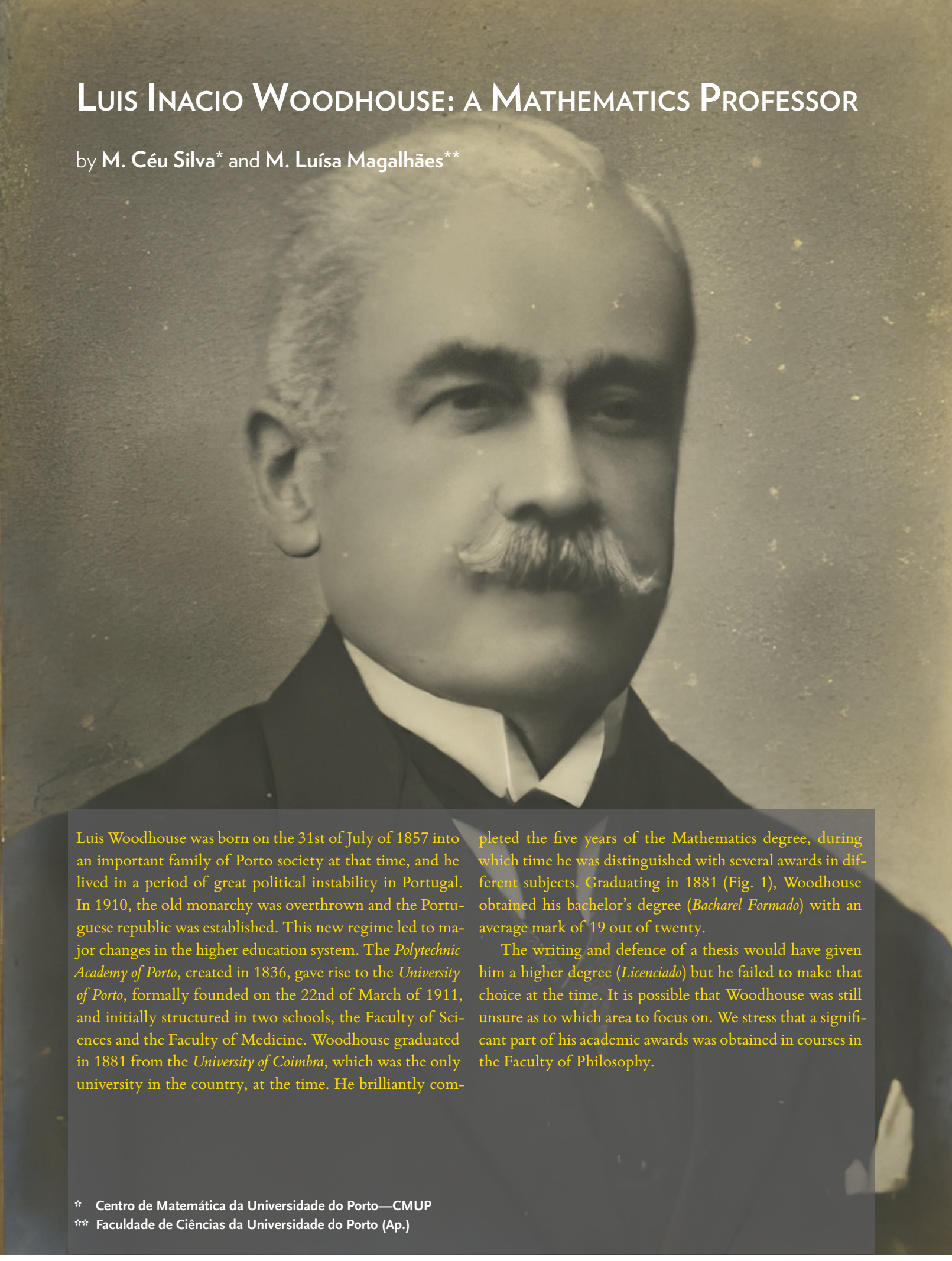
# Luis Inacio Woodhouse: a Mathematics Professor

by **M. Céu Silva*** and **M. Luísa Magalhães****



Luis Woodhouse was born on the 31st of July of 1857 into an important family of Porto society at that time, and he lived in a period of great political instability in Portugal. In 1910, the old monarchy was overthrown and the Portuguese republic was established. This new regime led to major changes in the higher education system. The *Polytechnic Academy of Porto*, created in 1836, gave rise to the *University of Porto*, formally founded on the 22nd of March of 1911, and initially structured in two schools, the Faculty of Sciences and the Faculty of Medicine. Woodhouse graduated in 1881 from the *University of Coimbra*, which was the only university in the country, at the time. He brilliantly completed the five years of the Mathematics degree, during which time he was distinguished with several awards in different subjects. Graduating in 1881 (Fig. 1), Woodhouse obtained his bachelor's degree (*Bacharel Formado*) with an average mark of 19 out of twenty.

The writing and defence of a thesis would have given him a higher degree (*Licenciado*) but he failed to make that choice at the time. It is possible that Woodhouse was still unsure as to which area to focus on. We stress that a significant part of his academic awards was obtained in courses in the Faculty of Philosophy.

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EM NOME DE DEUS, AMEN.

O DOUTOR ANTONIO BERNARDINO DE MENEZES,
Lente de Prima, Decano e Director da Faculdade de Theologia, Conego Capitular da Sé Cathedral de Coimbra, Socio do Instituto da mesma cidade, Vice-Reitor interino da Universidade, etc. Faço saber que LUIZ IGNACIO WOODHOUSE, filho de Roberto Guilherme Woodhouse, natural do Porto, havendo conseguido o Gráu de Bacharel na Faculdade de Mathemathica, como mostrará por sua Carta, e havendo continuado mais um anno de frequencia, ouvindo as lições de sua obrigação conforme os novos Estatutos d'esta Universidade, com prova d'elle se habilitou para fazer, como fez com effeito, a sua Formatura em 13 de Junho de 1881; no qual Acto, sendo examinado pelos Doutores seus Mestres, e sendo distribuidos e regulados os votos, foi approvado NEMINE DISCREPANTE, como consta do Assento que d'isso se fez no Livro dos Exames, Actos e Gráus do dicto Anno a fol. 120, o qual me foi presente ao assignar d'esta. E porque com a referida Approvação, conforme as Leis do Reino e Estatutos d'esta Universidade, pode usar de suas Lettras livremente em qualquer parte, lhe mandei passar a presente por mim assignada, e sellada com o Sêllo d'esta Universidade. Dada em Coimbra aos 9 de Junho de mil oitocentos e oitenta e tres.

**Figure 1.—**Certificate of Woodhouse's degree.

Furthermore, as a student he became interested in various scientific areas, in which he published four papers. The solution of a problem on number theory proposed by Gomes Teixeira in the *Jornal de Sciencias Mathematicas e Astronomicas* [1877, p. 96]. It was published with the title On the question Proposed in n° 6 in the *Jornal de Sciencias Mathematicas e Astronomicas* [Woodhouse 1877]. The proposal of a new proof to a geometrical question — the location of the centres of the so-called "Villarceau circles" — which had been solved two years earlier by Pedro Amorim Viana, a professor of Mathematics at the Polytechnic Academy of Porto. Woodhouse's proof with the title *Proof of a theorem of geometry* (*Demonstração d'um theorema de geometria*) was published in *O Instituto of Coimbra* [Woodhouse 1878]). A paper on the dating of the earth's geological past, entitled *Paleontological Chronology (General aspects)* (*Chronologia paleontológica (Traços geraes)*), published in the *Revista Scientifica e Litteraria* [Woodhouse 1880] and another paper *Astronomy (Hypothese Cosmogonica)* (*Astronomia (Hypothese Cosmogonica)*) published in the same journal [Woodhouse 1881]), in which Woodhouse sought explanations for the formation and evolution of the solar system and the movement of the planets. The choice of these last two themes was likely influenced by two of the teachers who most inspired him: Julio Augusto Henriques and João José Dantas Souto Rodrigues. It was also then that his friendship with Francisco Gomes Teixeira began. This friendship endured and strengthened until Woodhouse's death on the 13th of March of 1927.[1]

Woodhouse started his teaching career at the Polytechnic Academy of Porto in the academic year 1883/84. A year later, he was appointed as the professor of *Differential and Integral Calculus and Descriptive Geometry*. In 1885 he submitted the dissertation *On the Integration of Differential Equations of Dynamics* (*Da Integração das Equações Differenciaes da Dynamica*) [Woodhouse 1883] previously published in his application for full professor. On the 23rd of September of 1885, he became the holder of the 1st chair of the *Polytechnic Academy of Porto — Analytical geometry, higher algebra and spherical trigonometry*. Woodhouse was appointed as *Professor Ordinário* of the 1st group (Analysis and Geometry) of the 1st section (Mathematical Sciences) when the Faculty of Sciences was created. He was also awarded the degree of Doctor in Mathematical Sciences by the Academic Council, by proposal of the Faculty Director on the 30th of November of 1918. For over 40 years, Woodhouse taught *Analytical geometry, higher algebra and spherical trigonometry*, having adapted the program to teaching requirements over the years.[2] In 1922, he proposed doubling the number of lectures to the academic council because he considered that one year had become insufficient to teach the main subjects. As his proposal was rejected, he decided to create a free, extracurricular, complementary algebra degree. Unfortunately, the course did not have the partic-

[1] Beires 1951, pp. 190–191.

[2] Carvalho 1934, p. 196.

ipation he expected, so he interrupted it after several lectures.[3] Sometimes, either for convenience of distributing his teaching duties or filling his teaching schedule, Woodhouse taught other courses, such as *Astronomy and Geodesy*, *Celestial Mechanics*, and *Probabilities*.

Due to his personality traits — impartiality and rigor —, and to his versatility, he was often chosen for several different administrative positions in the institutions where he taught: the *Polytechnic Academy of Porto*, the *Faculty of Sciences*, the *Industrial and Commercial Institute*, and the *Higher Trade Institute*. He was part of administrative committees: the treasurer and Pro vice chancellor of the *University of Porto*; the 1st president of the Mathematics Section when the *Faculty of Sciences* was created in 1911; elected by his colleagues to the University Senate; director of the *Faculty of Sciences of Porto*. Woodhouse accumulated these activities with others that went beyond the scope of the Academy. In the City Council of Porto, he was a substitute member of the Executive Committee, a member of the council, and chair of the commission of studies on reorganizing the *Municipal Museum of Porto*. He was also vice president of the *Portuguese Association for the Progress of Sciences*, and a member of the drafting committee of the journal *O Instituto*.

Despite his many duties, Woodhouse's main contribution was to high school and higher education in its pedagogical and didactic aspects. His mediation in connection with these two levels of education was very important. In high school, Woodhouse took part in several committees which drafted proposals and suggested changes to the existing curricula. He presided over the final exams of the general course in the *Central High School of Porto* (*Liceu Central do Porto*), and was a member of the School Board, an interlocutor between the school inspectorate and the City Council. Among its tasks, the School Board was dedicated to preparing Pedagogical Conferences for training high school teachers. At the *Polytechnic Academy* and the *Faculty of Sciences of Porto*, Woodhouse actively participated in meetings of Academic Councils suggesting changes in the programs, redistribution of subjects, and reorganization of courses. Also worthy of note was his effort to create the Geographer Engineer course in the University of Porto.

At the closing session of the 1st Luso-Spanish Congress for the Progress of Sciences held in Porto in 1921, Woodhouse's talk was on *Teaching Mathematics in Portuguese Universities* (*O Ensino Matemático nas Universidades Portuguesas* [Woodhouse 1921]). In this talk, he clearly showed his scientific, pedagogic and didactic concerns regarding education, especially concerning Mathematics. Three measures proposed by Woodhouse should be mentioned. In order to minimize students' mathematical shortcomings at the beginning of higher education, he proposed creating a transition year between high school and college, in which high school curricula were expanded and deepened. He argued that a course in general mathematics being compulsory for students from the three sections of the Faculty of Sciences would alleviate the problem until a major reform of high school programs was made. On the other hand, he proposed a new plan for mathematical studies at the *Faculty of Sciences*, specially focused on differentiating curricula according to each student's degree. Woodhouse emphasized the challenging career of a teacher in the classroom, as a driver of learning and student interest, but was always aware of the demand and rigor.

We stress that according to Woodhouse the *Faculty of Sciences* should offer the course of History of Mathematics. He defended this position at academic council meetings in 1913, but this was not implemented because Gomes Teixeira was not available to do so. Recognizing the importance of research in History of Mathematics, in 1924 he proposed creating a Scientific Research Institute in the History of Portuguese Mathematics to the School Board, an institute for which Gomes Teixeira would be the director. The proposal was accepted by unanimous vote, although the institute was to be created only two years later.

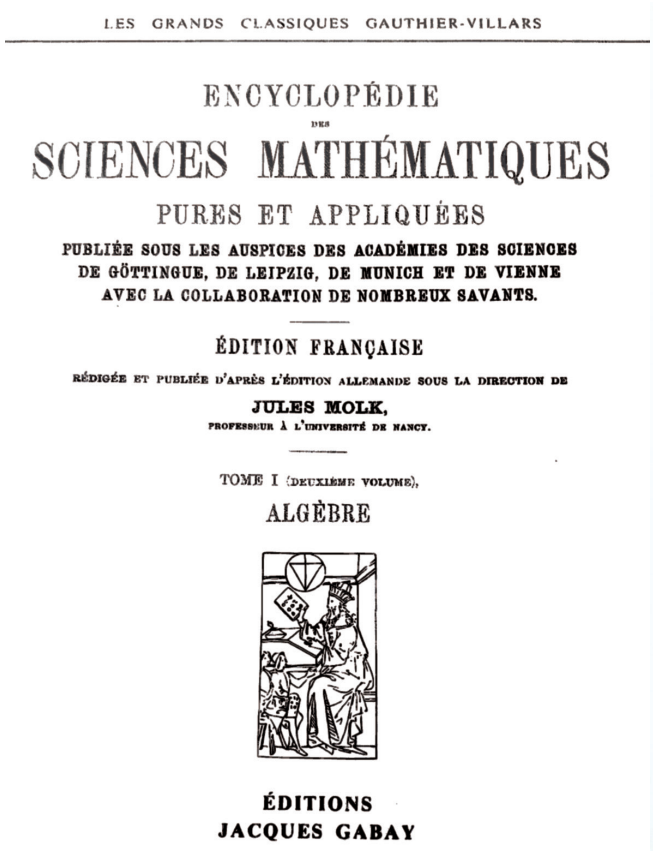
## Contribution to the history of algebra

Woodhouse's scientific interest focused mostly on algebra. He published his first work in algebra in 1885, Fundamental *Principle of the theory of algebraic equations* (*Princípio Fundamental da Teoria das equações algébricas*), in the *Jornal de Sciencias Mathematicas e Astronomicas* [Woodhouse 1885]. This work provided a non-constructive proof of the fundamental theorem of Algebra (it does not give a procedure to determine the solution, merely showing its existence). The work gave Woodhouse international recognition, resulting in his name being mentioned in the *Encyclopédie des Sciences Mathématiques Pures et Appliquées* (Fig. 2 and Fig. 3).[4]

Woodhouse starts off with the polynomial function $F(z) = \sum_{j=0}^{n} A_j z^j$ where the complex coefficients $A_j$ are written in the polar form, and the variable $z$ is represented both in polar and Cartesian coordinates. The work itself lacks figures although the solution presented presumes drawing one. He considered a plane coordinate system with origin $O$. Let $A_j = \rho_j(\cos\omega_j + i\sin\omega_j)$, $j = 0, 1, \ldots, n$, $z = r(\cos\theta + i\sin\theta) = x + iy$, and then $P_0 = O + A_0$ and

[3] Carvalho1934, p. 196.

[4] Neto, E., Vavasseur, R. Le 1907, pp. 203–204.



LES GRANDS CLASSIQUES GAUTHIER-VILLARS

ENCYCLOPÉDIE
DES
SCIENCES MATHÉMATIQUES
PURES ET APPLIQUÉES

PUBLIÉE SOUS LES AUSPICES DES ACADÉMIES DES SCIENCES DE GÖTTINGUE, DE LEIPZIG, DE MUNICH ET DE VIENNE AVEC LA COLLABORATION DE NOMBREUX SAVANTS.

ÉDITION FRANÇAISE

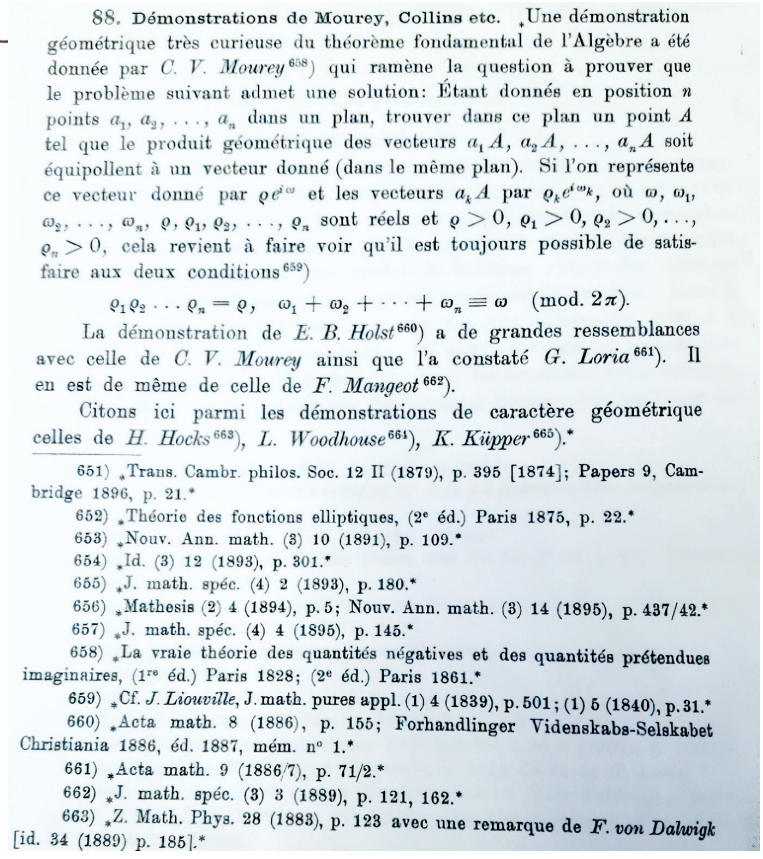
RÉDIGÉE ET PUBLIÉE D'APRÈS L'ÉDITION ALLEMANDE SOUS LA DIRECTION DE

JULES MOLK,
PROFESSEUR À L'UNIVERSITÉ DE NANCY.

TOME I (DEUXIÈME VOLUME),
ALGÈBRE

ÉDITIONS
JACQUES GABAY

**Figure 2.**—First page of the Tome 1 Volume 2 of the Encyclopédie des Sciences Mathématiques Pures et Appliquées.



88. Démonstrations de Mourey, Collins etc. *Une démonstration géométrique très curieuse du théorème fondamental de l'Algèbre a été donnée par *C. V. Mourey*[658]) qui ramène la question à prouver que le problème suivant admet une solution: Étant donnés en position $n$ points $a_1, a_2, \ldots, a_n$ dans un plan, trouver dans ce plan un point $A$ tel que le produit géométrique des vecteurs $a_1A, a_2A, \ldots, a_nA$ soit équipollent à un vecteur donné (dans le même plan). Si l'on représente ce vecteur donné par $\varrho e^{i\omega}$ et les vecteurs $a_kA$ par $\varrho_k e^{i\omega_k}$, où $\omega, \omega_1, \omega_2, \ldots, \omega_n, \varrho, \varrho_1, \varrho_2, \ldots, \varrho_n$ sont réels et $\varrho > 0$, $\varrho_1 > 0$, $\varrho_2 > 0, \ldots, \varrho_n > 0$, cela revient à faire voir qu'il est toujours possible de satisfaire aux deux conditions[659])

$$\varrho_1\varrho_2 \cdots \varrho_n = \varrho, \quad \omega_1 + \omega_2 + \cdots + \omega_n \equiv \omega \pmod{2\pi}.$$

La démonstration de *E. B. Holst*[660]) a de grandes ressemblances avec celle de *C. V. Mourey* ainsi que l'a constaté *G. Loria*[661]). Il en est de même de celle de *F. Mangeot*[662]).

Citons ici parmi les démonstrations de caractère géométrique celles de *H. Hocks*[663]), *L. Woodhouse*[664]), *K. Küpper*[665]).*

651) *Trans. Cambr. philos. Soc. 12 II (1879), p. 395 [1874]; Papers 9, Cambridge 1896, p. 21.*

652) *Théorie des fonctions elliptiques, (2e éd.) Paris 1875, p. 22.*

653) *Nouv. Ann. math. (3) 10 (1891), p. 109.*

654) *Id. (3) 12 (1893), p. 301.*

655) *J. math. spéc. (4) 2 (1893), p. 180.*

656) *Mathesis (2) 4 (1894), p. 5; Nouv. Ann. math. (3) 14 (1895), p. 437/42.*

657) *J. math. spéc. (4) 4 (1895), p. 145.*

658) *La vraie théorie des quantités négatives et des quantités prétendues imaginaires, (1re éd.) Paris 1828; (2e éd.) Paris 1861.*

659) *Cf. *J. Liouville*, J. math. pures appl. (1) 4 (1839), p. 501; (1) 5 (1840), p. 31.*

660) *Acta math. 8 (1886), p. 155; Forhandlinger Videnskabs-Selskabet Christiania 1886, éd. 1887, mém. n° 1.*

661) *Acta math. 9 (1886/7), p. 71/2.*

662) *J. math. spéc. (3) 3 (1889), p. 121, 162.*

663) *Z. Math. Phys. 28 (1883), p. 123 avec une remarque de *F. von Dalwigk* [id. 34 (1889) p. 185].*

**Figure 3.**—Page of the Encyclopédie where the name of Woodhouse is mentioned.

$P_j = P_{j-1} + A_j z^j$, $j = 0, 1, \ldots, n$. Note that $P_n$ represents $F(z)$. Woodhouse fixes $r$ and considers the closed curves $Q_j$, $j = 1, \ldots, n$ described by $P_j$ with $0 \le \theta \le 2\pi$ (in particular $Q_1$ is a circle with centre $P_0$ and radius $\rho_1 r$) and the circles $C_j$ with centre $O$ and radius $= \sum_{k=0}^{j} \rho_k r^k$. The circle $C_j$ contains the curve $Q_j$ and the circle $C_{j-1}$, $j \ge 1$. The idea of the proof is to show that there are $r$, $\theta$ such that $|F(z)| = 0$. Woodhouse shows that the Cartesian coordinates of $z$ vary continuously with $r$ and $\theta$, and that there exist $r'$, $r''$ $(0 < r'' < r')$ such that: the point $O$ lies outside of $Q_n$ if $r = r''$, and the point $O$ lies inside of $Q_n$ if $r = r'$. By continuity, he concludes that there exists $r \in [r'', r']$ such that $Q_n$ crosses the origin $O$. We stress that, in the particular case $n = 2$, we may just take $r'$ equal to the positive root of $\rho_2 r^2 - 2(\rho_0 + \rho_1 r) = 0$, and $r''$ equal to the positive root of $\rho_2 r^2 + \rho_1 r + \rho_0 = 0$.

At the 1st Luso-Spanish Congress held in Porto in 1921, Woodhouse presented the talk *Francisco Simões Margiochi's contribution to the problem of algebraically solving equations* (*Contribuição de Francisco Simões Margiochi para o problema da resolução algébrica das equações*). Woodhouse was referring to the *Memoire in order to prove that literal and complete equations of degree greater than four cannot have the root form* (*Memoria com o fim de provar que não podem ter fórma de raizes, as equações litteraes e completas de graus superiores ao quarto*) presented by Margiochi[5] to the *Academy of Sciences of Lisbon*, and published in the *Memórias da Academia de Sciencias de Lisboa* [Margiochi 1821]. In this work, Margiochi intended to prove that it is not possible to find a general algebraic expression to solve all polynomial equations with degree greater than four. Woodhouse explained Margiochi's procedure in detail and he showed that although the conclusion was correct, the method used did not allow him to prove it.

In 1924 Woodhouse published the work *The Horner Method and a forgotten Portuguese work* (1794) (*O Método de Horner e um trabalho português esquecido* (1794) [Woodhouse 1924]) in the *Imprensa Nacional* (Fig. 4).[6] This work was intended as a tribute to the Portuguese mathematician José Maria Dantas Pereira (1772–1836) who, in Woodhouse's opinion, should have been acknowledged for the method

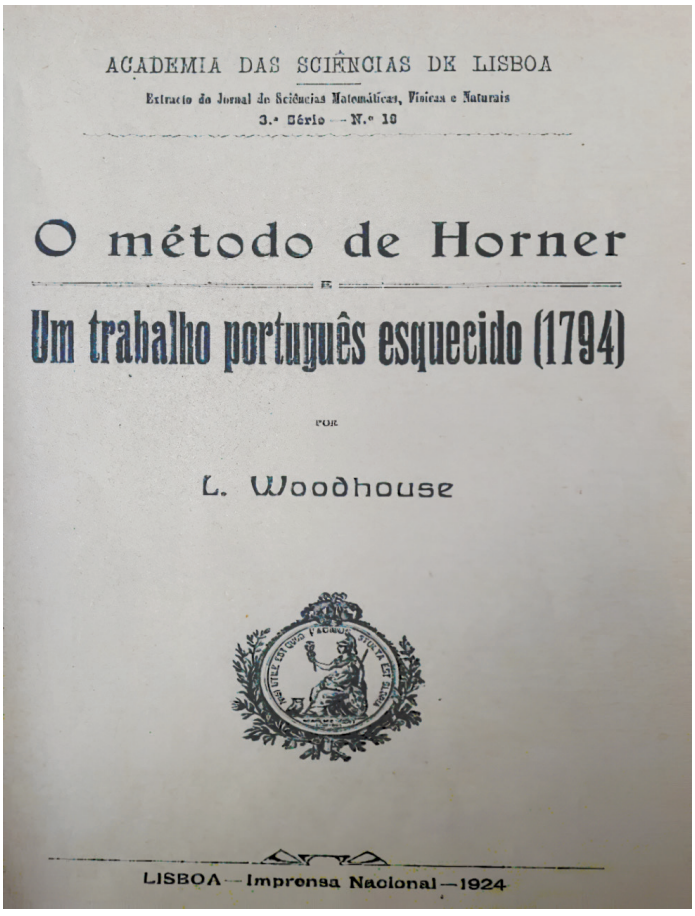
[5] Fracisco Simões Margiochi was a Mathematics Professor at the *Royal Navy Academy of Lisbon*, and a member of the *Academy of Sciences of Lisbon*.

[6] Also in Journal of Mathematical Physics and Natural Sciences [Vol. 5 of 3th Series, No. 94 (1924–1927) pp. 53–68].

known as Horner's method. By providing greater visibility of these works, he showed that algebraic studies in Portugal were in line with the cutting edge of the discipline. Essentially, Woodhouse's argument developed in three parts. Part 1 is a commented summary of the method that Horner used to calculate the real roots of an algebraic equation with real coefficients.

The method is contained in the memoire entitled *The New Method of Solving Numerical Equations of All Orders* presented by the English geometer William George Horner (1786–1837) to the *Royal Society* in 1819, and published in the *Philosophical Transactions of the Royal Society* [Horner 1819]. It describes a method to approximate the roots of a polynomial equation using Ruffini's rule. As Woodhouse pointed out, the method was still unknown in 1794 when Dantas Pereira presented his paper *Reflections on certain successive summations of the terms of the arithmetic series, applied to the solutions of various algebraic questions* (*Reflexões sobre certas sommações sucessivas dos termos das series aritmeticas, applicadas ás soluções de diversas questões algébricas*) at the Academy of Sciences. Dantas Pereira's work, referred to by Woodhouse, was published in *Memorias de Mathematica e Phisica da Academia Real das Sciencias de Lisboa* [Pereira 1799]. In part 2, Woodhouse briefly described the content of Dantas Pereira's memoire, rewriting it with slight changes in formulation and notation. He pointed out that while the author's goal was not to solve equations, the computation of the value of a polynomial at a given point is present in his work. Part 3 deals with the comparison between Dantas Pereira's method and Horner's method in order to compute the values of a polynomial with integer coefficients for integer values of the variable. Woodhouse showed that their structures are essentially analogous, and furthermore, he recalled that though Dantas Pereira's method does not use Ruffini's rule, it is more efficient because it reduces the number of calculations.

The 3rd Luso-Spanish Congress for the Progress of Sciences took place in Coimbra in 1925. Woodhouse delivered the first talk in the Mathematics Section — *Mathematics in Portugal in the early nineteenth century* (*A Matemática em Portugal no principio do século XIX* [Woodhouse 1925]) (Fig. 5)— once again turning his attention to the algebraic questions in which the Portuguese mathematicians of the time were interested. And he recalled that the dominant themes were astronomy and algebraic analysis.


ACADEMIA DAS SCIENCIAS DE LISBOA

Extracto do Jornal de Sciencias Mathematicas, Physicas e Naturais

3.ª Série — N.º 10

O método de Horner

E

Um trabalho português esquecido (1794)

POR

L. Woodhouse

LISBOA — Imprensa Nacional — 1924

**Figure 4.—**Cover of the extract of the Method of Horner published in Journal of Mathematical Physics and Natural Sciences.

Woodhouse highlighted the importance of two memoires of João Evangelista Torriani[7] published in the *Memorias de Mathematica e Phisica da Academia Real das Sciencias de Lisboa* (*Memórias dos Correspondentes*): *Deduction of a general formula which comprises Newton's theorems as to the powers of the roots of equations* (*Dedução de huma fórmula geral que compreende os Theoremas de Newton sobre as potencias das raizes das equações* [Torriani 1812]) and *Proving the formulas proposed by Wronski for the general solution of equations* (*Dar a demonstração das formulas propostas por Wronski para a resolução geral das equações* [Torriani 1819]). In the latter of these works, Torriani studied Wronski's memoire regarding the general solution of algebraic equations, which had been discovered a few years earlier. Furthermore, he proves that the solution given by the Polish mathematician is false for equations of degree greater than three. For this work Torriani was given

[7] He was a mathematics professor at the *Royal Navy Academy of Lisbon*, and a member of the *Lisbon Academy of Sciences*.

[8] See *Memorias da Academia Real das Sciencias de Lisboa*, Tomo VI, 1819, pp. CXXIII–CXXVIII.

[9] Echols 1893, p. 180. More recently, Roy Wagner published in *HOPOS: Journal of the International Society for the History of Philosophy of Science* the paper *Wronski's Infinities* in which he refers to Torriani's proof. Unfortunately, Wagner dated Torriani's work from 1819, although it is from 1818 [Wagner 2014, p. 57].

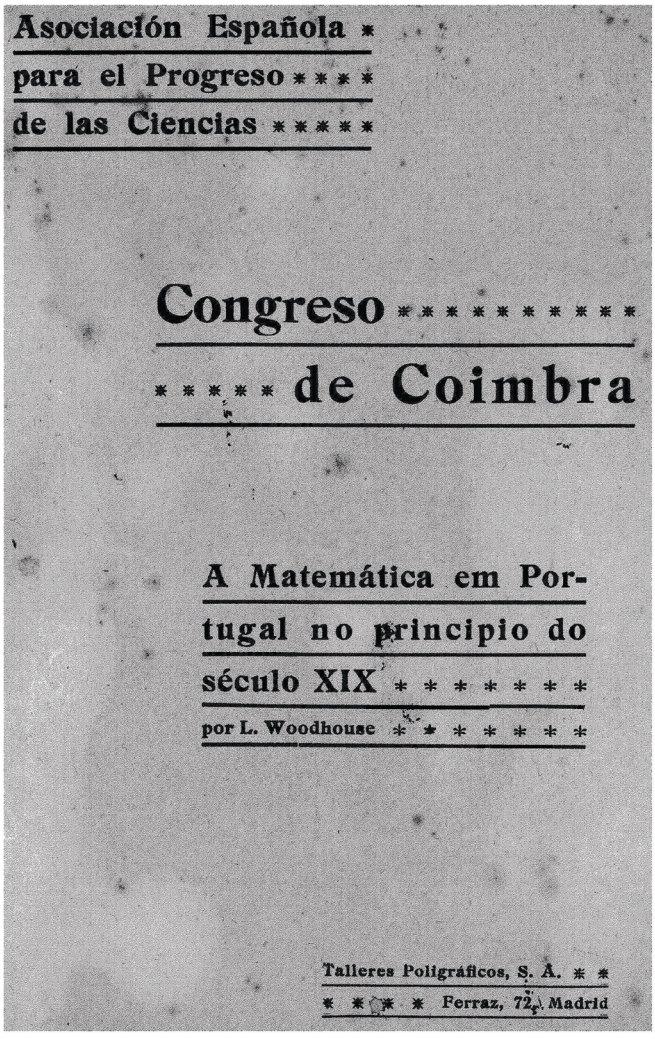



**Figure 5—**Front page of Woddhouse's talk at the Congress for the Progress of Sciences, in Coimbra in 1925.

an award by the *Royal Academy of Sciences of Lisbon*.[8] Moreover, he was internationally acknowledged in the *Bulletin of the New York Mathematical Society*.[9]

Woodhouse applied for membership to the *Royal Academy of Sciences of Lisbon* in 1925 with the following works: *Portuguese contribution to a famous algebra problem* (*Contribuição portuguesa para um celebre problema de algebra*[10] [Woodhouse 1921a]), *The Fundamental Principle of the theory of algebraic equations* (*Princípio Fundamental da teoria das equações algébricas* [Woodhouse 1885]), *The Horner Method and a forgotten Portuguese work (1794)* (*O Método de Horner e um trabalho português esquecido (1749)* [Woodhouse 1924]), *On the Integration of Differential Equations of Dynamics* (*Da integração das equações differenciaes da dynamica* [Woodhouse 1883]), *The Mathematical Renaissance in Portugal in the late 18th century and the Royal Academy of Sciences of Lisbon* (*O Renascimento Matemático em Portugal no fim do século XVIII e a Academia Real das Sciencias de Lisboa*[11] [Woodhouse 1923]), and *The Mathematical Teaching in Portuguese Universities* (*O Ensino Matemático nas Universidades Portuguesas* [Woodhouse 1921]). On the 4th of February of 1926, he was elected corresponding member of the *Lisbon Academy of Sciences*.

## Final Notes

Luis Woodhouse was highly regarded as a Professor of Mathematics in Porto. He was remembered by his students for his qualities of rigor, austerity and integrity. In his classes he practiced what he understood to be the teacher's mission: "he has an unquestionable devotion to teach, attracting and not coercing", and he defended a "closer relationship between teachers and students" [Woodhouse 1921]. With a conciliatory character, he was always ready to intervene in unfair situations with students or colleagues. Woodhouse took a critical stance on using experimental methods in teaching Mathematics, stressing that: "Mathematical knowledge systematically acquired by experimental methods or even obtained without the precision of rigor... what a fragile research tool it will be in the hands of those who try to use it! What a restriction, what educational benefits will those who use them get in this way?" [Woodhouse 1921]. Although Woodhouse devoted his main effort to teaching in its various aspects, he played an important role in the dissemination of algebra in Portugal, in the 18th and 19th centuries. At the Luso-Spanish Congresses for the Progress of Sciences, which he attended regularly, he discussed scientific papers presented to the *Academy of Sciences of Lisbon* in the first decades of its creation, which had since been forgotten for many years. Additionally, he stressed that they addressed current issues among the foreign scientific community of the time, sometimes anticipating methods and results. Thus, he intended to show that, contrary to popular belief, interest in mathematics remained alive in the period following Anastacio da Cunha and Monteiro da Rocha, and prior to Daniel Augusto da Silva.

[10] It is the text of the conference Francisco Simões *Margiochi's contribution to the problem of algebraic solving of equations* presented by Woodhouse at the 1st Luso-Spanish Congress held in Porto in 1921.

[11] Woodhouse presented it in the Luso-Spanish Congress held in Coimbra in 1923.

[12] On Anastácio da Cunha see Luís Saraiva in *CIM Bulletin 38–39*, December 2017, pp. 40–45.

## References


Beires, Rodrigo Sarmento (1951). "Evocação da vida e da Obra do Professor Gomes Teixeira". *Anais da Faculdade de Ciências do Porto*, 35 (1950–1951). Porto, Imprensa Portuguesa, pp. 173–192.

Carvalho, Scipião (1934). "Prof. Dr. Luis Woodhouse, Elogio proferido em sessão de homenagem de 13 de Março de 1935". *Anais da Faculdade de Ciências do Porto*, 19 (1) (1934 [sic]). Porto, Imprensa Portuguesa, pp. 192–203.

Echols, W. H. (1893). "Wronski's expansion". *Bulletin of the New York Mathematical Society*, 2 (1893), pp. 178–184.

Horner, William George (1819). "The New Method of Solving Numerical Equations of All Orders". *Philosophical Transactions of the Royal Society*, Part I, pp. 308–335.

*Jornal de Sciencias Mathematicas e Astronomicas*, 1 (1877). Coimbra, Imprensa da Universidade.

Margiochi, Francisco Simões (1821). "Memoria com o fim de provar que não podem ter fórma de raizes, as equações litteraes e completas de graus superiores ao quarto". *Memorias da Academia das Sciencias de Lisboa*, 7, pp. 317–349.

*Memorias da Academia Real das Sciencias de Lisboa*, 6 (1819), pp. CXXIII–CXXVIII.

Netto, E.,Vavasseur, R. Le (1907). "Le théorème fondamental". *Encyclopédie des Sciences Mathématiques Pures et Appliquées*, I (2), pp. 189–205.

*O Instituto. Revista Cientifica e Literaria*, 26 (July 1878–July 1879). Coimbra, Imprensa da Universidade, 1879.

Pereira, José Maria Dantas (1799). "Reflexões sobre certas sommações sucessivas dos termos das series aritmeticas, aplicadas a questões algébricas". *Memorias da Academia Real das Sciencias de Lisboa*, II, pp. 168–186.

Saraiva, Luís (2017). "José Anastácio da Cunha (1744–1787)". *CIM Bulletin* 38–39, December 2017, pp 40–45.

Torriani, João Evangelista (1812). "Deducção de huma fórmula geral que compreende os Theoremas de Newton sobre as potencias das raízes das equações". *Memorias da Academia Real das Sciencias de Lisboa* (Memórias dos correspondentes), III, pp. 1–8.

Torriani, João Evangelista (1819). "Dar a demonstração das fórmulas propostas por Wronski para a resolução geral das equações". *Memorias da Academia Real das Sciencias de Lisboa*, VI, 1, pp. 33–51.

Wagner, Roy (2014). "Wronski's Infinities". Hopos: *Journal of the International Society for the History of Philosophy of Science* 4 (2014), pp. 26–61.

Woodhouse, Luis Inacio (1877). "Sobre a questão proposta no n° 6". *Jornal de Sciencias Mathematicas e Astronomicas*, Vol. 1. Coimbra, Imprensa da Universidade, pp. 110–111.

Woodhouse, Luis Inacio (1878). "Demonstração de um teorema de geometria", in *O Instituto. Revista Cientifica e Literaria*, Vol. 26 (June 1878–June 1879), pp. 429–430.

Woodhouse, Luis Inacio (1880). "Chronologia paleontológica (Traços geraes)". *Revista Scientifica e Litteraria*, 1. Coimbra, Imprensa Académica, pp. 17–21.

Woodhouse, Luis Inacio (1881). "Astronomia (Hypothese Cosmogonica)". *Revista Scientifica e Litteraria*, 2. Coimbra, Imprensa Académica, pp. 46–49.

Woodhouse, Luis Inacio (1883). *Da Integração das Equações Differenciaes da Dynamica*. Porto, Typographia Occidental.

Woodhouse, Luis Inácio (1885). "Principio Fundamental da Theoria das Equações Algébricas". *Jornal de Sciencias Mathematicas e Astronomica*, VI. Coimbra, Imprensa da Universidade, pp. 177–182.

Woodhouse, Luis Inacio (1921). "O Ensino Matemático nas Universidades Portuguesas". Congresso do Porto de 1921. *Associação Portuguesa para o Progresso das Sciencias*. Porto, pp. 133–151.

Woodhouse, Luis Inacio (1921a). "Contribuição portuguesa para um célebre problema de álgebra". *Separata das actas do Congresso Luso-Espanhol para o Progresso das Sciencias, realizado no Porto em 1921*, pp. 1–11.

Woodhouse, Luis Inacio (1923). "O Renascimento Matemático em Portugal no fim do século XVIII e a Real Academia das Sciencias de Lisboa". *Asociación Española para el Progreso de las Ciencias. Actas del Noveno Congreso celebrado en la ciudad de Salamanca. II (Conferencias)*, 1923, pp. 175–191.

Woodhouse, Luis Inacio (1924). "O método de Horner e um trabalho português esquecido (1794)". *Jornal de Sciencias Mathematicas, Físicas e Naturais* (1927), 24 (5 Serie 3, 94). October 1924 – January 1927, pp. 53–68. Lisboa. Imprensa Nacional.

Woodhouse, Luis Inacio (1925). "A Matemática em Portugal no princípio do século XIX". *Separata das actas do Congresso Luso-Espanhol para o Progresso das Sciencias, Asociación Española para el Progreso de las Ciencias*. Congreso de Coimbra. Madrid, pp. 81–101.


For more information on Luis Woodhouse's life and works, the reader can consult

*Luis Inacio Woodhouse (1857–1927). O Professor e a sua Obra*. Maria do Céu Silva and Maria Luísa Magalhães. U.Porto Editorial, 2018.