British and Irish Civil Engineers in the Development of Argentina in the Nineteenth Century

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INTRODUCTION

The ICE's Editorial Board of the *Biographical Dictionary of Civil Engineers of Great Britain and Ireland: Volume 2 – 1830–1890* are compiling a reference work covering civil engineers active 1830–1890. One task was to establish criteria for inclusion. It was determined that selection should normally be based upon British/Irish birth and training, i.e., individuals 'emigrating' before the age of 14–21 would not normally be considered unless they later carried out works in Britain or Ireland. With this basic consideration in place it has been decided to review the work of British/Irish engineers outside their homeland, and consider the similarities and differences between 'countries'. This paper is going to focus on engineers who worked in Argentina, and compare what is known for other parts of the globe.

CIVIL ENGINEERING AS AN INTERNATIONAL ACTIVITY

Today civil engineering is regarded as an international industry with multinational consultants and contractors dominating major projects worldwide. This paper demonstrates through a study of engineering activity in the period 1830–1890 that this is not a new development. Modern civil engineering normally traces its origins to developments in Europe in the eighteenth century. These include the establishment of engineering schools and developments in the theory of engineering science. At a more practical level the technologies associated with the industrial revolution were making Britain the world's first industrial nation by the end of the century, and producing a new breed of engineers eager to exploit these technologies. The term 'civil engineer' itself first came into use c.1760.

This was preceded by significant civil engineering achievements in many parts of Europe – inland navigation improvements in medieval Italy, land reclamation in the Low Countries, great religious buildings, and substantial bridges. Associated with these were more or less formal groups of men – medieval 'Freemasons', or the Florentine 'Ufficales di fiume, ponte e strade' created in 1549.

There is plenty of evidence of international transfer of engineering expertise from mediaeval times through to the eighteenth century. In general terms 'Dutch' engineers were the first civil engineers to attain international fame – working across northern Europe, from the 14th century; Cornelius Meyer was employed in Italy the late seventeenth century. More pertinently engineers of the overseas empires of the Iberian peninsular were the first Europeans to create significant engineering works outside Europe. In the Americas their achievements were notable. (Gonzalez Jascon)

Before the eighteenth century much civil engineering expertise in Britain and Ireland was derived from elsewhere in Europe (Chrimes, 2004; Skempton, 1996, 2002). Few British engineers worked abroad in this early period. Some accompanied military expeditions such as the 'mason' John Rogers (d.1558) who carried out harbour improvement works around Boulogne following Henry VIII's conquest there. There were exiles like Sir Robert Dudley who worked on draining Livorno marshes (1621). The English were responsible for one great overseas work in the early modern period, the Tangier Mole 1667–1680.

BRITISH CIVIL ENGINEERING OVERSEAS AFTER 1760

Before 1760 civil engineering work by British and Irish engineers outside the British Isles was unusual. This changed over the next two generations as the impact of the industrial revolution, and the development of a profession of civil engineers took place, culminating in the foundation of the world's first professional engineering body, the Institution of Civil Engineers, in 1818. The development of the canal network attracted comment from the 1760s. In the early nineteenth century there was a veritable flood of visitors and technical spies, from Europe and North America.

Engineers and artisans went overseas from the eighteenth century taking with them 'secrets' of industry. By the 1820s this 'brain drain' was sufficiently serious to warrant a Parliamentary select committee. Some also went to British overseas possessions, e.g., India (the iron founder Jessop). Many were members of ICE (Skempton, 2002) but they were mostly involved in 'manufacturing', and the story has been well recorded by Henderson. British civil engineering activity overseas has been less well recorded.

Smeaton, consulted about Kronstadt Dockyard in 1777, was perhaps the first British civil engineer to be consulted about overseas work. The best–known early example is Thomas Telford's work on the Gotha Canal. Telford provided drawings, commented on the route, and advised on personnel to provide engineering and other technical expertise.

The Gotha Canal is unusual in that no obvious British political or financial interests were involved. Trevithick, Robert Stephenson and later John Hawkshaw were lured to Latin America by British mining interests in the 1820/30s. Thereafter British civil engineering overseas begins in earnest. It was a multifaceted process – either government inspired or capital driven, and dependent on the enterprise of individuals. For that reason generalisations can be difficult. One can get some idea of the scale of the process by reference to Table 1 which gives figures for ICE membership overseas 1840–1890 in selected countries.The selection reflects a range of British interests– in political rivals in Europe, settler colonies like New Zealand, trading colonies like India, and economic colonies like Argentina.

Table 1. ICE Membership Statistics, 1840–1890

	1841	1850	1860	1870	1880	1890
India	5	16	29	143	210	452
Australia	2	5	10	25	69	232
Argentina	1	–	–	3	14	118
Brazil	–	–	4	15	35	75
South Africa	–	–	3	6	43	72
Canada	5	2	5	13	41	69
Sri Lanka/Ceylon	–	2	3	7	32	42
New Zealand	–	–	1	5	39	60
Germany	3	2	4	6	13	9
Russia	3	3	6	6	8	5
Peru	–	1	1	1	4	6
Total Membership	475	695	931	1,802	3,823	5,785

BRITISH ENGINEERS IN EUROPE

Despite the example of the Gotha Canal it is evident from Table 1 that, compared to elsewhere, relatively few ICE members worked in Europe. This is perhaps unsurprising given the relative economic advance of those countries, and political rivalry. There may have been other reasons. Members working in Europe may not have changed their addresses. Consultancy work was relatively straightforward, one could easily visit or correspond with assistants. Those who registered European addresses were generally engineers managing works such as Baird in St Petersburg. After 1850 the Diaspora was generally to other continents.

TRADE COLONIES: THE INDIAN EMPIRE

Table 2. Engineers in India

India	Military Engineers	PWD Engineers	Railway Engineers	Others	Native Indian	Total civil engineers	ICE Members
1830		25				25	
1840		41				41	5
1850	203	108	14	5		125	16
1860	C 300	285	147*	10	2	550	29
1870		727	101		45	850	143
1880		1,060	217	17	85	1,200	210
1890		1,037	403		108	1,200	452

Note : In 1860 there were c.900 European staff on Indian railways (Kerr)

The British engineering influence in Victorian India can scarcely be overstated. The number of engineers known to be active there dwarfs any other part of the territorial Empire, and a significant and increasing proportion were members of ICE (Tables 1 & 2). The first Indian Presidency to have a 'board' of civil engineers was Madras, from 1786. Early attention was paid to the maintenance and reinstatement of existing irrigation schemes. By the 1820s the corps was so well established it was contemplating new works. Such developments came slightly later to Calcutta and Bombay, but by 1830 all three Presidencies had detailed a number of engineers and other personnel to civilian duties, albeit occasionally interrupted by war. Thus one can see much early civil engineering was 'government driven.'

Unsurprisingly, however, it was the coming of the railways that opened up major opportunities and need for investment. After a tentative start the first railway concessions were launched in the 1850s with guaranteed rates of return for investors, a lesson not lost in Argentina later. Unsurprisingly, they were taken up by British capitalists. The early railways were developed on the British model with UK consultants, UK resident engineers and most contracts being awarded to British contractors. Thus one sees through the 1850s and 1860s an invasion of British engineers trained in the railway mania years in Britain, who rapidly developed the railway infrastructure. Thus the nascent 'public works' culture of the early civil engineering in India was for a time overwhelmed. It soon reasserted itself as the resident and assistant engineers on the spot became increasingly sceptical about the quality of the contractors' work and direct labour became the favoured method of construction for all public works.

What then of the 'British Engineers in India?' With such large numbers involved it is difficult to be definitive. However, it is clear that an important minority of British engineers working in India were born there. An analysis of graduates at the Royal Indian Engineering College, Coopers Hill (Table 3) reveals at least 11% were born in India, the majority of European origin. An analysis of Indian directories reveals that in the ranks of the Indian Civil Service there was a minority, particularly in the lower ranks of assistant engineers in the Public Works Departments of native Indians qualifying as the century progressed. Of the 122 engineering biographies relating to British engineers working in India so far written 42, almost exactly one third were born there, and a further 5 outside the UK, probably the children of military officers and civil servants who also served in India.

Table 3. Origins of Coopers Hill Students

Year of education	Assumed UK/Ireland*	Euro–Indian	Native India	Other	India	Total
1870–1879	233	30	0	6	11%	269
1880–1889	199	27	3	9	12%	238

SETTLER COLONIES: NEW ZEALAND

New Zealand provides an interesting comparator with Argentina. It was one of the later British settler colonies –only areas like Rhodesia were later. Military struggles with the local Maori population were not resolved until the second half of the nineteenth century. Its remoteness also delayed its development, and to a degree this is reflected in the relatively large proportion of engineers who came there from Australia and India. Table 4 may understate the number of military engineers who carried out civil work in the early period. The arbitrary nature of the dates (1840, etc.) conceals rapid growth in number of engineers just after 1860, similar problems exist when considering Argentina. Nonetheless one can see that by the 1880s the number of 'British' engineers is being outstripped by those who were born and grew up in New Zealand. The relatively static numbers of 'British' engineers after 1870 suggests that the colony was developing self–sufficiency, which was not true in the Argentine.

Table 4. Origins of New Zealand Engineers (after F W Furkett (1953)

Year active	UK born / trained	UK born / trained NZ	NZ born	Other (mostly Indian and Australian)	Total	ICE Members
1840	10	1	0	1	12	0
1850	16	2	1	3	22	0
1860	49	9	1	4	63	1
1870	91	34	6	10	141	5
1880	100	54	39	22	215	39
1890	104	49	42	34	229	60

BRITAIN'S ECONOMIC COLONIES – LATIN AMERICA

Britain's relationship with most of Latin America was very different from that of North America. Rather than the colonial power, Britain in the early nineteenth century could be seen as the liberator. Even if the disintegration of the Spanish and, to a lesser degree the Portuguese, overseas Empires in the wake of the Napoleonic wars was evidently in Britain's general interests, for the aspirant bourgeoisie Britain's constitution and limited Parliamentary democracy was something of a model, whilst her economic and industrial advance promised new sources of wealth to a region traditionally seen by Europeans as a provider of raw materials. After direct involvement around the River Plate ended, as the century progressed it was as a source of investment capital that British aid was sought. Although technical expertise was needed, without capital many engineers' reports remained unrealised.

The snapshot of ICE membership (Table 1) in a few Latin American countries reflects the pattern of investment. Peru is an example of a country where US influence, in the person of the colourful Henry Meigs, was at its greatest, and British interest episodic, although it was the location of Thomas Brassey's, final contract, the harbour at Callao (1870–1875).

The large numbers of ICE members in Brazil and Argentina provide an interesting comparison with Britain's colonies. Brazil's case is particularly interesting as numerically it almost parallels that of Canada. There were in fact British engineers working in Brazil before 1860, early in the century with machinery and steam engines associated with Brazil's agricultural crops, and, after 1850, in railway development. Six of the fifteen ICE members active in Brazil in 1870 were Brazilian, indicating the close relationship between British and Brazilian engineers active there, particularly in the railways.

(Table 5) Origins of Engineers in Argentina 1830–1890 (after CAI, Justo Lopez, Mulhall; ICE Records)

	Argentina	British Isles	Other European	US	ICE Members
1830	2	1	10	0	0
1840	3	0	5	0	1
1850	3	1	5	0	0
1860	3	1 (17 in 1863)	3 (2 in 1863)	1 (1)	0 (3, 1863)
1870	12	4	10	1	3
1880	28	14	17	1	14
1890	105	115	16	1	118

EARLY BRITISH INVOLVEMENT IN THE ARGENTINE

Argentina is of interest for a different reason. Unlike Brazil and Canada its indigenous engineering tradition was destroyed by political upheavals around the mid–century. Spanish engineers who had carried out work in the colonial period were supplemented by French engineers in the Napoleonic period, and also Italians. The first British engineer to arrive may have been Santiago Bevans [sic] (1777–1832) (James Bevan?) a ‘hydraulic’ engineer who arrived in 1821, and drew up plans for Buenos Aires. In 1846 the first steam engine supplied by J E Hall of Dartford arrived. Industrial development was interrupted by political instability and civil war between Buenos Aires and other provinces, which characterised the period 1825–1862. After 1862 something like unity was achieved across modern Argentina, although war was conducted against Paraguay 1865–1870. One can see why such engineering expertise as had existed in the early nineteenth century was either directed into war or lost. From 1865 university engineering education was established and from 1870 Argentinian graduates became qualified civil engineers. As their numbers grew so did those of the British, also the chief trading partners, with 28% of the import trade and 24% of the export trade in 1870. Contractors Peto and Betts got their first railway concession in 1862 and Brassey, with partners Wythes, Wheelwright and Alexander Ogilvie, followed in 1864, just after the completion of the Grand Trunk Railway in Canada. Patrick Ogilvie was one GTR agent who moved to Argentina. Fast as the number of Argentinian engineers grew, so did the opportunities for the British and from 1885 Hawkshaw Son and Hayter established an office in Buenos Aires, the first British–based consultants to establish a permanent overseas base, so great was their business. With its nineteenth century history one sees how the British engineers in Argentina were to be more numerous there than in most of dominions in 1890. This was in part a reflection of the dominance of British trade in the area – although by no means as dominant as elsewhere (Table 6). Overseas investment grew rapidly in Latin America in the last quarter of the nineteenth century (Table 7), with a significant proportion in railways (Table 8). 78% of the network was effectively British owned in 1900. The enormous expansion after 1880 (Table 10) fuelled the demand for the engineers reflected in Table 5. The degree of return makes it easy to understand how this came to be so attractive (table 9).(Lewis, Lopez)

Table 6. Foreign trade, of India, Canada, Brazil, and Argentina with UK: 1871-1900

A. Percentage of British imports of the total import trade

Period	India	Canada	Argentina	Brazil
1871-1875		52		52
1876-1880	77	40	26	40
1881-1885	77	39	34	41
1886-1890	74	37	35	36
1891-1895	69	38	38	30
1896-1900	64	24	37	26

B. Percentage of exports to the UK of the total export trade

1871-1875		42		36
1876-1880	47	50	10	13
1881-1885	47	46	11	7
1886-1890	38	45	17	21
1891-1895	32	55	16	13
1896-1900	29	59	13	16

Table 7. Estimate of total British overseas investment – 1855-1904 (£million)

Period	At start of period	Increase of 5 years	South America – increase in decade
1855-1859	550	200	
1860-1864	750	100	
1865-1869	850	139	16
1870-1874	989	354	61
1875-1879	1.343	158	14
1880-1884	1.497	308	40
1885-1889	1.818	452	126
1890-1894	2.331	294	45
1895-1899	2.587	429	33
1900-1904	2.938	359	37

Table 8. Estimate of total British investment in railways (£million)

End of year	Argentina (1)	Brazil (2)	Canada (3)	India (4)	Total (A)	Total Investment (B)	(B) (A) %
1850			0,6	0,1	0,7	450	0,2
1860	0,1	1,0	19,0	12,0	32,1	750	4,3
1870	2,9	6,2	22,0	96,0	127,1	989	12,9
1880	6,2/6,5	11,6/13 4	58,0	110,2	186,0/188,1	1.497	12,4
1890	61,2	26,0/30,5	105,0	160,0	352,2/356,7	2.331	15,1
1900	93,6	33,6	123,6	226,0	476,8	2.938	16,2

Table 9. Comparative dividends declared upon ordinary stock by British and Argentine railway companies

	Buenos Aires Great Southern %	Buenos Aires & Rosario %	Central Argentine %	London & North Western %	Great Western %	Great Southern & Western of Ireland %
1868-1872	7.8			7.0	3.4	5.1
1873-1877	7.7		4.6	6.8	4.8	5.4
1878-1882	8.0		4.6	7.0	5.3	4.5
1883-1887	10.0	9.0	10.0	6.7	5.8	4.4
1888-1892	8.6	5.0	5.0	6.7	6.4	4.7
1893-1897	5.1	2.2	2.0	6.5	5.4	5.3
1898-1902	6.8	3.0	4.8	6.8	4.6	5.0

Table 10 Argentine Railways: expansion of the network

	Operational mileage year end	Increase
1880	1563	
1881	1563	0
1882	1636	73 (4.7%)
1883	1966	330 (20.2%)
1884	2261	295 (15.0%)
1885	2798	537 (23.8%)

	Operational mileage year end	Increase
1886	3627	829 (29.6%)
1887	4157	530 (14.6%)
1888	4705	549 (13.2%)
1889	5069	364 (7.7%)
1890	5861	792 (15.6%)
1891	7752	1891 (32.3%)
1892	8502	750 (9.7%)
1893	8607	105 (1.2%)
1894	8718	111 (1.3%)
1895	8772	54 (0.6%)
1896	8986	214 (2.4%)
1897	9169	183 (2.0%)
1898	9601	432 (4.7%)
1899	10199	598 (6.2%)
1900	10292	93 (0.9%)

The British presence in Argentina is well known, with the Welsh Patagonian community perhaps the best remembered today. The 1822 census of Buenos Aires province identified over 3,500 inglesias, and from Mulhalls' River Plate Handbook for 1863 one can identify over 1,600 'foreigners'. Outside Buenos Aires there were a striking number of Irish extraction, who had their own priests, newspaper (*The Standard* based in Buenos Aires) and schools. In Buenos Aires the picture was more balanced, with most trading nations represented by consulates alongside representatives of the South American Governments, but the British were still in the majority, with their own school, library, etc., and in the engineering world almost all were from the British Isles. Outside the trading community the settlers may have first come as a result of the abortive seizure of the River Plate area by 'British' troops in 1806. Some of the army may have chosen to stay.

THE FIRST BRITISH ENGINEERS AND THEIR BACKGROUND

One of the first engineers from the British Isles to accept the challenge of the Argentine, was the Irishman, John Coghlan (1824–1890). Born in County Kerry, he received his engineering education at the Ecole des Arts et Manufacturers in Paris, graduating with its diploma in 1844. He then returned to Ireland to work for two years with Sir John Macneill and Charles Vignoles and for six years for the Board of Works.

After a spell on railway and mining schemes in Europe about 1857 Coghlan was recruited as Engineer to the Buenos Aires Government. There was a strong Irish presence in the country at the time which may have facilitated his appointment, under the patronage of Lionel Gisbourne. After two years he began to supplement his income by private practice in the province. He obtained a series of appointments on the early Argentinian railway schemes. He designed the first waterworks and prepared the basis of the later design for the drainage of Buenos Aires. He also played a prominent role in the development of harbour facilities. After 30 years Coghlan returned to London in 1887 after an "honoured, fruitful and laborious career in the Argentine Republic" according to a testimonial from the President of Argentina. In London he was elected a Director of the Buenos Aires Great Southern Railway.

THE EARLY RAILWAY ENGINEERS

Coghlan was not the first British engineer in the Argentine of the 1850s. From 1854 a series of small railway lines were authorised radiating from Buenos Aires. The first, the 'Western Railway' was an 8 mile line from Pasque to Flores. Not a British owned concern, it had as its Vice-President Daniel G Phillips, a leading merchant, and as its engineer William Bragge (1820–1884). Bragge, from Birmingham had been apprenticed to C H Capper who supplied the steam engines which successfully pumped Kilsby Tunnel on the London and Birmingham Railway. After this severe introduction to civil engineering he worked for a number of other engineers, and briefly acted as engineer on the Chester and Birkenhead Railway before going to Brazil in 1846 to erect Rio's gasworks. Having built the first railway there, from Rio de Petropolis, he moved to Buenos Aires, erecting the 'Primitivo' Company's gasworks where he was assisted by his pupil C H Wilmot. On the western line Bragge was assisted by John and Thomas Allen, the former replacing him as Engineer on his return to Britain in 1858. Bragge was subsequently engineer at John Brown of Sheffield and made a fortune, presenting Birmingham Public Libraries with its 'Cervantes' collection. While Bragge rose to eminence in Britain, and Coghlan in Argentina, others on the early lines are largely unknown today. The Great Northern Railway (FCBVBA) 18 miles long to San Fernando, had as its engineers William Bilton, who died in Argentina in January 1863 and M King. It seems to have been poorly run until the arrival of Henry Crabtree in 1869. The Buenos Aires and Enssenada Railway (FCBA Enssenada) was a scheme of the American William Wheelwright, but had Coghlan as its Engineer, assisted by J C Simpson. The Eastern Argentine Railway F(CAE) was planned from Concordia to Mont Casseros. More is known about Simpson and the Rumballs, Engineers on the Great Southern Line (FCS). Other engineers like Neville Mortimer are now forgotten, as is the agent for Peto and Betts, Cockburn Muir, on the Great Southern.

The Rumball brothers, Thomas (1824–1902), and Alfred, were consulting engineers of distinction on many overseas projects. In the 1840s after training with Marc Brunel Thomas worked in Portugal as a surveyor, particularly for the earliest railway schemes in that country. In 1852 he was appointed Engineer-in-Chief for the construction of the Peninsular Railway of Portugal. From the mid-1850s, Rumball was consulting engineer for several major schemes in the Iberian Peninsula.

Having established his London office , Rumball continued for many years to undertake a range of schemes in Iberia. He also diversified his consulting work to South America and, in 1862, was appointed Engineer-in-Chief for the first length of the Buenos Aires Great Southern Railway in Argentina. Together with contractors, Peto and Betts, he also invested heavily in the railway and earned an excellent return from its success. He then undertook work for the Brazilian Government. In the 1870s, Rumball carried out work in the Ottoman Empire. Rumball's final railway building project was for a concession to build a railway between Lourenço Marques (Maputo) through Portuguese East Africa (Mozambique) to the Transvaal border. Such varied work was typical of many UK consultants of the time, for whom Argentina only briefly figured in their careers.

His brother's career followed a similar path. In the mid-1840s, following his pupillage with his brother, he became a pupil of Thomas Bartlett, the agent and partner of Thomas Brassey, then engaged on building the southern section of the Great Northern Railway. On completion of this line, Rumball joined his brother in Portugal. On completion of this line in 1858, Alfred was appointed as Assistant Engineer for the Victor Emmanuel Railway in Italy. He was then a District Engineer for the construction of the Bilbao & Tudela Railway.

In 1862, Rumball was employed by his brother as Resident Engineer on the Buenos Aires Great Southern Railway, overseeing the construction of the first length between Buenos Aires and Chascomus by Peto and Betts. He supervised the construction work on the next section, to Dolores, by direct labour.

In 1873, Rumball was appointed Consulting Engineer to the Argentine Government Railway Commission for the construction of the Central Northern Argentine Railway and the Rio Cuarto line.. He then left Argentina. For a spell In 1877, he was associated with an extension of the Hudiksvall & Herjeädalen Railway in Sweden. In 1880, his brother passed him a commission to consider improvements to the city of Santos in Brazil and he was retained as Engineer. In the 1880s and 1890s, Rumball also held several other senior engineering positions for British-owned railways in Argentina and Brazil, including the Cordoba & North Western Railway. He died suddenly in 1896 while still preparing plans for railway extensions.

RAILWAY CONSTRUCTION

Large scale railway development in Argentina was marked by the commencement of the construction of the Central Argentine Railway initially from Rosario to Cordova. The political problems of the Argentine down to the 1850s had been further exacerbated with regard to large capital works by a defaulted loan from Barings of 1824, which meant Britain was in conflict with successive governments. The political unification of the country following the defeat of the 'national' government of Urquica by the Buenos Aires' forces of Mitre in 1861 paved the way for serious negotiations. The model of the Indian railways with a guaranteed rate of interest (in this case 7%) was linked with a railway concession and a grant of land to be developed of one league on either side. While the American Wheelwright was the key to the negotiations it was the experience and capital of the contractors, Thomas Brassey, Alexander Ogilvie and George Wythes that gave the project credibility. Their willingness to accept half the land grant in part payment was a tremendous incentive to development.

Brassey's biographer, Helps, remarks (Helps, p.247) "I doubt whether in the history of railway enterprise, there has been anything so largely beneficial to the country wherein a railway has been introduced, or anything which has afforded such favourable opportunities for emigration as this Argentine Railway."

"There were no special difficulties in the construction of the Argentine Railway. Indeed, so easy was the ground that for part of the way the rails had only to be laid on the sleepers over the bare earth." Edwin Clark later remarked on progress at a mile a day. (Clark)

Responsible for the Central Argentine Railway Edward Woods (1814–1893) was probably the most influential of all the UK based consultants working in Latin America, Bridges were designed by the methods of Calcutt Reilly who briefly worked in his office. Woods extended the Ensenada line, designed the Belgrano Gas Works, Rosario and Parana waterworks and was consultant to the Andino Railway and the Northern line. His son was his resident engineer on the Central Argentine line.

While Woods was British born, Oswald Youngwood (1833–1881) was born in Calcutta, but trained in England, and then spent the early part of his career in the Iberian peninsular and Peru. In 1868, he set-up as a London consulting engineer, advising on Matthew and John Clark's proposed line between Argentina and Chile.

Railway construction in Argentina might be considered as relatively straightforward progress across large tracts of flat land. Engineers, however, soon found that flooding was a major problem. Edwin Clark, well known as Robert Stephenson's Resident Engineer on Britannia Bridge, was in Argentina when the storms of 2nd-3rd May 1877 took place, crossing an area of marshland for 50 kilometres, divided into three valleys, in a series of bridges and embankments with culverts. "The author was on the line during the great storm of the 3rd and witnessed the devastation, the banks melting away … The immediate effect of this enormous rainfall was to convert the level marsh into a vast lake, from six to eight feet deep." Hurricane fine winds and local variations in barometric pressure brought great waves of water "with destructive velocity on the banks and bridges … The banks crumbled away before this incessant rush, leaving the rails and sleepers suspended in the air … It offered more resistance where thoroughly covered silt vegetation." A major contributor to the damage was the inadequacy of the waterways, most clearly displayed in the Las Lorches Valley "the bridge at Pacheco, consisting of a centre iron girder of forty feet span, with two timber side spans of thirteen feet, each with massive piers and abutments, was destroyed … the two piers, being carried bodily away to a distance of sixty yards … In the Esoban Valley, the bridge was an iron bridge of sixty feet span with brick abutments. This bridge was swept bodily away together with one of the abutments … Incredibly "trains were regularly running on the 22nd May", 63,000 cubic metres of earthwork were used in the reconstruction. Bridges had been founded on hard superficial beds, which was undermined. At Pescado and elsewhere timber piles were used in a layer of hardened alluvium, rather than heavy brick foundations. (Clark)

Clark as a brief visitor was not unique. Manuscript accounts exist of the experiences of James Fforde, an Irish engineer and long-term agent of Waring Brothers, to investigate a potential line from Buenos Aires to Valparaiso. He went to the Argentine in March 1871. He witnessed the opening of the Central Argentine Railway at Cordova, but aside from survey work in the Uruguay river for the Argentinian engineer Madero, achieved nothing. Robert Jacomb-Hood, generally associated with the London, Brighton and South Coast Railway, went to Argentina the following year on behalf of a London consortium led by S Laing, and represented in Buenos Aires by J Lloyd. He helped prepare the tender which proved hopelessly high, for the Tucuman-Cordova railway concession.

One of Clark's pupils was Thomas Charles Clarke (1838–1893) who first went to South America to survey Guana deposits in Peru in 1871. He came to Argentina from Uruguay in 1879 and it was he who undertook the extension of the Buenos Aires and Campana Railway (FCBAC) from Campana to Rosario along the Panama River under the auspices of the London based Bueynos Aires and Rosario Railway (1884–). In all he was responsible for over 700 miles of construction for the company before he returned to London as a Director. The original consultant for the Campana line from 1867 was Edward Webb (1820–1879) who had assisted Bragge in Brazil. He spent much of his career in Brazil, but was responsible for work all over Latin America.

THE WATER SUPPLY AND DRAINAGE OF BUENOS AIRES

Railways were only one aspect of British involvement in Argentina. John Coghlan was responsible for Buenos Aires first waterworks around 1860. The fast growth of the city soon rendered the scheme inadequate, and John Bateman reported on the city water supply and drainage in 1870–1871 and some action was taken – although the pace of improvement in the city dismayed Edwin Clark when he visited on railway business in 1876–1877.

"The most striking features to a new visitor are the badly paved, narrow streets, which are generously only thirty feet wide, and none especially the narrow and irregular footpaths, so that in many places two persons can scarcely pass. The exhausting ups and downs as one walks along are very troublesome, each proprietor apparently regulating the level of his footpath, without any regard to that of his neighbour or of the street." (Clark)

Work had begun in 1873, but financial and political problems meant it had been suspended by 1877, not restarting until 1882. Tenders were advertised in 1872 and although Ogilvie, Wythes and Aird bid they lost out to the Argentine-based Newman, Medici and Company. Coghlan's scheme drew water from the River Plate above the city, and after passing through sand filters it was pumped to a service reservoir for distribution via water in mains, at the rate of 1.5m gpd. Bateman was asked to increase this, and improve the storm water drainage which was totally inadequate for the heavy storms, and also provide for the sewage disposal. A scheme was designed capable of 16m gpd. River Plate water was taken by an intake river and turned to the Recoleta works where it was filtered, stored and pumped by steam engines supplied by James Watt and Company, via 24in diameter cast iron mains to a service reservoir that was built on a monumental scale, 296ft square, of local brick clad in terracotta in French Renaissance style, 66ft to the top of the parapet. Within this were 3 tiers of tanks in 4 compartments, storing nearly 16m gallons of water. The internal wrought iron framework supported not only the tanks, but was also designed to withstand the wind pressure on the roofs. There were wrought iron framed domes in each corner and the centre. Terracotta work was supplied via Doultons by Burmantofts of Leeds, whilst the structural ironwork was imported from Belgium. The architecture was the work of one of Bateman's assistants, a Swedish engineer, Carl Nystromer, aided by Olaf Byre of Oslo.

Work on the water supply was carried out in tandem with the main drainage, with the city divided into 29 districts, generally drained independently, sewers draining to the lowest part where the sewage was admitted via regular chambers into the intercepting sewers. Most districts were designed for combined sewage and storm water. The larger sewers were of concrete, oval in shape, with earthenware blocks in the inverts. The main sewers which collected the sewage from the intercepting sewers was 14 ½ miles in length from a siphon under the Riactisselo river which then matched the southern boundary of the town, with outfall discharging continuously into the Plate. The low-lying Boca and Barreras district was tackled differently with extensive use of hydraulic power driving the sewage pumps. Shortage of suitable local material led to the import of all Portland cement from Britain.

A succession of resident engineers managed the project – Alfred Moore, George Higgin, Nystromer, L J Lowe; with Bateman and Richard Clere Parsons acting as UK consultants, and paying regular visits.

When work resumed in 1883 Buenos Aires had, as the result of a civil war, ceased to be the responsibility of the Provincial government, and became the capital of the Republic. Administration of the scheme thus passed from the provincial government to a Commission of the national government. The size of the scheme was reviewed as the target population of 200,000 of 1871 had now exceeded 400,000, and was still rising rapidly. In 1888 responsibility was transferred to a London-based company who struggled to match the revenue with the scale of works and, following the Baring Bank failure sold out to the Government. The final cost of the scheme was £5.5 million, and the population served was nearly 700,000 on completion. (Parsons).

BUENOS AIRES HARBOUR (Dobson)

British interest in the development of the port facilities of Buenos Aires extended through much of the nineteenth century, unsurprisingly given trading interests. The first British engineers to prepare a scheme were the Scottish engineers Bell and Miller who were involved in a number of works in South America in the third quarter of the nineteenth century. In 1862 the Buenos Aires engineer Eduardo Madero began to investigate the idea of docks for the port. In 1871 John F de la Trobe Bateman reported on a dock scheme as part of his proposals for the improvement of the city, and J J Revy carried out investigations on his behalf into the flow of the Plate and other rivers. Nothing came of any of these schemes because of the capital involved and the political situation until 1882 when Madero finally secured an Act for the construction of docks. On the advice of Baring Brothers he brought in Sir John Hawkshaw as Consulting Engineer. Hawkshaw and Madero's scheme aroused a certain amount of controversy. Perhaps because of nationalist jealousy an Argentine engineer gained a degree of local engineering support for his rival scheme which he argued would cost considerably less, using finger jetties rather than a long quay banked with a series of 4 docks. Despite this, Hawkshaw's scheme went ahead, with Thomas A Walker, on Hawkshaw's recommendation appointed general contractor and Armstrongs responsible for the hydraulic equipment.

What is striking about the project is the attitude of the principals, John Hawkshaw and Thomas Walker. The resident engineer, James Murray Dobson, son of Hawkshaw's resident engineer at Holyhead Harbour, his staff, and two of Walker's staff went to Argentina in August 1885. While this was normal, both Hawkshaw and Walker themselves not only followed, but also, in Hawshaw's case at least, spent three months. This is an indication of professional commitment, which in Hawkshaw's case must be compared to that of I K Brunel. Overseas work was not new for British civil engineers, Joseph Locke had moved to France initially to manage the railways between Paris and Le Havre in the 1840s, but generally the relationship, as in India, was one of Consulting Engineer in London, and Resident Engineer with more or less independence overseas. Hawkshaw soon recognised the significance both of Dobson's input and the work . The firm became Hawkshaw, Hayter and Dobson, almost certainly the first instance of a 'British' firm having a resident partner overseas. No doubt this was partly a reflection of the value of the works, c.£7 million, but perhaps also perhaps reflects the fact it was being conducted in an independent state rather than a colony(?) When completed in 1898 the docks were of a similar size and handling a similar amount of traffic as the Royal Docks in London. The work involved extensive dredging and land reclamation, with the excavation of 6.6 million cubic metres of material. Over 25 million bricks were used, and rubble masonry on a similar scale. In July 1889 13,361 cubic metres of rubble masonry were built, amounting to 26,700 tons of stone – believed to have been the most built in a similar period to that date. Most stone was quarried in Uruguay, but dressed granite was imported from Freemans in Cornwall Much was owed to Eduardo Madero, who died before the works were completed, and his two sons, and other Argentinian engineers. However, the successful completion of the work must be regarded as the result of the collaboration of engineer and contractor, despite the deaths of both Hawshaw and Walker.

CONCLUSIONS

It would be unfair on other nationalities, not least the Argentinians themselves, to portray the development of Argentina's infrastructure as the exclusive preserve of the British Isles. Just considering the gas supply of the Buenos Aires makes that clear. The original company – the Compañia Gas Buenos Aires (later the Compañia Primitivia de Alumbrado à Gas) was established in 1856 as an Anglo-Argentinian venture, later actively Argentinian with a French engineer, Leron. In 1869 the Compañia Gas Argentina was set-up at the suggestion of a 'French' organisation, and an oil gasworks built by George Bower, a British contractor. In 1872 the Buenos Aires (New) Gas Company (Sociedad Anonima Consumidores de Gaz) was set-up, thus time at the suggestion of Herr Jaeger, but in 1876 this became a London based company, with British engineers such as George Ernest Stevenson, MInstCE. In 1874 the Belgrano Gas Company was set-up, with Woods and then Thomas Quirk later, its Engineer, and in 1887 John Stori got another concession in the suburbs.

It was not all about civil engineering either. As well as gas engineers there were mining engineers like J G Adamson working near San Juan, who fled in fear of his life amidst fighting in 1867, and went on to help open up the nitrate industry in Chile. Barlers Burtonwasa responsible for more than 300 miles of telegraphs, H. Chamberlayn began by erecting machinery in 1864, while Edward Banfield, Manager of the Great Southern in the 1860s was a mechanical engineer who had worked for the GTR in Canada..

What is striking is how similar the pattern is to India, with many engineers spending much of their career there, but at the end, like Coghlan, retuning home and acting as consultants. It is also clear that while in the 1850s and 1850s many engineers only stayed a short time, the scale of investment from 1880 onwards meant a career could be built in Argentina, as Dobson demonstrated.

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