THE JOURNAL *BROTÉRIA* (1902-2002): JESUIT SCIENCE IN THE 20th CENTURY

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Introduction

In the past few years, historians of science have been studying the role played by the Jesuits in science teaching and communication during the 16th, 17th and 18th centuries, in order to better understand their contributions to science in this period.[1] The Society of Jesus, officially established in 1540 by Ignatius of Loyola, was fundamental in the teaching and transmission of scientific knowledge in Portugal, namely through a network of schools established during the 16th century in Lisboa, Évora and Coimbra.[2] For example, the College of Santo Antão, established in Lisbon in 1553, offered a course on mathematical sciences known as the *Aula da Esfera* — 'class on the sphere' — from 1590 until 1759, which is considered nowadays a landmark in the teaching of mathematics in Portugal.[3]

In the mid-18th century, however, the Marquis of Pombal (1699- 1882) launched a campaign against the Society of Jesus by accusing the Jesuits of being illiterate and the main cause of Portuguese backwardness. Within this campaign hundreds of books, treatises, pamphlets, reports and plays were published in Portugal and largely diffused in Europe, causing the banishment of the Jesuits from Portugal, in 1759.[4] This political campaign influenced the banishment of the Society of Jesus in France (1764), Spain (1767), Two Sicilies (1767) and Parma (1768) and fuelled the Vatican's suppression of the Order, in 1773, by the Pope Clement XIV.[5] From its

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[1] Some reference works on Jesuit Science: Ugo Baldini, *Legem impone subactis. Studi su filosofia e scienza dei Gesuiti in Italia. 1540-1632,* Bulzoni, Roma, 1992; Mordechai Feingold (ed.), *Jesuit Science and the Republic of Letters*, The MIT Press, Cambridge MA, 2003; Mordechai Feingold (ed.), *The New Science and Jesuit Science: Seventeenth Century Perspectives*, Kluwer Academic Publishers, Dordrecht, 2003; Marcus Hellyer, *Catholic Physics: Jesuit Natural Phylosophy in Early Modern Germany*, University of Notre Dame Press, Notre Dame, Indiana, 2005.

[2] John O'Malley, Gauvin A. Bailey, Steven J. Harris and T. Frank Kennedy (eds.), *The Jesuits. Cultures, Sciences, and the Arts, 1540-1573*, University of Toronto Press, Toronto, 1999.

[3] Henrique Leitão, *A Ciência na Aula da Esfera no Colégio de Santo Antão, 1590-1759*. Comissariado Geral das Comemorações do V Centenário do Nascimento de S. Francisco Xavier, 2007.

[4] José Eduardo Franco & Christine Vogel, "Um acontecimento mediático na Europa das Luzes: A propaganda antijesuítica pombalina em Portugal e na Europa", *Brotéria*, 169, 2009, 349-506; José Eduardo Franco. *O Mito dos Jesuítas. Em Portugal, Brasil e Oriente. (Séc. XVI a XX).* Gradiva, Lisboa, 2006. The main books published during this period were*: Relação abreviada* (1757), *Erros ímpios e sediciosos* (1759), *Dedução cronológica e analítica* (1767-68) and *Compêndio Histórico do Estado da Universidade de Coimbra* (1771).

[5] Bertrand Roehner, "Jesuits and the State: A Comparative Study of their Expulsions (1590-1990)", *Religion*, 27, 1997, 165-182; The Society of Jesus was suppressed by Clement XIV in the Papal Brief *Dominus ac Redemptor*.

suppression until its re-establishment, in 1848, the Portuguese intellectual elite took Pombal's judgment for granted: "The Jesuits were the most significant mark of backwardness in Portugal".[6] This line of reasoning, which perpetuated throughout the 19th and 20th centuries, justifies this historiographical void — the scientific activities of the Society of Jesus in this period remaining utterly unexplored. Nevertheless, in Portugal, the Jesuit colleges of Campolide (Lisboa, 1858) and São Fiel (Louriçal do Campo, 1863) were two of the most relevant secondary schools that made important efforts in science pedagogy and popularization, namely through the scientific journal *Brotéria*, as it has been briefly described elsewhere.[7]

Despite the existence of a multitude of documents pertaining to experimental practice and science pedagogy at the colleges of Campolide and São Fiel, the historical analysis of the role played by these colleges in Portuguese history of science still remains quite inadequate.[8] On the other hand, the journal Brotéria has encouraged the emergence of complex historical narratives that focus mainly on the relevance of the religious context in the 19th century for the foundation of a scientific journal by the Portuguese Jesuits, in 1902.[9] Despite their sheer importance, however, these studies still lack a historical analysis of the scientific activities of the Portuguese Jesuits in the 19th and 20th centuries. The single exception is the work of João Paulo Cabral, who establishes the importance of the scientific correspondence of Portuguese Jesuits and the botanist Gonçalo Sampaio (1865-1937) for the development of Botany in Portugal, between 1902 and 1920.[10]

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[6] José Eduardo Franco, "História da Brotéria (1902 – 2002)", pp. 90-142 *in* Hermínio Rico S.J. & José Eduardo Franco (eds.) *Fé, Ciência, Cultura: Brotéria-100 anos,* Gradiva, Lisboa, 2003.

[7] Francisco Malta Romeiras & Henrique Leitão, 2012, "Jesuítas e Ciência em Portugal. IV - A revista *Brotéria - Sciencias Naturaes* e a sua recepção nacional e internacional", *Brotéria,* 174, 2012, 323-333;Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. III - As expedições científicas e as observações dos eclipses solares de 1900 e 1905 ", *Brotéria,* 174, 2012, 227-237; Francisco Malta Romeiras & Henrique Leitão,"Jesuítas e Ciência em Portugal. II - Carlos Zimmermann S.J. e o ensino da Microscopia Vegetal", *Brotéria,* 174, 2012, 113-125; Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. I - António Oliveira Pinto S.J. e as primeiras experiências com Radioactividade em Portugal", *Brotéria,* 174, 2012, 9-20.

[8] Jorge Custódio, *O Colégio de Campolide*, Universidade Nova de Lisboa, Faculdade de Economia, Lisboa, 1988; Ernesto Candeias Martins, "Do Colégio de S.Fiel a Reformatório (séculos XIX-XX). Contributos à Re(educação) em Portugal", *Anais do VI Congresso Luso-Brasileiro da História da Educação,* 2006, pp. 826-851; João Mendes Rosa, *Colégio de S. Fiel*, GAAC - Grupo de Arqueologia e Arte do Centro, Coimbra, 2004; Maria Adelaide Neto Salvado, *O Colégio de São Fiel: centro difusor da ciência no interior da Beira.* Semedo - Soc. Tipográfica, Castelo Branco, 2001.

[9] José Eduardo Franco, *História da Brotéria e da evolução do seu pensamento pedagógico,* Roma Editora, Lisboa, 1999; Hermínio Rico S.J. & José Eduardo Franco (eds.), *Fé, Ciência, Cultura: Brotéria-100 anos,* Gradiva, Lisboa, 2003.

[10] João Paulo Cabral, "La revista Brotéria, los jesuitas naturalistas y Gonçalo Sampaio. Intercambio de plantas e ideas y el desarrollo de la botánica en Portugal", *Asclepio: Revista de Historia de la Medicina y de la Ciencia,* 62, 2010, 61-92.

Hence, the main objective of my doctoral research is to analyse systematically the scientific activities of the Portuguese Jesuits in the 19th and 20th century, thus providing a historical narrative that should be incorporated in the studies about science pedagogy and popularization in the European periphery. I intend to scrutinize the role played by the colleges of Campolide (1858-1910) and São Fiel (1863-1910) and by the journal *Brotéria* (1902-2002), namely through the analysis of its scientific publications, in a broader narrative of 19th and 20th centuries Portuguese history of science, by specifically describing the importance of Portuguese Jesuits to the development of physics, astronomy, botany, zoology, biochemistry and molecular genetics in Portugal.

It is also my intention to correlate this scientific endeavour of the Jesuits in Portugal with the charges of scientific backwardness that perpetuated since the 18th century. Moreover, I expect to integrate this scientific enterprise with the main pedagogical documents adopted by the Society of Jesus since the 16th century[11] and provide novel insights on the relationship between science and power in the Portuguese context, in three different political regimes: the Constitutional Monarchy (1858-1910), the Portuguese First Republic (1910-1926) and the Dictatorship (1926-1974). In this HoST "work in progress", however, I shall focus only on a brief history of the journal *Brotéria*.

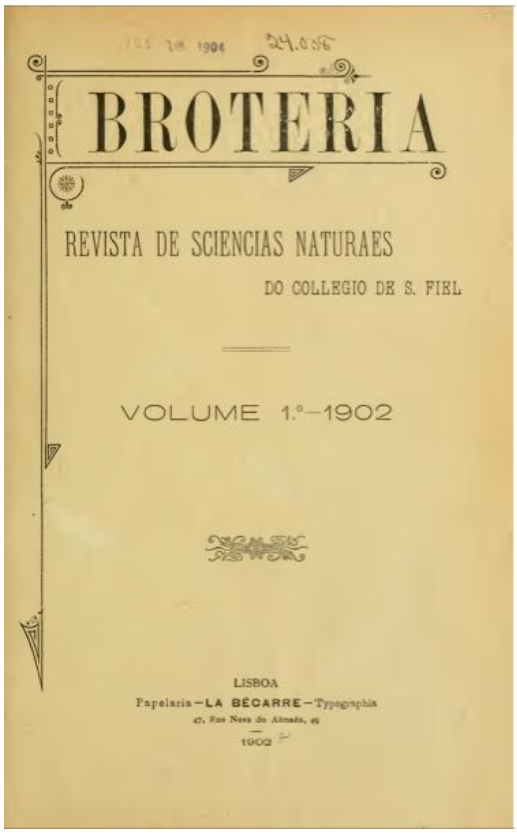
THE JOURNAL *BROTÉRIA*

Established by Joaquim da Silva Tavares S.J. (1866-1932), Cândido Azevedo Mendes S.J. (1874-1943) and Carlos Zimmermann S.J. (1871-1950), teachers of the Jesuit college of São Fiel (Louriçal do Campo), in 1902, and with more than 1300 research papers on zoology, botany, biochemistry and molecular genetics, this scientific journal was one of the most relevant learned journals in Portugal, in the 20th century.[12] In order to better understand its significance in the Portuguese and international contexts, I shall focus on some details associated with the origin of this journal and its main achievements, in the 20th century. I shall start with the religious

[11] *Monumenta Ignatiana. Sancti Ignatii de Loyola Constitutiones Societatis Iesu*, Rome, Institutum Historicum Societatis Iesu, 1948; *Monumenta Paedagogica Societatis Iesu. V: Ratio atque Institutio Studiorum Societatis Iesu (1586, 1591, 1599)*, Institutum Historicum Societatis Iesu, Rome, 1986.

[12] Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. IV - A revista *Brotéria - Sciencias Naturaes* e a sua recepção nacional e internacional", *Brotéria*, 174, 2012, 323-333; Hermínio Rico S.J. & José Eduardo Franco (ed.), *Fé, Ciência, Cultura: Brotéria-100 anos*, Gradiva, Lisboa, 2003. All the statistics concerning *Brotéria* are available on: http://webpages.fc.ul.pt/~fmromeiras/Broteria_/Estatisticas.html. "S.J." stands for "Society of Jesus" and always follows the name of a Jesuit priest.

and historical context that was behind the foundation of this learned journal by the Society of Jesus, in Portugal.


BROTERIA

REVISTA DE SCIENCIAS NATURAES

DO COLLEGIO DE S. FIEL

VOLUME 1.°—1902

LISBOA

Papelaria—LA BÉCARRE—Typographia

1902

Figure 1 - Cover of the first issue of the journal *Brotéria-Sciencias Naturaes*, 1902.

In the 19th century, Portuguese anticlericalism had reached a critical peak.[13] The controversies between laymen, especially scientists and politicians, and the clergy were frequent in this period. The positivism of Auguste Comte (1798-1857) influenced the public discourses and the official documents of some of the most distinguished Portuguese politicians such as Adolfo Coelho (1847-1919) and Antero de Quental (1842-1891).[14] Portuguese Jesuits were also part of this intricate plot, and one of the most relevant quarrels of this period, on the origin of man, implicated the famous republic physician Miguel Bombarda (1851-1910) and the Jesuit priest Manuel Fernandes Santana S.J. (1864-1910).[15]

[13] Carlos Moreira Azevedo (ed.), *História religiosa de Portugal*, Círculo de Leitores, Lisboa, 2002; Artur Vilares, *As congregações religiosas em Portugal*, 1901-1926, Fundação Calouste Gulbenkian e Fundação para a Ciência e Tecnologia, Lisboa, 2003; José Eduardo Franco, *O Mito dos Jesuítas. Em Portugal, Brasil e Oriente. (Séc. XVI a XX),* Vol. 2, Gradiva, Lisboa, 2006, pp. 90-98.

[14] Adolfo Coelho, *A Questão do Ensino*, Porto, 1872; Antero de Quental, *Defesa da Carta Encíclica de Sua Santidade Pio IX contra a chamada Opinião Liberal. Considerações sobre este documento*, Imprensa Literária, Coimbra, 1865.

[15] Artur Anselmo (ed.), *As grandes polémicas portuguesas*, vol. II, Verbo, Lisboa, 1967, p. 364.

In this anticlerical atmosphere, some of the most notorious politicians were constantly demanding the closure of the Jesuit colleges at the Portuguese Parliament, by arguing that the Society of Jesus was the main responsible for scientific backwardness in Portugal. This was the same line of argument used by the Marquis of Pombal, back in 1759, when he expelled the Jesuits from all Portuguese territories; only recently has this received view been object of revision.[16] All these public discourses and documents culminated with the suppression of the Society of Jesus in Portugal on 8 October, 1910, only three days after the republican revolution.[17] The imprisonment and proscription of Portuguese Jesuits, however, was not the most adverse consequence of the republican revolution. With the suppression of the Society of Jesus, the colleges of Campolide (1858-1910) and São Fiel (1963-1910) were bombed and violently invaded by rebels, who destroyed scientific instruments and invaluable manuscripts and books.[18] The scientific and pedagogical legacy that Portuguese Jesuits were developing since the 1850's was irremediably lost. These colleges were amongst the most significant pre-university institutions in Portugal, from 1858 to 1910. In these secondary schools, the Jesuits promoted an experimental approach to the teaching of botany, zoology, physics, chemistry and astronomy[19] — a landmark in the Portuguese historical context.[20]

Besides teaching the natural sciences, especially since the early 20th century, the Jesuits in Portugal were particularly concerned with the development of botany and zoology, their main domain of expertise in this period, having described and classified more than 2200 new species in the journal *Brotéria*, from 1902 to 1979.[21] In

[16] Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. V - Os Colégios de Campolide e de São Fiel e a implantação da República", *Brotéria*, 174, 2012, 425-440.

[17] Decree of the Portuguese Republic, 8/10/1910.

[18] Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. V - Os Colégios de Campolide e de São Fiel e a implantação da República", *Brotéria*, 174, 2012, 425-440.

[19] Francisco Malta Romeiras & Henrique Leitão (2012) "Jesuítas e Ciência em Portugal. III - As expedições científicas e as observações dos eclipses solares de 1900 e 1905 ", *Brotéria*, 174, 2012, 227-237; Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. II - Carlos Zimmermann S.J. e o ensino da Microscopia Vegetal", *Brotéria*, 174, 2012, 113-125; Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. I - António Oliveira Pinto S.J. e as primeiras experiências com Radioactividade em Portugal", *Brotéria*, 17, 2012, 9-20.

[20] Jorge Ramos do Ó, *O Governo de si mesmo: Modernidade pedagógica e encenações disciplinares do aluno liceal (último quartel do século XIX—meados do século XX)*, Educa, Lisboa, 2003, Jorge Ramos do Ó, *Ensino liceal (1836-1975)*, Ministério da Educação, Lisboa, 2009; Maria Cândida Proença, *A reforma de Jaime Moniz: Antecedentes e destino histórico*, Tese de Doutoramento, Universidade Nova de Lisboa, Lisboa, 1993, António Nóvoa, João Barroso & Jorge Ramos do Ó, "O todo poderoso Império do Meio", in António Nóvoa & Ana Teresa Santa-Clara (ed.) *Liceus de Portugal*, Asa, Porto, 2003, Inês Gomes," Os Gabinetes de História Natural dos antigos liceus - um estudo exploratório a partir dos textos legislativos" in *Actas do Congresso Luso-Brasileiro de História das Ciências*, 2011.

[21] *Indíces Gerais da Brotéria Científica* [1902-2002], Brotéria Genética, Braga, 2002. All the statistics concerning Brotéria are available on the website: http://webpages.fc.ul.pt/~fmromeiras/Broteria_/Estatisticas.html.

fact, this scientific orientation of taxonomic identification and description of plants and animals was closely associated with the work of the prominent Portuguese naturalist Felix Avelar Brotero (1744-1828) to whom the journal was dedicated.

Moreover, with the foundation of this journal, Portuguese Jesuits intended to reverse positivistic discourses and establish that there was no incompatibility between science and faith. There was also the will to contradict the popular belief that it was impossible for the Jesuits to achieve relevant and innovative scientific knowledge. Only with this particular enterprise could the Society of Jesus recover its scientific reputation, which had been completely shattered since the 18th century.[22] In a broader perspective, one can interpret the foundation of *Brotéria* as part of a larger strategy of an apostolic endeavour, which had included the foundation of various Portuguese Catholic organizations such as the *Centro Académico de Democracia Cristã* (1901). It is also impossible to detach *Brotéria* from other Portuguese spiritual periodicals of the Society of Jesus such as the *Mensageiro do Coração de Jesus* (1881) and the *Legionário de Maria* (1905), or from European cultural journals like *La Civilità Cattolica* (Italy, 1850), *Études* (France, 1856) and *Razón y Fé* (Spain, 1901).

Brotéria, in addition, should be included in a broader cluster of scientific periodicals, which had been published in Portugal since the 18th century. The most relevant of these journals were *Memórias de Agricultura* (1788-1791), *Memórias Económicas* (1789-1815), *Memórias da Academia Real das Sciencias de Lisboa* (1797-1856), *Jornal de Sciencias Mathematicas, Physicas e Naturais* (1866) and *O Instituto: Revista Científica e Literária* (1852-1981).[23] The journal closer to *Brotéria* was, however, the *Boletim da Sociedade Broteriana* (Coimbra, 1883), founded and directed by Júlio Henriques (1838-1928). Like *Brotéria*, this journal presented to its public original papers identifying and describing new botanical species. Júlio Henriques and Portuguese Jesuits cooperated intensively in the identification and description of botanical species, in particular, in the period between 1902 and 1932, as it has been described elsewhere.[24]

Between 1902 and 1932, under the direction of Silva Tavares, Jesuit naturalists focused primarily on the identification and classification of novel botanical

[22] José Eduardo Franco, "História da Brotéria (1902-2002)", in Hermínio Rico S.J. & José Eduardo Franco (eds.), Fé, Ciência, Cultura: Brotéria-100 anos, Gradiva, Lisboa, 2003.

[23] José Eduardo Franco, "História da Brotéria (1902-2002)", in Hermínio Rico S.J. & José Eduardo Franco (eds.), *Fé, Ciência, Cultura: Brotéria-100 anos,* Gradiva, Lisboa, 2003.

[24] António José Leonardo, *O Instituto de Coimbra e a evolução das ciências físico-químicas em Portugal de 1852 a 1952,* PhD Thesis, Universidade de Coimbra, Coimbra, 2011.

and zoological species. Beyond this scientific programme, however, there was clearly an apostolic intention behind *Brotéria*, evident since its foundation. In the opening issue, the famous metaphor of the "Two Books" was revived, with the naturalists claiming that the main objective of this journal was the diffusion of their studies, which was also meant to awaken the interest in scientific research, in Portugal, and contribute to an improved understanding of God's mysteries, a typical agenda of natural theologians:[25]

We rejoice with the idea that our contributions, as insignificant as they might be, can disseminate the taste for the natural sciences in our country. The natural world is a vast book, which has many pages to be opened. The name of our grand Creator is written on each of them. When opening these pages, what greater satisfaction could anyone have than unveiling the greatness of God, which is stamped equally on the immensity of the world and on the myriad of tiny animals and plants, whose existence only the microscope can uncover?[26]

The journal *Brotéria* was founded with an educational and scientific purpose. Indeed, the scientific relevance of *Brotéria*'s articles on botany and zoology can be grasped not only from the numerous words of praise by Portuguese botanists such as Júlio Henriques and José Veríssimo d'Almeida (1834-1925), but also from the inclusion of new species described by Portuguese Jesuits in annual catalogues of scientific journals such as the *Boletim da Sociedade Broteriana*, the *American Naturalist* and the *Journal of Mycology.*[27]

Five years following its establishment, in 1907, *Brotéria* was subdivided in three separate periodicals, *Vulgarização Científica* [Scientific Popularization], *Botânica* [Botany] and *Zoologia* [Zoology]. The journal *Brotéria-Vulgarização Científica*, entirely written in Portuguese, was especially designed to be profitable and in this way

[25] For the metaphor of the "Two Books" check Olaf Pedersen, *The Two Books - Historical Notes on Some Interactions Between Natural Science and Theology,* Vatican Observatory Foundation, Vatican 2007.

[26] "Duas palavras de introdução", *Brotéria,* I, 1902, V; Original transcription: "A ideia de concorrermos, por pouco que seja, para propagar o gosto das sciencias naturaes em nossa patria enche-nos de alegria. A natureza é um livro immenso, que tem ainda muitas folhas por abrir. Ora em todas ellas se encontra escrito o nome augusto do Creador. E será acaso pequena satisfacção ao abril-as mostrar nellas a grandeza de Deus, que tanto se estampa na immensidade do mundo, como na extrema pequenez, de myriades de animaes e planas, cuja existencia só o microscopio nos revela?"

[27] Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. IV - A revista *Brotéria-Sciencias Naturaes* e a sua recepção nacional e internacional", *Brotéria,* 174, 2012, 313-323; "Notes", *The American Naturalist,* 37(438), 1903, 438-442; "Notes", *The American Naturalist*, 38(447), 1904, 230-240; William Trelease, "Library contributions", *Missouri Botanical Garden Annual Report*, Vol. 1904, 1904, 87-129; W. A. Kellerman, "Notes from Mycological Literature. IX", *The Journal of Mycology,* 10(2), 1904, 81-90; W. A. Kellerman and P.L. Ricke, "New Genera of Fungi Published Since the Year 1900, with Citation and Original Descriptions (Continued)", *The Journal of Mycology,* 10(4), 1904, 199-223; "Index to American Botanical Literature (1904)", *Bulletin of the Torrey Botanical Club*, 32(7), 1905, 393-396; "Index to American Botanical Literature (1904-1907)", *Bulletin of the Torrey Botanical Club,* 35(12), 1908, 585-592.

cover the expenses of the specialised series *Zoologia* and *Botânica*, whose original articles written in English, French, German, Spanish, Portuguese and Latin, only interested Portuguese and foreign botanists and zoologists.[28] With more than 450 popularization articles published in chemistry, physics, agriculture, medicine and biology, *Vulgarização Científica* (1907-1925) was a successful Portuguese popularization journal during its 18 years of existence. In 1925, however, Silva Tavares decided to replace *Vulgarização Científica* for a cultural, philosophical and humanistic journal, which still exists today.

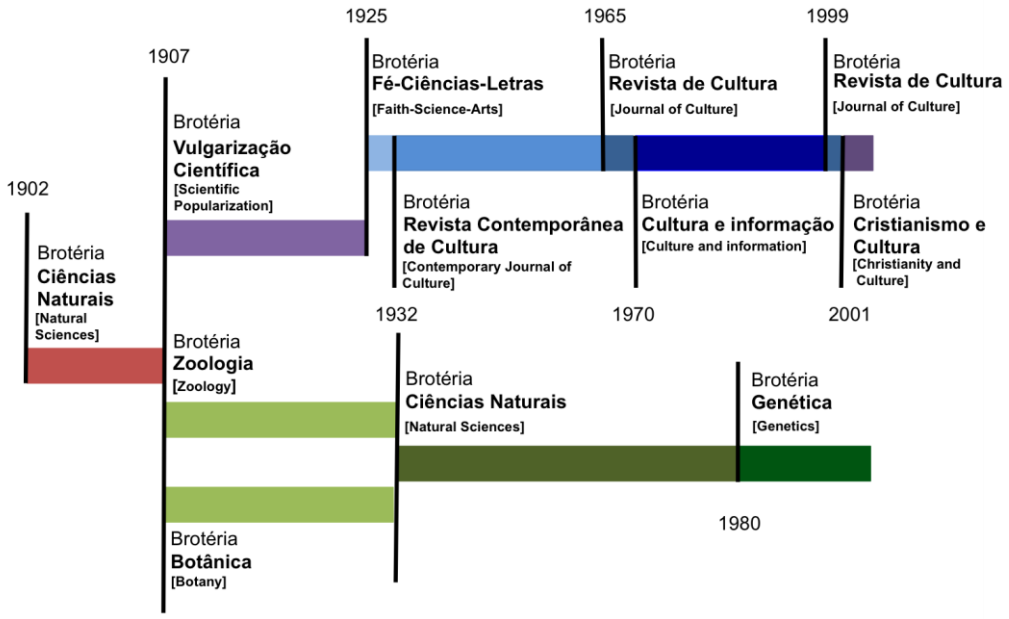


Figure 2 - Editorial evolution of the journal Brotéria. Adapted from Hermínio Rico S.J. and José Eduardo Franco (eds.), Fé, Ciência, Cultura: Brotéria–100 anos, Lisboa, Gradiva, 2003, p. 101.

Following the death of Silva Tavares S.J., in 1932, Alphonse Luisier S.J. (1872-1957) became the editor of *Brotéria*. This botanist specialized in briology; he identified and described 18 new species and 13 new varieties of mosses. His important collections (*Bryotheca Europaea*, *Bryotheca Atlantica* and *Bryotheca Exótica*), can be seen nowadays at the Jesuit college *Instituto Nun'Alvares* (Caldas da Saúde, Santo Tirso).[29] While Luisier was the editor of *Brotéria*, especially between 1939 and

[28] "Prólogo", *Brotéria–Série de Vulgarização Científica* VI ,1907.

[29] J. Vaz de Carvalho, "Afonso Luisier", *Diccionario Histórico de la Compañia de Jesús,* Universidade Pontificia Comillas, Institutum Historicum Societatis Iesu, Madrid, Rome, 2001, pp. 2440-2441; Maria Luísa, "Recordando o Padre Luisier – Nos 40 anos do seu falecimento", *Brotéria - Genética* XVIII, 1997, 99-101; Luís Archer S.J., "Centenário do nascimento do P. Alphonse Luisier, S.J", *Brotéria - Ciências Naturais,* 41, 1972, 1;

1957, a group of geneticists lead by António Sousa da Câmara (1901-1971), founder and director of the National Agronomic Station (*Estação Agronómica Nacional*) published several papers on plant genetics, thus showing that *Brotéria* was renewing itself and contributing to the scientific development of genetics and plant breeding in Portugal, a major line of research within the Dictatorship's scientific agenda.[30]

Under the auspices of Luís Archer S.J., from 1962 to 1979, *Brotéria* published international papers on biochemistry, focusing on relevant and state-of-the-art issues such as cell metabolism, enzymatic activities and protein electrophoresis.[31] Between 1965 and 1969, *Brotéria* published the doctoral dissertations of Francisco Guerra (1932-), Luís Archer and Roberto Salema (1932-), respectively on mitochondrial tumefaction, DNA-mediated transformation in bacteria, and biogenesis and structure of starch, thus disseminating the scientific work of these promising biologists.[32] From the 1970s onward, *Brotéria* published the first papers on molecular genetics, the vast majority of which was written by foreign researchers, thus indicating the international influence of this scientific periodical of the Society of Jesus.[33] In addition, in 1980, subsequent to the exponential growth of a variety of fields of molecular genetics, Archer modernized the journal and created the *Brotéria-Genética*, thus integrating the need for a specialised journal on genetics in Portugal,

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José Carvalhes, "Padre Alphonse Luisier", *Brotéria - Ciências Naturais,* 54, 1958, 3-16; José Carvalhes, "R.P. Alphonse Luisier, SJ, Homenagem ao cientista e ao mestre", *Boletim Cultural de Santo Tirso,* V, 1957, 223-249.

[30] Francisco Malta Romeiras & Henrique Leitão, "Jesuítas e Ciência em Portugal. IV - A revista *Brotéria - Sciencias Naturaes* e a sua recepção nacional e internacional", *Brotéria,* 174, 2012,. 323-33; Miguel Mota, "A contribuição da *Brotéria* para o desenvolvimento da Genética", in Hermínio Rioc S.J. & José Eduardo Franco (ed.), *Fé, Ciência, Cultura: Brotéria-100 anos*, Gradiva, Lisboa, 2003, pp. 517-527.

[31] William Sullivan S.J. & Adam J. von Knobelsdorff, "The *in vitro* and *in vivo* effects of fluoride on succinic dehydrogenase activity", *Brotéria-Ciências Naturais,* 31, 1962, 3-13; William Sullivan S.J., "The spectrophotometric determination of malic dehydrogenase and 'malic' enzyme in normal populations of *Tetrahymena pyriformis* GL.", *Brotéria-Ciências Naturais,* 33, ,1964, 143-158; Levi Guerra & F. Edmund Hunter, "Sucrose inhibition of gramicidin induced swelling of isolated rat liver mitochondria", *Brotéria-Ciências Naturais,* 34, 1965, 227-246; Elinor O'Brien & William Sullivan S.J., "Electrophoretic patterns of proteins constituents in tissues of tumor-bearing and non-tumor bearing animals", *Brotéria-Ciências Naturais,* 43, 1974, 3-14; Seikh Amjed Ali, A. Qayyun Siddiqui and A. Hasnain "Electrophoretic characteristics of soluble eye lens proteins of Ophycephalus punctatus (Bloch) in different concentrations of sodium chloride solution", *Brotéria-Ciências Naturais,* 44, 1975, 9-15; Carlos Azevedo, "Nucléolo - estrutura, citoquímica e aspectos funcionais", *Brotéria-Ciências Naturais,* 48, 1978, 3-52.

[32] Francisco Carvalho Guerra, "Tumefacção mitocondrial. Estudo comparativo das mitocôndrias do cérebro e do fígado", *Brotéria-Ciências Naturais,* 34, 1965, 3-226; Luís Archer S.J., "DNA-mediated transformation", *Brotéria-Ciências Naturais,* 36, 1967, 107-176; Roberto Salema, "Amido. Estudo ultrastrutural da sua biogénese em plantas superiores", *Brotéria-Ciências Naturais,* 38, 1969, 1-127.

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with his scientific agenda, following the example of Silva Tavares and Luisier, who had always combined their research with the editorial orientation of *Brotéria*. Up to 2002, *Brotéria-Genética* published more than 300 papers on bacterial genetics, plant and animal breeding, human genetics and bioethics.[34]

Future directions

With more than 1300 original scientific articles, *Brotéria* was one of the most relevant learned journals, in Portugal, from 1902 to 2002, as I have briefly explained. Some questions, however, require further investigation and still remain to be clarified: What was *Brotéria*'s national and international projection? Was *Brotéria* similar to other publications of the Society of Jesus throughout Europe? Is it accurate to analyse *Brotéria* as a popularization journal or should we consider a different historiographical concept? How did Jesuit naturalists interact with the Portuguese scientific community and how did these interactions contributed to the development of zoology, botany, biochemistry and molecular genetics in Portugal? Was the scientific reputation of Portuguese Jesuits fully rehabilitated in the 20th century? How did the different political regimes influence the scientific and editorial activities of Portuguese Jesuits?

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