

## **THE TRANSFORMATIONS OF HIGHER EDUCATION IN ANGERS DURING THE 19<sup>TH</sup> CENTURY: FROM PUBLIC LECTURES TO A CATHOLIC FACULTY**

*Anne Bidois*

This article analyses the place and role given to higher education and how the training was organized in the 19<sup>th</sup> century in French towns that lacked any proper academic institutions of higher education. The way in which alternative knowledge spread and was disseminated is discussed, from open courses and institutions that were partly state-controlled, such as the *École préparatoire à l'enseignement supérieur des sciences et des lettres*, to the development of the Catholic Institutes of Higher Education. The focus is on the French town of Angers.

\* \* \*

## **UNIVERSITY INSTITUTES AND FACULTY INSTITUTES IN THE UNIVERSITÉ DE PARIS. AN ANSWER TO THE CALL FOR NEW FUNCTIONS OF THE UNIVERSITY?**

*Thérèse Charmasson*

During the last twenty years of the 19<sup>th</sup> century and then again during the 20<sup>th</sup> century, between the two World Wars, an important number of institutes were created within the universities, in Paris and throughout the country. In 1920, the July 31<sup>st</sup> decree on the charters of the universities provided legal framework for these institutes that could be attached to faculties or universities. In Paris, however, several of the scientific institutes, among them the oldest and the most prestigious ones, such as the Radium Institute and the Applied Chemistry Institute, continued operating outside of the framework provided by these regulations. The Psychology Institute, on the contrary, was created as a university institute. A detailed study of the institutional history of these three institutes leads us to the conclusion that, although they shared the same title, their aims were different and their creation was an answer to new functions of the university.

## **LONG-TERM EFFECTS OF THE CREATION OF “TECHNICAL INSTITUTES OF THE FACULTIES OF SCIENCES” ON SPATIAL ORGANIZATION OF THE FRENCH SYSTEM OF HIGHER EDUCATION AND RESEARCH**

*Michel Grossetti*

André Grelon has studied the development of technical institutes linked to the faculties of science during the French Third Republic. These institutions, initially rather humble, kept expanding and became an important part of the French system of engineering education. This article shows that the fact that they were attached to the faculties has facilitated in some cases the importation to France of certain branches of knowledge such as chemical engineering or automatics, and enabled the boom of technical institutes, thus drawing the map of engineering research in France.

\* \* \*

## **TESTIMONY. ENGINEERING SCHOOLS IN NANCY (19<sup>TH</sup> – 21<sup>ST</sup> CENTURIES): HISTORY OF A RESEARCH PROGRAM**

*Françoise Birck*

The history of the great part of the engineering schools in Nancy had been written before the research program this article analyses was created and put into practice. The narratives were construed mostly by those who worked at these schools or even managed them, and tended to focus on evaluating education and research. The research done by the Nancy research group in collaboration with national and international networks, has made possible to introduce comparison and shattered the framework defined by the institutions themselves. Particularly, it has shown how, through a series of adjustments made without discussion on the principles, the institutes created by the university in order to provide scientific culture future to technicians to be employed in industry, ended up integrated in the system of *grandes écoles*, a particular feature of the French higher education. However, the research has so far left unanswered the question of how this academic approach could

make sense for all stakeholders involved in the schools' functioning, who are confronted today with the "big narratives" of the economy of knowledge, global competition and international rankings. It is tempting to think that showing the range of solutions proposed in the past during major national debates would give actors the opportunity to capitalize on these experiences to inform the debates of today.

\* \* \*

### **A NEW LOOK ON CHEMISTRY TEACHING BY JEAN-BAPTISTE DUMAS AT THE ÉCOLE CENTRALE DES ARTS ET MANUFACTURES AT THE BEGINNING OF THE 1870s**

*Virginie Fonteneau*

By studying a brief episode of the history of the École centrale des arts et manufactures - the resignation of two professors and one assistant of chemistry in 1873 -, this paper aims to prove that during this period Jean-Baptiste Dumas still had a strong influence on choices concerning chemistry teaching. Furthermore, it strives to show how this event has shaped the place of chemistry at school and the objectives it was supposed to serve at the end of the 19<sup>th</sup> century.

\* \* \*

### **EDUCATION AND SOCIAL STANDING: GERMAN ENGINEERS, 1870-1930**

*Wolfgang König*

This paper intends to submit an overview of the history of the German engineering profession during the 19<sup>th</sup> and 20<sup>th</sup> century trying to summarize the national particularities in five points. The focus will be on the period between 1870 and 1930. Beyond that, I shall also integrate some information on the time before, starting in the late 18<sup>th</sup> century, when some important ground for the development of the German engineering profession was laid. And

additionally, I shall give a brief outlook up to today which will demonstrate that history matters, also concerning the engineering profession.

\* \* \*

## **WHAT ROLE FOR THE ENGINEERS IN THE INDUSTRY?: SOME REFLECTIONS ON THE CASE OF PORTUGAL, XIX-XX CENTURIES**

*Ana Cardoso de Matos*

As in other countries, the relationship between engineers and industry in Portugal became more complex and diversified during the nineteenth century. Overall, in the nineteenth century, the involvement of engineers in the country's industrial development became crucial, whether through technical education in various branches of industry, via construction of industrial buildings, or even by the transfer and the application of technology. The projects for the industrial exploitation of natural resources of the country, especially those concerning the different energy or mineral resources, were also a way in which engineers were involved in the industry. Second, in the nineteenth century, some chemists developed an industrial activity very close to what we nowadays would call chemical engineering. The intervention of engineers within the political and administrative institutions as well as in the industrial associations and societies was just as important. In this paper, I analyse examples that illustrate the diversity of relationships between engineers and industry in the Portuguese context, trying to clarify the role that this professional group played in the industrial development of the country.

\* \* \*

## **DIFFERENT SHAPES OF THE INTERNATIONALIZATION DEBATING ENGINEERING EDUCATION BEYOND THE 20<sup>TH</sup> CENTURY**

*Antoine Derouet*

Many researches have shown that the history of engineering schools is shaped by extra-national dynamics. These dynamics are plural in their forms

and in their composition. Through the lens of debates in socio-economics teaching, this article attempts at characterizing these extra-national dynamics in order to highlight different forms of internationalization during the twentieth century. The author follows a socio-historical perspective and distinguishes four argumentative cycles, which could be considered as modalities of internationalization.

\* \* \*

## **ENGINEERS BETWEEN FRANCE AND THE OTTOMAN EMPIRE (18<sup>TH</sup> – 20<sup>TH</sup> CENTURIES): AN ENTANGLED HISTORY**

*Darina Martykánová*

This article strives to show the diversity and complexity of centuries-long exchanges in the field of engineering between France and the Ottoman Empire as well as of the actors who shaped these relations and were, at the same time, shaped by them. The inter-governmental relations were of utmost importance, but so were individual initiatives as well as the existence of a transnational space of interaction. The communication between actors of different ethnic, religious and linguistic background was facilitated by the existence of common identity patterns, such as French language and the discourse of modern civilization. In this space, new knowledge and skills emerged and circulated, and so did a new technical culture and new professional identity of engineer that had a transnational, even global dimension. This, in turn, further enabled professional communication and collaboration among people of different origins and allegiances and facilitated the success of projects and works of unprecedented size, location and complexity.

\* \* \*

## **BRAZILIAN ENGINEERS IN THE FRENCH 'GRANDES ÉCOLES' IN THE 19<sup>TH</sup> CENTURY**

*Silvia Fernanda de Mendonça Figueirôa*

In this paper, I present some of the results of my post-doctoral research, in

which I have attempted to map out a “community” of about ninety Brazilians who went to study engineering in France during the nineteenth century. My aim is to contribute to the understanding of the role played by these Brazilian engineers. The main argument is that they were the vectors of positivist and Saint-Simonist ideas, and were relevant for the Brazilian process of modernization.

\* \* \*

### **“PRINCE’S KISS”: TECHNOLOGY TRANSFER AND DORMANT KNOWLEDGE IN THE WORLD OF ENTERPRISE (USA - ITALY, THE 1950s-1960s)**

*Ferruccio Ricciardi*

This article deals with the phenomenon of technology transfer, especially the transfer of managerial and technical knowledge between the US and Italy during the 1950s. It focuses on the role of the expert in business consulting whose activity can activate some “native” knowledge relegated to shadows, forgotten or underutilized. Three emblematic cases are presented: the use of the budget, the adaptation of the doctrine of “human relations” for the management of personnel, and the “translation” of the administrative principles forged by Henri Fayol via the mediation of the US business milieu. Issued from an asymmetrical exchange, transfer results here as a circulation process that is part of a “community of practices”, that is to say a community sharing technical affinities and action devices.

\* \* \*

### **TESTIMONY. ANDRÉ GRELON, HIS CZESH EXPERIENCES AND AN INSPIRED CASE-STUDY: THE ELECTROTECHNICIANS FRANTIŠEK KŘÍŽIK ET VLADIMIR LIST**

*Marcela Efmertová*

The paper deals with international cooperation in the field of history of technology between the Czech Technical University and the Centre français

en recherche des sciences sociales in Prague, and several major French institutions (CNRS, EHESS, CNAME), as it has developed during the last twenty years. It shows the possibilities of such professional cooperation in the history of technology and their results, and analyses the contribution of André Grelon to this area. Furthermore, the author analyses two examples (František Křižík and Vladimír List) of Czech professional practical and scientific cooperation with France in the field of electrical engineering during the last three decades of the 19<sup>th</sup> century and between the two World Wars. The author analyses the participation of Křižík, electrical entrepreneur, in the Exposition Universelle de 1878 in Paris and his subsequent adjustment of differential controller of time of luminous intensity for arc lamp. Thanks to the French experience, the construction electrician List became the organizer of professional electrical life in Czechoslovakia between the two world wars, participating in the creation of the Czechoslovak Electrotechnical Association (ESČ), in a successful electrification of the country and cooperating efficiently with French experts, such as Ernest Mercier, in institutions such as the Société française d'électricité, CIGRE and UNIPEDE. The text shows the benefits of scientific and practical cooperation at international level. In this context, the author highlights the contribution of scientific and organizational work of André Grelon to Czech history of technology.

\* \* \*

## **ARCHAEOLOGY OF LIBERAL ENGINEER: THE MINES AND THE TECHNOLOGY IN FRANCE, 1760-1820**

*Anne-Françoise Garcon*

Being in charge of the state's technical policy in France, the Corps des mines is easily accused of "dirigisme" and commonly associated with mercantilism and Colbertism. Its intellectual archaeology, however, reveals a different reality. Between 1760 and 1780, liberal reformers such as Trudaine and Turgot vigorously discussed technical issues: How to help mining companies, known for requiring strong technical capital? In what legal framework? Using which technical pedagogy? Between 1791 and 1820, the lack of technical culture, the risks of mining exploitations and the lack of useful laws legitimized the Corps des mines. However, its conceptual framework

remained liberal. Synthesizing the ideas of Turgot and Trudaine, the Mining Law of April 1810 reveals these intellectual roots which gave the Corps des mines its practical philosophy.

\* \* \*

## **“TO BE OR NOT TO BE”: BUILDING A CIVILIAN IDENTITY FOR THE PORTUGUESE MILITARY ENGINEERS**

*Maria Paula Diogo*

This chapter aims at examining the relationship between the path towards modernization undertaken by Portuguese society and the emergence of a professional community embodying both technical knowledge and know-how, i.e., the engineers. From the 16<sup>th</sup> to the 18<sup>th</sup> century, Portugal remained largely on the outside of European industrialization. It is only after 1835 that it is possible to find effective changes in the Portuguese industrial fabric, which led to a conclusive process of modernization. These changes concerned the transformation of the basic conditions of manufacture spurred by the introduction of new forms of production (from a domestic-based system to a factory system), new machinery, the use of steam-driven energy sources and the enlargement of the factories. From 1850 onwards, Portuguese economy favored a close relationship between industrial strategy and the development of railway network, thus placing engineers at the core of modernization. The idea of progress as the natural offspring of technology is the main key to understanding how engineers became the pivotal professional community in building up the 19<sup>th</sup> century agenda for a renewed Portugal.

\* \* \*

## **A SOCIO-HISTORY OF ENGINEERS IN MAGHREB**

*Éric Gobe*

The emergence of the image of “modern” engineer in North Africa is linked to the modernizing ambition of states confronted with European powers’ expansionist policies and accompanying colonial activities. Consulting,

or “reform”, engineers first appeared in North Africa in the first half of the nineteenth century at the invitation of the Bey of Tunis. The Moroccans soon followed suit. Expert missions consisted in designing and implementing administrative and technical reforms which would allow them to compete with the triumphant Europe. The French, whose conquest of Algeria began in 1830, were undeterred and the Tunisian and Moroccan modernization efforts proved insufficient in preventing the establishment of French colonial interests in the two countries. The loss of sovereignty in the Maghreb led to replacement of the “reform engineer” by the “colonial engineer”. Colonization, in fact, slowed the development of the profession, as the industrialization of the conquered countries was never the aim of the colonial powers. It should also be noted that the Corps of Colonial Engineers consisted mainly of agronomists and civil engineers engaged in public works, both mainly of French origin, while local technical elites were generally excluded from scientific and technical missions.

\* \* \*

## ENGINEERING AS A PROFESSION IN PORTUGAL

*Maria de Lurdes Rodrigues*

The history of the engineers in Portugal is, in broad terms, similar to those of other industrial countries. However, it has some peculiarities related to the national context. Being an engineer in Portugal, England or Germany is not the same thing. Indeed, different countries have developed models for organizing technical work that provide engineers with very different frameworks, profiles and roles. It is possible to establish a chronology of development of the engineering profession in Portugal, highlighting three major periods: the origins - from military engineering to civil engineering (1812-1911); the conquest and affirmation of the social role of engineers (1911-1936); the age of the engineers (after 1936). During two centuries, engineers were the main protagonists of their history, interacting with different agents in order to mould engineering into a modern profession. Several internal and external factors, economic, political, cultural and cognitive ones, shaped this process.

\* \* \*

## TESTIMONY. FROM AGRONOMY TO HISTORY AND SOCIOLOGY, A SCIENTIFIC TRAJECTORY

*Pierre Vigreux*

Pondering the historical importance of agriculture, shown so strikingly by Marc Bloch, led me to the study of history at the INRA, after a career as rural engineer. This career change was possible, in the first place, thanks to Albert Broder, professor at the Université de Paris XII, who accepted to supervise my dissertation. However, André Grelon facilitated my transition and helped me discover the sociological dimensions of technology. Putting together biographies of the professors of the Conservatoire des arts et métiers (CNAM); the participation at the seminar "Technicians and Society" at the École des hautes études en sciences sociales (EHESS); his active participation in editing the *Historique des corps constitutifs du génie rural, des eaux et des forêts* (GREF); his invitation, in 2002, to speak at the conference organised in Sfax (Tunis) on "Modern Engineer in Maghreb" and his request to co-organize a conference in 2014 about "The Role of CNAM in the Modernization of French Agriculture after 1945"; for me, all this represented an opportunity to advance in my professional development. Last but not least, André Grelon was member of the jury that judged my Ph.D. thesis. Nowadays it is more than evident that technology should not be considered only in terms of its economic dimension. I have been able to understand this thanks to the teachings of André Grelon.

\* \* \*

## THE ENGINEERS IN THE ACADEMY OF SCIENCES OF PARIS (1840-1945)

*Claudine Fontanon*

The engineers I studied in the framework of my research in mechanics, fluid mechanics and aerodynamics in the 19<sup>th</sup> and 20<sup>th</sup> centuries, stand out for having been elected to the Academy of Sciences in Paris. Using the Academy's archives, I have tried to obtain complete information of engineers in this distinguished learned society. I have found forty members from 1820 to 1940.

This paper explores the category of “academic engineers” via the biographies of two of them: Aimé Laussedat, graduate from the École polytechnique, and Georges Darrieus from the École centrale des arts et manufactures.

\* \* \*

## **ENGINEERS' CAREERS IN INDIA. REMARKS ON THE SITUATION OF WOMEN AND THE EFFECTS OF AFFIRMATIVE ACTION TOWARDS DISADVANTAGED CASTES**

*Charles Gadéa*

This paper focuses on the civil engineers, a profession that symbolizes modernity, reflect the dynamics of the contemporary Indian society, but also the tensions and the disparities inherited from Indian history. The analysis leans on empirical material from a database which allows to study the careers of public water supply and sanitation department engineers in terms of gender, but also in terms of caste, or rather of the effects of public affirmative action policies intended to compensate caste inequalities through providing quotas of posts in education, in public jobs and in the promotion of civil servants. The results show that channels of career advancement for engineers from the most disadvantaged castes do actually exist and work rather well, allowing these engineers to reach top management positions. Nevertheless, this upward movement concerns almost exclusively men; women are rare in the profession and even more so those of lower castes.

\* \* \*

## **WINE OF QUALITY AND PRODUCTIVE AGRICULTURE: THE CONTRIBUTIONS OF LUIS JUSTO Y VILLANUEVA (1836-1880), INDUSTRIAL ENGINEER OF THE FIRST PROMOTION**

*Antoni Roca-Rosell; Guillermo Lusa Monforte; Jesús Sánchez Miñana*

Luis Justo y Villanueva studied at the Escuela Normal of the Real Instituto Industrial in Madrid, where he obtained the title of industrial professor and

two years later, in 1856, he graduated as an industrial engineer, within the first promotion. Studies on the history of industrial engineering have omitted this fact that one of us (Sánchez Miñana) warned by reviewing the daily press of the time. Justo y Villanueva spent much of his career in Barcelona, where he was a professor at the School of Industrial Engineers. He devoted much effort to the teaching of agricultural chemistry, not only in the framework of the School, but also in other entities. Its aim was to train rural owners and artisans in the possibilities offered by chemical engineering, but at the same time raised the rational use of scientific resources, promoting, for example, that wine producers improve and market their own wines, leaving little honest practices, such as counterfeiting and the relabelling of inferior and cheaper wines. We want to offer this work to our colleague André Grelon with the idea that he will find a stimulating intersection between two of his passions, the history of scientific engineering, and gastronomy and wine.

\* \* \*

## **«A NATIONAL PRIORITY» VERSUS «TRIUMPH OF TECHNOLOGICAL TRANSFER»: A CONTRIBUTION TO THE HISTORY OF MECHANICAL SUPPORT**

*Dmitri Gouzévitch*

This article revisits one of the emblematic moments of Russian history of technology: the invention of mechanical support by Andrei Nartov (1693-1756), Peter the Great's personal turner. This invention, dating to the first decade of the eighteenth century, is often presented as a triumph of the Russian people's ingeniousness, as it preceded by almost a century the widely-acknowledged invention by the Englishman Henry Maudsley. Far from joining the fight for claiming precedence, the author examines the life of Nartov with regards to the functioning of Russian tsar's turneries in Moscow and Saint Petersburg. These turneries, founded when Nartov was still a mere apprentice, were managed by a group of European (German, Dutch, English) mechanics who came to work in Russia upon the invitation of Peter I, bringing with them or building locally machine-tools of their invention. Nartov had worked under their supervision and by their side for a long period of time, before taking over the management. He became master mechanic and

personal turner of the tsar. In terms of competences, he was their pupil and inherited their ideas. Regarding their respective contributions, Nartov had first spent time finishing and putting to work his masters' products, before creating his own. As for the circulation of knowledge, he continued and developed their work on the Russian soil. Paradoxically, when the products of this collective endeavor, including the mechanical support attributed to Nartov alone, were exported to France in 1717, they did not inspire any invention of similar kind in Europe.

\* \* \*

## **BETANCOURT AND ELECTRIC TELEGRAPHY: THE ANATOMY OF AN APOCRYPH**

*Irina Gouzévitch*

This article, at intersection of several disciplines and approaches, is a critical contribution to a prominent issue in the history of technology: electric telegraphy. Its invention at the end of the eighteenth century, at least in the Spanish context, has traditionally been attributed to Agustín Betancourt, engineer and Enlightenment savant. Nonetheless, the historiography on this matter is extremely contradictory. The contradictions concern the place, the date and the nature of the invention, its precedents and prototypes, even the very identity of the inventor himself. In order to disentangle the web of contradictions, I have attempted at revisiting the whole story. I have crosschecked the sources, gone the original ones –these being much later statements by two respectable savants, Alexandre von Humboldt and François Arago, –and placed them to the context of the period. The results of this research question in a radical way what was until now considered as “established facts”. At the same time, they make it possible to formulate a hypothesis that grants sense to the paradoxes and explains, in great part, the existing historiographical contradictions.

\* \* \*

## **EXPERIMENTAL PHYSICS AND POETRY IN BARCELONA AFTER THE WAR OF INDEPENDENCE. THE MYSTERY OF A MANUSCRIPT**

*Carles Puig-Pla*

There is a manuscript (MCME 1105) in the Biblioteca de Reserva (Library Reserve) of the University of Barcelona which contains a number of works attributed to the seventeenth century Baroque poets. What is surprising is that, using some blank pages, handwritten notes on various experimental physics experiments also appear. The notes deal with experiments done in Barcelona in October and November 1814, and they are written by a second hand. This article tries to solve two enigmas: Why does experimental physics appear in a book of poetry? Whose does this anonymous second-hand belong to? Research led to investigate the Barcelona Philosophical Society, a society of enthusiastic teenagers that existed between 1815 and 1821 and whose members later played a prominent role in cultural and scientific fields in the first half of the nineteenth century.

\* \* \*

## **THE DEBATE ON SOLAR ENERGY FOR WATER DESALINATION IN 1884: REMAINS OF A OVERLOOKED DISCOURSE**

*Nelson Arellano Escudero*

In 1883-1884, three Anglo-Saxon engineers staged a debate about the use of solar energy for water desalination. It is interesting to review carefully this debate because its ideological influence on the technology selection process and its pioneering view of sustainability. In a process of thick description, we propose a narrative based on reviewing some engineering magazines from the nineteenth century, which revealed the existence of other evidence in the Spanish-speaking world that, apparently, never interacted with the three engineers. Our approach allows increasing the information about the processes of technological colonialism, techno-institutional complex, technical

lines, and water desalination, and discusses the contribution of the theoretical model of evolution of technology proposed by George Basalla, relieving cultural aspects in both phenomena about artefactual discarding and intermittent duration of objects.

\* \* \*

## **THE OPTICAL TELEGRAPH OF LUIS RANCAÑO AND JOSÉ VASCONI (1799): THE INVENTION, ITS DEVELOPMENT AND ITS PROTAGONISTS**

*Jesús Sánchez Miñana*

The paper relies on newly revised documents of the military archives in Segovia to give an account of the brief history of this optical telegraph. It begins with the demonstrations of the first prototype at a learned society in Saragossa where military engineer Rancaño and his former student Vasconi served as professors of mathematics, to the tests of new versions of the machine that seem to have been carried out between Madrid and the royal site of San Lorenzo de el Escorial, where they were shown to king Charles IV and queen María Luisa. An effort has been made to provide short biographies of the inventors, given that only Rancaño's Saragossa years had received some attention and Vasconi's life was almost entirely unknown. During the French occupation they both swore allegiance to king Joseph I Bonaparte and occupied high-rank posts. Their lot was quite different afterwards. Rancaño died in exile, probably in Paris, and Vasconi turned to private business in Spain although his expertise in fiscal matters was finally acknowledged by the Government.