TECHNOLOGICAL TRADITIONS AND NATIONAL IDENTITIES

A COMPARISON BETWEEN FRANCE AND GREAT BRITAIN DURING THE XIXTH CENTURY

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A CONTEXT OF GROWING COMPETITION

During the nineteenth century there was a strong link between technology, between engineering in particular, and the construction of national identities. This link was somewhat paradoxical since the nineteenth century saw the internationalization of technology. Technological knowledge and know how had been generally local. Now they were circulating all over the world. Throughout the century, the evolution of manufacturing processes and technological artifacts was to a large extent the result of this circulation. However, such a circulation was accompanied by a growing political and economical competition between nations. In this context, technology and its engineering component became both dimensions of the various national identities and measures of the degree of excellence of the nations present on the international stage. By the end of the century, this double role was epitomized by great civil engineering works such as the Eiffel tower, the Firth of Forth bridge or the Brooklyn bridge. These achievements were meant to be objects of national pride as well as arguments on the international market of civil engineering expertise[1].

Such a role implied that technology and engineering were to be all at once specific, intimately linked to national cultures, and comparable from one country to another. How were these rather contradictory requirements met with? This question will be the starting point of this article. In order to answer it, I will take French and British engineering as two case studies. Throughout the nineteenth century, French and British engineers were constantly looking at each other, trying to distinguish themselves while being often inspired by their mutual achievements. In other words, French and Great Britain engineering traditions were constructed in close relation one with another.

TECHNOLOGY AND NATIONAL PREJUDICES

Do something like national identities exist? Given the diversity of countries like France or Great Britain the answer is not evident[2]. My purpose here is not to discuss this difficult issue. My starting point will be rather the following observation: whereas the existence of national identities is problematical, the attempts made to create or characterize them cannot be dismissed as mere illusions. Throughout the nineteenth century, a whole range of authors tried to define the French and the British national identities, often in contrast one to the other. Mutual prejudices arose from these attempts. When attempting to understand the relations between France and Great Britain, it is almost impossible to get rid of these prejudices.

In his *Notes sur l'Angleterre*, Hippolyte Taine gave a good account of the most common prejudices regarding the French and the British during the nineteenth century. Taine began by comparing, I quote, "the interior of an English head with a Murray guide. It holds a many facts and few ideas, a lot of useful and precise information, little statistical surveys, numerous figures, accurate maps, short and dry historical accounts, moral and useful advises as a foreword, no general view, no literary ambition." "The French like the ideas for their own sake, added Taine, whereas the English tend to use them as mnemonic or predictive tools[3]."

Revealingly, Taine gave an example of these allegedly contrasting dispositions taken from the scientific and technological field. Stephenson and Foucault were the two figures involved in the comparison.

"The great engineer Stephenson was once asked how he had invented his machines, the locomotive in particular. He answered that it was by dint of conceiving with an extreme precision the different part, their shape, their dimensions, their articulations, their possible movements and the complete set of consequences brought by the replacement of one part, or by the change of a dimension or an articulation. Thus his mind looked like a workshop; all the

components were numbered and labeled; he took them one after the other, made them fit, and by trial and error found the right combination. On the contrary, Lon Foucault told me once that having found a theoretical proposition in mechanics that had been overlooked by Huygens and Lagrange, he had followed its consequences and these consequences had led him to the principle of his regulator."

"Generally, added Taine, the French understands through the use of deductive classifications, whereas the English thinks in inductive terms, by dint of application and memory, through the realistic representation of a large amount of individual facts, through a mass of distinct and juxtaposed documents[4]."

Taine gave a fairly representative account of the differences between the French and the British attitudes towards science and technology as they were figured out by the nineteenth century. Whereas the French were supposed to be primarily driven by theoretical speculations, the English were allegedly more practical. Whereas the former were deductive, the latter were mostly inductive.

This kind of assessment was rooted in more general beliefs regarding the differences between the Latin and the Anglo-Saxon cultures. In his*Lettres sur l'Amrique du Nord* published in 1836, the Saint-Simonian engineer Michel Chevalier drew a parallel between the passionate character of the French and the more reasonable nature of the English, between the enthusiasm and imagination of the former, and the common sense of the latter[5]. In the Saint-Simonian doctrine, England was made by the way responsible for the material advances of humanity, while France was supposed exert leadership on spiritual matters[6]. Although the English side generally agreed on the importance of its contribution to the material welfare of mankind, the second part of the proposition was met more reluctantly.

The opposition between theoretical and practical orientations, between deduction and induction, was as for it well summarized by the precedence given by the French to mathematics, whereas the English were supposed to refer themselves more often to mechanics, practical mechanics of course. Such a contrast can still be found in Duhem's *LaThorie physique*. Duhem was the inheritor of a typical nineteenth century prejudice, when he found fault with the use of mechanical representations by the British physicists. "The English mind can be clearly characterized by the extent of its faculty to conceive concrete ensembles and by the weakness of its faculty of abstraction and generalization[7]", declared Duhem for whom abstraction and generalization were undoubtedly French.

This kind of prejudice was for sure grounded into some kind of reality, a reality even more evident on a technological ground than on a purely scientific one. The French engineering profession emerged in domains such as fortification and engineering that bore almost no relation with mechanical construction[8]. On the contrary, throughout the eighteenth and nineteenth centuries, the construction of machines represented an essential field of activity for British engineers. The founding father of British engineering, John Smeaton, was involved both in civil and mechanical engineering[9]. Trained initially in the making of scientific instruments, he designed steam engines as well as bridges. In this context, the mechanical turn taken by an engineer such as Stephenson was by no mean exceptional. As the French engineer Joseph Dutens remarked in his *Mmoires sur les travaux publics de l'Angleterre* published in 1819, even the canals were designed as machines in England, whereas the French saw them as liquid roads or monuments[10].

But once more, my aim is not to indicate what is true and untrue in the representations of technological traditions constructed in the nineteenth century. My objective is to understand rather how they were constructed in order to allow both for international comparison and exchange and for the alleged existence of national identities.

DIFFERENCES AND COMPLICITY

To understand this construction, it can be useful to pay attention at the situation that was prevailing before, in other words to the relations between French and British engineers in the eighteenth century. French and British engineers were for sure quite different at the time. The French engineers were State engineers, organized in hierarchical corps such as the Ponts et Chausses or the Gnie corps. They were trained in specialized schools. They saw themselves as agents of a collective progress, of a fight against nature placed under the aegis of values such as public utility. In France, engineering could already be considered as a profession[11].

The British situation was quite different insofar that engineers were still relatively isolated individuals trained through traditional apprenticeship, often as instruments makers or surveyors. John Smeaton began for instance his career as an instrument maker. In Great Britain, engineering was not yet a fully organized profession[12].

What British engineering lacked in formal organization was counterbalanced by its creativity. From the steam engines to the first iron bridges, British engineers were already paving the way for the industrial revolution, contrary to their French colleagues who remained rather traditional in their approach of technological problems.

Despite these major differences, the French and the British saw themselves as colleagues rather than representatives of contrasting national differences. Their differences had by the way nothing to do with those that historians usually mention when they try to compare French and British engineering. Contrary to a rather common assumption, French engineers were not that versed in theory, in mathematics in particular, compared to their British counterparts. John Smeaton for instance a better scientist than his French equivalent, Jean-Rodolphe Perronet, the founder of the Ecole des Ponts et Chausses.

They were differences indeed in the way French and British designed roads, bridges or harbors. French roads were for instance rather straight, whereas their British counterparts were much more curved in order to avoid trimming the private properties which they ran alongside. During the second half of the eighteenth century, French engineers seldom built great humpbacked bridges, contrary to the British[13]. Although the United Kingdom already dominated the seas, rational harbors and arsenals such as those designed by the French for Cherbourg and other places could be seen nowhere along its coast[14].

However, those differences were not considered as essential. Revealingly, when he visited England in 1785, the assistant director of the Ecole des Ponts et Chausses, Pierre-Charles Lesage, remarked almost none of them[15].

The discrepant political, social and economical contexts were seen as more significant than technology itself. The United Kingdom considered itself as more advanced in these matters than absolutist France. A French engineer like Lesage agreed and he wrote in his diary that "no Englishman is excluded from the quality of citizen. Hence the self assurance, the patriotism and the pride of the English people." "Few countries pay their taxes with such a tranquillity, with so little complaint than England; in no other country are so many charities established for the suffering people[16]", added Lesage. It is no hazard if the construction of a clearly identified technological tradition was to rely strongly on this type of differences.

CONSTRUCTING ENGINEERING AS A PROFESSION

By the very end of the eighteenth century, the creation of the Ecole Polytechnique and the subsequent evolution of the French higher education system began to drive French and British engineering apart[17]. French engineers became learned in sophisticated mathematics and mechanics, whereas their English colleagues were still using more down-to-earth knowledge. Moreover, the French profession was more and more school based, whereas the English one remained faithful to the system of apprenticeship[18].

These emerging differences were not seen by the British engineers as absolutely fundamental. Many of them made an extensive use of the French textbooks, so that they didn't feel really behind their colleagues on a scientific ground. Telford was quite typical of this French influence. Among the books he donated to the Institution of Civil Engineers when he became its president, half were French[19].

Although proud of the technological superiority they had achieved by the end of the Napoleonic wars, the British engineers didn't look for a specificity to be found in their knowledge or even their productions. Their true superiority was moral. There lied the specificity of British engineering.

This specificity was epitomized by a new type of engineering institution: the professional society. The Society of Civil Engineers founded in 1771 and the Institution of Civil Engineers founded in 1818 were neither corps, neither

engineering schools[20]. The models they referred to were typical institutions of the United Kingdom: the Parliament, the Royal Society, the political and socials clubs. "Thus our Institution resembles the British Parliament ; where from a variety of talents and acquirements, much useful practical knowledge is derived[21]", boasted the members of the Institution of Civil Engineers shortly after its official recognizance by a Royal Charter in 1826.

What was at stake in these creations was summarized by Telford in his first speech as president of the Institution of Civil Engineers in 1820. In the Institution, began Telford, "the good sense of the members will always prove that manners and moral feeling are superior to written laws." Then he added: "In foreign countries similar establishments are instituted by government, and their members and proceedings are under its control ; but here a different course being adopted, it becomes incumbent on each individual member to feel that the very existence and prosperity of the Institution depends in no small degree on his personal conduct and exertion[22]."

Good sense, personal conduct and exertion, collective responsibility, those values derived from the British conception of what a profession was about. Through the creation of the Institution of Civil Engineers, this matrix of the British engineering profession, what was at stake was the transformation of a practice into a profession as honorable as law or medicine. Such a project was inseparable from political and social assumptions, from a liberal approach of engineering, an approach very different indeed from the French one.

This liberal approach was in its turn inseparable from a vision of the State as a moral authority in charge of general political, social and economical regulations. With the exception of domains such as the military, the State was not supposed to be directly in charge of technological progress. Professions and associations such as engineers and their institutions were the true actors of this movement towards progress.

It is in this perspective that the British claim for practicality must be probably understood. If it suited the British engineers to be seen as less theoretical and more practical than their French counterparts, it is probably because of their professional orientation, an orientation that they interpreted as their true specificity. Just as lawyers of physicians had to exercise their art, engineers had to be practical. They were not to be confused with scientists.

CONSTRUCTING ENGINEERING AS A VOCATION

Through the Polytechnic education, the relation between science and engineering was seen as a fundamental component of the French conception. After discovering their technological backwardness after the collapse of the Napoleonic Empire, French engineers often saw science as the only mean to catch up with their rivals. This vision was developed by engineers such as Charles Dupin or Claude Navier, in the memoirs they published after they had visited Great Britain[23].

But was science the true French specificity? Its universality forbade to see it as a permanent characteristic of the French engineering profession. Sooner or later, the British would catch up with the French scientific excellence. The political and social values promoted by the intensive use of scientific result were perhaps more fundamental.

These values, public utility, universality, impartiality, had been first appropriated by the State engineers. Impartiality was especially important when one had to expropriate people or to choose between projects that altered the value of land. By the end of the eighteenth century, two professional figures had been used by the State engineers as references impersonating utility, universality and impartiality: the army officer and the judge.

"If all men were reasonable, there would be no need for officers or judges, but given the men as they are, what is more useful, a great captain or a great judge?" such was the question asked to the students of the Ecole des Ponts et Chausses as a subject of French dissertation in the late eighteenth century[24].

The perfect State engineer had to combine the discipline and the sense of duty of the officer with the impartiality of the judge. For both the officer and the judge, professional activity had the character of a call. After them, engineering was be a vocation rather than a profession.

This set of connotations were to survive the evolution of the French engineering profession towards a more liberal conception. Although highly critical towards the State corps of engineers, the Civils that appeared in France towards

the end of the 1820s remained partially faithful to the fundamental values of their State predecessors[25]. Throughout the nineteenth century, French engineers saw themselves as relatively special. They were supposed to serve a great cause, the cause of public welfare and progress, with dedication and impartiality.

Such a conception had of course links with a conception of the State as a major partner in the process of innovation. Even as a civil, the engineer was still supposed to be a partner for the administration. Whereas competence and ethics were supposed to come first for British engineers, dedication and authority were perhaps the most fundamental characteristics of French engineers. By the end of the nineteenth century, the immediate transposition of general Lyautey's famous article on "the social role of the officer" into developments on "the social role of the engineer" confirmed the fact[26].

TECHNOLOGICAL TRADITIONS AND POLITICS

What I have tried to suggest in this article, is that throughout the nineteenth century, technological traditions had more to do with politics, with representations of what is legitimate, than with the actual content of the textbooks or what was realized by the engineers. Hence their association with the search for national identities. Technological traditions were supposed to be grounded in the fundamental ethics of the people. They had more to do with values than with achievements. Achievements made them however comparable. As a system of values, technology was rooted into the various national experiences. As a set of artifacts, it could be exchanged. This duality is perhaps still present today. After all, what we call globalization is based on the assumption that we can remain ourselves in a continuous process of exchange.

NOTES

[1] Cf. D. Billington, *The Tower and the bridge. The New art of structural engineering*, 1983, rd. Princeton, Princeton University Press, 1985 ; A. Picon, *L'Art de l'ingnieur. Constructeur, entrepreneur, inventeur*, Paris, Centre Georges Pompidou, Le Moniteur, 1997.

[2] A stimulating discussion of this question can be found in E. Kranakis, *Constructing a bridge. An Exploration of engineering culture, design and research in nineteenth-century France and America*, Cambridge, Massachusetts, The M.I.T. Press, 1997.

[3] H. Taine, *Notes sur l'Angleterre*, Paris, 1871, rd. Paris, Hachette, 1890, pp. 325-326.

[4] *Ibid.*, p. 326.

[5] M. Chevalier, *Lettres sur l'Amrique du nord*, Paris, Charles Gosselin, 1836. On Michel Chevalier, see in addition J. Walch, *Michel Chevalier conomiste saint-simonien 1806-1879*, Paris, Vrin, 1975.

[6] *Doctrine de Saint-Simon. Exposition*, Premire et deuxime annes, Paris, Bureau de l'Organisateur, 1830. On the Saint-Simonian doctrine, see for instance S. Charlty, *Histoire du Saint-simonisme (1825-1864)*, Paris, 1896, rd. P. Hartmann, 1931 ; G. Iggers, *The Cult of authority. The Political philosophy of the saint-simonians*, La Haye, 1958, rd. La Haye, M. Nijhoff, 1970.

[7] P. Duhem, *La Thorie physique, son objet, sa structure*, Paris, 1906, rd. Paris, Vrin, 1981, p. 126.

[8] Cf. A. Picon, *L'Invention de l'ingnieur moderne. L'Ecole des Ponts et Chausses 1747-1851*, Paris, Presses de l'Ecole nationale des Ponts et Chausses, 1992.

[9] On Smeaton, see A.-w. Skempton (ed.), *John Smeaton FRS*, London, Thomas Telford, 1981.

[10] J. Dutens, *Mmoires sur les travaux publics de l'Angleterre, suivis d'un mmoire sur l'esprit d'association et sur les diffrents modes de concession,* Paris, imprimerie Royale, 1819, p. v.

[11] Cf. A. Picon, *op. cit.*

[12] On the history of British engineering, see R.-A. Buchanan, *The Engineers. A History of the Engineering profession in Britain 1750-1914*, Londres, Jessica Kingsley, 1989.

[13] Cf. T. Ruddock, *Arch bridges and their builders 1735-1835*, Cambridge, Cambridge University Press, 1979.

[14] On the French designs for rational harbors and arsenals, see A. Demangeon, B. Fortier, *Les Vaisseaux et les villes*, Bruxelles, Lige, Mardaga, 1978.

[15] P.-Ch. Lesage, *Journal et observations sur les chemins d'Angleterre et principalement sur les grandes routes*, 1784-1785, E.N.P.C. Ms 48.

[16] *Ibid.*

[17] On the content of the Ecole Polytechnique curriculum as well as on the influence it exerted on the French higher education system, see B. Belhoste, A. Dahan-Dalmdico, A. Picon, *La Formation polytechnicienne 1794-1994,* Paris, Dunod, 1994.

[18] Apprenticeship remained dominant in Great Britain until the last decades of the nineteenth century. Cf. A. Guagnini, "worlds apart: academic instruction and professional qualifications in the training of mechanical engineers in England, 1850-1914", in R. Fox, A. Guagnini (ed.), *Education, technology and industrial performance in Europe, 1850-1839*, Cambridge, Paris, Cambridge University Press, Editions de la Maison des sciences de l'homme, 1993, pp. 16-41.

[19] *Minutes of the proceedings of the Institution of Civil Engineers for facilitating the acquirement of knowledge necessary in their profession and for promoting mechanical philosophy. First session. 1818*, meeting of the 17th of march 1820, I.C.E. N 93.

[20] On these two institutions, see G. Watson, *The Smeatonians. The Society of Civil Engineers*, Londres, Thomas Telford, 1989 ; G. Watson,*The Civils. The story of the Institution of Civil Engineers*, Londres, Thomas Telford, 1988.

[21] Institution of Civil Engineers, *Minute book 1826 to 1836*, vol. 2, meeting of the 20th of january 1829, I.C.E N 93.

[22] *Minutes of the proceedings of the Institution of Civil Engineers. First session. 1818*, meeting of the 21st March 1820.

[23] On the visits paid by French engineers to Great Britain during the first half of the nineteenth century, see M. Bradley, "Engineers as military spies? French engineers come to Britain, 1780-1790", in *Annals of science*, n 49, 1992, pp. 137-161.

[24] On the French dissertation of the Ecole des Ponts et Chausses, see A. Picon, *L'Invention de l'ingnieur moderne*.

[25] On the emergence of the French civil engineers, see J.-H. Weiss, *The Making of technological man. The Socials origins of french engineering education*, Cambridge Massachussetts, The M.I.T. Press, 1982.

[26] L. Lyautey, *Du Rle social de l'officier dans le service militaire universel*, Paris, Perrin et Cie, 1891. Shortly after the publication of Lyautey's essay, a "Rle social de l'ingnieur" is published by the journal *Etudes*. Its author is the Jesuit Henri-Rgis Pupey-Girard, the founder ot an Union sociale des ingnieurs catholiques.