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IN MEMORIAM: FRANÇOIS JONGMANS (1921–2014), MATHEMATICAL HISTORIAN

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Abstract

After retirement from the University of Liège, François Jongmans wrote on the history of mathematics for 25 years. His initial focus on Eugène Charles Catalan (1814–1894) broadened to 19th century mathematics in Belgium and France, and extended to the history of geometric probability. A long-term interest was the gauging of wine barrels, a topic neglected for two centuries. The present personal tribute derives from a collaboration on some seven papers, and an intensive correspondence of over 20 years. It sets the work on geometric probability and particularly barrel-gauging in a self-contained context, with additional background from the correspondence. This tribute will be electronically accessible on Google under the above title after publication.

Keywords: Bienaymé; Catalan; Cesàro; Barbier; geometric probability; broken rod; barrel gauging; Henri Breny; Anne-Marie Décaillot

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1. Biography

François Jongmans (FJ in the following) was born in Liège, a centre of French culture in Belgium, on 7 July 1921. At the time of his death at Chambéry, France, on the 23 May 2014, he was Professeur Ordinaire Émérite, Faculté des Sciences, Université de Liège, from which he had officially retired in 1988, although he dated his *de facto* retirement to 1986. From the time of his retirement he contributed much to the history of science, relating in particular to mathematics in Belgium and France, and even more specifically through our collaboration to the history of probability. It is from this history standpoint that the present tribute is written.

FJ's father, Corneille, of a family originating in Limbourg, was also born in Liège, where he was a metal turner. FJ's mother, Carola, was born in Lierre (Lier, a town in the Flemish region of the province of Anvers). Through regular visits to the home in Lierre of his maternal grandmother, FJ learned the Flemish language, and spoke it fluently.

FJ had a brother, Marcel, one year older. The parents had meagre financial resources, and wanting the boys to have a better life than their own, encouraged them to continue their education, rather than sending them out to work at the age of 14. The boys had only a corner of the kitchen table to study on.

FJ was able to complete secondary studies in Liège, and with strong encouragement from his professors, won a scholarship to the University. In a letter to me in March, 2005, concerning the title in Latin of his paper (which became Jongmans (2008)), he said 'I never learned Latin, as a boy of low social level, but I presume my maxim is lexically correct (can you check that?)'.

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In fact, he had an astonishing flair for languages. His letters, and our conversations, were always in very correct English. He translated for me from Italian into English most of a rather long paper on probability by Cesàro (1891a), (1891b), a student of Catalan's; and FJ's coauthor, Franco Palladino, wrote to him in Italian. FJ sent me long-obscure extracts in German. A letter of January 2001, concluded by 'Cordially in aeternam, et lux perpetuam', has a long passage on the Hungarian pronunciation of dipthongs.

In one of his final letters (12 May 2010) in which he reflected on his academic life, he wrote of his undergraduate years:

> If I was, let us say, a good student, my 4 years (from 1938 to 1942) spent at Liège University, were disturbed in 1940 by the 'presence' of the German army and the lack of some professors (prisoners of war), plus starvation, so the quality of studies was not at the top. As for research, I had chosen the field of geometry.

FJ's illustrious graduate career at Liège University as convex geometer, together with a complete list of all of FJ's publications (including the historical ones which I list below), is described in the obituary by Bair (2014a)

The family of Germaine, his wife-to-be, had spent five of the war years in London and Scotland. She commenced her studies in mathematics at Liège University in October 1945, fell for the handsome assistant FJ, and married him on 18 March 1948. She gave up her mathematical studies to care for her family. There were eventually four children, Jacques (a priest in Brazil), Pierre (1951–1967), Claire (a now-retired Professor of Law, in Liège), and Denis (now Professor of Geology at the Université de Grenoble in France).

After FJ's retirement from Liège University, he and Germaine, keen gardeners, continued to live in Magnée. In time, their garden had become too large to manage. On 6 October 1993, they moved to a newly built house in the village of Mortier, where at the time Denis and his family were living. Germaine died on 24 January 2008, at Argenteau, Belgium. Towards early October 2009, FJ left Mortier for sheltered housing 'at the end of a very small village called Preslette, in a typical "chalet" of Savoie, [one of several small homes] under direction of a gentle woman called Jacqueline Chateauneuf…'. The location was close to Denis and his family.

Our contact, apart from three meetings, was by handwritten letters, of which each of us kept copies. His first letter to me is dated 1 August 1989, the last is dated 30 December 2010.

FJ was a meticulous and excellent correspondent. My 'Jongmans' archived box in my retirement office at Sydney University has four folders of correspondence, over consecutive blocks of years to about 1998, and four folders in my office at home contain subsequent correspondence in folders over the period 2000–2008, until François was no longer able to write from his retirement home in France. Mme Chateauneuf and Claire kept me in touch with FJ by email until his death at a hospital near to his lodgings.

FJ left his body to science. In accordance with his wishes, there was no funeral ceremony.

2. François Jongmans and the history of mathematics

In a letter to me, of late September 2009, FJ wrote:

> I began myself to be interested in historical stuff about 1984, just before the end of my teaching career; Sluse and Catalan led me to Paul Butzer, to Bienaymé, to Seneta, and so on, until I met barrel gauging (today)…. The main event in the near future will be the publication (in Paris, more precisely in *Quadratures*) of my next (and last) paper about 'Barrel gauging'. (Jongmans (2010).)

His historical work, individually and collaboratively, was focussed on history associated with Belgium, and more heavily on the French-culture region of Wallonie, of which Liège is one centre. In particular, FJ's foci were René-François de Sluse (1622–1685), a renowned mathematician of Liège, and Eugène Charles Catalan (1814–1894), one of FJ's predecessors as Professor at Liège University.

Sluse had corresponded with the great thinkers of his time such as Blaise Pascal, Christian Huygens, and John Wallis, and was elected to the Royal Society in 1674, and is the subject of Jongmans (1985).

FJ's focus thereafter was Catalan. FJ's initial writings on Catalan are Jongmans (1986a), (1986b), and his studies in this direction only partly culminate in the book Jongmans (1996).

Professor Paul Butzer, a distinguished and energetic Professor of Mathematics at the Hochschule in nearby Aachen (Aix-la-Chapelle), was also interested in the history of mathematics, and a very fruitful and continuing collaboration ensued, as manifested in part by the papers Butzer and Jongmans (1989), (1991), (1999).

The great Italian mathematician Ernesto Cesàro (1859–1906), as a young man, had been Catalan's student in Liège around 1879. Subsequently, Cesàro developed a large correspondence, in particular with Catalan and Hermite. In 1997, F. Palladino and L. Carbone, the Italian guardians of Cesàro's legacy, turned to FJ with a view to formatting, editing, and publishing this correspondence. This appeared as two papers, Butzer *et al.* (1999), (2000). At about this time FJ embarked on a detailed commentary, letter by letter, on this correspondence. In a letter to me, dated 21 July 2000, FJ wrote:

> Finished 1st draft of the 'comments' on the correspondence Catalan–Cesàro. It was a hard job. I shall now await the reaction of Palladino…; in the meantime I'll begin the same work for Hermite–Cesàro.

In a letter dated 5 February 2002, FJ wrote:

> As for me, I am going to write now a paper about wine-gauging, interwoven with Cesàro's probabilities and comments on Cesàro's correspondence with Hermite and Catalan.

FJ regrettably did not live to see the preliminary version of SABIX (Verdier (2015)) celebrating the Bicentenary year of Catalan's birth, produced through the efforts and good offices of Norbert Verdier; and celebrating FJ's own work on Catalan. Nor did he live to see celebrations of that Bicentenary in Liège.

The stimulus to the collaboration and friendship of myself and FJ was the paper by Butzer and Jongmans (1989) about P. L. Chebyshev (1821–1894) and his contacts with Western European scientists. Catalan had been one such contact. The French mathematical statistician Irénée-Jules Bienaymé (1796–1878) (IJB in the following) had been another. This particular contact was central to my interest in the history of probability and statistics in 19th century France and the Russian Empire.

Professor Butzer had sent me the offprint, since the authors had seen and cited Heyde and Seneta (1977). I wrote on 13 July 1989 to thank him, and mentioned the possibility of the existence of Bienaymé family documents in Paris. Butzer replied politely that François, having more time since he was now retired, might be interested in IJB. And indeed he was, not least because of IJB's strong Belgian connections.

3. The Bienaymé connection

FJ's first letter to me, in clear handwritten English as were all the subsequent letters, is dated 1 August 1989, and advised that he was busy working on what was to become the book on Catalan (Jongmans (1996)). But he also said that he would be willing to go to Paris for a few days to investigate. In the meantime he would send me copies of three letters, of 1876, 1877, and 1878, from IJB to Catalan. The letters of 1876 and 1877 would contribute to both aspects of Jongmans and Seneta (1993). The long letter of 1878 was to play a central role in our later paper: Jongmans and Seneta (1994).

In a letter dated 15 March 1990, I wrote to FJ that I had made initial contact with Bernard Bru, whose main historical interest at the time was A. A. Cournot (1801–1877), a close friend of IJB. Bernard had recently discovered, amongst the Cournot materials, the essence of the lost proof of IJB of the criticality theorem of branching processes. Bernard was to become a good friend and valuable contact of us both.

FJ denied that he was anything of a probabilist or statistician, which was the general technical area in which we collaborated, but he was firmly focussed on the historical role of Belgian mathematicians of French culture. IJB could be considered as such, having spent a part of his childhood and youth in Bruges, the birthplace of Catalan. IJB's friend and contemporary leading Belgian statistician, the great L. A. J. Quetelet (1796–1874) was born the same year as IJB. It was not long before I had as enclosures with a letter from FJ dated 24 March 1990, typed copies of letters from IJB to Quetelet, in particular recalling nostalgically his Bruges years (1803–1811). Then, in a letter dated 21 September 1990, FJ gave me the good news that his contact, Germain Bonte, a retired officer with archival training, and with the Bruges archives as a hobby, had provided him with much information about members of the Bienaymé family. Germain Bonte's information later stimulated a paper on the history (Jongmans and Seneta (2000)) of Bruges as a nursery of mathematicians.

A long letter of eight closely handwritten pages dated 7 December 1990 from FJ contained a detailed account of his investigations in Paris, much detail from official archives on the Bienaymé family history, including photocopies of certificates of birth, death, and marriage of various family members.

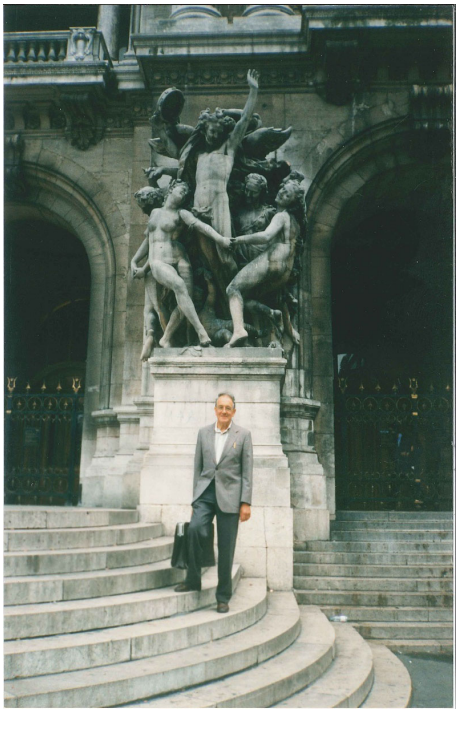
Our source materials on the Bienaymé family history and IJB's contact with Belgian mathematics were thus almost completed. We prepared a joint note on IJB combining what we had at the time. Published as Bru *et al.* (1992), it was a condensation of Bru (1991) and a forerunner of the comprehensive Jongmans and Seneta (1993).

There had been correspondence between IJB and A. Meyer (1803–1857), of which we learned from Henri Breny (1923–1991), a friend and colleague of FJ at the University of Liège. Breny's interest in the history of the course on probabilities at the University of Liège, whose teachers included Meyer, Catalan, and Breny himself, led to the work Breny (1992). Henri and I had been exchanging letters sporadically for many years before meeting at a conference in Maastricht in August 1985; and more intensively during the debilitating illness which took Henri's life, on 5 January 1991. FJ and I completed the historical work on Meyer's role, in the context of his quarrel with Schaar, and contact with IJB, on the turning point test for randomness, and it was published as Breny *et al.* (1992), immediately following Breny (1992). We also wrote an obituary: Jongmans and Seneta (1992). On my first visit to Liège, not long after, we visited Henri's grave, and his family.

The notes on Catalan's (1877) 'un nouveau principe' for probabilities in Breny (1992), and FJ's special interest in Catalan helped motivate us to take up studies focussed on Catalan's probabilistic work, published as Jongmans and Seneta (1994). A follow-up paper by Bair

(2014b), while primarily written to celebrate Catalan's 200th birthday, is no less a tribute to its author's mentor, FJ.

The five papers published in the period 1992 to 1994 on which both our names appear mark the first phase of our collaboration. The two papers in our overall collaboration which were published in *Archive for History of Exact Sciences* were communicated to that journal by Bernard Bru. We all three met in Paris in 1996, at the Bienaymé symposium organized by Bernard, and this photo of FJ is from that time.



François Jongmans

4. Phase two: Geometric probability and Virginia

Geometric probability is the study of probabilities of geometric quantities such as a length or an area. The topic began in 1777, with what is now called the *Buffon needle problem*. Buffon asked, in effect: if one drops a needle of length l 'at random' onto a set of parallel lines which are all a distance d apart, where $d > l$, what is the probability that the needle intersects one of the parallel lines? Under uniform distribution assumptions on certain statistically independent random variables to define 'at random', the probability sought is the probability measure of an area in the two-dimensional plane.

In Britain a variant of the needle problem contained in a textbook of Isaac Todhunter of 1857 consisted of seeking the probability of intersection from tossing an ellipsoid disc with major axis $l < d$. British activity in geometric probability was substantially advanced from 1865 by James Joseph Sylvester (1814–1897) and his protégé and colleague Morgan William Crofton (1826–1915).

In Paris the young Joseph-Émile Barbier (1839–1889) extended, by a probabilistic method, Buffon's result first to any convex figure approximable by regular polygons, and then to an

arbitrary unbroken curve, in Barbier (1860). French and British developments were almost completely independent, and reflected the complex and erratic process of communicating mathematical results across the Channel. I had collaborated on the communication problem with the well-known historian of mathematics Karen Parshall, with Sylvester as focus, and Bienaymé as correspondent, in Parshall and Seneta (1997).

I spent, from 1988 to 2004, a number of somewhat-separated semesters at the Department of Mathematics, University of Virginia, USA, teaching applied probability models and doing research. My impending visit there for the Fall Semester of 1999 was partly due to Karen, whose continuing focus was James Sylvester, while mine at the time was Crofton, largely from a biographical point of view. The culmination of that was to be Seneta and Johnson (2004). Crofton had written the article on 'Probability' for the famed ninth edition (1885) of *Encyclopaedia Britannica*, which was heavily focussed on his own sophisticated theorems of geometric probability. At the time I knew little of 'Crofton's theorems', or (apart from Buffon and Barbier) almost nothing of French and German developments. Clearly, collaboration with Karen should proceed along the biographical and technical framework: Sylvester/Crofton/Barbier; so we needed an expert on geometry, with good access to the related European literature. FJ was the self-evident and ideal candidate, because of his expertise in convex geometry, in his career before retirement (Bair (2014a)), and his facility of making connections with and within French-language mathematical writing.

In a letter dated 6 April 1999, FJ wrote about his current projects:

> Except for the Bruges nursery [pepinière] and for the correspondence Hermite–Cesàro (with Palladino etc.), I have nothing important before me but geometric probability.

But collaboration was in train already in February 1999.

FJ's early contributions to our three-way collaboration were biographical materials on Barbier, and the existence and consultation of the books by Czuber of 1884 (the first book addressing geometric probability), and of E. Borel and R. Deltheil of 1926. The latter discussed all of Sylvester, Crofton, and Barbier, and especially made Barbier's approach rigorous.

FJ wrote of Barbier:

> His contribution to geometric probability was saved from oblivion by Sylvester [in 1890–1891] and Delheil…. Will Barbier ever occupy his due place in the 'B' litany of French probabilists-statisticians: Buffon–Bienaymé–Barbier–Bertrand–Borel–Bachelier…?

FJ continued to be mathematically intrigued by Barbier's discussion of the convex case in continuing letters, for years beyond the time that I arrived in Virginia in late August 1999, with new references, ideas, and insights on geometric probability.

There was also a Catalan connection: Karen's investigations had revealed the existence of a published letter from Cesàro, to Sylvester. Ernesto Cesàro (1859–1906) had been Catalan's student in Liège around 1879. And in the Catalan–Cesàro correspondence, which FJ continued to annotate, there was a letter of March 1891 (Letter B5 of Butzer *et al.* (1999)) of Cesàro to Catalan critical of the treatment of a geometrical aspect in the book of one of Barbier's protectors, Joseph Bertrand, who became one of the protagonists of our three-author paper. This letter concerned Bertrand's cavalier treatment of the case when the number of outcomes in a random experiment is [nondenumerably] infinite, a situation which Cesàro treated rigorously by means of probability densities.

I completed a first draft of the three-author paper, before my departure from Virginia for Sydney, Australia, in mid-December 1999, and left it with Karen. The eventual result of the collaboration was Seneta *et al.* (2001), a British/French history of geometric probability. Its

typing and graphics were done by the excellently skilled Julie Riddleberger (recently deceased) of the Department of Mathematics at the University of Virginia.

5. Geometric probability: Catalan and Cesàro

Another famous problem in geometric probability, whose origin and solution go back to 1873, asks: if a rod of length 1 is broken into n pieces at $n-1$ randomly chosen points, what is the probability that exactly k segments are of length greater than x, where $k = 0, 1, 2, \ldots, n$, and $kx \leq 1$. Catalan had contact with geometric probability in the context of this problem of the broken rod. This was through his very energetic correspondent located at the University of Ghent, Paul Mansion (1844–1919), and then in connection with the probabilistic work of Cesàro. In 1874, Catalan, Mansion, and Joseph Neuberg founded the journal *Nouvelle Correspondance Mathématique*, which continued until 1880. Then Catalan encouraged Mansion and Neuberg to publish a new journal, *Mathesis*, which appeared from 1881. Comments on the French history of the treatment of the broken rod problem in 1878 by Mansion (as author) and Catalan (as editor) in an article *Nouvelle Correspondance Mathématique* elicited a letter, published in 1879, to the editor from one Lemoine. This letter attracted the attention of Cesàro, who, under the guidance of Catalan, published on the broken rod problem in *Nouvelle Correspondance Mathématique* in 1880; and then in 1882, 1883, and 1886 in *Mathesis,* with Mansion as editor, and with Lemoine unjustly dismissing the upstart novice Cesàro.

On my return to the University of Sydney in late 1999, I continued to work on three long-term historical projects, two of which had a connection with our collaboration. These two were eventually published as: Seneta and Johnson (2004), an invited biography of Crofton, and Seneta (2003), one of whose centrepieces was Quetelet, whose key but little-known paper of 1847 on free will, was found and sent to me by FJ in October 2000, who provided much ongoing information during its preparation.

FJ had written already in July 2000, of Cesàro's successful treatment of the broken diamond problem, which is related to the broken rod problem:

> …the broken diamond contributed to clear the way towards a sound treatment of density in geometrical probability, before the 'modern' period using systematically convexity, Minkowski calculus, integral geometry of Blaschke, etc.

So I also continued to work on a synthesis, mathematical verification and unification of Cesàro's fragments on the broken rod problem, encouraged by FJ's continuing intense interest and encouragement.

My first hand-written draft on the broken rod problem was dated 20 December 2000. I wrote to FJ on 20 April 2001 that I had finally verified, that morning, 'Cesàro's formula', albeit by algebraic rather than geometric means. But I then had to put all aside.

A few days after my retirement, on 30 June 2002, from my position as Professor of Mathematical Statistics at the University of Sydney, I wrote to FJ that I was still working on the 'free will' paper, and on the massive 'mathematics, Marxism, and religion' paper (to be published eventually as Seneta (2004)), and trying to work on the compilation of the broken rod material, and on FJ's correspondence on this topic.

I took all my Cesàro material with me on my next visit to the University of Virginia in the Fall of 2002, but again did not find the time to make any progress. I finally gave the first draft of December 2000 to FJ in August 2003 on my second, and last, visit to Mortier. (My first had been in June 1997.) The face-to-face contact stimulated, a 'first complete handwritten draft, September 2003', which was subsequently heavily annotated by FJ. The first typescript

version which resulted, with much taken from the Catalan–Cesàro correspondence, is dated 15 December 2003.

The resulting paper, after a long gestation period, was published as Seneta and Jongmans (2005), and is accessible on the internet by searching for its title. It gives a detailed account of Cesàro's achievement, and the background. In a sense it is a companion paper to Seneta *et al.* (2001). It was our last joint paper.

FJ's historical sources for Seneta and Jongmans (2005) motivated in part the paper Seneta (2011), which takes a geometric rather than analytic approach. In this connection there is also the study by Goodman (2008).

There had been a treatment of the broken rod problem by Laplace as early as 1777 (though not published until 1979). We owe this information to an email of Steve Stigler of 2 March 2006. Details may be found in Stigler (1986, pp. 120–122). The extremely meticulous FJ was upset by us having missed the reference in our paper, so I take the opportunity to include it here.

6. In dolio calamitas

After his elation in a letter of 17 February 2005 at the news of acceptance for publication of Seneta and Jongmans (2005), FJ's attention in this letter immediately focussed on the status of his historical project, commensurate with his career as a geometer, on geometrical models for measuring the volume of a barrel (*dolium* in Latin; *tonneau* in French), by way of a gauge (*jauge* in French). He had been engaged on this project since 1998 or 1999, initially stimulated by G. Noel and Germain Bonte.

The rod of wood or metal is plunged vertically or diagonally into a barrel lying on its side through a bunghole, an opening in the barrel at the highest point on the opposite side. The measurement on the gauge at the bunghole, $D = 2R$ for a vertical thrust, or k for a diagonal thrust, in the case of a vertical thrust, is used in conjunction with the length l of the barrel and the diameter $d = 2r$ at the ends to give an expression for the volume V of a full barrel by way of a generally empirical formula in terms of the 'fundamental triple' (l, R, r). By Pythagoras' theorem,

$$k^2 = \frac{l^2}{4} + (R + r)^2.$$

In the 19th and 20th centuries the chief tool has continued to be the diagonal rod, already known in Flanders in the 16th century, with the empirical expression for the volume given by

$$W_1 = qk^3, \tag{1}$$

with a suitable coefficient q dependent on units of measurement. Thus, W_1 needs only a simple calculation once k is obtained.

Currently, the French Office of Customs and Excise proposes a value of $q = \frac{3}{5}$, when measurements are in decimetres for lengths and in litres for volume.

In an historical example supplementing FJ's historical investigations, Carmichael (1857) (in the first paper with mathematical content to be published in Australia, when it still consisted of separate colonies), uses the fact that a cask containing $W_1 = 144$ imperial gallons was found to have a diagonal of $k = 40$ inches, to determine (using base 10 logarithms) $q = \frac{9}{4000}$ in (1) for use with these units of measurement. Carmichael wished colonial barrels to 'excel in convenience the range of [European] admeasurements at present in use' so proposed that colonial barrels follow the distinctive rule that $l/(D + d) = \frac{3}{4}$, and presented accordingly tables for pairs

(W_1, k), with W_1 ranging from 1:1000, giving commensurate fundamental triples, as an aid to colonial coopers.

However, W_1 does not always give a good approximation for the volume, since that is not entirely determined by the fundamental triplet (l, R, r), let alone k. There was work on formulae in terms of the fundamental triplet already in the 17th century, but we turn for the moment to the French Revolution.

During the French Revolution a formula was devised, given (and possibly justified by) the formal edict *Instruction ministérielle de pluviôse de l'an VII* (the date is almost equivalent to February 1799), the original text of which is lost. This formula asserts that the volume is given by

$$W_7 = \frac{\pi l(2D + d)^2}{36} = \frac{\pi l(4R^2 + 4Rr + r^2)}{9}. \tag{2}$$

FJ had put much effort into tracking traces of the lost *Instruction ministérielle* in subsequent literature. His close correspondent, Anne-Marie Décaillot (of whom more below), through her work on Edouard Lucas, had discovered a marginally connected manuscript by one Péraux. Then in a letter dated 10 March 2006 to me, FJ was excited because a book of Ken Alder (2002) about the metric system suggests that the *Instruction ministérielle* might be located at the *Bibliothéque Nationale* (*Estampes*). But in spite of a request to Mme Décaillot to investigate this, and Ken Alder's further advice, a letter from FJ dated 12 February 2007 revealed no progress on rediscovery, and so the situation remains to this day.

In his letter of 17 February 2005, FJ had written that his potential long manuscript about empirical and geometric models would stretch to 40 handwritten pages. In response to my suggestion that a paper of some 15 handwritten pages would more likely find quick publication, a 'short' paper in English, typed in LaTeX by his disciple and colleague, Jacques Bair, and eventually published in *The Mathematical Scientist* as Jongmans (2008), was received on 18 July 2006 and, heavily revised, after guidance by the Editor, Joe Gani, on 4 January 2007.

In this paper FJ first reviews five classical geometrical models for the volume of a barrel, four of which go back to Johannes Kepler in the 17th century. The fifth model, proposed by Charles Camus (1699–1768; who was an ancestor of Albert Camus) in 1741, indicated a fruitful theoretical approach after a period of stagnation. However, Camus' ideas were corrupted in the late 1700s by the publications of M. Dez:

> Then the French Revolution of 1789 initiated an empiricism devoid of elementary mathematics and a return to the cubic rod [the methodology expressed by (1)]…. This is the reason for the title of the present paper,…Truth in wine, but disaster in the wine barrel. (Jongmans (2008).)

Jongmans (2008) also proposed three new geometrical models motivated by Camus' ideas. In the main part of the paper all volumes, model and empirical (such as (2)), are given by an expression of the form

$$V = \pi l(\alpha R^2 + \beta Rr + \gamma r^2),$$

with the coefficients α, β, γ (positive, null, or negative) summing to unity. The expression presupposes, unlike (1), that units of volume are cubes of units of length. Such expressions for volume are therefore appropriate for the use of a *vertically* thrust measuring rod so the value of $D = 2R$ may be measured directly.

7. Last things

In a sad and moving letter dated 22 February 2008, contemplating at the age of 87 the likelihood of a move from Mortier to sheltered housing in France, FJ wrote:

> This is almost the dilemma you found in a marvellous poem you revealed to me at Breny's death: *Here, on the level sand, between the sea and land, what shall I build or write, against the fall of night?*…. How will I keep busy with some intellectual work?… In the near future my sole aim is to complete, hopefully with some help from Norbert Verdier, a small extension in French of my paper [In vino veritas…] to appear in June of this year.

(These lines of poetry, some of which occurred often in our correspondence, are by by A. E. Housman (1859–1936), and come from his collection *More Poems* (1936).) Indeed, through the encouragement and good offices of Bernard Bru and Norbert Verdier, FJ was able to write a more leisurely and more extensive paper, in his elegant French style, and with his own characteristic touches of humour, on barrel gauging:

> Péraux a du moins eu le mérite de dénoncer la surestimation de la solidité obtenue par les 'pluies' de l'an VII et de chercher un parapluie. (Jongmans (2010, p. 29).)

The paper, Jongmans (2010), his last, published online on 10 December 2009, when accessed by me on 19 December 2014, had 538 views of the Abstract, and 74 full-text views. (A full-text view requires a personal or library subscription.) It dispensed entirely with diagonal rod matters, and after an introduction goes directly to geometrical models, in the second section. This encompasses, with much detail, historical background, and commentary, and with additional models and numerical illustrations, the matter presented in Jongmans (2008). There is a third section, *Dissymétrie et ondulations*, on refinements, including relocation of points of inflexion in the modelling of the profile of a barrel. Finally, there are Appendices I and II by Norbert Verdier and Pierre Crépel.

In one of his last letters to me (dated 12 May 2010), a long response of four pages to mine which asked for biographical details, publications list, etc., he wrote with some cynicism but, with wry humour and gratifying satisfaction about the above:

> To be brief, I conclude that Descartes should have opened the way to barrel gauging much earlier, if celestial mechanics and logarithmic sliding rules had not locked the door for a long, long time. Luckily, the greatest mathematician of all centuries, after a century of meditation, saved in Savoie the honour of drinking mankind (in 2010).

FJ's letter of 22 February 2008 summarized our collaboration in moving terms:

> And I thank you deeply for the long trip we made together, in the company of my poor Germaine, and Eugen Zenta, and Genghis Khan, and Bienaymé, Catalan, Bernard Bru, Sylvester, Karen Parshall, Buffon, Crofton, Quetelet, Ernesto Cesàro, and so many others (Butzer, Breny), during more than 20 years.

('Eugen Zenta' is a play on my name, Eugene Seneta, and my Galician–Ukrainian origins. Prinz Eugen (Prince Eugene) of Savoy (Savoie), one of the greatest military commanders of all time, in the service of the Habsburg Monarchy of the Austrian Empire, had one of his early great victories against the Turks at the town of Zenta, now Senta, in Serbia.)

But the Jongmans story on history is not yet finished. FJ's handwritten *Commentaires*, with his own and Palladino's annotations on the Cesàro–Catalan correspondence were among FJ's

materials returned from Preslette by Denis Jongmans to Liège and Claire Jongmans, and have now been transcribed into digital typescript and lightly edited by FJ's student, colleague, and obituarist, Professor Jacques Bair. It is intended to make the typescript digitally available. We have not yet found the incomplete handwritten *Commentaires* on the Cesàro–Hermite correspondence.

The handwritten *Commentaires* on the Cesàro–Catalan correspondence as sent by FJ to Professor Franco Palladino, who died in 2010, has also been found among the Palladino papers by his daughter, Dr Nicla Palladino, whom I was able to contact through the help of Professor Luciano Carbone.

A paper by Professor Butzer on his collaborations with FJ is in preparation. This may include an account on unpublished investigations of the geographical connection of mathematicians such as Dirichlet and Christoffel with the local geographical region. Dirichlet's name, for example, is thought to derive from the name of the stream La Richelette.

Appendix A. Anne-Marie Décaillot (1941–2011)

I take this opportunity to include for posterity a brief tribute to Mme Décaillot, and give another indication of work awaiting completion. In response to my request for details about her, Bernard Bru replied in an email dated 10 July 2014, that Anne-Marie Décaillot had been one of his colleagues at the University of Paris 5. She wrote a doctoral thesis (Décaillot (1999)) under Bernard's direction, on the life and work of the great arithmetician Édouard Lucas (1842–1891), who had had contact with Catalan. In the course of the writing she entered into contact with FJ who provided much help, and was referee for her large paper (probably Décaillot (1998)) as FJ revealed to me in a letter of 2004.

Indeed, Bernard wrote in his email, a real friendship developed between her and FJ since they shared the same passion for mathematics and its history. Sadly, Anne-Marie died of a grave illness which had developed in the course of just a few months. Her book on the correspondence between Cantor and French savants (Décaillot (2008)) was also published in German translation in 2011.

In a letter to me dated 8 September 2002 FJ wrote:

> My work on wine gauging makes slow progress…. I also devoted a lot of time to biographical research for Bernard Bru…he asked me to gather some information about correspondents of Cournot in view of a last volume (this appeared as Bru and Crépel (1994)) completing the edition of Cournot's complete works…. I keep some contacts with Mrs Décaillot, who found two letters from Catalan to a new correspondent, Delaunay.

In a letter to me dated 12 December 2002, FJ wrote about the quarrel involving Cesàro, Catalan, Rouché, Bertrand, and André which one of the letters from Catalan to Delaunay illuminates, and of the discovery by FJ of a final paper in the saga by Catalan 'against Rouché', whose coordinates FJ communicated to Anne-Marie, with a view to a possible paper by her on the whole matter. It appears that such a paper was never written.

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