Carriages, coffee-cups and dynamometers : representing French technical cultures in the *London Mechanics' Magazine*, 1823-1848

Calèches, tasses à café et dynamomètres : représentations de la culture technique française dans le Mechanics' Magazine de Londres, 1823-1848

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Carriages, coffee-cups and dynamometers: representing French technical cultures in the London *Mechanics' Magazine*, 1823-1848

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Introduction: national stereotypes of contrasted practice

Contemporary British discussions of French technical culture in the second quarter of the nineteenth century and beyond have often assumed, if not explicitly stated, contrasting 'national styles' and modes of 'organization'. In France: centralized, state-oriented, theoretically driven, and institutionally supported work; an education system geared up to foster bureaucratic conformity; training focused on theoretical verities rather than practical exigencies. In Britain: decentralized expertise, coupled with individualistic, insular, empirically driven, and school-shy practice.¹ British practitioners are supposed to have been resistant to a growing tradition of French technical authorship associated with places like the *École Polytechnique*, the *École des Ponts et Chaussées*, the *École d'Application* at Metz, the *Conservatoire National des Arts et Métiers*, and the *École Centrale des Arts et Manufactures* (founded 1829),² and with professors like Claude-Louis-Marie-Henri Navier (1785-1836), Jean-Victor Poncelet (1788-1867), and Arthur-Jules Morin (1795-1880). In contrast to the philosophical (scientific) community, which enthusiastically if selectively appropriated French approaches,³ the engineers and

artisans are said to have been reluctant; and in the early nineteenth century British works tended, according to Donald Cardwell, to be 'elementary' or 'feebly descriptive'.⁴

But why should British engineers and artisans have worried about centralized, bureaucratic and theoretical approaches when, apparently, they had done so well in industry, engineering, and invention without them? It is usually assumed that it was not until well into the second half of the nineteenth century that French theoretical work filtered profitably on to the bookshelves of practical British engineers, let alone artisans. Likewise it is assumed that it took longer still for that literature of engineering to have much impact on the training of British engineers, who preferred a tried and tested system of apprenticeship. In this broad-brush representation, the British civil engineer, and even more the British artisan or mechanic, had little time for such Gallic preoccupations.⁵

In this paper I challenge, again, these images of contrasted practice by looking at British perceptions of French technological practice. My concern here is Britain, rather than England, although I accept that for contemporary commentators 'England' often signified

1 More nuanced accounts appear in D. S. L. Cardwell, *The organisation of science in England*, London, Heinemann, 1972, and R. Fox and G. Weisz, eds., *The organization of science and technology in France, 1808-1914*, Cambridge and New York, Cambridge University Press, 1980.

2 For example, J. H. Weiss, *The making of technological man. The social origins of French engineering education*, Cambridge, MA, MIT Press, 1982 (*École Centrale*).

3 For example, M. P. Crosland and C. W. Smith, 'The transmission of physics from France to Britain: 1800-1840', *Historical studies in the physical sciences*, 9, 1978, pp. 1-61; and C. W. Smith and

M. N. Wise, *Energy and empire. A biographical study of Lord Kelvin*, Cambridge, Cambridge University Press, 1989, pp. 149-168.

4 G. S. Emmerson, *Engineering education. A social history*, Newton Abbot, David & Charles, 1973; I. Grattan-Guinness, 'Work for the workers: advances in engineering mechanics and instruction in France, 1800-1830', *Annals of science*, 41, 1984, pp. 1-33; on the 'elementary' or 'feebly descriptive' in British technical works, see D. S. L. Cardwell, *The Norton history of technology*, New York, Norton, 1994, p. 205.

5 For a review of contemporary social and cultural history see P. McPhee, *A social history of France, 1789-1914*, Basingstoke and New York, Palgrave Macmillan, 2004, chap. 6-8.

Great Britain (forgetting the sensibilities of, for example, the Scots who were active in science, medicine and industry).⁶ I want to emphasize the great diversity of French-British interactions, beyond the fundamentally intellectual or political,⁷ and to show that all of these diverse interactions worked against such distinct national styles. Focusing here on the second quarter of the nineteenth century, the period of what Dunham called France's industrial revolution,⁸ I see wide evidence of such interactions. Nineteenth-century artisans, engineers, and natural philosophers (for example, Michael Faraday) travelled abroad for work and curiosity.⁹ British engineers (for example, I. K. Brunel) administrated and co-ordinated works abroad long before the empire of the late nineteenth century became a prime site for constructive and 'civilizing' endeavour.¹⁰ There were also correspondence networks, translations, and numerous other ad hoc means by which technical practice was transmitted. Individuals acquired, carried, and disseminated local skills to and from diverse venues.

To make this study more concrete I consider representations of France, and of French technical culture, in one important British periodical and, by way of occasional contrast, in some British professional bodies (like the Institution of Civil Engineers) and institutions (like the universities that were beginning to offer engineering classes). From the late 1830s there was a notable increase in the volume of technical literature; but here, I focus on a periodical founded in 1823. The *Mechanics' Magazine* (*MM*) was edited and printed in London but it was read far more widely. Its readership consisted primarily of literate but disputatious mechanics. Defining themselves against the gentlemanly, status-conscious civil engineers, the literary activists of the *MM* celebrated democracy, discourse and dispute. Their gaze fell on France and on French figures, institutions, processes, textbooks and theories. By exploring those, they portrayed an arena of mechanical politics and culture, occupied by contrasting identities. Images were bright, but they were complex – not simply negative or positive. Exhibitions (it

said) pandered to the useless wants of the aristocracy. Protestant artisans resisted Catholic oppressors. Fledgling Mechanics' Institutes struggled against despotism. Yet France had its answer to George Birkbeck in artisan educationalist Charles Dupin; and France was a workplace for adventurous skilled mechanics. Through de Pambour, Poncelet and Morin it could be a source, selectively, of technical insight and theory – even if built upon the example of British engineering works. Such representations of French technical culture 'from below' complement existing accounts of intellectual, cultural, or political encounter; but it must be understood that after twenty years, the *MM* had begun to abandon its allegiance to the artisan class. It is for that reason that in its later years we see a greater representation of the works of engineering professors: these men emerge as significant players in the transmission of elite technical literature from France to Britain.

The *Mechanics' Magazine*: an artisan republic of letters?

Discussions of technical exchange have often focused on colleges and professional institutions, largely perhaps because they are good at documenting their activities. But technical periodicals also provide a very useful means through which to explore micro-level questions of technical exchange. In terms of professional institutions, in Britain the Institution of Civil Engineers (ICE) was key.¹¹ At the time of its foundation in 1818 its ambition had been to represent the profession, and especially its more radical, and science-oriented, younger members. After overcoming fledgling difficulties, the ICE thrived under the presidency of Thomas Telford, himself an active reader and poet.¹² However, it was only towards the end of the period of this paper that there appeared the first printed volume of the *Minutes of Proceedings of the Institution of Civil Engineers* (*MPICE*, 1837); but then, however, the ICE's publications were challenged by serious, cautious, professionalizing periodicals like the *Civil Engineers and Architect's Journal* (first published 1837). Although I do not examine those journals here, I will (below) consider the contents of the ICE's library, especially as regards its foreign holdings. It was the appearance in print of the *MPICE* which made it possible for readers, and historians, to judge these foreign holdings.

Journals like the *MPICE* and the *Civil Engineers and Architects Journal* provided readers (and historians) with

6 A. Herman, *How the Scots invented the modern world*, New York, Three Rivers Press, 2001; R. A. Cage, ed., *The Scots abroad. Labour, capital, enterprise, 1750-1914*, London, Croom Helm, 1985.

7 For these see, for example, Charle et al. 2006 and Tombs 2006 respectively.

8 A. L. Dunham, *The industrial revolution in France, 1815-1848*, New York, Exposition Press, 1955.

9 B. Bowers and L. Symons, eds., *Curiosity perfectly satisfied. Faraday's travels in Europe 1813-1815*, London, Peter Peregrinus, 1991.

10 R. A. Buchanan, *Brunel. The life and times of Isambard Kingdom Brunel*, London, Hambledon and London, 2002, pp. 83-101 (Brunel in Italy, India and Australia); C. Andersen, 'The Civilisers'. *Consulting engineers, imperialism and Africa, 1880-1914*, PhD thesis, University of Aarhus, 2009.

11 G. Watson, *The Civils. The story of the Institution of Civil engineers*, London, Thomas Telford, 1998.

12 L. T. C. Rolt, *Thomas Telford*, Harmondsworth, Penguin, 1979, pp. 22, 200-202.

a working idea of France and French technical activities for the literate civil engineer and architect in the early to mid nineteenth century. But these periodicals served an elevated and affluent social stratum: those becoming, or having become, civil engineers, managers of large public works and so on. They tell us less about the understandings of France and things French available to, or created by, non-elite communities: the class of mechanics and artisans. Such questions are hard to investigate when even the literate individuals in such a group were more likely readers than writers. But in fact from the 1820s there was a sustained surge in the production of literature more closely targeted on these lower strata. I concentrate here on the *Mechanics' Magazine* – or, to give it its original title, the *Mechanic's* [sic] *Magazine, Museum, Register, Journal, & Gazette*, first published on 30 August 1823. Its founders and editors, the patent agent Joseph C. Robertson and the journalist Thomas Hodgskin, spoke not for a civil engineering oligarchy but rather for the autonomous practical artisan.¹³

The *Mechanics' Magazine* (*MM*) is a window on to the mechanical culture of the second quarter of the nineteenth century. Where subsequent professionally oriented periodicals monitored style, content and contributors to construct and reinforce norms of atemporality and disinterestedness, the *MM* self-consciously differentiated itself from such gentlemanly behaviour. The editors played a dominant role, setting the loose rules of engagement and generating much of the copy.¹⁴ Its literary activists celebrated not hierarchy and consensus, but democracy and dispute. Especially in its first decades, the journal was lively, verbose, opinionated, controversial, at times abusive and apparently fearless on a wide range of topical issues – from gutta percha hats to perpetual motion machines. It rarely missed an opportunity to criticise the mis-deployment, or mis-comprehension, or misrepresentation, of mechanical know-how. The editors were as happy to criticize the external authorities as they were their own (usually pseudonymous) correspondents. Such contributors to the *MM* could

freely inquire or comment on technical processes and topical issues but they had to be prepared for searching and at times scathing critique from their peers.

This ephemeral literature tends to be downplayed as a source in the history of engineering, considered unimportant in comparison to actual engineering works, patents, memoirs, monographs and manuscripts for a variety of reasons: the popularity of such works can be seen to undermine their credibility; the fact that publication was often anonymous might make them hard to use in a discipline that likes its (named) heroes; the very shield of anonymity facilitated a lack of 'decorum' in its discourse and indeed the early editors made little attempt to control that discourse. This 'no holds barred' approach, one which had been squeezed out of the writings of the civil engineers, makes the *MM* particularly revealing to the historian about the kinds of things that could be said, the ideas that could be entertained, and the representations that could be manufactured and repeated in all matters of concern to the readers – the artisans and mechanics who could individually or collectively afford 3d. (three pence) for an issue.

The first volume of the *Mechanics' Magazine* announced that this journal was 'ours and for us': by and for the class of practical mechanics. The frontispiece catalogued numerous Anglo-Saxon inventors upon two Ionian pillars, redolent of the pillars of Hercules familiar from Francis Bacon's *Instauratio magna* and *Sylva sylvarum*.¹⁵ Those pillars flanked a neo-classical hybrid of the messenger Mercury and the physician Asclepius; below him the motto 'knowledge is power' reinforced still further the Baconian allusion. But where Bacon's publishers showed a ship under sail passing beyond the pillars of Hercules, the *MM* depicted a paddle steamer passing by a Boulton and Watt beam engine. On the face of it, the *MM* would celebrate all things domestic and all things British. If there was little sign here of openness to foreign influence, the pages within told a different story.

In fact, the editors and correspondents of the *MM* had a rich, at times envious, at times mocking, understanding of foreign engineering, industry and art. Although the *Mechanics' Magazine* was edited from London and published there (at first by Knight & Lacey on Paternoster Row), it was distributed far more widely. For English speakers there were agents in Dublin and in North America. From 1836 (or earlier) it was formally distributed by G.W.M. Reynolds, Proprietor of the 'French, English, and American Library', at 65 Rue Neuve, Saint Augustin,

13 I. R. Morus, *Frankenstein's children. Electricity, exhibition, and experiment in early nineteenth-century London*, Princeton, NJ, Princeton University Press, 1998, pp. 72-74; id., 'Manufacturing nature: science, technology and Victorian consumer culture', *British journal for the history of science*, 29, 1996, pp. 403-434.

14 Compare E. S. Ferguson, 'Technical journals and the history of technology', in Stephen H. Cutcliffe and R. C. Post, eds., *In context. History and the history of technology. Essays in honor of Melvin Kranzberg*, Bethlehem, London and Toronto: Lehigh University Press, 1989, pp. 53-70.

15 P. Burke, *A social history of knowledge. From Gutenberg to Diderot*, Cambridge, Polity Press, 2000, pp. 112-113.

Paris;¹⁶ and from 1838 (or earlier) until the 1850s A. & W. Galignani of Rue Vivienne, also Paris, provided copies for readers on the Continent.¹⁷ Judging by the many surviving copies this long-lasting journal was read more widely still. The images of foreign lands and foreign technical culture presented were thus somewhat sensitive to a readership outside Britain. The level of that sensitivity varied. An early issue of the *MM* related the anecdote of the Chinese tailor. Asked to show his skill by duplicating a European coat, the tailor soon returned an exact copy – complete with elbow patch.¹⁸ Such anecdotes no doubt amused, even as they recycled stereotypes of national mechanical identity.

The first two decades of the *MM* reveal a wealth of perspectives on France and French technological culture. There was an endless supply of similarly flippant tales: thus, Georges Cuvier's brain had been certified by a Parisian professor as the 'most voluminous' ever known!¹⁹ But the geographical proximity of France, a long history of political and cultural ties, and a readership which included (apparently) 'un ancien Élève de l'École Polytechnique' who had studied with Monge and Lagrange, meant that the 'Frenchman' and 'his' technological products could never be so one-dimensional as the Chinese tailor's.²⁰ For the radical, yet literate, artisan, snippets from French newspapers, reports of the Academy of Sciences, gleanings from technical treatises, and numerous other ephemera provided more serious fodder, even if spiced with humour. And the representations which appear reflect writers', and more rarely travellers', judgments, prejudices and ambitions. They certainly reproduce stereotypes, both of the French and the British, especially the British workmen. 'France' often stood for what was not, in general, 'right'. A suitably distant 'France' showed the British artisan what not to be: Catholic, enslaved, weak, enamoured of luxury, inferior in technical skill or capacity. Yet France could also be an imagined utopia, showing 'good' or 'better' possibilities for British technological practice; and French mechanics, more rarely, could be portrayed as allies in self-manufacture.

Heroes, martyrs, fairies, tricksters and weaklings: images of French invention

The first issue of the *Mechanics' Magazine* opened with a eulogy to James Watt – who was not, perhaps, obvious material for an exploration of British-French technical

exchange. What did the inventor of the separate condenser (1769) have to do with France? In fact, as the University of Glasgow's instrument maker and part-time philosopher, Watt had learnt French;²¹ in 1783 he agitated for standards of measure to be shared by Britain and France;²² and with his partner Matthew Boulton he visited Paris in 1786 to market the new engines.²³ Watt's cross-channel friendships and technical exchanges (for example, with chemist Claude Louis Berthollet),²⁴ certainly helped this aspiring *philosophe* first to become a Corresponding Member (1808) and then one of only eight Foreign Members (1814) of the exclusive *Académie des sciences*.²⁵ The Scottish-born James Watt was, for the *MM*, 'one of the few Englishmen [sic], who have been elected members of the National Institute of France'.²⁶ The French had honoured him: Watt showed readers that the artisan should be anything but insular.

Yet, according to the *MM*, French monarchs had not always been kind to mechanics. The story of the 'independent Potter' and Huguenot Bernard Palissy (c. 1510 - c. 1590), showed readers the (alleged) horrors of Catholicism, the dignity of Protestantism, and the shaming of Kings when innately skilled craftsman refused to abandon right religion. Brought to Paris by Henry III, Palissy clung to his faith as his capricious former protector urged him to convert: nothing could 'compel a potter of Saintes to bow the knee to senseless images of wood and stone'. The *MM* saw Palissy returning home unmolested, thriving under the real friendship of 'heaven and [of] earth' – the latter being especially good, of course, for a worker in clay.²⁷ A Catholic county and its oligarchs had failed to quash the inventive spirit of defiantly Protestant artisans. And indeed, Palissy's tale continued to provide material for Protestant apologists (including the Religious Tract Society), even though modern accounts suggest a far from tranquil death in the Bastille.²⁸

21 B. Marsden, *Watt's perfect engine. Steam and the age of invention*, Cambridge, Icon, 2002, pp. 12, 31.

22 P. Tunbridge, *Lord Kelvin. His influence on electrical measurements and units*, London, Peter Perigrinus, 1992, pp. 86-87.

23 J. Tann, 'Marketing methods in the international steam-engine market: the case of Boulton and Watt', *Journal of economic history*, 38, 1978, pp. 363-391.

24 H. W. Dickinson and R. Jenkins. *James Watt and the steam engine*, London, Encore Editions, 1981 (1st published in 1927), pp. 66-67.

25 R. L. Hills, *James Watt. Vol. 3. Triumph through adversity*, Ashbourne, Landmark, 2006, p. 247; D. P. Miller, "'Puffing Jamie": the commercial and ideological importance of being a "philosopher" in the case of the reputation of James Watt (1736-1819)', *History of science*, 38, 2000, pp. 1-24.

26 *MM* (30 August 1823), pp. 2-3.

27 *MM* (30 August 1823), p. 11.

28 C. L. Brightwell, *Palissy, the Huguenot potter. A true tale*,

16 For example, *MM* (4 June 1836), p. 144.

17 For example, *MM* (12 May 1838), p. 96.

18 *MM* (20 September 1823), p. 63.

19 *MM* (2 June 1832), p. 144.

20 *MM* (16 October 1827), p. 192.

If men could be secular saints or Protestant martyrs, what did the *MM* make of French manufactures as an expression of national character? One answer focused upon the display at the sixth and most recent exhibition of French manufactures at the *Louvre* (1823). The first such 'exposition' had been in 1798; it and its ever-larger successors made familiar gestures towards spectacle and towards stimulating industry, through competition (explicitly with the British), diffusing knowledge, and marking progress. Illustrious juries pontificated on who might, and who might not, exhibit. French government provided significant sponsorship. – hoping to see industry and exports stimulated, and ultimately, at least, favouring cheap mass production rather than luxury goods. French openness to wide publics was meant to contrast British norms of technical secrecy – although they were not adhered to by the proponents of the *MM*.²⁹ Despite the large number of informative and celebratory catalogues ultimately available, and the fact that British mechanics (like 'A TRAVELLER') did attend, the *MM* borrowed the savage words of the *Courier Français*, a radical journal whose attitude to (hereditary) privilege can be inferred from its 1790s' depiction of Louis XVI as 'un cochon' in his pigsty.³⁰ Those French exhibitions, it seemed, pandered to the extravagant consumption of the aristocracy with luxury goods. This was a world of 'gold and silver', 'silk and ... cachemeres ... crystal, bronze, and porcelain':

it seems as if a nation of fairies had brought its tributes to a nation of kings. But are there only kings in France? Does all the nation ride in carriages, or walk on carpets? Does all France drink champagne out of cut glass, and coffee out of porcelain cups, resplendent with gold? – Alas, no!³¹

The true measure of manufactures was 'extensive use'; few could buy such 'expensive fineries'. This was labour applied to 'gratify whims', not 'supply real wants'; this was production for the eye, not the stomach.³² Here, then, was the *Mechanics' Magazine* dissenting at a distance: it was easier to criticize French extravagance,

under its 'Lilliput Monarch', than to point the finger at similar domestic excesses.³³ The same year, 'Ignoramus' asked the *MM* to generate a list of pocket watches and their qualities (including suitability for the traveller). This apparently innocuous request had a sting in the tail, since such a list would induce an individual 'to go to a respectable man in the trade, and effectually prevent him from being duped by ... one of French manufacture', however handsome.³⁴

For examples of the contrary messages conveyed and of the willingness of the editors to tolerate a kinder approach to the French, especially if it led to the international sharing of technical expertise, we turn to the weekly 'Inquiries' section. Here readers asked for or offered advice on practical manufacturing techniques: how best to paint on glass, to renovate woollen cloth, or to polish marble? One correspondent admitted the French, good at trickery and surface, had taught the English how to make cheap wood look like mahogany, by administering a concoction including dragon's blood [sic] to any closely planed, fine-grained, wood.³⁵ 'A SUBSCRIBER' unashamedly asked for details of the manufacture of French fine goods so recently disparaged: 'How are the medallions cast in France'? Most would have seen the medals of 'Buonaparte and his family' brought to England – but how could the 'sharpness and beauty of those executed in Paris' be reproduced? Did the British know the secret of gilding non-metallic objects in a manner resembling *or moulu*, as in 'French snuff-boxes and other trinkets'? 'Our neighbours the French' knew much about gilding worth borrowing – including how to avoid mercury and thus to secure the health of the artisan. Was France, therefore source not of fripperies but 'very important discoveries'?³⁶ But 'AN OLD CASTER', although admittedly ignorant of the French method of casting, was 'inclined to think the English mode is quite as good'. To prove it he offered to show his cast bust of Shakespeare.³⁷

Paradoxically, it was French ingenuity in the form of the 'Dynamometer of Régnier' (invented in 1798 to test horses) that provided the true comparison of Frenchman and Englishman. Under the heading 'instrument for determining the comparative strength of animals', the *MM* recorded one of the most 'singular facts respecting man'. Régnier himself had shown experimentally not only the 'superiority in point of strength of the civilized over

London, Religious Tract Society, 1877; A. Fyfe, *Science and salvation. Evangelical popular science publishing in Victorian Britain*, Chicago and London, University of Chicago Press, 2004.

29 See K. E. Carpenter, 'Industrial exhibitions before 1851 and their publications', *Technology and culture*, 13, 1972, pp. 465-486; K. G. Beauchamp, *Exhibiting electricity*, London, Institution of Electrical Engineers, 1997, pp. 9-11.

30 *MM* (27 May 1826), p. 71 (British visitor); V. P. Cameron, 'The challenge to rule: confrontations with Louis XVI', *Art journal*, 48, 1989, pp. 150-154, p. 152.

31 *MM* (6 September 1823), p. 30.

32 *MM* (6 September 1823), p. 30.

33 *MM* (20 September 1823), p. 63. The reference is presumably to Louis XVIII.

34 *MM* (20 December 1823), p. 269.

35 *MM* (4 October 1823), pp. 91-92.

36 *MM* (31 January 1824), p. 367.

37 *MM* (6 March 1824), pp. 446-447.

the savage state' (the 'savages' of Van Diemen's Land were particularly remiss) but also the physical superiority of the 'well-fed and free-born Englishman over the soup-eating and enslaved Frenchman'.³⁸ Absolute measures of work, rather than discussions about technical character or style, established the hierarchy of nations.

The virtues and vices of the centre: public safety and education

Some French savants, however, might offer advice that, since good for the artisan and restrictive to manufacturers, was palatable to the *MM*. One of the best qualified to do this was the *MM*'s hero Charles Dupin (1784-1873). Dupin carried particular credit with British readers because, between 1816 and 1818, he had visited the ports of England, Scotland and Ireland and then written up an account; an English translation appeared in 1819.³⁹ In September 1823 he flattered the *MM*'s readers by calculating that English steam power could have erected the great pyramid of Egypt in a mere eighteen hours.⁴⁰ A month later the *MM* editors related Dupin's summary of proposals to enhance the safety of steam-engine manufacture and erection. Naturally, as a 'vast' exporter, Britain paid 'superior attention' to its engine-making and the French lagged behind. But Britain could still learn from French suggestions about additional safety valves, 'proving' the strength of boilers by hydraulic press, erecting safety walls, and declaring the working pressure of boilers. Last but not least, the names of manufacturers whose engines have been connected with an accident should be made public to make them 'more vigilant'.⁴¹ They should, as it were, be named and shamed. What France lacked in manufacturing development, it made up for in moral guidance – and strategies governing the relationship between manufacturer, public and employee.

But a strong central administration had its drawbacks. This was shown vividly in the alleged, and occasional, reaction of state power towards the educational projects Dupin and his sympathetic *MM* editors would champion: the Mechanics' Institutes becoming so prominent not just in the British towns but, apparently, in France as well.

The average Frenchman might make a puny partner to an Englishman but the former needed his strength in a country where the march of the human mind could be arrested by the autocrat. The promoters of the *Mechanics' Magazine* were, of course, fervent supporters of the London and Glasgow Mechanics Institutes. They were supporters, too, of such educational bodies that emerged in imitation 'from below' – at the desire of the working classes. They thus preferred artisan action to the middle-class or commercial philanthropy which carried its own constraints.⁴² In October 1823, the mechanics of Glasgow had stimulated the formation of Mechanics Institutes in 'eight other places in Scotland'. Yet in France, all was not well:

[H]ad not despotism – cunning in its cruelty, and potent from its recent successes – stretched forth its iron sceptre, to arrest the march of the human mind, the great city of Lyons in France would have added another temple to scientific knowledge.⁴³

Apparently the French newspapers had reported plans to establish in France's second city, an Institution in imitation of the Glasgow Mechanics Institution (1823). The *Scotsman*, published in Edinburgh, was now claiming that this had been 'put a stop to' by express command of the French government. A pedagogic uprising, upon what the *Mechanics' Magazine* called the 'wing of science', had been crushed by despotism.

Later the *MM* admitted, temporarily, that France had been cured of its despotism since (even) Charles X had allowed 'mechanics to congregate' to hear lectures in Paris: the *MM* showed that (even) France was more enlightened than those in November 1825 resisting the Mechanics Institute movement in Armagh, the 'Irish capital of High Church, or, in other words, *Anti-Mechanic* prejudices'.⁴⁴ A month earlier, in October 1825, the *MM* gave a positive account of 'the celebrated Baron' Charles Dupin's attempts to introduce 'instruction for mechanics at Paris'. Dupin lectured to these industrious classes on geometry and mechanics 'as applied to the arts'. The '*French Paper*', from which the *MM* had borrowed this intelligence, claimed that 'learned Professors' were following Dupin's example in other French cities.⁴⁵ To supply the artisan with that knowledge the lack of which had kept him in his place, Dupin's lectures were soon published.⁴⁶ The *MM* implied that, through its ally Dupin,

38 *MM* (29 November 1823), pp. 209-210; John Pearn, 'Two early dynamometers', *Journal of the neurological sciences*, 37, 1978, pp. 127-134.

39 C. Dupin, *Narratives of two excursions to the ports of England, Scotland, and Ireland, in 1816, 1817, and 1818: together with a description of the breakwater at Plymouth, and also of the Caledonian Canal, translated from the French of Charles Dupin*, translated by G. Sidney, London, Richard Philips, 1819.

40 *MM* (27 September 1823), p. 68.

41 *MM* (4 October 1823), pp. 83-84; John Pearn, 'Two early dynamometers', *Journal of the neurological sciences*, 37, 1978, pp. 127-134.

42 I. R. Morus, 'Manufacturing nature', *op. cit.*

43 *MM* (29 November 1823), pp. 213-214.

44 *MM* (19 November 1825), p. 75.

45 *MM* (8 October 1825), p. 431.

46 C. Dupin, *Géométrie et mécanique des arts et métiers et*

a prominent member of the French Institute, the French were copying British pedagogic programmes. We thus find a curious inversion of more familiar debates from the late nineteenth century, when the British looked enviously to continental Europe for models of technical education.

As the author of *The commercial power of Great Britain* (1825), and an honorary member of the ICE, Dupin was worth listening to. The *MM* happily cited his admission of the 'great inferiority' of French industry, the stagnation of its commerce, and England's 'rapid progress'. More ominous was the claim that if government 'encouraged' establishments for mechanical progress, the French would catch the English up, as they had done with chemistry.⁴⁷ There was no want of rhetoric in Britain about the virtues of the Mechanics Institute, but Dupin's flattery to the French mechanics served well for British readers when he announced: 'In Great Britain, the whole industrious class is now awakened to a new existence; it is snatched from routine, it is withdrawn from ignorance – the principles and application of the useful sciences are unfolded to it.' French mechanics could share in the prosperity certainly due to the British.⁴⁸

Journeying to France – and reasons for not staying

Dupin, like Prony and de Pambour, had visited Britain to witness exemplars of technical practice. But what did the *MM* think of the British who made the return visit? The spring of 1824 saw extensive discussions of these matters when a House of Commons committee met to consider the effect of repressive (anti-union) Combination Laws and, especially, of laws prohibiting the emigration of artisans and the export of machinery. The *MM* reported the proceedings at length, reproducing verbatim the responses of key manufacturers like Timothy Bramah and Henry Maudslay. Even without such laws, skilled workers needed to travel with new machinery to erect it. Under the current regime, enterprising British manufacturers (e.g., Manby, Edwards, Steele) had simply set up businesses abroad (for example, in Liège, Charenton, and Chaillot). Paradoxically, the best workers were going abroad; and French industry was beginning to make what the English could not export.

They had had little difficulty recruiting large numbers of the best British workers, all too happy, at least in the beginning, to take a bribe to go, or to exercise their skills for wages which were higher than those at home (and higher than those paid to locals abroad). The

English in Paris were then recruited to poach further Britons abroad. Such were the laws that real fears of penalties were serving to discourage (and effectively to prevent) skilled workers from returning. Indeed, there were reports here of visits to Paris by manufacturers who had met with Englishmen abroad who *wanted* to return – but who could not get the passports to come back. In further evidence, there was talk of the ease of decamping to France despite the laws forbidding it: but the experience was one in which huge salaries were initially offered – but then reduced since it was clear that those enticed over had no way of returning, and would take what was offered in their adopted country. These accounts, in all their variety, indicate just how permeable the French-English boundary was, even when laws were enacted to strengthen it. The passage of managers, men and machines thus enabled the transmission of technical information in both directions.⁴⁹

The *MM* did not, in fact, endorse this traffic in skilled workers between England and France. It gave extensive coverage to a pamphlet, apparently written by an experienced traveller, advising artisans all about 'the experiment of crossing the channel' and working life in Paris. The *MM* shared the view of the author in its summary of this 'Journeyman's guide to France, with reasons for not staying'. The trip could be cheap, and asylum soon found with fellow Englishmen; but there were rather many reasons to stay at home: irregular work; poorer wages than at home (although a piano-maker could earn eight times the wage of a pastry-cook); the indignity of instructing 'a parcel of Frenchmen ... who will very soon do the work as well as yourself, and for a quarter of the money'; cramped lodgings; and indifferent food (except for the fruit, which was cheap). Why travel to a county where beer was served in smaller pots, and the good stuff was 'only to be had at the English public houses'? What Englishman would put up with the low standards acceptable to the 'gay inhabitants of the empire of the lillies'? It was better to stay at home than to sacrifice 'that Freedom which an Englishman enjoys'.⁵⁰

Institutions and academics: conduits for French engineering

In the 1970s, Emmerson suggested that 'French applied mathematicians were particularly active' in the early nineteenth century, but that 'their work took years to gain currency in other European languages'.⁵¹ Emmerson had

des beaux-arts: cours normal professé au Conservatoire royal des arts et métiers, 3 vols., Paris, 1825-1826.

⁴⁷ *MM* (22 October 1825), p. 5.

⁴⁸ *MM* (27 May 1826), p. 71.

⁴⁹ *MM* (13 March 1824), pp. 11-14 (extended evidence on machinery and artisans going abroad).

⁵⁰ *MM* (3 April 1824), p. 52 (guide to France).

⁵¹ G. S. Emmerson, *Engineering education*, op. cit., p. 231.

in mind figures like Gaspard de Prony (1755-1839), of the *École des Ponts et Chaussées*, a traveller to England and translator from English to French, known for his friction brake or dynamometer (1821);⁵² Jean-Victor Poncelet, of the *École d'Application* at Metz (1825-35), author of the *Introduction à la mécanique industrielle* (1829);⁵³ and Arthur-Jules Morin who worked with Poncelet, taught both at Metz and at the *Conservatoire National des Arts et Métiers* in Paris (from 1839), and introduced his own dynamometer in 1841.⁵⁴ There were many others. What light can the ICE with its *Minutes of Proceedings*, the publishers, the new British academic engineers (from the later 1830s), and indeed the *Mechanics' Magazine* shed on this question of technical exchange?

Turning first to the ICE, we find that Institution's library, like its collections of maps, plans, and models, was central to its mission – at least by the later 1830s. The library accumulated works, including foreign ones, by donation from affluent members, especially those close to the governing Council: William Cubitt, Joshua Field, the military engineer and author Colonel Charles William Pasley, or Telford's disciple the canal, road and (eventually) railway expert John Benjamin Macneill.⁵⁵ The library also exchanged works with other institutions or public bodies. Enterprising publishers donated works, including foreign ones. The library, like the institution, was dominated by the English, and works in English – often given by their authors. But, as the French Institute had done, the ICE accumulated distinguished foreign associates, like Dupin, Navier, and Morin.⁵⁶ They tended to donate their own books: thus Morin presented his *Aide-mémoire de mécanique pratique* (Metz, 1838), and his *Notice sur divers appareils dynamométriques* (Paris, 1841).⁵⁷

A survey of the late 1830s and early 1840s shows that the library fully represented these international interests and interactions, developing a modern working

collection. There were visual records, sometimes in English, of foreign 'works' (like W. B. Bray's sketches and plans of bridges in Paris).⁵⁸ There were numerous books, pamphlets and reports in French, German and Italian. Foreign dictionaries, some given by Cubitt and Field, made this wisdom accessible to non-expert linguists.⁵⁹ The books in French covered particular geographical areas (e.g., the navigation of the Saone).⁶⁰ They described the public works of particular departments (notably that of the Seine, with statistical reports).⁶¹ There was mathematics and useful science (Lacroix on probabilities; Lalande's logarithmic tables), bolstered by the donation of Thomas Young's library.⁶² There were specialized treatises (Pasley donated Louis Joseph Vicat's work on cements),⁶³ compendia of engineering art (e.g., Louis Bruyère's *Études relatives à l'art des constructions*, Paris, 1823-1828),⁶⁴ or journals (Macneill donated runs of the *Annales des ponts et chaussées* and the Duke of Buccleuch gave the *Annales des mines*).⁶⁵ There were also, increasingly, translations from foreign languages, including French, into English. Here John Weale, occasional publisher for the ICE itself, was a prime example: Weale translated Vicat's treatise into English (1837) but that was just one amongst many entries in his engineering and architectural 'libraries'. Weale sent the ICE his translations of de Pambour's *On locomotive engines*⁶⁶ and the same author's *New theory of the steam engine*.⁶⁷

The ICE had become a considerable repository of foreign technical practice, but it had done so ad hoc, largely due to individual agency as travellers returned inspired by trips to France, networks of exchange within an international scientific fraternity, or the advertising ventures of enterprising publishers. Thus in March 1840, engineer Richard Beamish could still approach ICE president James Walker with the observation that in the Institution's published works he found there little evidence of familiarity with the engineering literature or public works of other countries and few scientifically distinguished foreign honorary members. Beamish claimed, a little unfairly, that the many 'foreign publications full of scientific & practical information' were sadly barely known 'even by name to the mass of the

52 See M. M. Bradley, 'Prony the bridge builder: the life and times of Gaspard de Prony, educator and scientist', *Centauros*, 37, 1994, pp. 230-268, esp. p. 237; A. Picon, *L'invention de l'ingénieur moderne. L'École des ponts et chaussées, 1747-1851*, Paris, Presses de l'École nationale des ponts et chaussées, 1992.

53 'Jean-Victor Poncelet (1788-1867)', *Dictionary of scientific biography* (article by René Taton).

54 C. Fontanon, 'Un ingénieur militaire au service de l'industrialisation: Arthur-Jules Morin (1795-1880)', *Cahiers d'histoire et de philosophie des sciences*, 29, 1990, pp. 90-118.

55 'Cubitt, Sir William (1785-1861)', 'Pasley, Sir Charles William (1780-1861)', 'Macneill, Sir John Benjamin (1792/3-1880', *Oxford dictionary of national biography*.

56 *MPICE* 1837, p. 7 (Navier's death).

57 *MPICE* 1843, p. 50.

58 *MPICE* 1837, pp. 9, 14.

59 *MPICE* 1838, pp. 13, 14 ; 1843, p. 42.

60 *MPICE* 1837, p. 11.

61 *MPICE* 1838, pp. 14, 17.

62 *MPICE* 1838, p. 15.

63 *MPICE* 1838, p. 18.

64 *MPICE* 1837, p. 11.

65 *MPICE* 1838, p. 13; 1839, p. 21; 1842, p. 36 ; 1844, p. 42

66 *MPICE* 1837, p. 12.

67 *MPICE* 1839, p. 23.

profession', a fact which made Beamish 'ashamed of our exclusive practice'. He proposed therefore 'a foreign Secretary, who would become the interpreter of those writings, and thus spread the light of other lands on our own.' That officer would abstract works in Italian, German and French, including the "'Annales de Chimie'", "Annales des Mines", "Annales des Ponts & Chaussées"''. The question was, who would be best qualified to carry out such a task?⁶⁸

What was needed was someone of good social and professional pedigree, with tutored scientific understanding, extensive experience abroad, excellent connections with European institutions and savants, and an aptitude for foreign languages. Beamish had in mind Lewis D. B. Gordon.⁶⁹ This Edinburgh Scot from a legal family had worked on the notorious 'Thames Tunnel' with the illustrious French expatriate Marc Isambard Brunel;⁷⁰ he had been one of the most gifted students of Edinburgh natural philosopher, Alpinist and Europhile James David Forbes;⁷¹ he had travelled and studied in German lands (especially at the Freiberg School of Mines) and in France 'for the very purpose of obtaining that knowledge which our own Institutions are unable to afford';⁷² and he knew the principal European languages.⁷³ Walker was unmoved – apparently not on the grounds that foreign, or scientific, literature was unimportant, but rather imagining that the encounter was best done as needs dictated, not through an individual paid to select and filter. The path which the ICE decided not to follow as a professional institution was, however, fully explored by the British academics.

A recently established scientifically inclined engineering professoriate, flourishing from the late 1830s manifested considerable enthusiasm for French (and other foreign)

technical authorship and practice.⁷⁴ Although not an engineering professor, Forbes lectured on engineering topics, in February 1838 recommending Pambour's *On locomotives engines* and other French works on mechanics as essential literature for aspirant professionals (like his then student Macquorn Rankine).⁷⁵ As a professor of engineering in Glasgow, Lewis Gordon issued his class with bibliographies packed with foreign works, and described what he had seen on his travels – including Morin's dynamometers, witnessed at Metz.⁷⁶ Before he took over as engineering professor at Trinity College Dublin in 1841, Macneill had donated French journals and a French comparison of the economy of canals and railways to the ICE,⁷⁷ and also translated a work on railways by Navier (1836). Gentlemanly engineers at Cambridge University were catered for jointly by William Whewell and Robert Willis, whose *Mechanics of engineering* and *principles of mechanism* (with its *cinématique* or kinematics) enthused about or rested upon French theoretical engineering (including Poncelet, de Pambour, and others).⁷⁸ Temple Chevallier and his colleagues at Durham encouraged, even expected, their gentlemanly 'academic engineers' to achieve a reading (if not speaking) knowledge of modern rather than classical languages (especially French and German), in order to further their studies. Papers set at Durham University, and grades achieved, indicate the relative lack of success of tyro engineers in these studies.⁷⁹ The Reverend Henry Moseley, who taught the engineers at King's College London, knew his French mechanics well, and abstracted Morin's experiments on

74 B. Marsden, ' "The progeny of these two Fellows" ': Robert Willis, William Whewell and the sciences of mechanism, mechanics and machinery in early Victorian Britain', *British journal for the history of science*, 37, 2004, pp. 401-434.

75 Forbes to H. Hope, 1 February 1838, f. 504, Letter Book II and also the 'Progress books' (= natural philosophy class lecture lists) in J. D. Forbes papers, St Andrews University Library; Constable 1877 and B. Marsden, ' "A most important trespass" ', *op. cit.*; Ben Marsden, "Engineering science in Glasgow: economy, efficiency and measurement as prime movers in the differentiation of an academic discipline", *British journal for the history of science*, 25, 1992, pp. 319-346.

76 L. D. B. Gordon, *Syllabus of a course of lectures on civil engineering and mechanics. Mechanics*, Edinburgh, Constable, 1841; id., *Civil engineering and mechanics. Engineering aphorisms and memoranda. A synopsis of lectures to be delivered session 1847-8*, Glasgow, Griffin, 1847; B. Marsden, ' "A most important trespass" ', *op. cit.*; C. W. Smith and M. N. Wise, *Energy and empire*, *op. cit.*, p. 291.

77 The Comte Pillet-Will's *De la dépense et du produit des canaux et des chemins de fer* (Paris, 1837): see *MPICE* 1838, p. 14.

78 B. Marsden, ' "The progeny of these two Fellows" ', *op. cit.*

79 Durham University, *The Durham University Calendar for 1841*, Durham, Francis Humble, 1840, esp. engineering exam papers.

68 Richard Beamish to James Walker (President of the ICE), March 1840, in Richard Beamish Collection, Science Museum Library.

69 B. Marsden, ' "A most important trespass" ': Lewis Gordon and the Glasgow chair of civil engineering and mechanics, 1840-1855', in C. W. Smith and J. Agar, eds., *Making space for science. Territorial themes in the shaping of knowledge*, Basingstoke, Macmillan, 1998, pp. 87-117, pp. 89-90.

70 R. Beamish, *Memoir of the life of Sir Marc Isambard Brunel*, London, Longman, 1862; B. Marsden and C. Smith, *Engineering empires. A cultural history of technology in nineteenth-century Britain*, Basingstoke, Palgrave Macmillan, 2005, pp. 227-228.

71 J. C. Shairp, P. G. Tait and A. Adams-Reilly, *Life and letters of James David Forbes*, London, Macmillan, 1873.

72 Despite suggestions by his biographer, Gordon does not appear to have studied at the *École Polytechnique*. I thank Bruno Belhoste for discussions on this point. T. Constable, *Memoir of Lewis D. B. Gordon*, Edinburgh, T. and A. Constable, 1877, p. 42.

73 Richard Beamish to James Walker (President of the ICE), March 1840, in Richard Beamish Collection, Science Museum Library.

traction in his 1842/3 magnum opus.⁸⁰ Railway engineer Charles Blacker Vignoles, a professor at University College London, was perhaps the least theoretically oriented; but his practical and biographical connections with France were extensive.⁸¹ Thus for a small but influential group of engineering educators, France provided inspiring models in practice and in theory.

French theory and British practice: high theory for artisans

Much remains to be discovered about the infiltration of French technical literature into the ICE and British academia; but even less is known about its dissemination to the offices, workshops and field-sites of middling engineers and artisans. Men like Forbes, Gordon, Whewell, Willis, Macneill, and Moseley were professionally or professorially aware of French work; but their knowledge did not exist in a vacuum. We have already seen the *MM*'s intense concern with practical activities across the channel. I propose that there is evidence to suggest that the technical literature was also within the intellectual horizons of readers and contributors. In an echo of the early worship of Dupin, the *MM*'s artisan readers and editors dabbled with French theoretical engineering in parallel with the movement to get British engineering education into academia. Certainly by the end of the 1840s, there would be impassioned pleas in the *MM* for readers to engage in self-culture by reading up on French theory (see below).

What, then, did the *Mechanics' Magazine* make of that French technical literature? One recurring theme was the habit of the French to erect theories on the basis of raw British practical experience. One *MM* reviewer, noting that useful theories of hydraulic practice tended to be foreign (and especially French), lamented the fact that 'making a study of this branch of engineering knowledge' was not a thing 'to qualify a man for professional eminence in England'. In Britain the rule was 'first get a dock or harbour to do, and afterwards to find out how it is to be done'.⁸² Such was the case with the British railways. Back in 1829 Henry Booth had presented the Liverpool & Manchester Railway (L&MR) as a tremendous experiment in steam locomotion.⁸³ Savants did indeed adopt the L&MR as a site for large-scale engineering experiment. Like Prony, Dupin, and many others, François-Marie Guyonneau de Pambour travelled

to England to learn about railways in action; assisted by Nicholas Wood, de Pambour gathered data and made experiments on the L&MR and its locomotives. These formed the basis of his *Traité théorique et pratique des machines locomotives* (Paris: Bachelier, 1835). Its basis in British experience made de Pambour's book a hit in Britain, especially after Weale's translation appeared. The *MM* used this, however, as an opportunity to reflect on the relationship of 'French Theory and English Practice':

It is not a little singular, that, while England is making so great a progress in the actual establishment of railways, the French have published a much larger number of works on their mathematical theory; although this is, perhaps, not by any means the first instance in which the same state of things has occurred. A Colonel de Pambour has just added to the rather long list of publications by his countrymen on the subject, a very elaborate book of calculations on railway theorems, in which he lays down his positions rather more dogmatically than his little experience (all apparently gained in England) seems to warrant. He has not, however, much to fear from his English competitors in the line, the principal of whom are Mr. Macneill, of "canal navigation" celebrity, and – John Herapath, Esq.!⁸⁴

The review illustrates neatly the *MM*'s inferred knowledge of French technical literature on railways and its continued subscription to Baconian experiment ('experience') as the source of useful knowledge. It succeeds, also, in disparaging de Pambour for dogmatism (a Gallic stereotype), whilst taking shots at two British practitioners. Macneill had maintained too long his preference to roads and canals; and as a key ICE figure and surveyor to the Irish Railway Commission he was suspiciously close to parliamentary elites. Herapath was an easy target: a controversial scientific gentleman ('Esq.') who had the audacity, despite little practical experience, to edit a rival journal, the *Railway Magazine*.⁸⁵

Despite this sniping, de Pambour was hard to ignore, partly because his works satisfied a parochial, if understandable, appetite for data born of large-scale experiments on British works; and partly because Weale saw to it that *A new theory of the steam engine* (1838), an extended *Theory of the steam engine* (1839), and a *Practical treatise on locomotive engines* (1840) were all available in English.⁸⁶ Thus the *MM* reproduced or debated

80 Henry Moseley, *The mechanical principles of engineering and architecture*, London, Longman, 1843, esp. pp. 612-613.

81 'Vignoles, Charles Blacker (1793-1875)', *ODNB*.

82 *MM* (16 April 1842), p. 308.

83 B. Marsden and C. Smith, *Engineering empires*, *op. cit.*, pp. 136-145.

84 *MM* (4 June 1836), p. 144.

85 'Herapath, John (1790-1868)', *ODNB*.

86 F. M. G. de Pambour, *A practical treatise on locomotive engines, founded on a great many new experiments on the Liverpool and Manchester, and other railways*. London: John Weale, 1840; B. Marsden and C. Smith, *Engineering empires*,

data and, occasionally, equations, from de Pambour's books: his records for 1831 to 1834 of distance travelled and reliability of the L&MR locomotives (mostly by Robert Stephenson);⁸⁷ his claims about friction on rail;⁸⁸ his formulae (and Navier's) on the properties of steam in engines working expansively at high pressures, as disputed by and improved upon by William Pole.⁸⁹ Clearly de Pambour was not beyond dispute and nationalist animosity occasionally bubbled up. In 1838, for example, Thomas Oxley and 'Nauticus' locked horns over the relative merits of the steam-engine and the electro-magnetic engine, and of cranks to transmit their power. 'Nauticus' incautiously wrote of the 'recent *practical* investigations of the performance of *cranked* engines, by the Chevallier de Pambour, who', he continued ironically, 'has some *slight* knowledge of mathematics' - and certainly enough to upset Oxley's calculations.⁹⁰ Oxley, aggrieved, replied 'that there are plenty of Englishmen who thoroughly understand this subject, and that it was quite unnecessary for 'Nauticus' to give himself the trouble to *travel* to France for an opinion'.⁹¹ De Pambour came under fire a year later when investigations of (the French-trained) Isambard Kingdom Brunel's Great Western Railway 'system' spawned studies by Dionysius Lardner on frictional and air-resistance to rail travel. Lardner began by dismissing the 'course of experiments' made by 'a French gentleman, M. de Pambour' - who in any case had got his maths wrong.⁹² Later still, 'Indicus' claimed that both Lardner and de Pambour, in neglecting the slope of their experimental lines, had come up with erroneous formulae.⁹³

De Pambour's were not, of course, the only foreign works to receive the *MM*'s attention. In March 1842, the *MM* introduced a regular item on 'Progress of foreign science'.⁹⁴ Gordon discussed the merits of Fourneyron's turbine;⁹⁵ Moseley's discussion of Morin's experiments was abstracted and critiqued.⁹⁶ There were numerous translations, too, although these met various responses. One or more of Navier's works (including that of Macneill) flushed out, rather surprisingly, literary aficionados concerned, on the *MM*'s behalf, about good language.

Macneill had approached a linguist to advise on terms, but too late had been offered the term 'clivity' (as an alternative to the 'gradient') of a line of transportation. Nevertheless that term was soon being used and a correspondent ('Q. Briggs') noted that this term, 'adopted in the translation of Navier', was ultimately unsuccessful - since a gradient might be level, whereas clivity, from *clivis*, or hill could hardly be.⁹⁷ Translators might receive little thanks for their work; or they might be welcomed with relief in the technological arenas of the mid nineteenth century. As late as 1843, many good works remained inaccessibly French: thus, in 1843 a review of Holtzapffel's new work moaned that 'All the best works on turning are in the French language'.⁹⁸ Thank goodness, then, for John Weale who, in the same year, brought out the oddly titled *Ensamples [sic] of railway making; which, although not of English Practice, are submitted, with Practical illustrations, to the civil engineer and the British and Irish public*. Here the 'ensamples' were taken (rather apologetically) from the Belgian railway system but might just be of some value. The *MM* commented: 'the latter is a very good translation, for which not a few of our English engineers will be very glad to exchange their French originals'.⁹⁹ To discard a copy, one must first own it and, presumably, hope to read it - a detail which again hints that there was more reading in French, or at least more encouragement to it, amongst subscribers to the *MM* than one might at first expect.

Rather firm evidence on this point appeared in the spring and early summer of 1847 in a very extended series of 'Remarks on the use of mathematical knowledge to engineers, and hints to those who have not the benefit of a tutor'.¹⁰⁰ The remarks advised a 'self-taught' practical engineer (not a tutored or a university student) how to navigate the literature of applied mathematics. The anonymous author first set out to destroy the conviction that his readers 'might as well learn Arabic as mathematics'. He admitted that it might have arisen because too few books dealt adequately with the subject, there was too little basis in actual experiments (although Morin and Coulomb provided good examples), too few understood the meaning behind the symbols (here Poincot was the supreme counter-example); and there were too few books with practical examples (lamenting the absence of problems from the *École Polytechnique*). For this author, 'every one who intends to acquire

op. cit., p. 146.

87 *MM* (30 July 1836), p. 291.

88 *MM* (11 December 1841), p. 451.

89 *MM* (30 September 1843), p. 245.

90 *MM* (31 March 1838), p. 442.

91 *MM* (12 May 1838), p. 94.

92 *MM* (19 January 1839), pp. 266-267.

93 *MM* (2 May 1840), pp. 682-683.

94 *MM* (12 March 1842), p. 200.

95 *MM* (21 May 1842), p. 411.

96 *MM* (24 December 1842), p. 586.

97 *MM* (6 August 1836), p. 317; for another reference to Navier, see Pole's article above.

98 *MM* (21 January 1843), p. 37.

99 *MM* (21 January 1843), p. 43.

100 *MM* (3, 17 and 24 April and 1, 8 May 1843); pp. 325-328, 368-372, 393-397, 425-427, 440-443 (quoting 325, 369, 370, 371, 441).

an extensive knowledge of mathematics, or indeed any science, will find an acquaintance with the French language indispensable'. That would allow him to read the key books – available from Baillière's in London's Regent Street: books on statics and dynamics (especially by the clear-thinking Poinot and by Poisson); Prony's *Mécanique analytique* and *Architecture hydraulique*; and the best work for the practical engineer, which was Prony's 'well-known' *Mécanique industrielle* (a summary of his lectures at Metz). The author of course considered English works: Whewell's well-known works on mechanics were good – but he had 'some queer crotchets' which put him 'totally at variance with all the great French writers'. If there be any doubt, the author was targeting his study guide on the working man: thus he called Moseley's textbook 'valuable to the *mathematical student* and *amateur* of engineering science ... but little calculated to assist practical men'. For advice on how to study, the author went to D'Alembert: '*Allez en avant et la foi vous viendra*'.

Conclusion

In its mechanical discourse, the *MM* did not, then, restrict itself to the narrow, impartial, or disinterested forms of technical expression that were emerging amongst the professionals at the Institution of Civil Engineers or the academics and their students. Instead it speculated, and pontificated, widely: about the limits of monarchy and hereditary privilege when contrasted with the virtues of innately skilled low-born British artisans; about structures of society and surveillance which contrasted despotic control with the autonomy of that same dignified mechanical genius; on the chain from savagery to civilization, as illustrated by the inferior, soup-fed, Frenchman contrasted with the beefy Englishman; about religion, where the alleged virtues of Protestantism debunked Catholicism; about the misdirection of skill into surface luxury on display at the *Louvre* rather than the new-pyramid-building British steam-engine; about education through Mechanics Institutes and, later, through a self-culture (whith a rigorous course of applied mathematics); about travelling to France – or staying at home, but becoming an informed 'armchair traveller'; about the pleasures and pitfalls of reading and translating foreign literature which brought doubtful theoretical order to resplendent British practice; about national identities, whether radical or reactive, expressed in technical endeavour.¹⁰¹

101 See C. MacLeod, *Heroes of invention. Technology, liberalism and British identity, 1750-1914*, Cambridge, Cambridge

There was no single, one-dimensional view. The journal was neither simply pro-France, nor directly anti-France. Within these pages, 'France' was a finely textured tapestry woven out of mechanical politics. The *Mechanics' Magazine*, rather, expressed a 'thick description' of France, of its peoples (whatever their social rank), of its institutions, and of its technological practices. The contradictions amongst those representations is hardly surprising: conflict was evidence of the kind of lively debate which characterized the *Magazine* and its community. That thick description said as much about the British and their foibles as it did about the French. British artisans, writing and reading the *MM*, were anxious to consolidate both their identities and their specialist knowledge. France helped them do this.

By considering such representations of French technical culture 'from below', I hope to have enriched and enlivened existing accounts of technical exchange in the early nineteenth century – particularly those accounts which have focused on the selective adoption of elite technical literature from France into Britain into places like the new academies of engineering established from the 1830s and into the 1840s. There are, I hope I have shown, other stories about the reciprocal transmission of technical cultures at a less elevated level, below that of the elite civil engineer or professoriate. Even so, towards the end of the period observed here, the 'upward mobility' of the editors, authors, and readers of the *Mechanics' Magazine* worked to soften its critical stance. The anecdotal and polemical material, so prominent in the early issues, gradually disappeared as editors and other contributors focused less on mechanical practice and more on an emergent 'engineering science'.

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