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RESEARCH ARTICLE

Belgium and probability in the nineteenth century: The case of Paul Mansion

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Argument
This paper explores how the Belgian mathematician Paul Mansion became interested in probability theory. In comparison to many other countries at the time, probability theory had a much stronger presence in Belgium. In addition, Mansion, who was an avowed Catholic militant, had found probability theory to be a useful means of reflecting on certain problems pertaining to determinism and randomness that were arising in scientific debates at the time. Mansion's work took place during a time of consolidation of mathematical education in Belgium, as well as a new interest in probabilistic results and the foundation of the Institute for Philosophy in Louvain by his friend Désiré Mercier. The present paper addresses how these aspects intersected at the turn of the twentieth century.

Keywords: History of probability; Belgium; Paul Mansion; Adolphe Quetelet; Catholic faith; Evolution theory

Introduction

In 1902, the Belgian mathematician Paul Mansion (1845-1919) gave a talk at the Brussels Royal Academy of Science, which was subsequently published in the *Bulletin of Brussels Royal Academy* under the title "Sur la portée objective du calcul des probabilités" (On the objective significance of the calculus of probabilities) (Mansion 1903). The first sentence of this article states that "there are few countries where the calculus of probability holds as important a place as in Belgium" (ibid. p.1235). Mansion illustrated this fact by pointing out that a course in probability had been part of the syllabus for the *Doctorat en sciences physiques et mathématiques* (corresponding more or less to a master's degree) since 1835, and the syllabus for the *Hautes écoles techniques* (upper-level technical schools) since 1838. Indeed, the introduction of these courses so soon after Belgium's independence from the Netherlands in 1831 suggests that those in charge of education in the young country had paid particular attention to including the mathematics of randomness in scientific education for youths.

When compared to the situation in France during the same period, the contrast is striking. Probability theory came to be a significant part of French syllabi for higher mathematical education programs only after the First World War, or even later. The difference between Belgium and France in this respect—as emphasized by Mansion in his 1902 talk—has already been commented on by Mathematics historian Ivo Schneider (1987) (see in particular p. 193). French mathematician Joseph Bertrand (1822-1900) addressed the mathematics of randomness in several lectures throughout the 1880s at Paris' *Ecole Polytechnique* and *Collège de France*, but did not hide his skepticism towards a topic that he regarded above all as a source of recreation (though he admitted that it had some practical utility, for instance through the so-called law of errors).[1] It was also the subject of a course given by Henri Poincaré (1854-1912) at the Sorbonne in the 1890s. Poincaré

[1]On Bertrand's lectures, see, for instance, Bru (2006).

was the first major scientist in France since Laplace, Poisson, and Cournot to consider probability theory from a keen mathematical perspective, and did so because the new theories in physics, especially the kinetic theory of gases, required its use.[2] Ultimately, however, France would have to wait for Emile Borel and the 1920s to see the beginning of a large-scale transformation of the position that probability theory held in scientific higher education.

Although at the time Belgium was, as it is today, a multilingual country, the economic and cultural elites—and therefore rulers—of the time belonged above all to the francophone community that had led the 1831 revolution. Moreover, the French Napoleonic era was not so distant, and it was unavoidable that Belgium would take its southern neighbor, the great francophone power, into account as a model. Some of the newly created institutions in Belgium had a clear French influence, such as the justice system, which was based on the Napoleonic code. Belgian students often pursued their higher education in prestigious French institutions such as the *Ecole Polytechnique* in Paris, and several Belgian academics were even of French origin. Very soon after independence was proclaimed, however, Belgian rulers expressed their desire to develop a local educational system that would generate the elites that the country needed without needing to call on either their know-it-all southern neighbor or their all too self-interested neighbor on the other side of the English Channel.

In contrast to this distancing from its neighbors to the south and west, Germany, the young emerging European power in the East, was viewed with increasing sympathy. This is reflected, for instance, in an anonymous review published in the *Revue de Bruxelles* in 1837 (Arendt 1837,149-167), in which the author insists that the French influence in Belgium is generally being considerably overestimated abroad. Gradually, and mostly after 1870, when Bismarck's victory over France gave rise to the emergence of the German Empire, Belgium's eastern neighbor became the main attraction and a new source of inspiration, resulting in many students pursuing their education in Germany.[3]

However, and more significantly, there were also many aspects of Belgian society that depended solely on specific local characteristics, and favored the country's emergence as a leader in a specific domain. In particular, in Adolphe Quetelet (1796-1874), Belgium found a champion of the mathematics of randomness. For almost forty years, Quetelet was the most influential statistician in the world, a powerful man of action, a formidable academic politician, and a true personification of the Brussels Academy. Quetelet's influence on the limited mathematical scene in Belgium was so strong that it was quite natural for probability theory to become a central topic in higher education.

Similar situations can be observed in other places and at other times: being a scientist (or a writer, a philosopher, and so on) in a small, young country is a misfortune, because of the isolation, but also a stroke of luck for a man of action because it offers an open field to play upon.[4] This is what Quetelet did with probability theory in Belgium. As its geographical position made Belgium a transitional area between the German and the French cultural zones, Quetelet's task was to present German probabilistic techniques (law of errors, least squares, and so on) alongside French analytical rigor. Jozeau (1997) has studied in detail the parallels between geodesy and the shift in leadership from France to Germany, as seen from the Belgian point of view. She has shown how, after Quetelet, Belgian mathematicians such as Guillaume-Adolphe Nerenburger (1804-1869), Anton Meyer (1801-1857), and Jean-Baptiste Liagre (1815-1891) dealt with geodesy, particularly in relation to their teaching at the artillery school, considering Laplace too complicated and Cournot too philosophical and elementary to be applied, and preferring to use Gauss's, Struve's, and Bessel's approach. We shall examine Quetelet's, Meyer's, and Liagre's activity below in the section devoted to probability theory in Belgium.

[2]On Poincaré and probability, see, for instance, Mazliak (2015) and numerous references therein.

[3]On the general question of the Belgian political perspective on academic research, consult Halleux (2015).

[4]On this point, in a different time and context, see for instance Mazliak and Šišma (2015).

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Paul Mansion was born in 1844, and therefore belonged to a generation educated entirely within the Belgian system. Though probability theory remained a limited part of Mansion's published work, throughout his entire life he remained interested in the topic, combining that interest with a rather unusual personal agenda. The present paper aims to provide information about Mansion and about his vision of probability, as well as his participation in some scientific debates of the time in relation with his deep personal Catholic engagement. The first part of the paper is devoted to general biographical information about Mansion. The second part addresses Mansion's interest in probability. Finally, in the third part of the paper we examine what Mansion's 1902 talk at the Brussels Academy revealed about his vision of probability, as well as his understanding of the importance of probability in some of the scientific debates of the time.

Mansion was one of the most active Belgian mathematicians for more than forty years. He was therefore at the center of a large network of scientists, with whom he exchanged ideas, letters, and publications. Fortunately for historians, many of his personal papers have been largely preserved in several archives, which are listed at the end of the paper. There is therefore a considerable amount of information available about Mansion that can help us better understand his scientific work.

This is not the first study to focus on the significance of the Belgian setting as a means of approaching the history of an academic discipline. Both Wils and Rasmussen (2012) and Vanderstraeten (2018), for instance, have done so in the context of sociology. Vanderstraeten (2018) describes in detail how several institutions were created within Belgian public, religious, and anti-religious universities in the late nineteenth and early twentieth century to support or oppose sociology. The members of these institutions had to position themselves with respect to the situation in neighboring countries (e.g. France with the development of the Durkheimian movement), and the local circumstances in Belgium enabled the pursuit of an original Belgian path, at least until the Great War, which brought the process to a complete halt. The period of time considered in the aforementioned histories of sociology is almost identical to that of the present paper about probability, and several institutions played a role in both domains.

This paper is a continuation and extension of a previous work, devoted to the history of the mathematics of randomness in Belgium (Mazliak 2019). Since that study's presentation in 2018 at a meeting organized by the French Statistical Society (SFdS) at the Institut Henri Poincaré in Paris, I have been able to include a substantial amount of new information about the context and the key players, which I believe helps better portray how Mansion's vision of probability was fueled by his scientific environment. The aim of the present paper is therefore twofold: to provide some general information about the particular Belgian academic (and, especially, probabilistic) environment that developed during the second half of the nineteenth century, and to explain how Mansion followed a singular trajectory, in which he tried to combine his mathematical interests and his religious ideas.

1 - Paul Mansion: A Belgian and Catholic mathematician

Paul Mansion, a young mathematician in an emerging Belgium

Mansion's disciple Alphonse Demoulin (1869-1947), who in 1893 became his colleague in Ghent and was himself a reputed specialist in differential geometry, recorded many details about Paul Mansion's childhood (Demoulin 1929). Paul Mansion was born in 1844 in Marchin-lez-Huy in the province of Liège. He was the ninth child of a family of ten, and his father Paul-Joseph Mansion was a public official for the *commune*. Paul-Joseph was fifty-three years old when Paul was born, and died soon after. The family nevertheless remained relatively well off, as Paul-Joseph had acquired several properties and lands. Paul's mother died when her son was only seventeen, and he passed into the care of his older brothers.

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In 1844, Belgium was still quite a newly independent country. While formal independence from the Netherlands was achieved in 1830 after a short revolution and the ascension of Leopold I to the throne, it was not until 1839 that the king of Holland accepted the borders of the new state, as guaranteed by the Great Powers. The question of education arose early in Belgian political life, as there was a need to address the role played by the Catholic church in public education. In 1842, the liberal Prime Minister Jean-Baptiste Nothomb (1805-1881) reached a compromise with the Catholic party. Each *commune* would have a primary school for children, and this school could either be funded by the *commune* (*subsidiée*) or "adopted," meaning that an existing private school would be officially chosen by the *commune*, which would also provide funding, and, if necessary, a building. The law stipulated that teachers must have a degree from a state-approved school. Religion was part of the syllabus and had to be taught by Catholic priests, so the Church still had some control over schools (Deprez 1970).

Mansion entered Marchin's communal school when this regulation was in force. His teacher, Jean-Joseph Blaise, was one of the teachers with a degree from a state school. A brilliant pupil, Mansion pursued his studies at secondary school in Huy, and, in 1862, having decided to become a science teacher, was admitted to a program at the *École Normale* in Ghent designed to train teachers for secondary schools. In 1847, special training courses (*cours normaux*) were created at the state universities. The University of Liège was responsible for preparing students for an upper-level degree (*agrégation*) in teaching in the humanities, and Ghent University oversaw the scientific domains.[5] This division, however, created tension, as other departments, such as the Law department at Ghent University and the Medicine department at the University of Liège, feared that these new courses would result in a drastic decrease of the number of students in their programs. Thus, in the end, the planned division of educational programs was not carried out (for instance, the University of Liège continued to offer science courses). Even so, Ghent was the most natural place to study mathematics.

Mansion had two first-rate teachers during his schooling in Ghent: the mathematicians Félix Dauge (1829-1889) and Mathias Schaar (1817-1867). Mansion declared later that he never forgot Dauge's lectures on mathematical methodology, about which Dauge published a celebrated book in 1883.[6] Schaar, a remarkable polymath, taught arithmetic and analytical mechanics. In 1865, Mansion graduated from the *École Normale* as an *agrégé* and, in October 1865, he began teaching at the preparatory school for civil engineering in Ghent where Schaar was the schools inspector. As Mansion probably, at this stage of his career, wished to obtain a university degree (which the *agrégation* was not), he also defended a doctorate in physics and mathematics on 13 August 1867. He may have been encouraged to do so by Schaar himself, as Schaar, who was seriously ill, had not been able to teach since January 1867. Schaar died very soon afterwards (in April), and so his position became vacant. Paul Mansion was appointed to the chair of Differential and Integral Calculus and Higher Analysis at the University of Ghent on 3 October 1867 at the rather young age of twenty-three. This appointment seems to have resulted from Dauge's and Schaar's efforts to ensure that their brilliant *protégé* would stay in Ghent.

A mathematician in Ghent

Mansion's appointment in Ghent appears to have consolidated a local mathematical tradition that had been well-established since the beginning of the century. The founding figure of this development in Ghent mathematics had been the French mathematician Jean-Guillaume Garnier (1766-1840), who had arrived in 1817 following a rather unusual trajectory. At the end of the

[5] Joseph Roulez, the rector of Ghent, had proposed an even more radical change designed to rationally organize higher education in the country: to eliminate humanities teaching at Ghent University and scientific teaching at the University of Liège altogether.

[6] On Dauge and Mansion, see Voelke (2005), p. 371.

eighteenth century he had been an important actor of the French mathematical scene (it is for instance thanks to Garnier that Joseph Fourier was sent to Paris from his rather obscure position of mathematics teacher in Auxerre). But Laplace took a dislike to Garnier for reasons of competition with Poisson and Garnier resolved to seek his fortune elsewhere than in Paris (Droesbeke 2005). In an article devoted to Garnier, Mansion made the following comments, probably based on information obtained first-hand from his older colleagues, who had known Garnier well.

> [Garnier] was the main force for renewing the study of higher mathematics in Belgium, through his works and especially his students. Among these were Quetelet, Timmermans, Verhulst, Lemaire, Ed Lannoi, L. Casterman, A. Leschevin, Mareska, Ch. Morren, E. Manderlier, Fr. Duprez, and A. Goethals. Garnier was virtually the only professor of the Faculty of Science from Ghent who did not deliver his lectures in Latin. He was one of the founders and collaborators of the two scholarly collections of the time, the Annals of Belgium and Mathematical and Physical Correspondence. (Mansion 1913a, 12)

As Mansion noted, the outstanding importance of Garnier's presence in Ghent can be seen through the list of his students, who formed the first generation of mathematicians in the independent Belgium, with Quetelet ranked first among them. Garnier supervised Quetelet's thesis on conical sections, which was defended in July 1819 in Ghent. In 1825 the two men founded the first Belgian journal specializing in mathematics, entitled *Correspondance mathématique et physique.*[7]

Mansion's first paper, *On the Problem of Points,* published by the Royal Academy of Sciences in Brussels, was devoted to a probabilistic question (Mansion 1870).[8] It is not clear why Mansion chose this topic, but his professor Emmanuel-Joseph Boudin (1820-1893), who at the time taught the probability course at Ghent University, may have suggested it. In any case, the paper provided an opportunity for Mansion to become acquainted with the papers of another mathematician who would play an important role in his scientific life, a professor in Liège, the French-born Eugène Catalan (1814-1894).[9] Indeed, Catalan is one of the only references cited in Mansion's *Problem of Points,* which, in addition to noting Poisson's research on Pascal's problem of points, also cites a paper by Catalan in the *Journal de Liouville*, in which the latter presents some combinatorics results (Catalan, 1842). Using Catalan's results, Mansion proved that it was possible to obtain the solution to the general problem of points using only combinatorics, which was an alternative approach to what Laplace had done with integral calculus and what Poisson had done with a direct probabilistic approach.

Catalan had remained continuously interested in the discipline, mostly in connection with his focus on combinatorics. Moreover, as a student at the *École Polytechnique* during the 1830s, Catalan benefited from virtually the only high-level teaching in probability theory available at that time in France, although only a few students seem to have been drawn to this opportunity. Of these, Bravais and Catalan were more or less the only future mathematicians. Though Catalan's main mathematical interest was not probability, he continued to devote some works to it here and there. Jongmans and Seneta (1994), for instance, have investigated how in 1841 Catalan proposed a martingale model of drawing successive balls from an urn.

The letters exchanged between Catalan and Mansion shed light on their relationship (Fonds Mansion, KBR). They developed a real friendship, despite their difference in age (thirty years) and political views. In 1869, Mansion contacted Catalan to ask about the possibility of embarking on a PhD (*doctorat spécial*) in elliptic functions. In his detailed reply of 20 October 1869, Catalan explained that the Belgian system for PhDs remained quite obscure to him; but he was

[7]On Garnier and Quetelet, see Droesbeke (2005).

[8]For a comparison between Mansion's approach to the problem of points with other approaches, see Gorroochurn (2014).

[9]For detailed information about Catalan, another extraordinary French mathematician who settled in Belgium, see Jongmans (1996).

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encouraging, and suggested that Mansion come and visit him in Liège. In 1870, with the help of Catalan, Mansion completed a PhD on the theory of multiplication of elliptic functions, subsequently defended in Liège. Catalan, a consummate networker, managed to get Mansion invited to Göttingen for a research stay with Alfred Clebsch (1833-1872) and Ernst Schering (1833-1872). Clebsch was Riemann's successor at Göttingen and considered to be one of the top experts on elliptic functions of his time. He and Mansion soon became good friends, as testified by the collection of letters that Clebsch sent to Mansion over a short period of time.[10] The relationship ended very suddenly, as Clebsch died unexpectedly in 1872 after a brief illness.

In 1871, Mansion married Cécile Belpaire, daughter of the engineer Alphonse Belpaire (1817-1854), who had played an important technical role in the newly independent state, in particular in the organization of the railway system. For instance, he published a study devoted to the economic management of the particularly dense rail network in Belgium (Belpaire 1847). The Belpaire family was wealthy and well-connected within Belgian political and intellectual circles, and this marriage certainly facilitated Mansion's access to these circles and his role as an academic authority in Ghent, despite his young age.

In 1874, Catalan decided to resume publication of Garnier and Quetelet's journal *Correspondance mathématique* under the fairly obvious title *Nouvelle correspondance mathématique* and asked Mansion to help him. Although the new journal was supposed to deal with mathematical topics taught in the upper classes of secondary schools and in engineering schools, Catalan, who from 1876 at 1880 was its primary motive force, gradually raised the level, so that the journal, which was less and less suitable for educational needs in Belgium, ultimately failed. In 1881, it was replaced by a new publication, *Mathesis*, founded by Mansion and Joseph Neuberg (1840-1926). The journal's scope was the same as that originally intended for the *Nouvelle correspondance,* but Mansion and Neuberg had the wisdom to keep *Mathesis* at the level they had assigned to it, so that it could survive and develop (Demoulin, 1929, 107). The journal continued to be published without interruption for thirty-five years until the end of 1915, when the war brought an end to the publication.

Mansion's central research topic was analysis. He was a prolific author and published often, especially in the two journals that he edited (*Nouvelle correspondance, Mathesis*) and in the transactions of the Brussels Academy of Science. Mansion was also a regular contributor to the British journal *Messenger of Mathematics*. In 1873, he won a prize from the Belgian Academy of Science for his paper on the theory of second-order partial differential equations that was subsequently published as a book in Paris in 1875, and was distributed throughout Europe (Mansion 1875). Mansion also undertook the huge endeavor of publicizing Belgian mathematical activity, for instance in the Italian journal *Bolletino,* published in Rome by Balthasar Boncompagni. Since the very beginning of his career, Mansion also published many studies on the history of science and numerous obituaries for Belgian colleagues. In 1882, he was elected a corresponding member of the Sciences Class of the Royal Academy of Belgium, and then a full member in 1887. In 1892, he was officially put in charge of the course on probability theory at Ghent University, when he replaced Boudin as the chair of calculus of probability.

A Catholic scientist

One of the unusual characteristics that must be taken into consideration in order to understand Mansion's scientific activities is his Catholicism. Mansion was a devout Catholic throughout his life, and a deeply committed militant for his faith. The University of Liège and Ghent University were the country's two state universities, and Mansion's first position was at Ghent University in

[10]A small collection of letters sent from Clebsch to Mansion is part of Mansion's archive (KBR). These letters reveal that Clebsch was very satisfied with his meeting with the young Belgian mathematician, whom he advised on his future career and with whom he exchanged reflections about the resolution of partial differential equations.

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1867. During the almost fifty years that he spent at this non-religious, secular institution, Mansion openly displayed his commitment to Catholicism and perceived himself to be a defender of the faith. Mansion in fact engaged in numerous activities connected to his Catholic faith. He was a member of the congregation of Our Lady of the Seven Sorrows and a member of the Saint Vincent de Paul society in Ghent, and remained close to the Jesuits throughout his entire life. But, more importantly for the topic of this paper, very early in his scientific life Mansion sought a way to connect his faith with his professional life.

An opportunity arose in 1870, when he created the *Cercles Cauchy* with his friend the engineer Charles Lagasse de Locht (1845-1837).[11] The idea was to hold regular meetings, bringing together several of the brightest students at Ghent to counter what they held to be atheistic propaganda based on allegedly scientific arguments. Lagasse had originally intended to name the *Cercles* after Leibniz, but Mansion insisted on replacing the protestant philosopher's name with that of the Catholic mathematician Cauchy. Under Mansion and Lagasse's impetus, other *Cercles Cauchy* appeared in Belgium. The Belgian Jesuit, mathematician, and teacher at Saint-Michel College in Brussels, Ignace Carbonnelle (1829-1889), instituted a *Cercle Cauchy* in Brussels, and some years later, in 1875, founded the Brussels Scientific Society (*Société scientifique de Bruxelles*).

The explicit motto of the Society was to oppose anti-religious positivism. Its aim was to help Catholic scholars promote the advancement and diffusion of science in order to combat rationalist and atheist doctrines and establish a barrier against emerging materialist and anti-religious movements. The Brussels Scientific Society was very active and published the proceedings of its meetings under the title *Annales de la Société scientifique de Bruxelles*. Mansion had been one of the Brussels Scientific Society's founding members, and served as its president from 1889-1890. In his recent paper, Stoffel (2020) studies how Mansion's program coincided with that of the Brussels Scientific Society.

In 1877, a scientific journal was launched and published in Louvain and in Paris under the title *Revue des Questions Scientifiques*. From the beginning, the journal—which still exists today—was conceived as a scientific journal that would offer a Catholic view of the advances in science, giving preference as authors to scholars who clearly belong to the Roman Church. Mansion made many contributions to the journal.

Nye (1976) provides a detailed study of the first years of the Brussels Scientific Society, and emphasizes how questions about determinism were of central concern to its members in those years. It is noteworthy that, alongside French members such as Hermite and Pasteur, the society included a Joseph Boussinesq (1842-1929), a Catholic mathematical physicist who was deeply involved with the study of randomness and probability. At the time Boussinesq was a professor in Lille, and he would later (in 1896) succeed Poincaré at the Sorbonne as chair of the calculus of probability and mathematical physics.

Mansion was close to another important prelate, and future cardinal, Désiré Mercier (1851-1926). According to Mercier's biographer Laveille, while Mercier was a student of theology, his interest in science prompted him to attend various lectures delivered by Mansion in Ghent (Laveille 1928, 64.). Their shared commitment to Catholicism was certainly important to their relationship from the beginning. A letter that Mansion sent to Mercier some years later (in 1882) provides interesting insight into Mansion's feelings about the Belgian academic situation with regard to Catholicism. At that time, one of Mercier's cousins was a student in Ghent. Mansion wrote to Mercier:

> I will do my best so that your cousin Gustave … does not lose his faith in the dangerous environment in which he finds himself. He has already come to see me twice, which is promising, and he spoke to me quite frankly about his convictions. I think I have convinced him to become a member of the congregation; I will encourage him again at the next opportunity

[11]On the creation of the *Cercles Cauchy* by Lagasse and Mansion, see Lagasse (1920) and Hilbert (2000), p. 53.

and I will also advise him to join the small Catholic society of students of Ghent University. (Mansion to Mercier, 12 November 1882, in Fonds Mercier, LA)[12]

Mercier was probably the most famous Belgian cleric of the nineteenth and twentieth centuries. Of course, today he is mostly remembered for his activity during World War I.[13] But Mercier had much earlier gained a singular position on the Belgian intellectual scene. As De Volder (2016, 13-14) expresses it, Mercier, who had an insightful mind and was a brilliant professor, was philosophically and scientifically progressive, while knowing how to maintain orthodoxy, which protected him from the setbacks suffered by other Catholic thinkers of the time. Mercier's activity in the Belgian context is addressed in the collection of essays about Mercier written by Roger Aubert (1994) and, more recently, in De Maeyer and Kenis' article about the creation of a Catholic intelligentsia in Belgium in light of the "modernist crisis" (2017). Deeply interested in philosophy, natural sciences, and mathematics, Mercier was ordained as a priest in 1874, and defended a doctorate in theology in Louvain in 1877, at the precise moment that the reign of Pope Pie IX ended and his successor, Leo XIII, was elected (in February 1878).

Leo XIII had a strong desire to provide the Catholic Church with the tools needed to confront the problems posed by various recent scientific discoveries. Almost immediately after his election, the new pope, in his 1879 encyclical *Aeterni Patris,* chose to reintroduce Thomas Aquinas's philosophy as a basis of reflection. This was not seen as a concession to liberalism, but as a means of emphasizing the importance of Aquinas's teachings to prevent the errors made by modern philosophy (such as Kantianism).[14] Nevertheless, the encyclical clearly stated that philosophical work was the product of rational activity, and this made a scientific approach to the world possible for Catholic elites who had looked on the extremely rigid dogmatic answers given by the former pope with concern. This attitude, they thought, had increased the gap between the Church and academics, and Mercier shared this opinion. He was convinced that the rigidity of the old religious regime had been counterproductive to scientific progress, due primarily to the fact that most clerics and theologians were scientifically illiterate. Mercier, who had a strong personal relationship with the new pope, took this opportunity to implement his intellectual institutional agenda, the aim of which was to renew scholastic philosophy and create a resolutely positive attitude towards science within the Church, defending the idea that scientific activity must be guaranteed relative autonomy and freedom.

Mercier's major achievement was the opening of the Higher Institute of Philosophy (Institut supérieur de philosophie) in Louvain in 1889. Pope Leo XIII was an enthusiastic supporter of his friend Mercier's project. In the pre-project plan presented to Rome for approval in 1887, Mercier suggested that the institute offer lectures on philosophy in the morning and scientific talks in the afternoon (De Raeymaeker 1951, 534). The institute would soon become one of the main research centers on neo-Thomism and spiritual reflection on science, though initially there were many clashes with other elements within the University of Louvain, who viewed Mercier's experiments with a critical eye.

The year 1894 saw the inauguration of the new building of the Institute of Philosophy, directed by Mercier, and its formal association with the University of Louvain, which Leon XIII required of the rector Abeloos. This resulted in a few years of open friction between Mercier and the university's administrative board, who had been very critical from the start of Mercier's plan to base the

[12]« Je ferai mon possible pour que votre cousin Gustave . . . ne perde pas la foi dans le milieu dangereux où il se trouve. Il est déjà venu me voir deux fois, ce qui est de bon augure et il m'a parlé très franchement de ses convictions. Je crois l'avoir engagé à se faire de la congrégation; je l'y engagerai encore à la prochaine occasion et je lui recommanderai aussi de faire partie de la petite société catholique des étudiants de l'université de Ghent ».

[13]On this aspect, consult for instance De Volder (2016).

[14]On the ambiguity of Leo XIII's position, see Serry (2004).

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study of theology on scientific results. Nevertheless, Mercier succeeded in avoiding major threats to his Louvain institute, which was allowed to continue.[15]

It is probable, however, based on the account of the beginning of the institute given by De Rayemaeker (1951, 534–540), that this hostility from his colleagues prompted Mercier to look outside of Louvain for the teaching staff that he needed. He asked Mansion, his friend and former teacher in Ghent, to become his main expert on mathematics. Mansion gave a series of talks on the fundamental principles of mathematics during the first year of the institute (1890-1891) and another on the fundamental principles of mechanics during the institute's second year (1891-92) (De Raeymaeker 1951, 538). He wrote several papers for Mercier's journal *Revue néo-scolastique,* which was founded in 1894 as the official publication of the institute.[16]

Both Mercier and Mansion were deeply interested in the role the church must play in the education of youth. In a letter dated 28 November 1906, Mansion wrote:

> I find that the Catholic press does not tackle neutral teaching well. It should continuously say and repeat that the teaching is anti-pedagogical because it does not develop the child's religious faculties harmoniously with other faculties; as a result, it is an inferior education from a literary and scientific point of view. (Mansion to Mercier, 28 November 1906, Fonds Mercier, Archives de l'Université catholique de Louvain)[17]

Mercier and Mansion had a good opportunity to present their views to a broader audience on the occasion of the third international congress of Catholic scientists, held in Brussels in September 1894. These congresses had been launched in 1886 at the instigation of another cleric, Maurice Le Sage d'Hauteroche d'Hulst (1841-1896).[18] In 1886, d'Hulst had organized an international congress of Catholic scientists that was to be held in Paris on Easter 1887. In his circular letter of 1 February 1886, published in the *Annales de Philosophie Chrétienne,*[19] d'Hulst mentions that the aim is to gather *professors and writers who were known for adding real scientific value* in the service of Christian convictions and to invite all Catholics who were interested in the development of science for the defense of the faith (Beretta 1996, 269). Mansion and Mercier were both members of the organizing committee. The proceedings of the congress testify to Mansion's continual involvement in the preparation phase. He was a member of the preparatory commission (in fact, a vice president) and, as reported in the historical report, was probably the most active member in that he *attracted almost all his Catholic colleagues from the university of Ghent (28 out of 30) and a considerable number of members from Ghent, Anvers and Western Flanders* (Anon. 1895, 9). The seventh section of the proceedings, devoted to *mathematical and natural sciences,* includes Mansion's presentation to the congress (Mansion 1895). It also contains a contribution by Charles Hermite, who attended the Congress, and was certainly considered the most valuable scientific endorsement of the meeting (Hermite 1895).

[15]Mercier's tactical skill, combining charm and authoritarianism, is well-explained in De Maeyer and Kenis (2017).

[16]Of these, see, in particular, Mansion (1896a), Mansion (1896b), Mansion (1908), and Mansion (1920a).

[17]Je trouve que la presse catholique n'attaque pas bien l'enseignement neutre. Elle devrait sans cesse dire et répéter qu'il est antipédagogique parce qu'il ne développe pas les facultés religieuses de l'enfant d'une manière harmonieuse avec les autres; par suite, c'est un enseignement inférieur au point de vue littéraire et scientifique.

[18]On d'Hulst's involvement with the congresses of Catholic scientists, see Beretta (1996). D'Hulst communicated with the mathematician Georg Cantor (1845-1918) after his conversion to Catholicism. Cantor's correspondence reveals how French scholars played an important role in this change. On this question, see Décaillot (2008) chapter 3, which also contains many general considerations regarding the Catholic intellectual and scientific scene during the last two decades of the century.

[19]Volume 111 of the *Annales de Philosophie Chrétiennes* on pp. 401-404 (1885-1886). Reproduced in Beretta (1996), pp. 267-272.

2 - A diffuse interest in probability

Belgium as fertile ground for probability

We have already mentioned how Quetelet played a central role in Belgian academic life and how, under his influence, probability theory became a central topic of study. Quetelet was probably the first to perceive that statistics must fundamentally rely on the calculus of probability (Droesbeke et Tassi 1997, 44). In a nice, recently published study, Donnelly (2016) undertakes an in-depth examination of the genesis of Quetelet's interest in the mathematics of chance and their application to the study of the social domain. Quetelet's initial decision to pursue a career as a writer in parallel with his mathematical studies (he defended a PhD on conical sections supervised by Garnier at Ghent University in 1819) sheds light on his taste for description, which he ultimately put to work in the service of science, after the decisive encounter with Laplace's work during his stay in Paris in the 1820s. Following in his predecessor's footsteps, Quetelet would establish his tutelage on the Belgian scientific scene in two sectors where descriptions play a particularly acute role, astronomy and probabilistic statistics, at the end of the 1820s. Quetelet's taste for teaching made him a highly appreciated pedagogue throughout his entire life, celebrated for his clear and simple explanatory style.

Droesbeke (2005) studied Quetelet's continuous promotion of mathematical education in Belgium, with a special emphasis on popularization. Three important books published by Quetelet over three consecutive years, during his campaign for the creation of an observatory in Brussels, speak to his desire to disseminate scientific culture throughout the country. In order to make the calculus of probability more accessible to a wide audience, Quetelet sought to create a sort of arithmetic of probability based only on fractions and proportions. His former PhD adviser at Ghent University, Garnier, suggested the expression "arithmetic of probability" after reading Quetelet's book with enthusiasm. Garnier commented that he "could not understand how it had not come before" (Droesbeke 2005, 15).

Though Quetelet's frenetic activity had begun before the Belgian revolution, the state's newly acquired independence clearly spurred him on further. Droesbeke (2005) explains how Quetelet participated in, and often directed, the development of the Belgian educational system. In particular, he supported the creation of polytechnic schools, whose syllabi were required to include theoretical, as well as practical, scientific lectures, and he was also involved in the organization of the Royal Military School. Quetelet was, moreover, one of the developers of the *Université Libre de Bruxelles,* which was founded in 1834 in response to the establishment of the Catholic Institution of Higher Education in Malines, which was quickly transferred to Louvain in 1835.

The study of probability in Liège was promoted by the mathematician Anton Meyer.[20] In her study of geodetics in the nineteenth century, Marie-France Jozeau describes how Meyer learned German least-square techniques when he visited Germany for a few weeks in 1846 in order to familiarize himself with new probabilistic methods for geodesy (Jozeau 1997, 99–104). In 1838, probably with Quetelet's support, Meyer had been offered the Chair of Higher Mathematics at the *Université Libre de Bruxelles,* and later at the University of Liège in 1849. Jozeau observes that Meyer proposed a new syllabus for the doctorate-level course in analysis, most likely inspired by Quetelet (ibid., 106). The syllabus now contained two explicitly separate parts: superior analysis, elliptic functions, and calculus of variations on the one hand, and probability and social arithmetic on the other hand. Between 1849 and 1857, the year of his sudden death, Meyer taught a course on probability that may have been the most structured course offered at a European university at the time, fulfilling Quetelet's plan of connecting the theoretical approach to probability theory of the French mathematicians Laplace, Lacroix, and Poisson, with the Germans' practical developments concerning the law of errors.

[20]For more on this singular personality, see Jozeau (1997).

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In 1856, Anton Meyer submitted a proof of the Central Limit Theorem in the special case of two-valued random variables to the Academy of Brussels. Meyer's proof was not based on the usual procedure, which can be traced back to de Moivre and had also been detailed in Laplace (1812). Instead, Meyer used an extension of Laplace's generating functions.[21] Meyer's article unfortunately appears to have been lost, but we know of its contents due to a brief report (Brasseur, 1856) written by Jean-Baptiste Brasseur. The latter hoped that Meyer's method would lead to a more exact discussion of how "terms of higher orders of smallness" could be neglected. Meyer's paper was accepted for publication under the condition that the "convergence of the series" should be examined more thoroughly. Ultimately the paper was not published, as Meyer died the following year (Fischer 2010, 24-25).

A few months before his death, Meyer had been involved in a controversial argument with Liagre, a former student of Quetelet who taught probability theory in military academies, mostly from a practical point of view, and who in 1855 had presented a note to the Brussels Royal Academy in which he introduced the first elements for the so-called turning-point test.[22] Meyer published his reaction in 1857 as a note, in which he rather tactlessly criticized Liagre for his alleged sloppiness. This resulted in some controversy at the Royal Academy (as Liagre as an important member of the institution, while Meyer was only a corresponding member), illustrating the difficulty of maintaining a balance between a theoretical and a practical point of view in probabilistic questions.[23]

Around the time that he died, Meyer was completing the manuscript of a textbook on the calculus of probability. The manuscript remained untouched for more than fifteen years, but was eventually published in 1874 by the *Société royale des sciences de Liège* under the supervision of François Folie (1833-1905). Meyer's book makes systematic use of Laplace's method for the asymptotic development of integrals to present the law of errors. The method itself is presented in a very clear mathematical appendix (Meyer 1874, 421-435). Meyer's course on probability was clearly designed for students with a quite extensive mathematical education. Thus, the book offers a rather remarkable continuation of Laplace' *Analytical Theory of Probability* (1812), which Meyer had probably read with enthusiasm while he was in Paris.

In "On the Objective Significance of the Calculus of Probabilities" (Mansion, 1903, abbreviated henceforth as "Objective Significance"), Mansion wrote that Meyer's 1874 textbook was the only genuine treatise on probability theory written in a European language between Poisson's book in 1837 and Bertrand's book in 1889. This statement may be somewhat exaggerated, and Hald (1998), for instance, seemed to feel that the value of Meyer's book was due more to its clarity than its originality. The most essential fact regarding Meyer's book was its subsequent translation into German in 1879 by the Prague mathematician Emanuel Czuber (1851-1925). We do not know how Czuber became aware of the existence of Meyer's treatise, but his specialization in geodesy offers a reliable clue. In 1876, Czuber had indeed defended a professorial thesis in geodesy with the title *Theorie und Praxis der Ausgleichsrechnung*. He may also have begun to lecture on probability theory at the *Deutsche Technische Hochshule* as a privatdozent beginning in 1876 (Hyksova 2011, 112).

Czuber (1878) clearly shows that, in addition to geodesy, Czuber was concerned with actuarial sciences in 1878. Czuber was probably attracted by the mathematical soundness of the approach used in Meyer's textbook to base the law of errors on a precise mathematical structure. He added a

[21] I would like to thank an anonymous reviewer for having observed that this approach based on generating functions was also present in Robert Leslie Ellis' *On the Foundations of the Theory of Probabilities,* published by the Cambridge philosophical society in 1844, and in Augustus De Morgan's 1845 entry *Theory of Probabilities* for the Encyclopedia Metropolitana.

[22] This test, which is used to verify the random nature of a data series, was rediscovered, apparently independently, some years later by Bienaymé. See Heyde and Seneta (1977), 124-128.

[23] On the dispute between Liagre and Meyer, see Breny, Jongmans and Seneta (1992).

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preface to the translation of Meyer's treatise that comments on its content. Czuber explained that, due to the recent development of actuarial science, he had felt the need to rewrite and fill out some parts of the book, in particular by extensively revising Chapter Eight, which was devoted to compensation of errors. The aim was to make this chapter useful for standard situations, but also to include the most recent theoretical developments on the subject. Czuber also completely revised Chapter Nine, which was devoted to insurance problems, as this topic was of major importance to his actuarial interests. In his 1901 entry on probability theory in the *Encyklopädia des Mathematisches Wissenschaft*, Czuber mentioned Meyer's book as a fundamental reference textbook, along with Cournot (1843) and Laurent (1873). It is plausible that Mansion did not mention these treatises in "Objective Significance" (Mansion, 1903) because they were not specifically intended for students specializing in mathematics.

As previously mentioned, Meyer's treatise contained the lectures on probability given in Liège. Eugène-Joseph Boudin (1820-1893), Mansion's former teacher and Chair of Calculus of Probability prior to 1892, had taught a course in probability at the University of Ghent (the other state university) and the Ecole du Génie Civil for more than forty years. In 1913, Mansion wrote in his biographical note on Boudin for the Liber Memorialis of the University of Ghent:

> As for the course on probability, it is a true masterpiece in terms of the principles and the order of the subjects, deeply influenced by Laplace's best ideas and superior to the best textbooks on the topic. The theory of errors is based on Hagen's hypothesis[24], the philosophical value of which Boudin was the first and, for a long time, only one to recognize, diverging from Laplace on this point with good reason. The author of the present note hopes someday to repay a debt of gratitude to his former master by publishing a definitive edition of this beautiful course, with a slightly modernized analytical point of view. Boudin granted him permission to do so a few years before he passed away.[25] (Mansion, 1913b, 110)

In fact, it was a long time before Boudin's treatise was properly published. Between 1865 and 1889, three rather confidential handwritten editions were published (Boudin, 1865, 1870, 1889). In 1869, the young Mansion provided a copy of Boudin's first handwritten edition to Eugène Catalan, who replied:

> I must begin by thanking you for sending Boudin's Probability lessons: so far, I am delighted with this book, which will be an excellent base of operations for me. It will not only be of great use to me, but could also be useful to others: I believe that M. Boudin would do right to have it printed with modifications, additions, and so on. In the meantime, please convey to him

[24]Gotthilf Hagen (1797-1884), a disciple of Bessel, made the following assumption in 1837: "The error in the result of any measurement is the algebraic sum of an infinitely large number of elementary errors ["elementäre Fehler"], which are all equally large, and each of which can be just as positive as negative" (Hagen 1837, 34). This basic justification for the method of least squares for arbitrary distribution had already been mentioned by Laplace in his 1810 supplement to his earlier memoir on least squares, based on Gauss's work on normal distribution and least squares. According to Stigler (1986; 201), Quetelet's fascination with normal distribution dated from his discovery of Laplace's work when he was in Paris in the 1820s. As Fischer (2010, 94) comments, it is not clear whether Quetelet's statistical research was influenced by Hagen's work, although he did quote Hagen, for instance in Quetelet (1846). Hagen's influence on Quetelet and Boudin remains to be elucidated.

[25]Quant au Cours de calcul des probabilités, tout imprégné des idées les meilleures de Laplace, c'est un vrai chef-d'oeuvre sous le rapport des principes et de l'ordre des matières, supérieur aux meilleurs manuels. La théorie des erreurs y repose sur l'hypothèse de Hagen dont Boudin, le premier et longtemps le seul, avait reconnu toute la valeur philosophique, s'écartant avec raison de Laplace sur ce point. L'auteur de cette notice espère quelque jour s'acquitter d'une dette de reconnaissance envers son ancien maître en publiant une édition définitive et un peu rajeunie au point de vue analytique de ce beau cours. Boudin lui en avait donné l'autorisation, quelques années avant sa mort.

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my sincere compliments. (Eugène Catalan to Paul Mansion, 1 December 1869, Fonds Mansion, KBR)[26]

The final edition of Boudin's lessons, with considerable extensions and additions, would be published in a highly symbolic way much later, in 1916, while Ghent was under German occupation and the Germans were supporting the creation of a Flemish university to replace the university of Ghent. Mansion succeeded in having them printed in Ghent by the printing house Hoste, as a clandestine publication of the Paris academic publisher Gauthier-Villars. Unfortunately, I was not able to find any documents related to this matter in the Hoste archives in Ghent (Liberas archive). Mansion probably saw publication of the book, which was of course only released after the liberation of Belgium in 1918, as a patriotic act, and many subtle comments included in the book, emphasizing the role and presence of Belgium in the Concert of Nations, can be interpreted as such. He included his own "Objective Significance" (Mansion, 1903) as an appendix to the book.

Paul Mansion as a probabilist

Mansion's publications on probability, though not very numerous, were spread out throughout his forty-five-year career, demonstrating his continuous interest in the discipline. Probability was, in particular, the topic of his first published study in 1868. Mansion also seems to have been interested in the technical aspects of probability (mostly limit theorems: the law of large numbers and central limit theorem), as well as the epistemological interpretation of probability's role in contemporary science at the time. There is an obvious link between the two. As was the case for Poincaré in the last third of the nineteenth century, Mansion questioned whether a probabilistic approach could reveal a part of the objective reality. In other words, was this approach only a mathematical trick, or did it reflect some reality of the world?[27]

The first time that this question appears in Mansion's work is a small note included by the philosopher Paul Janet in the second edition of his essay on final causes in 1882 (Janet, 1882). In the preface to this edition, Janet commented that he had to modify his original text after having received many reactions to the first edition in 1876. As the book had been conceived as a polemical text, aimed at provoking comments on a topic rarely commented on in France, this had been quite natural for Janet. He mentioned that cross-examination of philosophical questions was a more common feature of Anglo-Saxon culture than of French culture. Janet (1876) questioned whether recent progress in science necessarily led to doubting the existence of God, and explored how classical approaches to the question needed to be adjusted to adapt to this change. In the second chapter of the book, Janet analyzed the so-called physical-theological proofs.

Among the comments he had received, Janet wrote, one of the most interesting was from Paul Mansion. Janet decided to reproduce Mansion's letter as an appendix in his new edition (Janet 1882, 720–725). Mansion's note is entitled "The Epicurean argument and the calculus of probability." In it, Mansion contests an assertion made by Janet in the book's first edition regarding the Epicurean objection to the "final cause" proof of the existence of God. This proof states that the world is too well organized not to reflect the intelligent design of a creator. Epicureans object, stating that, if the world is an assembly of elementary particles randomly associated with one

[26]Je dois commencer par vous remercier de votre envoi du Cours de Probabilités: jusqu'à présent, je suis enchanté de cet ouvrage, qui va me faire une excellente base d'opérations. Non seulement il me servira beaucoup, mais encore il pourrait servir à d'autres: je crois que M. Boudin commettrait une bonne action en le faisant imprimer avec modifications, additions, etc. En attendant, présentez-lui, je vous prie, mes compliments sincères.

[27]Remember that, even for Poincaré, conventionalism was not the ultimate answer to the question: the so-called method of arbitrary functions he invented in order to attribute probabilities to events was seen as the main way to reveal the objective contents of a probabilistic modeling. See Mazliak (2015).

another, one must necessarily conclude that there exists a time in which the world will be distributed in any given arrangement (for instance the present state).

Janet asserted that the calculus of probability may be used to study the validity or invalidity of this argument: in particular because if the number of particles is infinite, the probability of assuming the present state of the world is zero, so that the Epicurean argument is dismissed. Mansion contested this use of probability, though, as he himself wrote, it seemed highly tempting at first glance. First, Mansion wrote, infinity is a mathematical abstraction, so it cannot be used in a proof about the real world. Second, even if the number of particles is finite, the conclusion that the world must assume all the possible states is valid only if one assumes that some internal forces guarantee that the atoms behave in such a way that the rules of the calculus of probability are applicable (in modern terms, that they are uniformly distributed over the various possibilities). This is an assumption we have no specific reason to make. Therefore, Mansion wrote, probability cannot be a useful approach to the Epicurean objection. He would later include a section along the same lines in Mansion (1903) (section XI).

Mansion's probabilistic technical research probably focused on the limit theorems because applying them was the only way to attribute an objective value to a probabilistic result. At the end of the nineteenth century, especially after Cournot's studies, Laplace and Poisson's works were revisited, and Mansion used several results of these works to improve the rate of convergence in the law of large numbers. In particular, Mansion was interested in the convergence rate of the probability of large deviations of the average number of successes from theoretical probability. With the exception of a small group of probabilists connected to Mansion and a few Russian mathematicians, these questions would not attract substantial attention until the arrival of a new generation of mathematicians after 1920. Another topic present in Mansion's works is an extension of Laplace and Gauss' least-squares method, extending Quetelet's, Catalan's, and Bouvier's studies.[28]

Another aspect of Mansion's interest in probability was his central position in a small and very active network of mathematicians linked in one way or another to the Belgian scientific scene. Mansion's studies about the law of large numbers provide a good illustration of the publications from this group. In 1892, Mansion published a paper in the Annals of the Brussels Scientific Society (Mansion 1892). In 1895, it was followed by the paper published by the astronomer and meteorologist Edouard Goedseels (1857-1928) in the same journal (Goedseels 1895). Then, two new papers by Mansion appeared in 1902 and 1904 (Mansion, 1902, 1904). In 1907, the Louvain mathematician Charles de La Vallée Poussin (1866-1962) extended Goedseels' and Mansion's results in two articles on Bernoulli's theorem (Vallée Poussin 1907a, 1907b).[29] Mansion and De la Vallée Poussin's results were used in Montessus de Ballore's *Elementary Lessons in Probability Calculus* (1908).

The French mathematician Robert Montessus de Ballore (1870-1937) was then a professor of mathematics at the Catholic University of Lille. Probability was a central topic in his communications with Mansion. In 1904, Mansion sent a copy of "Objective Significance" (Mansion 1903) to Montessus and suggested that he visit him in Ghent (Mansion to Montessus, 28 April 1904, in Fonds Montessus, SUA). In 1906, Montessus suggested that they publish a book together on probability theory, but Mansion declined, explaining that he was working on publishing his former colleague Boudin's lecture notes (Mansion to Montessus, 25 December 1906, in Fonds Montessus, SUA). However, he expressed his interest in Montessus' project, and when Montessus' s *Lessons* (1908) was published in 1908, Mansion advised his colleague to send his book to the Jesuit father Fernand Willaert (1877-1953), an astronomer who was investigating the meaning of probability, in Louvain, so that he could write a review of the book for the

[28]For the contextualization of Mansion's research about limit theorems and least squares, consult the two recent, excellent volumes of Bru and Bru (2018). See in particular n° 167 pages 251–255.

[29]On de la Vallée-Poussin's results, see Le Ferrand (2014).

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Revue des Questions Scientifiques (Mansion to Montessus, 2 April 1908, in Fonds Montessus, SUA).

Willaert indeed wrote a review for the journal in which he praised the clarity and readability of the book (Willaert, 1908). He also devoted several pages to expressing his skepticism about Montessus' assertion that Bernoulli's theorem provided the calculus of probability with objective value. Willaert contended that there was in fact no genuine objective value to any mathematical abstraction: such a conclusion would be merely a psychological illusion, because mathematics is a powerful theoretical tool, and many of its results are close to what can be observed in reality. It is therefore somewhat impossible to determine the exact conditions under which an abstract model agrees with reality.

Even though he was slightly more positive about this possibility in his book, Montessus seems to have appreciated the review, and wrote to Willaert to express his gratitude. Willaert replied to thank Montessus for his kindness and to insist on the fact that the central problem regarding probability was indeed estimating the degree of agreement between the experimental result (for instance when one throws a die) and the theoretical result (Willaert to Montessus, 9 August 1908, in Fonds Montessus, SUA). This shows that, for Willaert, as well as for Mansion (and also Poincaré or Borel at that time), the question of the objectivity of calculus of probability results was under scrutiny.

It is significant to compare Montessus' book with Borel's *Elements of Probability Theory* (1909), which was published at the same time. While Montessus' book mentioned elementary lessons on the *calculus* of probability, Borel evoked the *theory* of probability. Both authors declared in their introductions that their aim was to help disseminate a subject that was gaining more and more importance in the contemporary study of phenomena. But, while Montessus clearly announced that he was targeting a wide and non-specialist audience, Borel did not conceal his desire to inspire the curiosity of young mathematicians with his work. While Borel placed himself within the mathematical structure proposed by Poincaré, Montessus was clearly more on the side of the validity of practical application. Mansion and de la Vallée-Poussin's approximating inequalities for Bernoulli's theorem were part of this agenda.

Montessus' book is probably also the first place where the results from Bachelier's 1900 thesis on the theory of speculation[30] were quoted, although I was unable to find any information about how Montessus became acquainted with Bachelier's work. A reasonable hypothesis is that this information came from Poincaré: Montessus defended his PhD (on continuous fractions) in 1905 at the Sorbonne in front of a jury presided over by Poincaré; his second thesis (as usual, its topic had been chosen by the faculty, probably by Poincaré himself) was on the calculus of probability. For this occasion, Montessus needed to prepare a survey of recent works on probability, and necessarily took Bachelier's thesis into account.

As mentioned above, Montessus was professor at the Catholic Institute in Lille – which was not a neutral fact in those years of tension between the church and the state in France. Although Montessus was certainly not as involved in the Catholic church as Mansion was, their common religion clearly played a role in their relationship. In his letter of 25 December 1906, Mansion congratulated his colleague for having received the great Paris Academy of Sciences prize for his thesis on continuous fractions, and wrote that he would share the news with the Brussels Scientific Society. He expressed his satisfaction because "it is always good for the public, and young people in particular, to learn that one of the world's leading scientific bodies has rewarded the work of young Catholic scientists" (Mansion to Montessus, 25 December 1906, in Fonds Montessus, SUA).[31]

[30]See Courtault (2000).

[31][c]ela fait toujours bon effet sur le public, et sur les jeunes gens en particulier, d'apprendre que l'un des plus éminents corps scientifiques du monde couronne les travaux de jeunes savants catholiques.

Another member of Mansion's "Belgian" probabilistic network was the Italian mathematician Ernesto Cesarò (1859-1906). After some disappointment in Italy during his secondary studies, the young Cesarò was sent to Liège (his brother was already a student there) to study engineering: he entered the mining school in 1874 and graduated in 1878. However, Cesarò decided to continue his studies at the University of Liège and began to publish mathematical works, receiving much encouragement from Catalan. Cesarò returned to Italy in 1883 and, after several complicated years, eventually obtained a chair in Palermo and then in Naples.

Though Cesarò is known today above all for his contributions to differential geometry and the theory of series, he was also interested in probability, as demonstrated by several publications, mostly in the *Giornale di Battaglini* or in Mansion's journal *Mathesis*. Most of these publications were devoted to specific problems such as the "diamond cleavage" problem, a geometric probability problem in which the question is to decide which division in three pieces would be optimal for the jeweler (Cesarò, 1886). However, Cesarò was also interested in broader aspects of probability theory. In his long two-part paper, "Considerations on the Concept of Probability" (Cesarò, 1891), Cesarò studied how probability can be interpreted in cases where there are an infinite number of possibilities. For Cesarò, assigning a probability value as a limit was perfectly acceptable, and no more subjective than the attribution of a value to the sum of a non-absolutely convergent series. Mansion emphasized the soundness of Cesarò's approach in "Objective Significance", and regretted that the latter's probabilistic work was not better known, due to its publication in an Italian journal that was not widely read (Mansion 1903, 59).

3 - Another look at probability

"On the Objective Significance of the Calculus of Probabilities" (Mansion, 1903) was an official speech delivered by Mansion in the solemn setting of the Academy of Brussels. It can be seen as an overview of the concept of probability that he had forged from the beginning of her career. One cannot help but be struck by a certain number of examples chosen by the mathematician to illustrate the importance of contemporary thinking on quantified chance and its use. In addition to section XI, which takes up the arguments developed in the letter to Paul Janet concerning the aforementioned use of probabilities to justify the argument of final causes, there is also section VI, which is devoted to the question of transformism in evolution as put forward by the biologist and Catholic thinker St George Jackson Mivart, and two other long sections (XIV and XV), devoted to the theory of the accumulation of probabilities of the Catholic theologian Newman. To the latter are added direct references to Catholic authors from different specialties, such as the French Catholic engineer and thinker Georges Lechalas (1851-1919), author of several articles in Louvain, and the Belgian Jesuit historian Charles De Smedt (1833-1911). These numerous references to the late-nineteenth-century Catholic intellectual sphere signal Mansion's desire to clearly situate his own reflections on contemporary probabilities within a spiritual context. The third part of this article is devoted to this unique approach.

A reflection on evolution

The publication of Charles Darwin's *The Origin of Species* in 1859 created a major crisis in the Roman Catholic world. The status of man in the natural world was at stake, and became the topic of numerous controversies about various possible interpretations of Darwin. The reception of Darwin's book by Catholic theologians, and more generally by Catholic thinkers, immediately generated considerable discussion and argument. This crisis has been the subject of numerous historical studies. The present paper is obviously not the right place for such an overview, and we shall limit our comments to some elements that will enable us to place Mansion's comments in context. Much of the information in this section is taken from Brundell (2001), Blancke (2013),

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and Artigas, Glick and Martinez (2006), which the reader can consult for more complete information.

The 1860s, which saw the end of Pope Pius IX's rigid pontificate and the collapse of the Pontifical states under the pressure of Italian unification, was certainly not a suitable time for open discussion. The pope even called on Catholic intellectuals to assist him in his fight against modernity, including any non-fixist theories of the world, which were considered to be radically incompatible with biblical teaching. The situation began to change with his succession, in 1878, by Pope Leo XIII, who had already declared his wish for there to be a change in the dialogue between the Church and modern science. This wish primarily concerned questions about evolution, as Catholic intellectuals felt it was necessary to respond to theories about biological species when they were applied to humans. For many Catholic thinkers, leaving these questions to anti-clerical militants would have been simply negligent. Therefore, the last decades of the nineteenth century were a period of intense reflection on evolution, as Catholic theologians, philosophers, and scientists sought a version of Darwin's theory that was compatible with the teachings of the Catholic Church.

Of special importance were the reflections by some English-educated converts from Anglicanism. Their responses, which were marked by considerable scholarly independence, were supported by a tradition of liberal thinking at various journals that offered them a wide audience. The most influential response was that of the biologist St. George Jackson Mivart, whose career path illustrates the immense difficulties that Roman Catholics experienced in responding to non-fixist theories. Mivart had been an enthusiastic Darwinist and a collaborator of Darwin and Huxley before he began to raise objections regarding Darwin's concept of natural selection. In his widely disseminated book *On the Genesis of Species*, published in 1871, Mivart proposed a Lamarckian-type adaptation of Darwin's theory: he accepted the principles of the evolution of species but, contrary to Darwin, who supported the idea of small, continuous variations, Mivart defended the idea of large, discontinuous variations (Artigas, Glick & Martinez 2006, 238). Such discontinuities could be traced to a divine plan, which would have been more difficult to do for small variations arising by sheer chance. Mivart's work received high praise from Catholic intellectuals, in particular the influential Reverend Newman, another convert from Anglicanism to whom we shall return in the next section.

Though Mivart was an avowed supporter of evolution, because he was an opponent of the most dangerous consequences of this theory as outlined by Thomas Huxley ("Darwin's bulldog"), he was seen as an authentic supporter of the Catholic cause. Newman was also a declared evolutionist, as testified to by the following passage from a letter he sent to a friend:

> As to the Divine Design, is it not an instance of incomprehensibly and infinitely marvellous Wisdom and Design to have given certain laws to matter millions of ages ago, which have surely and precisely worked out, in the long course of those ages, those effects which He from the first proposed. Mr. Darwin's theory needs not then to be atheistical, be it true or not; it may simply be suggesting a larger idea of Divine Prescience and Skill. Perhaps your friend has got a surer clue to guide him than I have, who have never studied the question, and I do not [see] that "the accidental evolution of organic beings" is inconsistent with divine design—It is accidental to us, not to God. (Newman to J. Walker of Scarborough, 22 May 1868, in Dessain & Gornal 1973)

In 1876, Pope Pius IX offered Mivart a Doctorate of Philosophy, and his successor Leo XIII, a close friend of Newman (whom he made Cardinal in 1879), also had a deep appreciation for Mivart. This did not prevent Mivart from getting into serious trouble later on. Between 1885 and 1887, Mivart became embroiled in a serious dispute with Reverend Murphy and Bishop Newport after the publication of articles in the journal *Nineteenth Century*, in which he resolutely defended the freedom of Catholics to question the scientific assertions in the Bible, and lamented the “harm that priestly ignorance of science causes Catholics” (Artigas, Glick & Martinez 2006, 244). In the Vatican, the small Jesuit group Civilità Cattolica, supporters of a rigid doctrinal approach to Church policy regarding evolution (resulting in a condemnation of evolutionary theory) and of strict control of scientific publications by theologians, had gained more and more power over the elderly pope, provoking a “U-turn in papal policy” (Brundell 2001, 93). Mivart was obviously suspect in their eyes, and in 1893 they succeeded in having him condemned by the Congregation of the Index (this was not directly for his writing on evolution, but rather for articles putting forward a non-orthodox concept of hell). Though Mivart was formally rehabilitated in 1894 after a retraction and a declaration of submission to the Church authorities, this contributed to his ultimate condemnation in 1900, shortly before his death.

In 1896, Mivart supported Reverend John Augustine Zahm’s book *Evolution and Dogma*, in which the University of Notre Dame academic enthusiastically promoted Mivart’s theory of evolution. The translation of the book into Italian provoked a violent reaction from the Holy Office. A complete explanation of the reasons behind his condemnation must also mention Mivart’s 1898 articles on the Dreyfus case in France, in which he violently attacked the hypocrisy and abominable nature of the ecclesiastical position on the subject (Root, 1985).

According to O’Brien (1931), the actions that the University of Louvain took for a rapprochement between evolution and the Scriptures was “one of the greatest, if not indeed the greatest, of all the universities conducted under the auspices of the Catholic Church” (115). Mivart made regular visits in Louvain, where he defended a Master’s thesis in medicine in 1884 and became a professor of Natural History the same year. He taught a course on the philosophy of natural history in Louvain between 1890 and 1893, but had to resign after his condemnation by the Index.

De Raeymaeker (1951, 520) mentions that, as early as 1881, Mivart had been referenced in the course taught by Mercier in Malines, where he held the chair of philosophy. In his Louvain institute, Mercier prominently featured Mivart’s theory, writing of him in 1894: “Let us proudly quote the work of our colleague S. G. Mivart. … No one has done as much as he has to show the weaknesses of positivism and help to oppose it and restore honor, in England and America, to the fundamental tenets of the Scholastic” (Mercier 1894, 9). Also in 1894, worried about the rising tensions between the Institute and the other elements of the university, Mercier contacted the rector to confirm that, after his rehabilitation by the Holy Office, Mivart would still be able to teach at the Institute. He wrote in a letter to the rector:

> I join with Mr. S. George Mivart in praying that His Eminence the Rector use his influence with Our Lords the Bishops to ensure that this Catholic scholar be included again among the members of the Academic Body. If Mr. Mivart was wrong, he humbly recanted. He is still capable of providing valuable services for the Catholic cause and to that of scholastic philosophy in England. Wouldn’t it be a good deed to help restore him to something of his former prestige? (Mercier to the Rector Abeloos, 26 July 1894, in Fonds Institut de Philosophie, LA)[32]

In a section on transformism in “Objective Significance” (Mansion, 1903), Mansion explores how a probabilistic approach may help support Mivart’s views on transformism through discontinuous and large variations. In 1877, the Belgian philosopher and psychologist Joseph Delbœuf (1831-1887) from the University of Liège, who had a strong interest in mathematics, wrote a paper attempting to provide mathematical support for transformism (Delbœuf, 1877). This paper discussed how combinatorics demonstrates that evolution systematically favors the predominance of

[32]Je me joins à M.S. George Mivart pour prier Mgr. le Recteur d’user de son influence auprès de NN.SS. les Evêques pour obtenir que ce savant catholique soit incrit à nouveau parmi les membres du Corps Académique. Si M.Mivart s’est trompé, il s’est humblement rétracté. Il est capable de rendre encore de précieux services à la cause catholique et à celle de la philosophie scolastique en Angleterre. Ne serait-ce pas une bonne action d’aider à lui rendre quelque chose de son ancien prestige?

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mutations. Delbœuf's interest in evolutionary theory seems to have been more related to the fact that it was the burning scientific question of the time, rather than to its religious implications. Despite its oversimplifications, Mansion praised Delbœuf's attempt, and further commented on some necessary adjustments that needed to be made to correct his false conclusion. The result was an argument in favor of Mivart's vision of evolution.

Probabilism and faith

In relation to the excitement around the theory of evolution, reflections about the calculus of probability and its presence in scientific modeling were of particular interest to Mercier and Mansion. Probability, and its relationship to knowledge and certainty, had been continuously discussed at least since Hume. In the middle of the nineteenth century, the relationship between probability and religious faith was the main topic studied by one of the most influential theologians of the time, the Englishman John Henry Newman (1801-1890), a former Anglican minister who converted to Catholicism in 1845. In 1870, Newman published his major book *Grammar of Ascent* (Newman, 1870), in which he asserted that, in everyday life, the accumulation of probabilities replaces formal logic. The latter is generally inoperative because it is too rigid to be applied to the continuously changing circumstances of life. For instance, I am certain that Britain is an island, although I have never verified this fact myself: it is the accumulation of probabilities in favor of the fact that Britain is an island that leads me to certainty. This concept was supported by many modernist theologians, especially Jesuits such as Henri Brémond (1865-1933), who published an overview of Newman's main ideas (Bremond, 1905), which are scattered throughout Newman's book in a somewhat confusing manner.

Newman's central idea was that man has access to an "illative sense" allowing him to form a personal logic built on a cluster of probabilities, and to convert these probabilities into certainty. This "sense" is the central property of mankind that "helps him out" in confronting the questions of faith. While Newman's probabilism was highly praised in Catholic circles, this was not true everywhere, even in the case of theologians (Anglican admittedly) such as Edwin Abbott (1838-1926), who were afraid that it would become an incitement to atheism by casting doubt on any belief. In their excellent paper, Smith, Berkove, and Baker (1996) present Abbott's famous parodic novel *Flatland, a Romance of Many Dimensions* as a response to Newman's theories.

Like all Catholic intellectuals in the second half of the nineteenth century, Mercier was deeply interested in Newman. Boccaccini (2017) presents a comparative study of Newman's, Brentano's, and Mercier's approaches to knowledge. As he mentions, all three thinkers opposed the domination of Kantian idealism by developing a metaphysics based on gnoseological traditions with roots in medieval philosophy. Mercier was particularly interested in the new science of psychology. De Raeymaeker (1951, 550) notes that, as early as 1891, a course of experimental psychology was taught at the Institute of Louvain by Ghent University professor of pharmacology Jean-François Heymans (1859-1932), and a laboratory was soon established. In their interesting—though slightly hagiographic—book, Misiak and Staudt (1954) present Mercier as the "Catholic pioneer of scientific psychology" (chapter 3, 34–52).

Mercier was engaged in reflection about probability. Louvain's archive includes his lecture notes on probability theory, which were presented to students at the institute in 1891, among his personal papers. The content of the lectures was not particularly original, but two points deserve emphasis. First, Mercier's aim was to teach the mathematical basis of probability theory. He presented his students with the principles governing probability (the principles of total probabilities and compound probabilities) and gave many examples of calculations using these principles. In keeping with his intellectual plan to provide his institute's students with a strong scientific grounding, Mercier thought that a philosopher must begin by learning the techniques of a science before constructing a philosophical approach to it. Mercier most likely intuited that this was the only proper way to avoid condescension from scientists. Some philosophers shared

Mercier's sentiment. Léon Brunschvicg, for instance, wrote that "philosophical speculations that relate to the space of geometers without any other specification, whether a reality or a pure idea or a form of intuition, have lost touch with current science" (Brunchvicg 1912, 444).

A second observation is that Mercier does not mention the possibility of an objective probability, but only the concept of a subjective probability that mathematical probability is supposed to quantify and make calculable. Although he is not quoted in Mercier's notes, this approach is in line with Newman's use of probability simply as a tool to illuminate free will.

It was from Mansion's lectures in Ghent that Mercier learned the basis of the calculus of probability, and he had asked Mansion to give lectures on mathematics, including its history and philosophy, at the institute since the very beginning. This formed part of the background of "Objective Significance" (Mansion, 1903), which presented his conception of the objective contents of probability a century after Laplace and Condorcet. As Mansion mentioned, in the second half of the nineteenth century several scientists, such as Bertrand and Poincaré, claimed that this objectivity was mostly an illusion. In his final edition of Boudin's treatise (Boudin, 1916), in which he inserted "Objective Significance" (Mansion, 1903) as an appendix, Mansion stated his conclusion regarding the nature of probability:

> Our first thesis is as follows: The object of the Calculus of Probability is events that are subjected to a complex law, resulting from a principal law according to which certain numerical relations are constant, and secondary disruptive laws giving birth to weak variations of these ratios. In the study of such events we can consider the results deduced from the law of large numbers to be legitimate. We conclude from this principle that the Calculus of Probability can be applied to moral statistics, games of chance, and evolutionism, but not to judgments in civil or criminal matters, or to the probability of causes. Our second thesis is Newman's principle of the accumulation of independent probabilities. Properly speaking, it cannot be translated into a formula, except in a symbolic form using an unknown function. We show that this principle, thus far ignored by geometers and logicians, is the perfectly legitimate source of our practical certainties, in all the sciences that are ultimately based on evidence, such as the natural sciences or historical sciences. (Boudin, 1916, xiii)

At the end of "Objective Significance," Mansion twists Laplace's formula in a slightly provocative manner by asserting that for God, and only for him, "nothing is uncertain and the future, like the past, is present for Him" (Mansion 1903, 90). Perhaps Mansion would have praised what Georges Bernanos, another Christian militant, would write fifty years later: "what we call chance is perhaps after all only the logic of God" (Bernanos 1947, 1613).

4 - What would the Jesuits be without probability?

There is another unique aspect of Mansion's scientific life that is somewhat connected to his interest in the calculus of probability: his complicated relationship with one of the main founders of this field of study, the French mathematician and philosopher Blaise Pascal. In a short, popular biography of Paul Mansion published in a local magazine, local historians Paul Grognard and Andrée Hubin wrote that there was a single topic that provoked real moments of rage in the otherwise extremely even-tempered Mansion. They noted that "[Mansion] lost his composure if, occasionally, someone in his presence dared to boast about the scientific merits of Blaise Pascal. 'Pascal did not invent anything,' he would say, 'he cultivated paradoxes without reason, he was not a genius, he was an original evil'" (Grognard et Hubin 1973, 43).

Mansion's last published paper (Mansion 1920b), written during the Great War and published posthumously in the *Revue des Questions Scientifiques* (not without some hesitation due to its argumentative tone) claimed to be a scientific biography of Pascal. Its central thesis is presented

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without nuance by the elderly Mansion: there is no such thing as Pascal's scientific achievement, with the noticeable exception of his research on the calculus of probability. According to Mansion, Pascal had borrowed all of his supposed discoveries from various scientists (Torricelli, Descartes, Mersenne, Desargues, Roberval, Otto de Guéricke, Stevin, and more). He maintained that French writers and scientists were fully responsible for constructing a legend around Pascal's genius. Indeed, Mansion wrote that "in France, despite all of the documentation, the admiration for Pascal is almost idolatrous, even among those who know and acknowledge the deficiencies of his mind and character .... It is this half-canonization that we are trying to counteract" (Mansion 1920b, 333-334).

In a second part of this paper, Mansion tried to prove that Pascal was not the Jansenist he was portrayed as by those who wanted to prove that he was an opponent of the Catholic Church, a position that supposedly should have been ensured by his scientific and independent originality. On his deathbed, he argued, Pascal was repentant, receiving extreme unction as a submissive son of the Church. Mansion's opinion was judged to be excessive even by his close friends.

Why was Pascal such a focal point in Mansion's life? The first possibility that comes to mind is that Mansion was closely associated with many institutions and people linked to the Jesuits, and it is well known that most of Pascal's attacks were directed against the Jesuits. In Pascal's view, the Jesuits—who, indeed, during Louis XIV's reign had had direct access to the king and viewed the so-called Jansenists as heretics more or less comparable to Protestants—were hypocrites, and their casuistic approach to the faith was a satanic way of manipulating the consciences of their listeners. Pascal was particularly severe in his Provinciales about the way Jesuits misused probability: they became champions of probability, which had been invented for the sole purpose of perverting the morals that the Church had received from Scripture and from the Fathers. A famous Pensée sums up Pascal's hatred towards his concept of Jesuit probabilism: "What would the Jesuits be without probability and probability without the Jesuits? Take away probability and you can no longer please the world. Bring in probability, we can no longer displease it" (Pascal 2004, 286).

However, the proximity of Mansion to the Jesuits seems like a weak explanation for his obsession. After all, the Belgian Jesuit Henri Bosmans communicated regularly with his former professor at Ghent University,[33] and Bosmans wrote several laudatory texts on Pascal's mathematical works at the time. Bosmans felt that Mansion's opinion of Pascal was too harsh, though he wrote in "On the Mathematical Work of Blaise Pascal" (Bosmans, 1924), that on the whole it was true that other scientists before Pascal had made many of the discoveries that were later attributed to him. Bosmans did not wish to perpetuate Pascal's legend without tempering it with some criticism, as had been done too often, especially in 1923 on the tercentenary of Pascal's birth. On the contrary, Bosman's desire was to present the Pascal beyond the legend, as a profound and powerful, but human, mind. He wrote that he considered Pascal to be "not only a good but also a great geometer. It is impossible, however, to appreciate his true merit, unless one forgets the enthusiastic exaggerations that writers, strangers to the subject, have written about him" (Bosmans 1924, 7-8).

One hypothesis that could explain Mansion's hostility is that he may have been influenced by the violent discussions about Pascal that took place in France at the beginning of the Third Republic. Anti-clerical Republicans placed Pascal on a pedestal as a symbol of the fight of free-thinkers against the clerical hegemony. Quantin (2014) explores how the inclusion of Pascal's Provinciales by Republican and anti-clerical ministers, such as Jules Ferry or Paul Bert, in the syllabus for the baccalauréat in 1880 and the Brevet supérieur in 1884 had been part of the school war in France. On the one hand, the anti-clericals saw Pascal's accusations against the Jesuits as a welcome condemnation of the Church's desire for dominion over the French scholastic system. On the other hand, however, several Catholics were convinced that it was actually possible and necessary to restore Pascal to a position as a major spiritual and religious thinker. They began to

[33]Their correspondence was published and commented on in Hermans (2010). Pascal is not mentioned in their letters.

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produce new annotated editions of the Provincales, which met with mixed reviews in the Catholic world.

Although I have not found any direct proof of Mercier or Mansion having paid special attention to what was happening in France, they could not have missed such developments, and, being deeply engaged in the Church, most likely looked on them with worry. In addition, they had probably been horrified by the expulsion of teaching congregations by the French government under Emile Combes in 1901, resulting in thousands of French congregationists settling in Belgium.[34] Pascal was in fact present on the Belgian intellectual scene during the second half of the nineteenth century, as demonstrated by several publications, each of which relies heavily on religious arguments, although they vary in the way they portrayed Pascal.

In 1855, Emile Lion, a lawyer from Liège, wrote an article on Pascal for the *Moniteur de l'enseignement*, which was the official journal of teachers published by the Athénée in Tournai, republished as the separate booklet (Lion 1855). While Lion's text was clearly intended as a rehabilitation of Pascal, it cannot be said to have displayed genuine hostility towards the Church, even though it contains some remarks that can be interpreted as hostile to the most rigid tendencies of Catholicism. Lion wrote for instance that "Pascal was not one of those exalted spirits who indulged in the great dreams of philosophy, and his geometrical mind would not have endured such mysticism" (Lion 1855, 32).

Thirty years later another book (Laurent 1884) was published about Pascal in Tournai. It belonged to the series *Musée moral et littéraire de la famille* and was related to the local Jesuits' attempt to promote an image of Pascal as an obedient son of the Church, although slightly naive and deceived by heretics. According to Laurent, Pascal had been subsequently and unjustly attacked both by some Catholics who considered him to be a Jansenist, and by some anti-clericals who saw him as a fanatic. But, Laurent (1884) writes that "the day comes when the trick is discovered, and full justice is finally returned to the victims of Voltairean hatred" (Laurent 1884, 5). The fourth chapter of this book, which is devoted to the Provinciales, is delightful. We learn on page 43 that "irreligious criticism has exhausted all the formulas of praise in the French language, in favor of the work that we cannot pass over in silence." However, Laurent adds on the next page, using a notorious casuistic line of reasoning: "God did not judge him as severely as men did, because he found him to be a Jansenist, guilty in action but not nature, according to the didactic classification."

Opinions about Pascal thus seemed rather pacified at the end of the nineteenth century in Belgian Catholic circles, and Mansion appears to have been a rather mysterious exception to this rule. Moreover, other scientists with whom Mansion had many views in common, such as the physicist Pierre Duhem, were enthusiastic followers of Pascal.[35] Pascal's more or less minor presence in Mansion's scientific life is nevertheless quite noticeable, and Mansion's singular obsession may have fueled his interest in the calculus of probability. After all, his first publication (Mansion 1868) was about a very typical Pascalian problem, the problem of points. Thus, despite his harsh criticisms in "Pascal" (Mansion 1920b), Mansion seemed to have had mixed feelings about the French thinker, and at least praised him for his work on probability.[36]

[34]On this topic see Cabanel and Durand (2005).

[35]On this see Stoffel (2007).

[36]Mansion's hostility towards Pascal was not his only show of opposition to a philosopher. In another paper written during the war and published posthumously as "On the Supreme Importance of Mathematics in Cosmology, about Kant" (Mansion 1920a), Mansion explained that Gauss had considered Kant's concept of space to be totally irrelevant to mathematics. According to Mansion, the history of geometry provides an unequivocal argument against Kant's concept of space as an innate form of sensibility. It was not the first time that Kant's misunderstanding of mathematics was stressed: Couturat (1904), on the occasion of the centennial of Kant's death, had already harshly criticized Kant's absurd anti-analytical approach to mathematics. Mansion's comment may have been the first to call out certain neo-Thomistic arguments. In May and June 1895, Mansion had read a series of lectures in Louvain about non-Euclidian geometries and their anti-Kantian consequences. These questions were subsequently discussed within the Louvain Institute. At the beginning of the twentieth century, a cleric,

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Conclusion

The years following the Great War saw an important evolution in the presence of probability on the worldwide mathematical stage. Although this movement was part of a series of transformations that began long before the 1910s, such as the profound changes that occurred in the field of physics, it acquired considerable momentum during the 1920s, and probability (theoretical as well as applied) gradually became a major topic of research in those years. A significant example of this new situation is the rapid development of Markov chains recounted in Bru (2003). The transformation was especially spectacular in France, where, under the powerful influence of Emile Borel in particular, probability began to appear in syllabi and also as a dynamic research domain, with the emergence of interest from first-rate scientists such as Maurice Fréchet and Paul Lévy. Therefore, a strong emphasis on probability, which had been fairly unique to Belgium in the second half of the nineteenth century, as discussed here, gradually became the norm in other countries. As was explained above, the distinct features of the Belgian situation help explain how Belgium became a leading country in probability around 1850. The presence of Quetelet and other mathematicians at the time, their dynamic activity within the restricted scientific arena of a small, new country seeking an avenue for original scientific development, the curious geographical location between two powerful neighbors (France and Germany), as well as the francophone element facilitating the import of French mathematics (and French mathematicians, such as Garnier and Catalan) all came together to form the complete, complex picture.

Paul Mansion therefore appears to be a good representative of the Belgian mathematical community of his time. However, he also had some unique personal characteristics, chiefly his desire to combine his scientific work and his religious faith. A striking example of this desire is found in a public letter, quoted in a footnote in Mercier's textbook (Mercier 1922). After the liberal newspaper *La Flandre Libérale* had complained about Mansion's religious commitment, which seemed incompatible with his position as a scientist at Ghent University, Mansion responded in scathing terms. Mansion wrote in particular that

> It is unscientific to speak incessantly of the antagonism between science and Catholicism in general, without ever going into detail. If La Flandre Libérale and the other Belgian anti-Catholic journals are so sure of this antagonism, what prevents them from presenting the so-called antinomies between science and faith to us, Catholics, with precision, in a table with two parallel columns? In the first would be the scientific truths borrowed from physics, chemistry, astronomy, mineralogy, geology, botany, zoology, anthropology, biology, and so on. In the second, opposite this list, if they are known, the contrary decisions of councils and popes, as found, for example, in the Enchividion of Denzinger. But we dare to predict that the second column will remain empty, if we insert only authorized interpretations of the Bible and the Catholic Tradition, and if we do not put in the first, under the pretext of science, unprovable assertions. (Mercier 1922, 38)[37]

Abbot Charles Sentroul (1876-1933), defended a PhD in which he asserted that, contrary to Mansion's opinion, non-Euclidian geometries were interpretable in a way that reconciles Aristotle and Kant (Sentroul, 1905). "On the Supreme Importance of Mathematics in Cosmology, about Kant" (Mansion 1920a) was a response to Sentroul's criticism, in which Mansion defended the idea of the necessity of mathematics in order to understand philosophy as being on par with the importance of philosophy for a deep understanding of mathematics.

[37]Il n'est pas scientifique de parler sans cesse de l'antagonisme de la science et du catholicisme, en général, sans jamais descendre au détail. Si *la Flandre libérale* et les autres journaux anticatholiques belges sont assurés de cet antagonisme, qui les empêche de nous mettre sous les yeux, à nous catholiques, les prétendues antinomies de la science et de la foi, avec précision, dans un tableau à deux colonnes parallèles ? Dans la première seraient les vérités scientifiques empruntées à la physique, à la chimie, à l'astronomie, à la minéralogie, à la géologie, à la botanique, à la zoologie, à l'anthropologie, à la biologie, etc.; dans la seconde, en face, si l'on en connaît, les décisions contraires des conciles et des papes, telles qu'on les trouve, par exemple, dans l'Enchividion de Denzinger. Mais nous osons prédire que la seconde colonne restera vide, si l'on n'y insère que des interprétations autorisées de la Bible et de la Tradition catholique, et si l'on ne met pas dans la première, sous prétexte de science, des assertions indéfendables.

Because Mansion was so active in publishing and popularizing mathematics, notably with his journal *Mathesis*, he was able to infuse probability theory with some special contributions through his reflection on determinism and interpretation of probability, all of which occurred in the context of academic quarrels in the young country, as well as in the midst of disturbances in the Church due to contact with scientific modernity. While it is true that Mansion's reflection on the meaning of probability gradually faded into the background in the twentieth century due to the empowerment of probability as a mathematical domain, this bears witness to the ambiguous state of a discipline whose concepts have always retained something of the original desire to define randomness and chance.

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