

## **SCIENCE, KNOWLEDGE, AND THE ART OF FORTIFICATION: TRADITION AND INNOVATION IN THE TRAINING OF MILITARY ENGINEERS IN 17TH-CENTURY PORTUGAL**

*Antónia Fialho Conde*

Innovations in the field of military engineering are contextualized with questions of knowledge and the emergence of new languages in the modern era. Images and illustrations are becoming increasingly important and sophisticated in explaining reality and theoretical discourse. This also reflects the Jesuits' recommendations regarding the use of mathematical concepts and scientific instruments, as well as the call for the use and practice of instruments, given the fallibility of the senses: Euclidean postulates must constitute the paradigm of scientific proof, taking precedence over Aristotle's natural philosophy. Military engineering has proven to be the field par excellence for the application of mathematical knowledge: many engineers are excellent mathematicians, trained by the Jesuits.

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## **THE ROLE OF LEONHARD EULER (1707-1783) IN THE DEVELOPMENT AND TRANSMISSION OF SCIENTIFIC KNOWLEDGE AT SAINT PETERSBURG ACADEMY OF SCIENCES**

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The Eighteenth century was the period of the development of the transmission of scientific knowledge in Europe through academies and their publications. In 1725, Peter the Great (1672-1725), Tsar of Russia, founded the Saint Petersburg Academy of Sciences and Arts. This Academy became one of the major scientific centres in Europe. The philosopher, mathematician and diplomat Gottfried Wilhelm Leibniz (1646-1716) proposed the plan of the creation of the Academy and became a private advisor, and a good friend of the Tsar. Later, Leonhard Euler (1707-1783) moved from Basel to the Saint Petersburg Academy of Sciences from 1730 to 1741, and he returned to the

Academy in 1766 until his death. In our article, we analyse the role of Euler in the scientific development of this Academy and in the modernization of Russia.

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## **REVEALING THE INVISIBLE AND THE HIDDEN: THE TRANSIT OF VENUS ACROSS THE SUN AND NON-ASTRONOMICAL EXPERIENCE OF EUROPEAN ASTRONOMERS ON THE TERRITORY OF THE RUSSIAN EMPIRE IN EIGHTEENTH CENTURY**

*Dimitri Bayuk*

The transit of Venus across the Sun was an important astronomical event in 1769. It enabled to establish the size of the Solar System with unprecedented exactness. Many expeditions were sent to different parts of the Earth to observe it. Observers of eight of them conducted the observations from the territory of the former Russian Empire. Despite three of the eight main observers — Jacques-André Mallet, Jean-Louis Pictet and Christian Mayer — led their expeditions without being members of the Saint Petersburg Academy of Arts and Sciences, which directly contradicted the explicitly articulated will of the Empress, the Academy invited them and covered their travel expenses. Some recently published archival materials shed light on the mechanism how this contradiction became possible and which role the international scientific communication played in it.

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## **FROM THE ACADEMIC ENDORSEMENT OF THE MECHANICAL ARTS TO THE INTRODUCTION OF THE TEACHING OF MACHINERY IN CATALONIA (1767-1831)**

*Carles Puig-Pla*

Between 1767 and 1831 the Royal Academy of Natural Sciences and Arts and the Private Board of Commerce of Barcelona played a crucial role

in the increasingly high regard in which the mechanical arts were held and the promotion and dissemination of mechanization in Catalonia (Spain) from 1767 to 1831. The Academy stressed the importance of useful science and appointed academicians within a wide range of artists. It awarded the title of Artistic Academician to value and encourage the cultivation of the practical arts. Furthermore, it became a centre for collaboration between distinguished academicians and skilled craftsmen, particularly machinists and instrument makers.

The Board of Commerce for its part was constantly aware of the need to introduce technical innovations and to push forward the development of Catalan industry by means of its progressive mechanization. In particular, at the beginning of the 19th century it undertook, in collaboration with the Academy of Sciences, action aimed at providing a technical training in the field of mechanics and mechanization. Finally, it achieved to establish a Chair of Machinery (1831) directed by H. Bordeje, a Spanish technician trained in France and England. The Board of Commerce for its part was constantly aware of the need to introduce technical innovations and to push forward the development of Catalan industry by means of its progressive mechanization. In particular, at the beginning of the 19th century it undertook, in collaboration with the Academy of Sciences, action aimed at providing a technical training in the field of mechanics and mechanization. Finally, it achieved to establish a Chair of Machinery (1831) directed by H. Bordeje, a Spanish technician trained in France and England.

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## **RUNNING FRANCESC SANTPONÇ'S STEAM ENGINE. WERE THE EXPECTATIONS MET? A CONTROVERSY AND A WAR**

*Maria Montava Gadea*

Between 1804 and 1805, in Barcelona, a team of craftsmen of recognized professional value built a double-effect steam engine. The team was leaded by the doctor Francesc Santponç i Roca (1756 – 1821). The project was conceived at a time when few initiatives of this type of technology had been carried out in Spain. All these initiatives took place with the hiring of experts from

the United Kingdom, a country where this type of technology had been developed. In this article, we reflect on the expectations generated by the machine built in Barcelona by local technicians without the help of foreign experts. We give some conclusions on whether the expectations were met and to what extent they could be achieved. In addition, we reflect on the circulation of technical knowledge that the project of this machine generated. We also highlight the extend of technical skills and technological knowledge that the project entailed for the technicians and for Santponç. The greatest proof of this last statement is the design of an unprecedented automation system. The French War (1808 – 1814) put on hold the circulation of technical knowledge that was promoted by the project. The project of the steam machine was a commitment with steam technology promoted by Catalan businessmen and carried forward by technicians and technology experts who exceeded their limits by consulting foreign works and through experimentation.

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## **PIERRE-JACQUES CHATAU AND HIS OPTICAL TELEGRAPH SET IN RUSSIA (1834-1839)**

*Jesús Sánchez Miñana*

A French national, Pierre-Jacques Chatau, during a stay in Russia from 1833 to 1841 introduced the optical telegraphy in the Empire with the establishment of two lines operating day and night from Saint Petersburg, one of them reaching Warsaw, possibly the longest ever built. Based solely on the apparently scarce bibliographic sources, a brief account of his life and works is given, wishing to promote further interest and research on the subject.

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## NATIONAL AND COSMOPOLITAN: THE (GREEK) ARMY CORPS OF ENGINEERS (1830s-1860s) AND THE “PONTS ET CHAUSSÉES EUROPÉENS”

*Konstantinos Chatzis*

The existence of “Ponts et Chaussées Européens,” i.e., a transnational space inhabited by engineers of various nationalities specializing in public works, and characterized by multiple and intense circulations — of people and artifacts, engineering knowledge and technical practices, educational models and regulations— connecting national territories that are geographically distant from one another, is attested by a series of recent historical works. However, systematic and in-depth studies treating the modalities of its constitution, its precise modes of operation, and the specific mechanisms of its maintenance, reproduction, and extension are much rarer. Taking inspiration from studies dealing with small-scale objects and relatively short time frames with a view to connecting their local (micro)findings to broader processes and phenomena, the present article takes advantage of the existence of abundant and mostly unpublished documentation to transform the case of the (Greek) Army Corps of Engineers (1830s-1860s) into a vehicle for exploring the (micro)processes of constitution and (micro)modalities of operation of “Ponts et Chaussées Européens” in the 19th century.

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## BLUEPRINTS OF POWER: PORTUGUESE ENGINEERS AND AFRICAN COLONIES

*Maria Paula Diogo*

This article, written in tribute to Dmitri Gouzevitch, reflects on engineers as architects of imperial power—a theme central to both our research. Dmitri examined the Russian Empire under Peter I, while my work focuses on the Portuguese colonies in Africa, particularly Angola and Mozambique. Across a century of difference, engineers were pivotal in both contexts, shaping infrastructure, guiding state-led economic and transport projects, and con-

solidating imperial control. Through railways, ports, and other networks, they transformed the physical, economic, and social landscapes, translating technical expertise into the expansion and maintenance of empire.

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## **THE BIRTH AND GROWTH OF THE ENGINEERING PROFESSION IN EUROPE IN THE 19TH AND EARLY 20TH CENTURIES**

*André Grelon*

During the 19th and 20th centuries, engineering was establishing its modern configuration. In this paper, there is an approach to this multinational process in which French engineering institutions played an important role. Nevertheless, diversity and local conditions were finally the context that give us the possibility to analyze this process of professionalization in which Europe became central.

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## **THE ECOLE CENTRALE, THE CENTRALIENS AND THE IBERIAN PENINSULA: MUTUAL INTERESTS**

*Ana Cardoso de Matos, Antoni Roca-Rosell*

The French technical schools had a significant influence on the development of engineering in the Iberian Peninsula. In this paper, we analyze the relationship between the École Centrale des Arts et Manufactures, established in 1829 in Paris, and Spanish and Portuguese engineering. The École Centrale was a pioneer in training civil engineers; therefore, it attracted the interest of the Iberian countries as they were engaged in their own industrial development. There were similarities in the training of engineers and also connections between the Centrale graduates and the Spanish and Portuguese engineers. In fact, several French Centraliens pursued their professional careers in the Iberian Peninsula. All of this means that the Iberian world of engineering should be understood by taking into account its links with European engineer-

ring and, in particular, the world derived from the École Centrale.

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## **HENRI POINCARÉ AND MATHEMATICS IN RUSSIA (PRELIMINARY SKETCHES)**

*Sergey S. Demidov*

We examine Henri Poincaré's connections with Russian mathematicians, as well as some points concerning the reception and development of his ideas in Russia. We present his contacts with S. V. Kovalevskaya, his correspondence with A. M. Lyapunov, the rise of the qualitative theory of differential equations up to the works of A. A. Andronov and his school, without forgetting his influence on Soviet topology. We also present the translations of his works and their role in Russian scientific thought.

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## **LIVING TOGETHER IN PARIS WITH THE GOUZÉVITCH: THE ORIGIN OF A LONG FRIENDSHIP AND A FRUITFUL CONVERSATION ABOUT SPANISH-RUSSIAN SCIENTIFIC EXCHANGES**

*Leoncio López-Ocón Cabrera*

Dimitri Gouzevitch was a humanist engineer who, as an engineering historian, was interested in the work carried out in Russia by European engineers such as Agustín de Betancourt, a Spaniard of Canarian origin, and in the ability of these technicians to establish transnational communication networks. As a tribute to his interest in the study of Spanish-Russian scientific and technical relations, these pages present examples of connections between Spanish scientists and the Russian world during the Soviet era. Specifically, it recounts the trips made to the Soviet Union in the 1930s by the veterinarian Nicanor Almarza Herranz and the phonetician Tomás Navarro Tomás.

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## PIRQUINEROS IN THE 21ST CENTURY. MEMORY, TECHNIQUES, AND VESTIGES: AN INDUSTRIAL ARCHAEOLOGY IN THE YERBA LOCA SECTOR, LO BARNECHEA, CHILE (19<sup>TH</sup>-20<sup>TH</sup> CENTURY)

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Through work carried out within the framework of the valorization of archaeological sites, we examine “pirquinería” (mineral mining) in Chile from a historical, technical, and social perspective, combining a review of archives (1950-2000) with oral history in the Yerba Loca sector, Lo Barnechea commune, Metropolitan Region of Chile. Using documentary sources along with testimonies from the inhabitants of Chile’s central foothills, we appreciate the evolution of this small-scale mining as an expression of modernity at intersecting scales, situating it as a practice of local knowledge and part of the way of life and customs of human groups.

An industrial archaeology approach to sites PLBI001, PLBI002, and PLBI003, identified in the Los Bronces Integrated Project, reveals activities that may have been related to pirquinería (mineral mining), although evidence points to the practice of muleteering, a way of life that allows us to understand the mobility not only of mining resources but also of the tools and knowledge complementary to the functioning of this social system (working materials, food, people, etc.).

It is argued that, despite the historical trajectory and certain advances in institutionalization, gaps persist in policy evaluation and in the recognition of the cultural and technical value of this artisanal mining, which poses challenges for its future sustainability. The Yerba Loca case has revealed a possible loss of memory about the pirquinería activity, which requires more extensive research.

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## GLOBAL NETWORKS OF CARE: INDUSTRIAL HERITAGE ACTION-RESEARCH IN AND FROM CHILE, CONNECTING PEOPLE AND PLACES

*Marion Steiner*

Moving on from the classical “Networks of Power” (Hughes, 1983) to “Global Networks of Care” (Steiner, 2025b, quoting Moulshri Joshi), this article reflects on the strategic design and implementation of a Chilean Fondecyt research project, executed from 2023 to 2026, which intertwined a critical historiography of global electrification with community approaches to sharing industrial heritage gloCALLy. In the first two parts of this article I resume main findings from these two different spheres and academic disciplines that are represented by the History of Technology on the one hand and by Heritage Studies on the other. The third part is dedicated to the presentation of key strategies and step-by-step methodologies for the project’s three years of impact-oriented implementation. Here, I share thoughts about good practice, experiences, and recommendations for further action-research work, especially with regards to strengthening critical historiographies and collaborative industrial heritage activities in, from, and for Chile. I end with some notes on how the contents and methodology that have been elaborated over the past three years from this project, have also hugely inspired (and continue to do so) the work of TICCIH, The International Committee for the Conservation of Industrial Heritage, which celebrated its 50th Anniversary and the inauguration of a new Board at its recent World Congress in August 2025 in Kiruna, Sweden, starting a new era for global industrial heritage work.

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