Bourdin à Olivier Heroult: Descartes dans les collèges au XVII^e^ siècle. *Kritikon Litterarum*, 45, 194–223.

Meyer, Véronique 1993. "Les thèses, leurs soutenances et leurs illustrations dans les universités françaises sous l'Ancien Régime." *Revue de la Sorbonne*, 12, 43–111.

———. 2002. *L'illustration des thèses à Paris dans la seconde moitié du XVII^e^ siècle*. Paris: Paris-Musées.

———. 2017. *Pour la plus grande gloire du roi. Louis XIV en thèse*. Rennes: Presse universitaires de Rennes.

Mouy, Paul 1934. *Le développement de la physique cartésienne*. Paris: Vrin.

D'Orgeix, Émilie 2005. *Fortification et perspective militaire au XVII^e siècle en France.* In Mario Carpo and Frédérique Lemerle eds. *Perspective, projections, projet. Technologies de la représentation architecturale, Les Cahiers de la recherche architecturale et urbaine*, 17, pp. 91–105.

Raphael, Renée 2017. *Reading Galileo: Scribal technologies and the Two New Sciences*. Baltimore: Johns Hopkins University Press.

Rice, Louise 1999. *Jesuit Thesis Prints and the Festive Academic Defence at the Collegio Romano.* In John W. O'Malley, Gauvin Alexander Bailey, Steven J. Harris, and T. Frannk Kennedy eds. *The Jesuits: Cultures, Sciences, and the Arts, 1540–1773*. Toronto: University of Toronto Press, 148–69.

———. 2007a. Apes philosophicae: *Bees and the Divine Design in Barberini Thesis Prints*. In Lorenza Mochi Onori et al. eds. *I Barberini e la cultura europea del Seicento. Atti del convegno internazionale (Roma 7–11 dicembre 2004)*. Roma: De Luca, 181–94.

———. 2007b. POMIS SUA NOMINA SERVANT: The Emblematic Thesis Prints of the Roman Seminary. *Journal of the Warburg and Courtauld Institutes* 70, 195–246.

De Rochemonteix, Camille 1889. *Un collège de Jésuites aux XVII^e et XVIII^e siècles: Le Collège Henri IV de La Flèche*, 4 vols. Le Mans: Leguicheux.

Righini-Bonelli, M. L. 1976. *Il Museo di Storia della scienza a Firenze*. Milano: Electa.

Romano, Antonella 1999. *La Contre–réforme mathématique*. Rome: École française de Rome.

———. 2006. *Teaching Mathematics in Jesuits Schools. Programs, Course, Content, and Classroom Practices*. In John W. O'Malley, Gauvin Alexander Bailey, Steven J. Harris, T. Frank Kennedy eds. *The Jesuits II: Cultures, Sciences and the Arts, 1540–1773*. Toronto: University of Toronto Press, 355–70.

Roux, Sophie 2013a. *A French Partition of the Empire of Natural Philosophy (1670–1690)*. In Daniel Garber and Sophie Roux eds., *The Mechanization of Natural Philosophy*. New York, Dordrecht, Boston, London: Kluwer Academic Publishers, 55–98.

———. 2013b *Pour une conception polémique du cartésianisme. Ignace–Gaston Pardies et Antoine Dilly dans la querelle de l'âme des bêtes.* In Delphine Kolesnik ed., *Qu'est–ce qu'être cartésien?* Lyon: ENS Éditions, 315–37.

———. 2017. *The Two Comets of 1664–1665: A Dispersive Prism For French Natural Philosophy Principles*. In Peter Anstey ed., *The Idea of Principles in Early Modern Thought*. New York and London: Routledge, 98–146.

———. 2019. *The Condemnations of Cartesian Natural Philosophy under Louis XIV (1661–1691)*. In Delphine Antoine-Mahut, Steven Nadler, and Tad Schmaltz eds., *Oxford Handbook to Descartes and Cartesianism*. Oxford: Oxford University Press, 755–79.

Truci, Isabella 1976. Le Anamorfosi di Jean François Niceron all'Istituto e Muso di Storia della Scienza di Firenze. *Annali dell'Istituto e Museo di storia della scienza di Firenze* 1, 57–64.

Sabra, Abdulhamid I. 1981. *Theories of Light from Descartes to Newton*. Cambridge: Cambridge University Press.

Shapiro, Alan E. 1973. Kinematic Optics: A Study of the Wave Theory of Light in the Seventeenth Century. *Archive for History of Exact Sciences* 11 2–3, 134–266.

———. 2008. Images: Real and Virtual, Projected and Perceived, from Kepler to Dechales. *Early Science and Medicine* 13, 3,270–312.

Simon, Gérard 1988. *Le Regard, l'être, l'apparence dans l'optique de l'Antiquité.* Paris: Seuil.

———. 2019. *Kepler, rénovateur de l'optique*. Edited by Delphine Bellis and Nicolas Roudet. Paris: Classiques Garnier.

Smith, A. Mark. 2015. *From Sight to Light. The Passage from Ancient to Modern Optics*. Chicago: University of Chicago Press.

Pantin, Isabelle 2008. "Simulacrum, Species, Forma, Imago: What Was Transported by Light into the Camera Obscura?" *Early Science and Medicine* 13, 245–69.

Vanpaemel, Geert 2008. *Mechanics and Mechanical Philosophy in Some Jesuit Mathematical Textbooks of the Early 17th Century*. In Walter Roy Laird and Sophie Roux eds., *Mechanics and Natural Philosophy before the Scientific Revolution*. New York: Kluwer Academic Publishers, 259–74.

Ziggelaar, August 1971. *Le physicien Ignace-Gaston Pardies S.J. (1636–1673)*. Odensee: Odensee University Press.

Zittel, Claus 2009. *Theatrum philosophicum. Descartes und die Rolle ästhetischer Formen in der Wissenschaft*. Berlin: Akademie-Verlag.

———. 2011. *Conflicting Pictures: Illustrating Descartes'* Traité de l'homme."In Sven Dupré and Christoph Lüthy *Silent Messengers. The Circulation of Material Objects of Knowledge in the Early Modern Low Countries.* Berlin: Lit-Verlag, 217–60.

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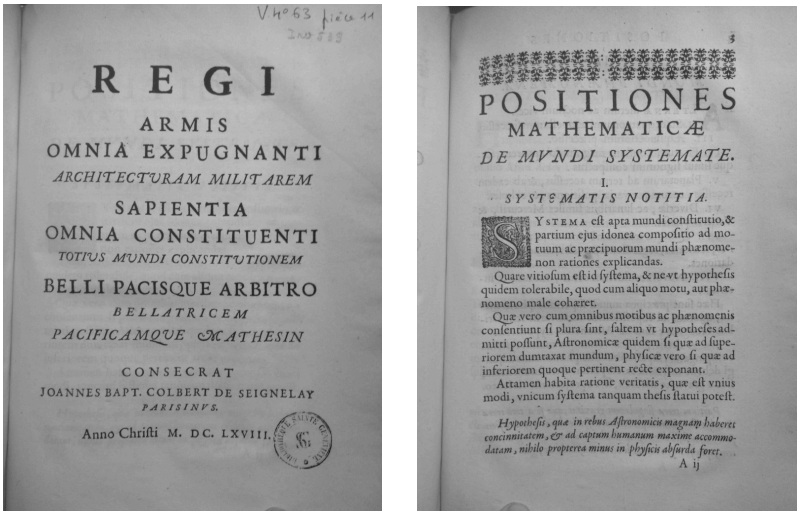

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BELLATRICEM
PACIFICAMQUE MATHESIN

CONSECRAT
JOANNES BAPT. COLBERT DE SEIGNELAY
PARISINVS.

Anno Christi M. DC. LXVIII.

3

POSITIONES
MATHEMATICÆ
DE MVNDI SYSTEMATE.

I.
SYSTEMATIS NOTITIA.

SYSTEMA est apta mundi constitutio, & partium ejus idonea compositio ad motuum ac præcipuorum mundi phænomenon rationes explicandas.

Quare vitiosum est id systema, & ne vt hypothesis quidem tolerabile, quod cum aliquo motu, aut phænomeno male cohæret.

Quæ vero cum omnibus motibus ac phænomenis consentiunt si plura sint, saltem vt hypotheses admitti possunt, Astronomicæ quidem si quæ ad superiorem dumtaxat mundum, physicæ vero si quæ ad inferiorem quoque pertinent recte exponant.

Attamen habita ratione veritatis, quæ est vnius modi, vnicum systema tanquam thesis statui potest.

Hypothesi, quæ in rebus Astronomicis magnam haberet concinnitatem, & ad captum humanum maxime accommodatam, nihilo propterea minus in physicis absurda foret.

A ij

Figure 1: the front page and the first page of Colbert's mathematics thesis booklet in-4 (30 August 1668). Bibliothèque Sainte-Geneviève (Paris).

Source gallica.bnf.fr / Bibliothèque nationale de France

Figure 2: Colbert's philosophy thesis print (29 August 1668, 103 x 76 cm. The King, descending from a chariot driven by Mercury and surrounded by allegorical figures representing the arts and sciences, is brought by Minerva to the list of theses to be defended. BnF (Paris), département Estampes et photographie.

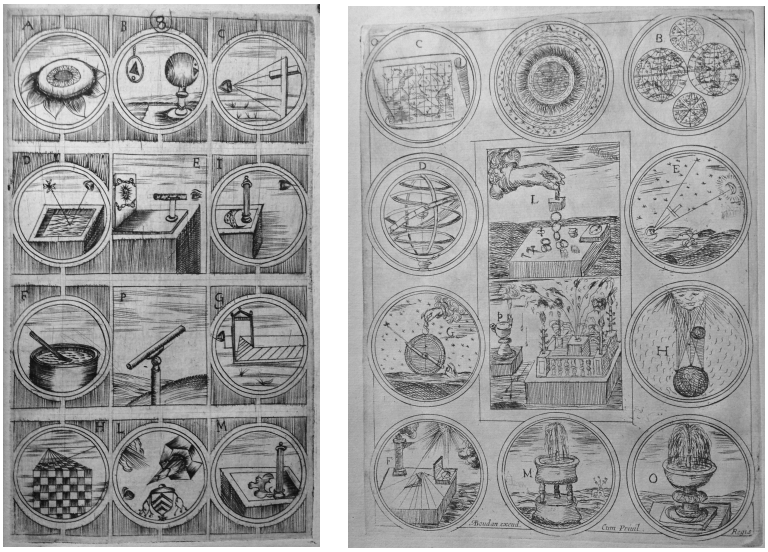

Figure 3: Potier, 1640, in-4, Bibliothèque Sainte-Geneviève, Paris, cliché N. Boutrous. While the right plate presents a variety of topics (astronomical observations, magnetic phenomena, geographical maps, and fountains), the left plate is entirely devoted to optical phenomena: anatomy and physiology of the eye (A, B, C), reflection (D), refraction (F), laws of perspective (G, H), anamorphosis (E, L, M), and, at the center, the *specillum* (O) which is put in parallel with Galileo's telescope (P).

Figure 4: Henri, 1639, in-4, BnF (Paris), département Littératures et art. This is the only copy that includes this frontispiece in which the rectangles and circles are printed while the images inside them are drawn by hand. It is entirely devoted to optical transformations; the three pictures in the top cartouches represent the *specillum*.

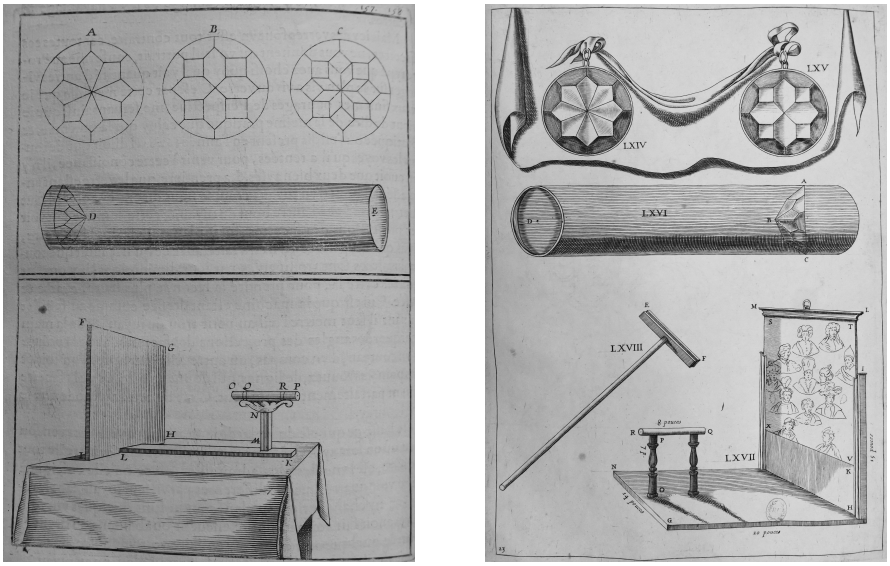

Figure 5: The optical device according to du Breuil, 1649, 157, in-4 (left, Bibliothèque Sainte-Geneviève, Paris, cliché N. Boutrous) and to Niceron, 1638, in fol., plate 23 (right, Bibliothèque de l'Institut National d'Histoire de l'Art, Collections Jacques Doucet, 4 RES 876).

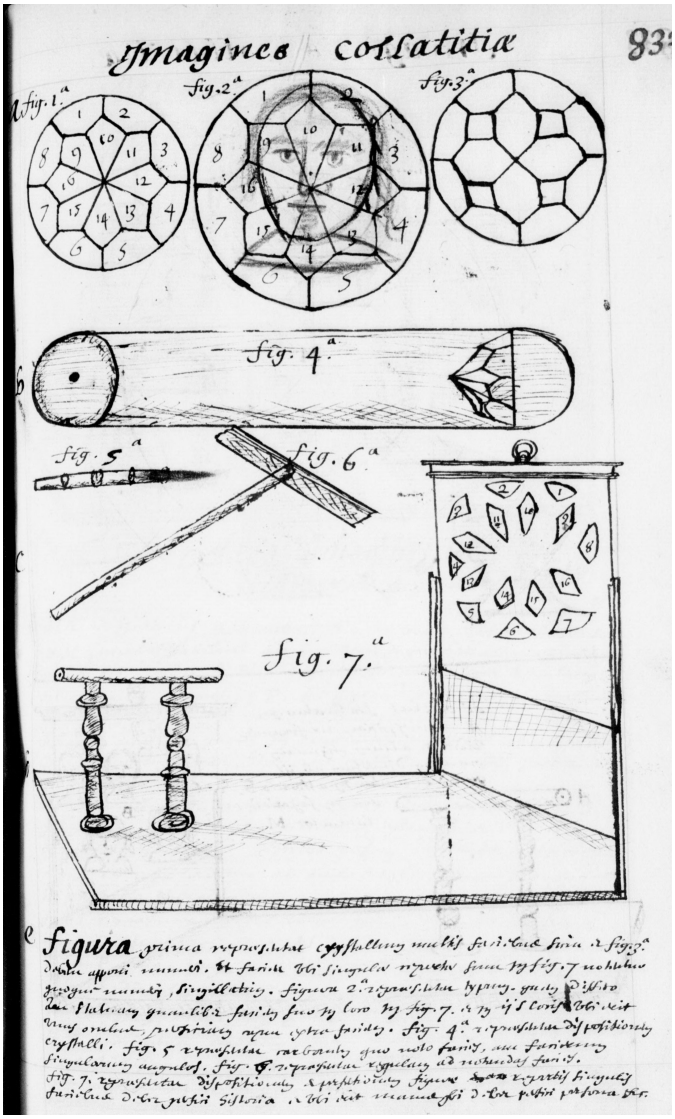

Figure 6: A drawing explaining the *specillum* in BnF (Paris), Département des manuscrits, Ms Lat. 17862, f. 932, in-4.

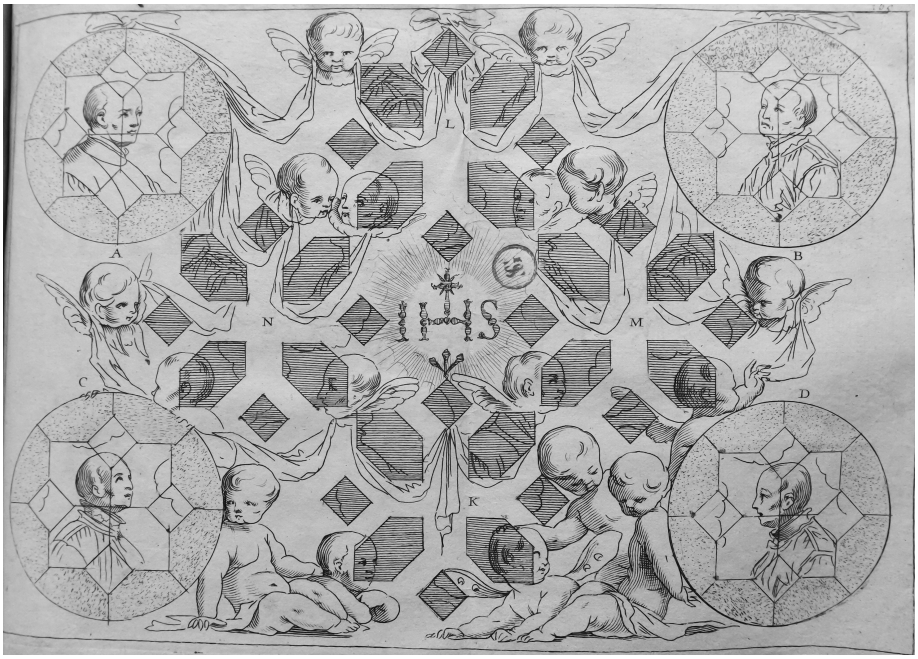

Figure 7: Portraits of Ignatius and other saints hidden in a representation of angels and cherubs visible through the *specillum* according to du Breuil 1649, 166, in-4, Bibliothèque Sainte-Geneviève, Paris, cliché N. Boutrous.

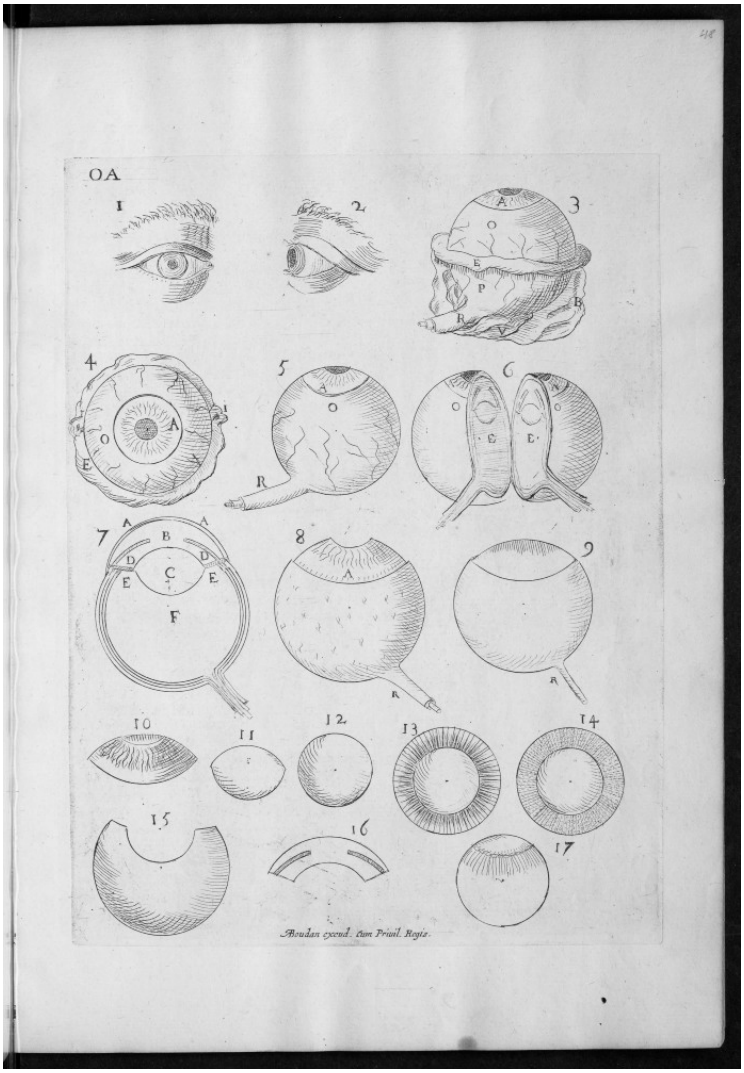

Figure 8: The engraving “Oculus,” in-4. BnF, Département des manuscrits, Ms. Lat. 17861, f. 896; Cornouaille and Manchon, 1638, 15; Henri, 1639, Bibliothèque Municipale de Lyon, [n.p.]; Gaillard, 1640, [5].

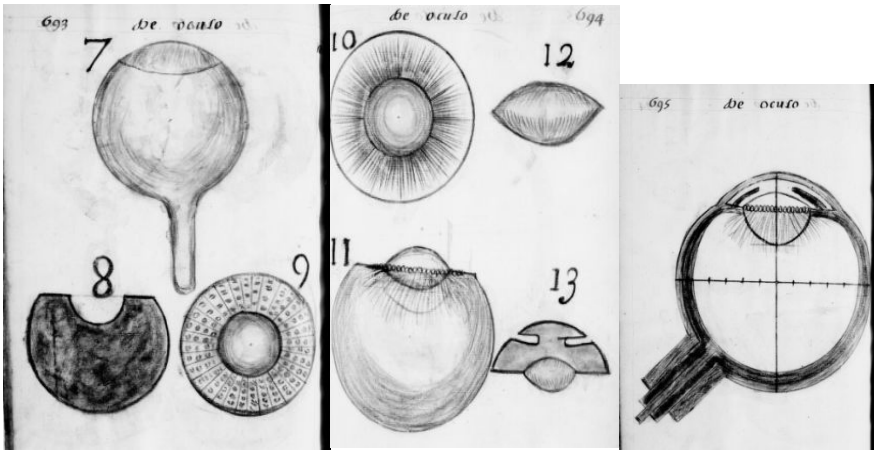

Figure 9: Some of the corresponding drawings in BnF, Département des manuscrits, Ms. Lat. 17862, f. 693–5. The drawing that shows the inclination of the optical nerve (right) is copied from Scheiner (Figure 11, left).

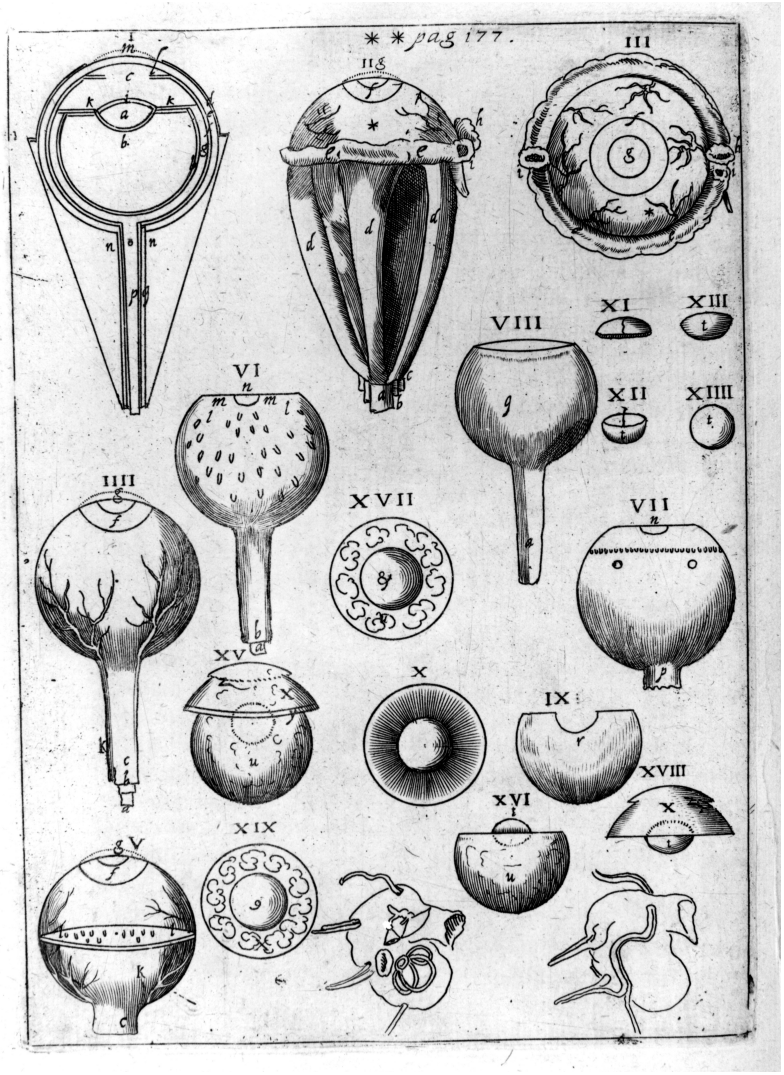

Figure 10: Platter, 1583, tab. 49, as reprinted in Kepler, 1604, 177 (public domain from commons.wikimedia.org).

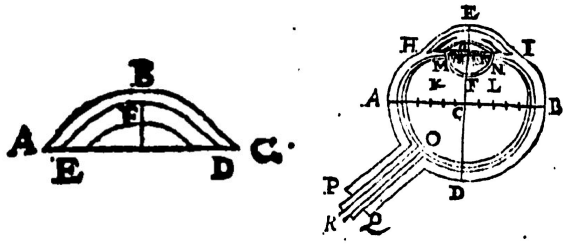

Figure 11: Scheiner, 1619, 14 (the aqueous humor EFD between the crystalline and the vitreous humor) and 17 (the eye with its inclined optical nerve).

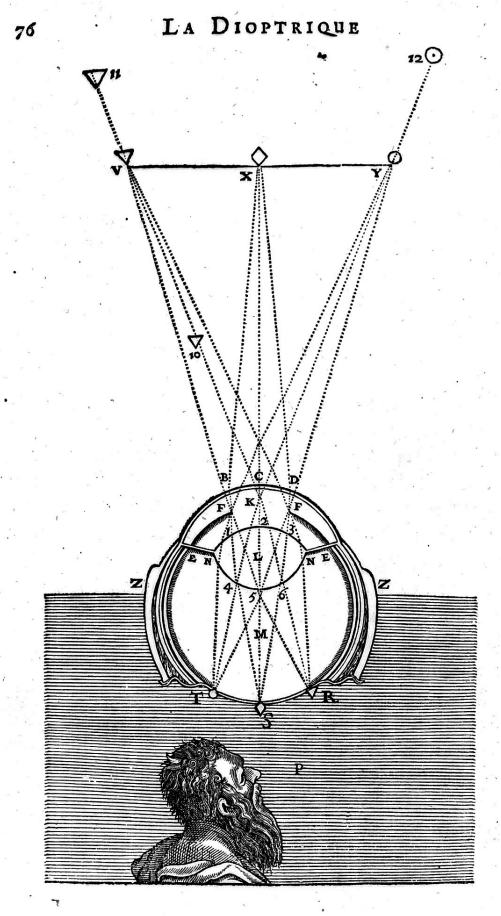

Figure 12: Graphical conventions of Descartes' *Dioptrique*, in Descartes, 1964–1974, vol. VI, 106.

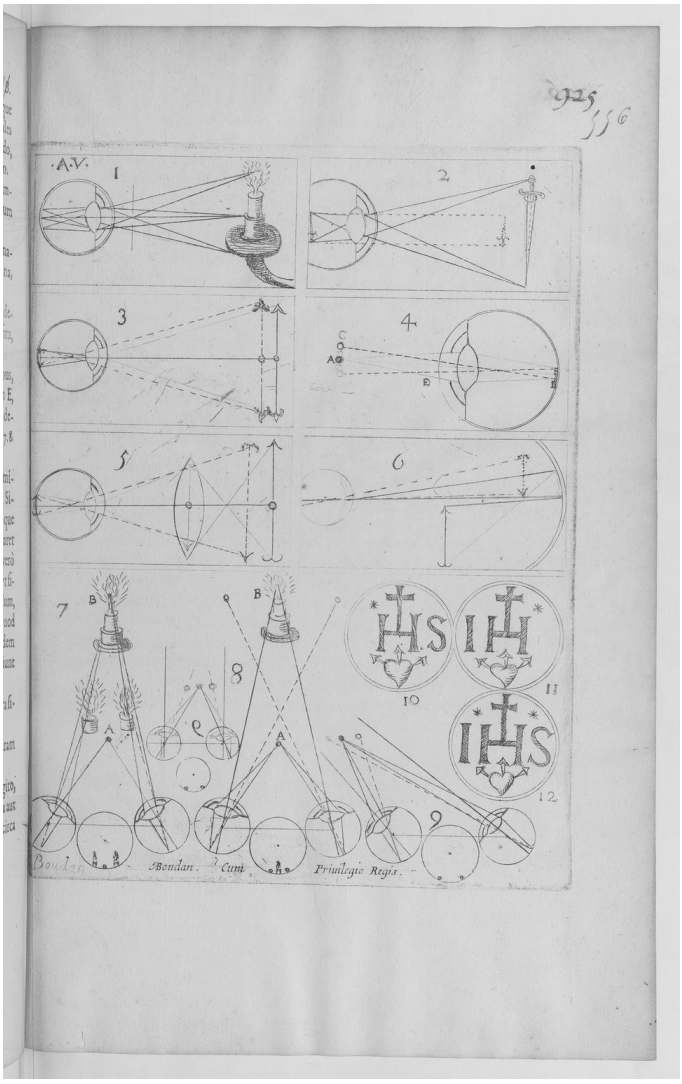

Figure 13: Graphical conventions of the engraving “Visio absoluta,” in-4, BnF, Département des manuscrits, Ms. Lat., 17862, f. 925; Henri 1639 [n.p.], Bibliothèque Municipale de Lyon.