

The departmental system of railway construction in British West Africa, 1895–1906

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From the mid-1890s and the appointment of Joseph Chamberlain as Secretary of State for the Colonies the British government sought to promote the economic development of its Crown colonies.¹ Although most of them were rich in natural resources and agricultural potential, the lack of infrastructure, i.e. railways, harbours, wharves etc., required to transport goods inland and exports overseas discouraged businessmen from investing in their exploitation. If a colony was to develop economically, it needed a transport network which, by facilitating the movement of soldiers and administrators, would also help to maintain the political stability required by capitalists. Equally, it was important that the network promoted economic growth and that its cost was kept to a minimum. Most railways were built with borrowed funds that were to be repaid from the additional taxation reaped from the economic activity they generated, and, if they were owned by the government, operational surpluses.

The construction of Crown colony railways was organised by the Crown Agents, a quasi-government organisation, which additionally purchased all non-locally manufactured stores required by colonial governments, issued their London loans, and managed their UK investments.² Most Crown colony lines were built in West Africa, and, until approximately 1906, they were built by the departmental system of construction, rather than, as previously in these colonies, by government-employed contractors or private firms (Table 1).³ The term ‘departmental system’ was a misnomer. Theoretically the infrastructure was built by the constructing colony’s Public Works Department. In reality the involvement of such bodies varied according to their experience and expertise. In the developed colonies the Public Works Department completed most of the work, which was monitored by the Agents’ consulting engineers. In less developed colonies, and particularly in West Africa, where in 1895 few railways had been built and the country was unsurveyed, the consulting engineers were ‘practically the contractors’ of projects.⁴ After the Colonial Office had decided to investigate the possibilities of construction, the consulting engineers organised a reconnaissance survey, which determined possible routes, and, until approximately 1904, a location survey, which was far more detailed and set the exact direction of the line. Using the information collected, the

consulting engineers created designs and estimated the likely cost and economic viability of the project. Their report was passed to the Crown Agents, who added their own comments, and then to the Colonial Office, which decided whether the scheme should go ahead. If approval was given, the consulting engineers recruited a resident engineer and support staff, which travelled to the colony. There, directed by the consulting engineers in London, using indigenous labour, and until 1904 preceded by the location survey engineers, they carried out the work.⁵ On its completion the consulting engineers then supervised the operation of the line.

The lines constructed in West Africa under the departmental system were the subject of much Colonial Office, colonial, parliamentary and press complaint.⁶ Works were relatively expensive compared with either pre-construction estimates (Tables 2 and 3) and equivalent French and German lines (Tables 3 and 4).⁷ Furthermore, once completed, the railways were often uneconomic, with receipts failing to cover costs (Table 5). They were also of poor quality.⁸ Many had excessive gradients and curves, and defective drainage, culverts and ballasting. Working expenses were therefore high and large amounts of money had to be spent improving and, in some cases, relaying track. In the early 1920s, for example, Lagos and the Gold Coast spent respectively £1 million and £418,000 improving line alignment.⁹ On the other hand, railways and other works constructed by the more developed Crown colonies were often less expensive (Table 6) and of better quality. Nevertheless, in many cases they were still more costly than similar works constructed elsewhere (Table 6), and the standard of construction was again subject to criticism.¹⁰

Table 1 Crown Agent supervised railway construction (miles)

<i>Colony</i>	1871	1880	1895	1914
West Africa	0	0	0	1,632
Ceylon	74	136	158	375
West Indies ^a	25	62	203	115
Other ^b	66	167	417	351
Total	165	365	778	2,473

Notes *a* Jamaica. *b* Mauritius. 'Other' includes Mauritius, Hong Kong, Fiji, Cyprus, Nyasaland and Natal. Natal ceased to be a Crown colony in 1894. The Federated Malay States have been omitted, as the construction of their lines was not supervised by the Agents.

Source Parl. Papers 1882 lxxiii; Parl. Papers 1894, xcii (Cd 7526); Parl. Papers 1901, lxxxvi (Cd 751); Parl. Papers 1905, xcvi (Cd 2679); Parl. Papers 1918, xxv (Cd 9051).

Table 2 West African departmental system, average cost overruns per mile, 1898–1914 (%)

<i>Colony</i>	<i>Overrun</i>
Gold Coast	54
Southern Nigeria	47
Sierra Leone	11

Table 3 West African railway construction, 1898–1914

<i>Railway</i>	<i>Length (miles)</i>	<i>Gauge</i>	<i>Gradient/curves/ rail weight</i>	<i>Cost per mile (£)</i>	<i>Date completed</i>	<i>Miles construc- ted per month</i>	<i>Under/ over- estimate (%)</i>	<i>Method of con- struction</i>
<i>Southern Nigeria</i>								
Lagos–Ibadan	125	3 ft 6 in.	1 in 50 10 chains 55 lb yd	9,967	March 1901	2.049	+ 78	Dept
Ibadan–Oshogbo	62	3 ft 6 in.	1 in 60 in, 1 in 80 out 8 chains	6,905	April 1907	2.3	+ 9	Dept
Oshogbo–Illorin	61	3 ft 6 in.	1 in 80 15 chains	7,883	August 1908	3.05	+ 36	Dept
Illorin–Jebba	60	3 ft 6 in.	n.a.	8,587	1910	3	n.a.	Dept
Jebba–Minna	160	3 ft 6 in.	1 in 80 in, 1 in 100 out	8,693	1912	6.7	+ 65	Dept
Average cost per mile £8,407								
<i>Sierra Leone</i>								
Freetown–Songotown	32	2 ft 6 in.	1 in 60 5 chains 30 lb yd	6,061	December 1898	0.97	+ 45	Dept
Songotown–Rotifunk	23	2 ft 6 in.	1 in 50 30 lb yd	4,224	March 1900	2.55	– 17	Dept
Rotifunk–Bo	80	2 ft 6 in.	1 in 50 30 lb yd	3,988	October 1902	3.5	+ 23	Dept
Bo–Baiima	87	2 ft 6 in.	1 in 50	3,604	1905	n.a.	+ 0.4	Dept
Mountain railway	5½	2 ft 6 in.	1 in 22	5,604	1904	0.38	+ 4	Dept
Average cost per mile £4,696								
<i>Gold Coast</i>								
Sekondi–Tarkwa	40	3 ft 6 in.	1 in 40 5 chains 50 lb yd	9,162	May 1901	1.2	+ 53	Dept
Tarkwa–Kumassi	130	3 ft 6 in.	As above	10,669	September 1903	4.8	+ 89	Dept
Tarkwa–Broomassie	26½	3 ft 6 in.	n.a.	6,101	1910	1.104	+ 20	Dept
Accra–Akwapim	36	3 ft 6 in.	1 in 80 45 lb yd	9,856	1912	1.08	+ 47	Con- tractor
Average cost per mile £8,947								
<i>Northern Nigeria</i>								
Baro–Kano	355	3 ft 6 in.	1 in 60	3,915	March 1911	8.07	+ 8	PWD
Bauchi line	90	2 ft 6 in. (3 ft 6 in. formation)	n.a.	2,000	March 1912	6.43	0	PWD
Average cost per mile £2,957								
<i>Nyasaland</i>								
Shire River line	113	3 ft 6 in.	1 in 44 5.5 chains 41 lb yd	5,854	1908	n.a.	n.a.	Private

Notes and sources One chain = 66 ft. The cost-per-mile figures given in Parl. Papers 1905, lvi (Cd 2325) are inaccurate, and, where possible, therefore, have not been used. *Lagos–Ibadan*: CO 520/51/25175; CO 147/152/4983; CO 766/1; CO 520/51/18323; CO 446/47/12976; Shelford, *Some Features*, p. 5. Cost includes the Carter/Denton bridges. *Ibadan–Oshogbo*: CO 520/109/1087; CO 520/70/41397, Shelford to CO, 26 November 1908. *Oshogbo–Illorin*: CO 520/109/1087. *Illorin–Jebba*: CO 766/1, CO evidence. Estimate only available. *Jebba–Minna*: Hansard, 5th series, 1923, clxv.1464/5; CO 520/51/25175. *Freetown–Songotown*: Parl. Papers 1905, lvi (Cd 2325); CO 267/422/14724; CO 267/420/18005. *Songotown–Rotifunk*: Parl. Papers 1905, lvi (Cd 2325); CO 267/434/26730; CO 267/470/13753. *Rotifunk–Bo*: Parl. Papers 1905, lvi (Cd 2325); CO 267/464/52678; CO 267/470/13753. *Mountain railway*: CO 267/474/23391; Shelford, *Some Features*, p. 3. *Sekondi–Tarkwa*: CO 96/434/17000; Parl. Papers 1905, lvi (Cd 2325). *Tarkwa–Kumasi*: CO 96/412/39660; Parl. Papers 1905, lvi (Cd 2325). *Tarkwa–Broomassie*: CO 96/512/18603. *Accra–Akwapim*: CO 96/524/14210; CO 96/461/31830. *Baro–Kano*: CO 446/107/10210. *Bauchi line*: Hansard, 5th series, 1912, xlv. 2276; CO 766/1, CO evidence. *Shire River*: FO 2/693, Schneider to Henderson, 8 August 1902; CO 766/1, CO evidence. The company claimed that the line cost £7,500; *ibid*.

Table 4 French and German West African lines, mileage

<i>Railway</i>	<i>Miles</i>	<i>Gauge</i>	<i>Cost per mile (£)</i>
<i>French West Africa</i>			
Ivory Coast	281	Metre	6,417
Lome–Palime	63	Metre	6,190
Cotonou–Save	162	Metre	5,185
Konakry–Niger	93	Metre	5,120–5,696
St Louis–Dakar	164	Metre	5,120
Thies–Kayes	423	Metre	4,624
Kayes–Niger	350	Metre	4,224–4,800
Central Dahomey	204	Metre	4,117
Lome–Atakpame	104	Metre	3,456–5,309
Porto Novo–Pobe	47	Metre	3,357
Lome–Anecho	27	0.75 m	2,015
Average cost per mile £4,529–£4,803			
<i>German West Africa</i>			
Swakopmund–Windhoek	n.a.	1 ft 10½ in.	3,114
Otavi RR	n.a.	1 ft 10½ in.	2,010
Average cost per mile £2,562			

Notes and sources *Ivory Coast line*: L. Wiener, *Chemins de fer de l'Afrique* (Paris, 1930), p. 94. All figures 1913. 1913 exchange rate: one franc = 9.5d. *Lome–Palime*: Newbury, *The Western*, p. 144. *Cotonou–Save*: *ibid.* *Konakry–Niger*: CO 879/86/7650, No. 3. Wiener gives a 'pre-war' figure of £6,523 per mile: *Chemins de fer*, p. 83. *St Louis–Dakar*: CO 879/86/7650, No. 3. *Thies–Kayes*: Wiener, *Chemins de fer*, p. 85. *Kayes–Niger*: CO 879/86/7650, No. 3. Wiener gives a 1913 figure of £6,232 per mile: *Chemins de fer*, p. 92. *Central Dahomey line*: Wiener, *Chemins de fer*, p. 101. *Lome–Atakpame*: Newbury, quoting a 1921 French bulletin, gives a figure of £3,456 per mile: *The Western*, p. 144. Wiener quotes a figure of £5,309 per mile: *Chemins de fer*, p. 98. *Porto Novo–Pobe*: *ibid.*, pp. 103–4. *Lome–Anecho*: *ibid.*, p. 97. *Swakopmund–Windhoek*: *Railway Gazette*, 29 November 1907, p. 649. One dollar = 49.325d; *Otavi RR*: *ibid.*

Table 5 Profits and losses of West African and other Crown colony railways (£)

<i>Colony</i>	<i>Net profit/loss</i>	
	<i>1901</i>	<i>1911</i>
<i>West African lines</i>		
Gold Coast	– 16,179	97,751
Lagos	130,131	n.a.
Northern Nigeria	n.a.	– 80,008
Sierra Leone	– 11,753	– 12,823
<i>Other Crown colony lines</i>		
Ceylon	177,629	357,067
Cyprus	n.a.	– 6,313
Hong Kong	n.a.	– 40,790
Mauritius	25,688	27,230
Straits	15,503	n.a.
Trinidad	4,360	20,626
Jamaica	– 77,307	4,258

Notes Profit/loss net of working costs and capital interest charges. The figures are unsatisfactory, failing to indicate whether competitive transport rates were set. On a macro level, the railways will have reduced transport costs and promoted economic development. In the Gold Coast, for example, railway rates were equal to 11.3d per ton, as compared with the handcart's 22d per ton and head loading's 20d–60d per ton. (Gould, *The Development*, p. 25.)

Source *Stock Exchange Official Intelligence*, 1913, p. xc.

Table 6 Cost of other colonial lines, 1912/15

<i>Colony</i>	<i>Mileage</i>	<i>Cost per mile (£)</i>	<i>Gauge</i>	<i>Method of construction</i>
<i>Crown colony lines</i>				
Cyprus	61	2,023	2 ft 6 in.	Dept
British Honduras	25	5,291	n.a.	Dept
Barbados	28	6,968	2 ft 6 in.	Private
British Guiana	98	7,023	2 ft 6 in.	Private
Natal	399	8,916	3 ft 6 in.	Contractor
Ceylon	577.75	11,038	83% 5 ft 6 in., 17% 2 ft 6 in.	33% contractor, 67% dept
Straits/FMS	359	11,325	Metre	Local
Trinidad	81.5	11,436	Standard	56% contractor, 44% dept
Jamaica	184	13,804	Standard	79% private. 21% contractor
Mauritius	120	15,650	Standard	Dept
Hong Kong	21.5	25,581 ^a	Standard	Dept
<i>Non-Crown colony lines</i>				
Victoria (eighteen lines)	610	1,290–2,400	2 ft 6 in., 5 ft 3 in.	n.a.
Queensland (five lines)	227	1,327–2,495	3 ft 6 in.	n.a.
South Australia (seven lines)	238	1,544–2,590	3 ft 6 in., 5 ft 6 in.	n.a.
Egyptian delta line	303	1,708	2 ft 6 in.	n.a.
Rhodesia	1,937	5,008	3 ft 6 in.	Private
India	34,656	9,524	51% 5 ft 6 in., 42% metre, 7% 2 ft/2 ft 6 in.	n.a.

Notes ^a Includes cost of tunnelling. Natal's mileage figure only includes track constructed from 1894, when the colony became self-governing; the colony's cost per mile figure is for track built to 1907. In 1869 the average cost of Indian railways was £18,000 per mile, largely because the 5 per cent return the government guaranteed the private-sector companies that built the lines encouraged extravagance (Kerr, *The Railways*, p. 54; A. K. Banerji, *Finance in the early Raj: investments and the external sector*, London, 1995, p. 199; Report of the General Manager of Railways and Harbours for the Year).

Sources Parl. Papers 1913, lviii (287); Parl. Papers 1916, xxxii (Cd 8329); *Trinidad and Tobago Blue Book, 1914/15*; *Mauritius Annual Report, 1914* (Cd 8172); Parl. Papers 1907, lvi (103); CO 67/136/28061, report, 15 July 1903; *Report of the General Manager of Railways and Harbours for the Year ending 31 December 1913* (Cape Town), pp. 10–11.

Previous histories of West African railways have usually concentrated on individual lines and have tended to deal either with the political machinations that led to the decision to build them or with the operation of the completed lines.¹¹ Those few writers who have examined the construction process, often in passing, have blamed the high costs and poor quality of the lines on the African environment.¹² This article argues that all those involved in the construction process acted in their own interests, and that it was self-interest that led to the high cost and poor quality of the work. The first section identifies why the Crown Agents, the Colonial Office and the consulting engineers adopted the departmental system, and examines the traditional explanations for the inadequacies of the projects. The departmental system's tendency to increase the cost of schemes, and to lead to the building of unprofitable, poor-quality lines is then explained. The article concludes with

an analysis of the Crown Agents' attempts to thwart the adoption of other methods of construction.

Adoption of the departmental system

Despite the Crown Agents' claims to the contrary, no other country adopted the departmental method of construction, which, until the 1890s, they themselves generally disparaged.¹³ Along with the Colonial Office and their consulting engineers, however, the Crown Agents then underwent something of a conversion and began to endorse the system.¹⁴ Their support was variously ascribed to colonial reluctance to use contractors, the high cost of contractor-built lines, the harsh local conditions and the small scale of some of the projects, which, it was claimed, would discourage reputable firms from tendering for work.¹⁵ A far more important factor, though, was self-interest.

In the case of the Crown Agents, this took the form of a desire to escape their parlous financial position, to avoid criticism, and to assist and expand the business of their West African consulting engineer, with whom two of the Agents had a personal relationship. Owing to a reduction in its charges by the Colonial Office in 1893, the Agency failed to cover its costs (Figure 1). In order to avoid bankruptcy, it was important that the Agency dealt with all orders for building materials. The Agency received a 1 per cent commission for handling such requisitions, which, owing to their size and their uniformity and low attendant processing costs, were highly profitable. The departmental system guaranteed such purchases, while private firms and contractors generally supplied their own materials.¹⁶

Secondly, the departmental system gave the Crown Agents greater control over the building process, which appeared to reduce the likelihood of poor-quality lines and criticism from colonial governors that could lead to calls for the reorganisation or even abolition of the Agency. For two of the Crown Agents, Sir Montague Ommanney, the Senior Agent and from 1901 the Colonial Office Under Secretary of State, and Sir Maurice Cameron, the Agent in charge of engineering, it also provided personal gains. Ommanney was the father-in-law of Frederic Shelford, who from 1899 as his father's partner, and from 1905 on his own account, was the Agents' railway consulting engineer for West Africa.¹⁷ One of Sir Maurice Cameron's 'greatest friends' was Thomas Shelford, Frederic Shelford's uncle.¹⁸ Cameron, in 1890, when a Straits engineer, had shared a house with Thomas Shelford and his wife, and, from 1895 to his death in 1900, Shelford financed Cameron's £10,000 Colonial Office security bond.¹⁹

Self-interest, similarly, motivated the consulting engineer's and the Colonial Office's support of the system. For the former, departmental construction provided huge rewards. The engineers earned no remuneration for lines built by private firms that received no colonial support, and the fees and expenses obtained for the supervision of government-sponsored private builders and contractors were usually far lower than those for the organisation of departmental construction. As private lines were operated by the construction

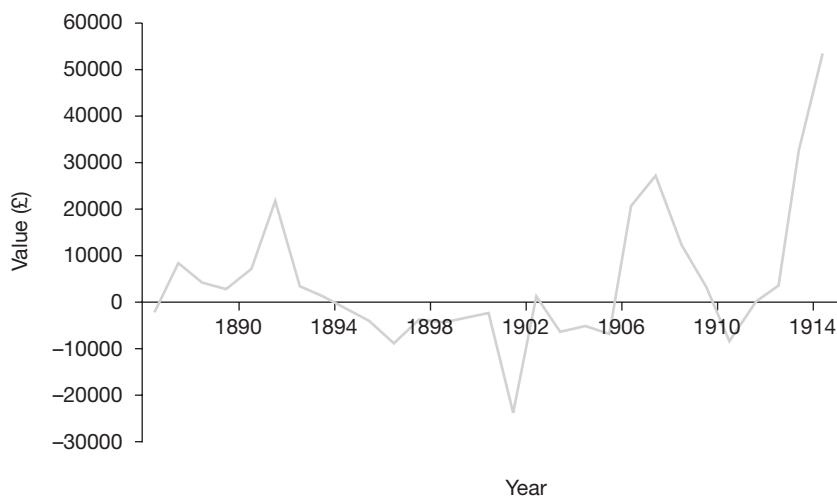


Figure 1 Office account surpluses and deficits, 1886–1914. Note Surplus/deficit = net receipts (total receipts less balance less transfers from Office Reserve Fund) less net expenditure (total expenditure less balance in hand less transfers to Office Reserve Fund). Source CO 323 series, Crown Agent accounts

company, the consulting engineers also lost their post-construction fees. In addition, control over construction ensured that their designs were built to the highest standards, and prevented the ‘loss of professional reputation and the chance of re-employment’ and social awards, such as knighthoods, that were of great importance to the late nineteenth-century engineering profession.²⁰

The Colonial Office, lacking technical and business expertise, generally followed the advice of the Crown Agents and consulting engineers as regards the method of construction and benefited from the adoption of a system which enabled it to avoid the delay in the commencement of works and interest group demands for an early start that inevitably arose when contractors were used. Department construction also ensured, through Crown Agent supply, the purchase of British construction materials, and reduced the likelihood of clashes between constructors and local communities, which could easily escalate into political problems.²¹ Lastly it dispersed responsibility for the final works, and avoided the legal proceedings that usually followed a contractor’s demand for compensation and extras, which drew attention to over-expenditure.

The West African environment

The Crown Agents and consulting engineers claimed that the underestimation and high costs of works were the result of the African landscape, climate and indigenous labour force. It was argued that much of the country traversed was mountainous and riven by rivers and streams, necessitating the construction of costly viaducts, bridges, earthworks and cuttings; the Freetown to

Songotown railway, for example, contained eleven viaducts in its first twenty miles alone.²² The heavy rainfall meant that slips and washouts were a common occurrence, and the unhealthy nature of the climate resulted in a high death/invalidity rate and constant changes in personnel, which had 'a disastrous effect on cost, progress and quality of work'.²³ From 1898 to 1904 each construction post on the Sierra Leone, Gold Coast and Lagos railways, for instance, was filled by respectively 5.45, 4.31 and 3.84 employees.²⁴ Similarly, the dense tropical forest that extended 150 miles from the coast increased clearing expenses, and, owing to the rapid regrowth, maintenance costs, and made surveying difficult, leading to poorly aligned routes.²⁵ There was also a shortage of ballast and labour, particularly skilled workers, forcing the import of men from neighbouring colonies and the employment of Europeans to train and supervise them.²⁶ To build the Gold Coast railway, for example, 13,000 labourers were brought into the colony, mostly from Lagos.²⁷ In addition, the lack of wharfage made the landing of materials difficult; the absence of roads and paths necessitated the use of just one base and precluded the transport of materials in advance of the railhead; and, in the case of the Sekondi–Kumasi and Freetown–Songotown lines, progress was slowed by native revolts.

The environment did increase costs, which fell over time as engineers learnt how to overcome many of the natural problems, labour became more skilled, landing facilities were established, and lines extended inland, where the country was more open and the climate healthier.²⁸ However, it seems unlikely that the environment was the only cause of the high expenditure and the poor quality of the track laid. British lines were more expensive than those built by the French in West Africa, which were constructed by similar methods and, in the case of French Guiana, in far harsher conditions.²⁹ The difficulties of West African construction had also long been known and should have been factored into the estimates; some of the drawbacks were offset by advantages, such as construction from the coast – 'just everything when building a railway' – and there is some evidence that Shelford 'bolstered up and magnified' some of the environmental problems faced.³⁰ In 1908, for example, he attributed a 20 per cent rise in the Tarkwa–Prestea line to a doubling of labour costs which the Gold Coast governor and transport managers all denied had occurred and Shelford himself later admitted to have been an exaggeration.³¹

Cost

The true reason for the high cost of departmental projects was self-interest. The Crown Agents, like their consulting engineers, cared little about high expenditure, which increased Agency/company income and, provided that capital repayments were covered by receipts, was unlikely to lead to colonial criticism. They were, however, highly averse to the construction of poor-quality lines, which could prompt damaging criticism. They encouraged the adoption of high standards of construction, adopted costly procedures to

tackle the principal agent problems that could impair quality, and recommended the use of construction location surveys.

In West Africa the official standard set by William Shelford allowed speeds of up to 15 m.p.h.³² Similar low standards were laid down in other Crown colonies and in French and German territories and the United States and Canada. The resultant narrow-gauge, steep-gradient, sharp-curve pioneer lines were sufficient for the low traffic levels of most undeveloped colonies, could easily be improved as traffic increased, and had low operating expenses. Moreover, they had relatively low capital costs. Narrow-gauge track reduced material and land expenses, and, because it used tight curves, avoided the necessity for cuttings and embankments, which was particularly important in difficult country.³³ On a pioneer line, stations, ballast, earthworks and rolling stock were reduced to the absolute minimum, stone bridges were replaced by steel trestles, and certain facilities, such as fencing and platforms, were dispensed with completely.³⁴ The low capital costs allowed longer lines to be built, which increased the traffic catchment area and revenue. If development subsequently led to the establishment of new trade routes, the lines could be cheaply and easily redirected or replaced.

The Crown Agents and their consulting engineers opposed these railways, which, rapidly constructed and requiring relatively few building materials, generated little purchasing commission and few fees, and increased the likelihood of poor line performance and colonial criticism. Apart from the first railways, the consulting engineers and Crown Agents generally recommended the construction of high-standard works and, from the early years of the twentieth century, advised that earlier sections should be improved.³⁵ The only exception to this policy was when it appeared that a colony would have difficulty covering the debt charges of a quality line. In such cases the Crown Agents occasionally asked the consulting engineers to reduce standards.³⁶ Usually, however, a compromise was achieved. Where a 3 ft 6 in. gauge line was not affordable it was suggested that the earthworks and bridges should be constructed for a 3 ft 6 in. line but that 2 ft 6 in. track should be laid, which would allow the railway to be upgraded easily in the future.³⁷ Temporary bridges were constructed prior to their subsequent replacement by stone structures, particularly on railways crossing relatively few rivers and streams, where the upkeep before replacement would not lead to serious inconvenience or expense.³⁸ In the case of the Baro–Kano line it was proposed that good second-hand permanent way materials should be purchased from the Beira railway.³⁹

The Crown Agents and consulting engineers justified these recommendations by arguing that the capital savings of low-standard lines were offset by high operating costs. Narrow-gauge railways were comparatively unsafe and subject to costly accidents, and the rolling stock was relatively expensive and prone to break down.⁴⁰ Steep gradients and sharp curves increased the dangers of derailment, collision and flood, required relatively more tractive force, increasing fuel consumption and wear and tear, and increased the length of track to be maintained.⁴¹ The light rails of pioneer lines, meanwhile,

were less durable than their heavier counterparts, the incomplete earthworks and poorly ballasted track required greater maintenance, and wooden sleepers had a relatively short life span. It was also stated that such lines had low traffic-carrying capacity. Narrow-gauge locomotives were relatively small, and steep gradients and sharp curves reduced train speeds. Given the consulting engineers' high traffic estimates for most West African lines, the railways would therefore have to be upgraded after only a short period, which, owing to the resultant disruption of traffic, would prove relatively expensive.

Not all experts supported the Crown Agents' and consulting engineers' thesis. It was claimed that it took many years before the slightly higher operating costs of low-standard railways offset their lower capital cost, and that, provided specially designed light rolling stock with a uniform axle load was used, a 2 ft 6 in. line had the same carrying capacity as a standard-gauge railway.⁴² More important, as both the Crown Agents and their engineers were aware, the consulting engineers' traffic estimates were deliberately exaggerated in order to encourage the construction of lines. Even if low-standard railways did have relatively low traffic-carrying capacities, it was highly unlikely that the lines would have to be upgraded.

According to principal-agent theory, all principals face two problems: adverse selection and moral hazard. Adverse selection arises from the capacity of agents to hide information about their ability from principals prior to signing a contract. Moral hazard is the temptation for agents to pursue interests of their own that are incompatible with those of their principals after a contract has been agreed.⁴³ To avoid adverse selection, the Crown Agents recruited sub-agents whose ability could easily be discovered, and to counter moral hazard they paid them salaries, which discouraged the rapid completion of work, and a premium above the market rate, thus raising the cost of dismissal for opportunism or slacking. Though they helped to ensure quality construction, these strategies greatly increased the cost of the works.

When recruiting new consulting engineers the Crown Agents tended to select men at the top of their profession, for whom the financial cost of poor performance of their duties would be high, leading to the loss of their commercially valuable high status, and who had generally been involved in works of similar scale to those in the Crown colonies. Such men, however, were expensive and were often over-qualified for the projects for which they were employed, and, as a result, they sometimes expended little effort on the work.⁴⁴ For the post of West African consulting engineer the Crown Agents recruited Sir William Shelford, whose family connections with the Agents and Colonial Office meant that poor-quality work would involve a social cost, such as the loss of familial respect, and further reduced the problems of adverse selection.⁴⁵ Unfortunately this advantage was partly offset by Shelford's lack of African building experience.⁴⁶ He was also in poor health, and much of the work was completed by his son, Frederic, who, when he became a partner in the firm in 1899, was just twenty-eight and had been an associate member of the Institution of Civil Engineers for just two years.⁴⁷ Frederic Shelford's engineering skills were rated poorly by the Colonial

Office. The Clerk, A. Fiddian, commented in 1905 that ‘no one has much confidence in ... [him]’.⁴⁸ Nevertheless, on his father’s death in June 1905 he was retained as West African railway consulting engineer, largely on the insistence of Ommanney and given a ‘partnership’ with the Crown Agent engineer Sir Benjamin Baker and, on Baker’s death, Robert Elliott Cooper.⁴⁹ These, however, appear to have been marriages of convenience, entered into merely to satisfy the Colonial Office, with neither ‘partner’ having much involvement in construction.⁵⁰

In the case of resident engineers recruitment was undertaken by consulting engineers and the candidates selected were approved by the Crown Agents. Demands by colonial governors for directors of local Public Works Departments to be employed were generally resisted on grounds of quality. Most lacked the necessary experience or qualifications for such a role, were too pre-occupied with their normal duties to concentrate fully on construction, and would place too much weight on the views of the colonial government, on whom their future livelihood depended.⁵¹ The Crown Agents’ rejection of these demands raised costs. Unlike Public Works Department directors, the resident engineers who were appointed had little knowledge of local conditions, no sense of shared endeavour with the colony and, because they were employed on short contracts, had to be paid relatively high salaries.⁵² Unused to local conditions, they were also more prone to illness and were often resented by colonial officers, who withheld help and information.⁵³

Indigenous workers were recruited by the colonial administration. Colonial officers, through their good relations with chiefs, ensured a more than adequate supply of quality labour and prevented friction between local residents and constructors. But their use raised expenditure. Wishing to maintain friendly relations with local tribes, they ensured that labourers obtained more than fair terms and that agreements were continued even when conditions had been broken (Table 7). In Northern Nigeria they also demanded that workers should be paid by the day, which added to administrative expenses, and, to prevent the disruption of agriculture, stipulated that natives could be employed for only two months, which increased training costs and reduced labour effectiveness.⁵⁴

The Crown Agents paid their consulting engineers a set fee plus expenses for their pre-construction work and, for their supervision of construction, a fee plus expenses in developed countries, in West Africa a salary and expenses and,

Table 7 West African unskilled labour rates, 1904

<i>Colony</i>	<i>Rate per day</i>
Gold Coast	1s 3d
Lagos	1s 0d
Sierra Leone	10d
Dahomey	6½d
Kayes Niger	5½d

Notes 1904 exchange rate: one franc = 8½d. The French rates are ‘unofficial’.
Source Parl. Papers 1905, lvi (Cd 2325), p. 22.

from 1905, a fee based on estimates.⁵⁵ The payment of expenses as well as a set fee discouraged the engineers from minimising quality in order to maximise their income, and the adoption of salaries removed the temptation introduced by fees to speed construction at the expense of quality. Both the method and the size of the remuneration were the subject of criticism. Fees were usually determined after a project had been completed, owing to the difficulty of estimating the work involved before building commenced.⁵⁶ Consequently, once Colonial Office authorisation had been given, consulting engineers had an incentive to add to works.⁵⁷ The Crown Agents, in an attempt to prevent such abuse, in 1905 reminded all their consultants that estimates should include all costs and should not be altered without Colonial Office authority, and that any excess should immediately be brought to the notice of the Agency.⁵⁸

In West Africa, unconstrained by contractual time limits and penalty clauses or the opportunity cost of slow construction, Shelford appears to have exploited the payment of salaries, and deliberately slowed progress in order to maximise remuneration. The Colonial Office noted that he had 'a strong tendency', whenever asked for an opinion on a comparatively minor point, to say that he 'must consider it as one part of a very big question, and that, in the meantime, nothing should be done'.⁵⁹ His construction methods, similarly, slowed progress. Little plant was used, as machinery supposedly was expensive when compared with the cost of labour and its efficient use was impeded by the thickness of the forest and by the unsophisticated nature of the West African labourer.⁶⁰ Consequently rock was bored by hand rather than by mechanical drill; trees were felled by axes and ropes instead of by felling machinery; tree stumps that could have been blasted were 'grubbed' up, and earth was dug by picks and hoes rather than spades or steam shovels, and moved away from cuttings by basket, as opposed to wagons running on rails.⁶¹ Shelford also failed to use the spoil removed from cuttings to build up embankments, 'the invariable rule', preferring to dump cutting material and obtain embankment earth from specially dug pits.⁶² He rarely built temporary diversions around heavy earthworks and viaducts to prevent their construction slowing down track laying.⁶³ Clean broken stone ballast, time-consuming to produce, rather than sand and gravel, was insisted upon, and embankments were raised to their full height immediately and not in stages, which would have reduced the loss and the need to replace ballasting material.⁶⁴

Although the Crown Agents were confident that the idea that slow construction increased his remuneration 'had never crossed ... [Shelford's] ... mind', in 1905 his salary was replaced by a fee set according to a percentage payment scale based on the estimated cost of work and paid in annual instalments, with a small proportion held over until after completion.⁶⁵ The new fee eliminated the benefits of slow construction and increased estimates and thus reduced cost overruns and criticism, and prevented Shelford maximising his income, since the Colonial Office refused to authorise excessive estimates. It also eliminated the relatively high cost of salary negotiation and increased the Crown Agents' control of the building process, as the post-construction payment could theoretically be held back if the line was not up to standard.

As regards the scale of remuneration, the Crown Agents appear to have paid their consulting engineers higher fees and salaries than either private clients or other government departments (Table 8).⁶⁶ On at least one occasion Sir Maurice Cameron seems to have awarded Shelford a higher salary rate than that of the Senior Agent, Sir Ernest Blake.⁶⁷ The consulting engineers also gained from the absence of costly site visits, the size and regularity of Crown colony income, and the commercial value of their position, which attracted private business. Likewise, West African construction staff wages were generally three times those paid in the United Kingdom and, in 1897 in Lagos, slightly higher than those of South American railway engineers.⁶⁸ They additionally obtained various perks. Workers were given four months' paid leave per year and invalidity and widow allowances, and the consulting engineers, unbeknown to the Crown Agents, manipulated leave regulations to ensure that on completion of projects staff were dismissed only after they had taken their holiday entitlement.⁶⁹

Table 8 Crown Agent and Foreign Office railway consulting engineer construction fees, 1897–1906

<i>Consulting engineer</i>	<i>Cost of works supervised (£ million)</i>	<i>% of salary to cost</i>	<i>% of expenses to cost</i>	<i>% of total remuneration to cost</i>
Shelford & Son (Crown Agents, West Africa)	4.0	0.6	0.9	1.54
Gregory Eyles & Waring (Crown Agents, Far Eastern colonies)	5.8	0.2	0.28	0.49
Rendal & Robertson (Foreign Office, Uganda railway)	4.9	0.074	0.075	0.149

Sources Parl. Papers 1907, lvi (103); CO 323/527/8695.

In the case of the consulting engineers, the relatively large remuneration was partly due to the Crown Agents' difficulty in accurately forecasting project work loads; their reluctance to 'haggle', which they found unpleasant; the need to recompense consulting engineers for the relatively large amount of correspondence generated by the department system; and the reluctance of consulting engineers to take responsibility for designs created by others, which prevented the replacement of consulting engineers who demanded excessive salaries.⁷⁰ Similarly, high construction staff wages were partly designed to compensate engineers for the poor African working conditions. A large proportion of both premiums, however, appear to have been paid to increase the cost of dismissal for poor-quality construction.

Finally, by allowing location surveys to be carried out during construction rather than before building commenced, as was the practice when contractors were used, the departmental system led to hurried surveys, particularly if construction was 'treading on ... [the surveyor's] ... heels'.⁷¹ The findings

were consequently incomplete and insufficiently considered, with the result that alignment and gradients were poor and expenditure was high.⁷² It was later claimed that pre-construction surveys were ruled out by the administrative urgency with which the railways were built. Yet there were usually months and often years before building commenced when surveys could have been undertaken. A more likely explanation for their use is that the Crown Agents and consulting engineers wished to begin earning income from construction as soon as possible, and suspected that a realistic estimate based on a separate location survey would reduce the likelihood of Colonial Office authorisation of a railway. Moreover, when it was not certain that the departmental system would be adopted, they perhaps feared that a survey would allow the work to be put out to contract. Separate surveys were also against the Colonial Office's interests. Surveys took up to two years to complete, and, in the meantime, officials would be subject to intense pressure from outside interest groups for whom the delay meant lost profits.⁷³

Unprofitability

A further strategy adopted by the Crown Agents and consulting engineers to maximise their incomes was the encouragement of the Colonial Office to authorise lines, which led to the construction of uneconomic railways. Colonial Office approval was encouraged in three ways. Firstly, in West Africa, the consulting engineers constantly recommended that the Colonial Office should sanction reconnaissance surveys and, to encourage acceptance, appear to have understated their cost.⁷⁴ Such surveys promoted discussion, and, if they were published, led to pressure from outside bodies for construction, which helped to commit the Secretary of State to a project.⁷⁵ Likewise, on the completion of a location survey, the consulting engineers usually advised the Colonial Office that, to save expenditure and avoid subsequent delays, the surveyors should be allowed to stay in the colony and undertake the location survey of a possible extension of the line, the cost of which, as acknowledged by the Assistant Under Secretary, C. P. Lucas, again partly committed the Colonial Office to construction.⁷⁶

Secondly, until 1905 and the replacement of their salaries with fixed fees, the consulting engineers underestimated or, according to the Crown Agents, took 'an optimistic view' of the cost of lines, which encouraged construction and, by reducing the likely debt charges, enhanced the expected profitability of projects. This underestimation was achieved through the minimisation by the consulting engineers of the difficulties of construction⁷⁷ and the omission of items of expenditure. For instance, the estimate for the Accra harbour works failed to include accommodation expenses, and that for the Accra-Kpong line, expenditure on a harbour for the unloading of construction materials.⁷⁸ What is more, estimates often contained inadequate margins for contingencies; used approximated quantities, particularly for bridges and rolling stock; underestimated land prices, where these were determined by the consulting engineers; took no account of the rise in labour costs that

would result from the project's own demand for workers, and assumed an excessively low exchange rate.⁷⁹

The Crown Agents and consulting engineers, thirdly, overestimated the likely returns from railway lines, which encouraged Colonial Office authorisation and strengthened the Crown Agents' case for the construction of excessively high-standard railways. Although it took account of administrative and political factors, and the views of the constructing colonies and outside pressure groups, the Colonial Office, in deciding whether construction should go ahead, depended heavily on consulting engineer and Crown Agent advice. In 1907, when it was suggested in Parliament that the consulting engineers 'advise in order to get work', the Colonial Office Clerk, J. F. N. Green, accepted that the engineers 'in a very limited sense' influenced decisions to construct.⁸⁰ Sir Montague Ommanney went further and admitted that 'consideration is, in the great majority of cases, whether the line will pay, about which the consulting engineers have more to say than anybody else'.⁸¹ Generally the Colonial Office accepted the Crown Agents' and consulting engineers' optimistic conclusions. Belonging to a culture that regarded State economic planning as unnecessary and even pernicious, they had few guidelines for judging the likely success of schemes. The idea of using transport for development purposes was also relatively new, and the perceived success of the policy in the United States and Canada had created the impression that the construction of railways automatically led to growth.⁸² Yet even when they were less than convinced by the consulting engineers' figures, wishing lines to be constructed, they were still highly receptive to recommendations that reinforced their preference. In the case of the Sierra Leone Freetown–Songotown line, for example, Joseph Chamberlain admitted that he was 'distrustful' of the traffic estimates produced by the consulting engineers, as they had 'no solid basis to go upon', but, nevertheless, was prepared to sanction the line.⁸³

The recommendations put forward by the Crown Agents and consulting engineers were usually excessively optimistic. The majority of the consulting engineers' reports predicted that proposed lines would immediately cover both working and debt charges. Where this was not the case it was usually forecast that increases in traffic would ensure that the loss was only temporary, and that, in the meantime, any shortfall would be offset by increased tax revenue on the trade fostered by the line, and that, in colonies without railways, valuable experience of construction in the region would be gained.⁸⁴ Occasionally, when it appeared that a railway they had disparaged would be built, the consulting engineers were prone to improve their forecasts of profitability.⁸⁵ When a completed line failed to pay they continued to insist in their reports that their forecasts would be fulfilled, or used the failure to encourage further construction, warning that, unless another extension was built, the line would remain unremunerative.⁸⁶ Shelford, for instance, claimed that the Lagos–Otta line, which was not expected to cover debt charges, would be successful if an extension was built to Ibadan.⁸⁷ On completion of the Otta–Ibadan section, which covered neither its own nor the original

section's costs, he advised that the two sections would be remunerative only if a further extension was built.⁸⁸ The Crown Agents usually accepted the consulting engineers' conclusions, generally raising doubts only when they believed them to be overly pessimistic.⁸⁹

The consulting engineers arrived at their conclusions after determining the loan interest/sinking fund charges and working expenses of the proposed scheme, and comparing the result with the likely immediate and future revenue. Debt charges were based on the estimated cost of the line, and working expenses on the operating costs of similar railways.⁹⁰ Revenue comprised import, export, passenger and government receipts. Although the methods adopted varied according to the information available, export estimates were generally calculated using the export figures of the nearest port, surveyors' road traffic counts or the results of multiplying the average yield per square mile of the main crops grown by the number of square miles likely to be served by the railway, from which home consumption, the average population per square mile multiplied by the assumed annual *per capita* consumption, was subtracted.⁹¹ Total exports were then multiplied by the freight rate that the consulting engineers believed the exports could bear, which was generally below that charged by competing forms of transport. Import estimates were based on import figures or the import traffic of a similar railway, which were again multiplied by a given freight rate, which was generally higher than that for exports, as imports had greater value. Passenger revenue was calculated using population figures, surveyors' road traffic counts and the passenger rates of similar lines. To calculate future receipts, the likely crop per acre of the product likely to be grown was multiplied by the acreage of the estimated cultivation area and a set freight rate, and added to an estimate of the natural increase in traffic, generally the recent traffic growth of a similar line.⁹²

The consulting engineers' estimates of profitability tended to be wide of the mark. Debt charges were based on underestimated construction costs, and working expense estimates used figures from dissimilar lines and, in the case of extensions, often assumed that in the first instance the line would be worked at a reduced cost by existing staff.⁹³ As regards receipts, the Crown Agents believed the statistics used to be 'vague and problematical', and even the consulting engineers recognised that they were 'necessarily indefinite'.⁹⁴ All calculations were based on a single assumed freight rate, which took no account of the different goods to be carried. Surveyors' traffic counts were limited, extending at most over only one week and taking no account of seasonal variations in movement.⁹⁵ The information obtained from African chiefs and merchants, who regarded the surveyors as European interlopers and railways as a military or commercial threat, was often inaccurate or false.⁹⁶ Many figures, meanwhile, were obtained from dubious sources; a forecast £30,000 saving in administrative and military costs from the construction of the Baro-Kano line, for instance, was based on a letter from the Northern Nigerian governor in which he stated that such a saving 'may be conjectured'.⁹⁷ In addition the consulting engineers assumed that all existing and future traffic would be transported by rail, and dismissed factors such as

the possibility of competitive price reductions by road, river and head load carriers, the low value attached to time in African culture, and a preference for existing forms of transport.⁹⁸ In the case of future returns, projections were based on little evidence, and took no account of the possible unwillingness of indigenous farmers to grow new crops, the lack of roads that were necessary for motor transport, or the problems of perishability.

Poor construction

The poor quality of West African lines was largely the result of Shelford's engineering inexperience and the low priority he attached to this aspect of construction, and inadequate Crown Agent, Colonial Office and colonial government monitoring of works, which also contributed to the high costs. Shelford continued to be employed by the Crown Agents partly because it was a number of years before they became aware of his sheer incompetence and disregard for quality. Agency monitoring procedures were poor, and Shelford's use of the African environment as an excuse for his lack of ability must initially have appeared convincing. In the meantime the marginal utility the Crown Agents gained from his employment, i.e. the goodwill of Sir Montague Ommanney, who, as Under Secretary of State, was their direct supervisor, was greater and more certain than the perceived loss of marginal utility from the slightly less well-constructed lines.

Shelford was unconcerned about quality because the marginal utility he obtained from failing to produce the best possible lines was greater and more certain than the marginal utility lost.⁹⁹ By caring little about quality Shelford gained financially. The resultant large number of requests from operating railways for advice increased his line supervision work load and income; greater care and the monitoring of construction staff would have reduced the profit he made from his expenses. When the construction of a new line was authorised by the Colonial Office, by rapidly completing his current work and making himself available he ensured that the project was not given to a rival firm.¹⁰⁰ Also, consulting engineers were never held financially responsible for defective construction.¹⁰¹ In theory such gains should have been offset by the fear of harm to his reputation and the loss of future colonial and commercial work. This may not have arisen because of the distance of the works from Britain or inter-temporal inconsistency – the tendency for individuals when faced with a small gain available in the short term and a superior reward obtainable in the distant future to choose the inferior option, the achievement of which is relatively certain. A more likely explanation is that, after the death of William Shelford, the deterrents became far less important. Frederic Shelford worked exclusively for the Crown Agents and probably intended to remain in the engineering profession for only a limited period. In 1910 he successfully applied for an East African cocoa fibre concession. Five years later, at the age of forty-four, he retrained as a barrister and, from 1917, practised at the parliamentary bar. He then bought and managed a Nyasaland tea plantation.¹⁰² His failure to build the best possible lines was

also unlikely to lead to the loss of colonial work. The Crown Agents rarely sacked consulting engineers who were found to have acted irresponsibly, as dismissal made other firms of high standing reluctant to undertake projects. Given his relationship with Ommanney, it seems unlikely that the Crown Agents would have even contemplated such action against Shelford.¹⁰³ Moreover, poor construction could easily be ascribed to environmental or other factors. When questioned about the state of the Lagos–Ibadan and Sekondi–Tarkwa lines, for example, Shelford claimed that it was common practice for principals to take over works before ‘the finishing touches have been added’, and argued that railway departments were using him as a scapegoat to escape blame for poor maintenance, inadequate inspection and their failure to test rolling stock.¹⁰⁴

The Crown Agents’ supervision of construction was inadequate probably because they were confident that careful recruitment and the payment of salaries and premiums would prove sufficient to prevent quality-impairing moral hazard. Monitoring was also expensive and had to be met out of their purchase commission income. They thus employed no engineers to monitor the consulting engineers’ work, depending instead on their own observations. Unfortunately these were poor. Sir Maurice Cameron had no experience of railway construction.¹⁰⁵ Sir Ernest Blake, who managed the West African railway projects, as ‘they were more a question of policy than of engineering’, had no engineering expertise whatsoever and did ‘not pretend to deal with engineering matters’.¹⁰⁶

Colonial Office and colonial government monitoring was equally deficient. The Colonial Office implicitly trusted the advice and information provided by the Crown Agents and consulting engineers, accepting that ‘when an expert is called in, one is very much in his hands’.¹⁰⁷ The Colonial Office, in any case, lacked both the technical expertise and the experience, time and inclination to judge the accuracy of the information provided, which, to minimise criticism, was perhaps deliberately presented by the consulting engineers in a highly technical and lengthy form. Colonial and other criticisms of construction were also usually dealt with by Sir Montague Ommanney, who was unwilling to criticise either his former employers or his son-in-law and generally supported the consulting engineers.

In the colonies the long periods of leave and high invalidity and mortality levels led to constant changes of resident engineer, which made the supervision of construction staff difficult. Furthermore the Crown Agents insisted that the resident engineer should be under the direct control of the consulting engineer as regards technical matters, and governors were asked not to intervene in the construction process.¹⁰⁸ The policy was theoretically designed to ensure that lines were built according to the agreed standards, that consulting engineers could be held directly responsible for the works, and to avoid delay, but in reality it was probably a crude attempt by the Crown Agents to prevent colonial criticism of the construction process.¹⁰⁹ Inevitably the ruling resulted in much resentment on the part of colonial governments, which felt that they had no control over the construction of their

own infrastructure, and led to a number of bitter clashes between governors and resident engineers.¹¹⁰ The Crown Agents at first refused to reconsider the policy.¹¹¹ Pressure from the Colonial Office, however, caused them to relax the rules slightly. In 1902, in Lagos, consulting engineer and resident engineer correspondence additionally went through the office of the railway manager, who, on behalf of the governor, could inspect the site at any time.¹¹² In 1906 resident engineers were also placed under an obligation to ‘furnish direct to the colonial government any information required’, to follow the governor’s wishes in all matters ‘affecting the use of works when completed’, provided they were consistent with sound engineering, and to refer to the colony questions that would effect colonial relations with the indigenous population.¹¹³ Governors, though, were still discouraged from intervening in the construction process unless the matter was urgent.¹¹⁴

The slow death of the departmental system began soon after the completion of the first West African lines, when it became clear that it was unlikely that debt charges would be covered by revenue, owing to the high cost of construction and the inaccuracy of the consulting engineers’ traffic receipt forecasts.¹¹⁵ Facing high taxes and traffic rates, and concerned about the quality of the lines and rumours of corruption, colonial merchants and governors bombarded the Colonial Office with complaints. The consulting engineers blamed the lines’ problems on the African environment, ordered their staff not to speak to the press, dismissed newspaper criticism as ‘inspired by contractors’, deliberately misrepresented the size of the original estimates and tried, but failed, to persuade the Colonial Office to allow receipts from the working of partly completed lines to be used to reduce capital costs.¹¹⁶ Taking a more positive approach, the Agency attempted to reduce the likelihood of high costs and slow construction. For example, the consulting engineers were reminded that estimates should include all expenditure, location surveys began to be undertaken before costs were estimated, Shelford’s salary was replaced by a fee, and greater government intervention was permitted in the construction process. These efforts, however, proved to be in vain. The Colonial Office, troubled by parliamentary suggestions that ‘successive Secretaries of State have connived at ... [the consulting engineers’] ... abuses’, insisted that the 1906 Accra–Akwapim line in the Gold Coast should be built by contractors, the Blantyre to Port Herald extension in Nyasaland privately, and the Baro–Kano line in Northern Nigeria by the colony.¹¹⁷

In the case of the Gold Coast railway the Crown Agents and consulting engineers appear to have deliberately sabotaged the proposed reform. The contract was inadequately advertised, with the result that only five applications were received.¹¹⁸ The three highest, all from reputable firms with tropical experience, were rejected as too expensive, and the lowest was discounted as unrealistic.¹¹⁹ The contest was won by a Mr Murphy, whose tender was 19 per cent below the consulting engineers’ estimate of construction. An Irish tramway promoter, Murphy had no experience of overseas railway building and no large-scale UK experience.¹²⁰ Furthermore, his layout had been designed by the resident engineer of the Lagos extension, who left

the project when Murphy, having obtained the contract, reneged on an agreement to make him a partner.¹²¹ Not surprisingly, the line was expensive, poorly built, lacked sufficient bridges, ballast and earthworks, and was completed behind schedule.¹²²

To persuade the Colonial Office to abandon its plans to allow the Nyasaland extension to be constructed privately, the Crown Agents embarked on a long campaign of attrition. The Colonial Office, well aware of the Crown Agents' 'plain hostility' and 'distinct prejudices' towards the company, was bombarded with a series of insubstantial allegations and objections.¹²³ In particular the Crown Agents insisted that a clause in the new contract should specifically require the resident engineer's approval of the formation level.¹²⁴ Sir J. D. Rees, the chairman of the holding company of the proposed builder, believed the clause unnecessary 'and an attempt to thwart us'.¹²⁵ The Colonial Office agreed, with the Assistant Under Secretary, H. W. Just, regarding the Crown Agents' conduct as in 'thorough disrepute'.¹²⁶ The Secretary of State, the Earl of Elgin, consequently wrote a conciliatory letter to Rees and, with his patience 'nearly exhausted', informed the Agency that he 'must *insist* on there being no more difficulties manufactured'.¹²⁷ The Agents' response was to ask the constructing company whether it accepted Rees's agreement that the clause covered the formation level – behaviour that the Colonial Office clerk C. Harris found 'incredulous' and 'improper'.¹²⁸ To Sir Bradford Leslie, the firm's consulting engineer, however, the Agents' motives were clear – they disliked private construction and held an 'ambition that no independent people should be allowed to construct railways in a Crown colony'.¹²⁹

Similar methods were used to halt the construction of the initially small-gauge Baro–Kano line by the Northern Nigerian Public Works Department. The Crown Agents disparaged the railway and Ommanney dismissed it as 'a sheer waste of money'.¹³⁰ The consulting engineers, at first, proposed a standard 3 ft 6 in. line, which they estimated at £5,679 per mile, but then submitted a counter-proposal for a 20 in. railway, which they claimed could be built more cheaply than the Public Works Department's 2 ft 6 in. line.¹³¹ The efforts of the Crown Agents and their consulting engineers, however, were to no avail. On the appointment of Sir P. Girouard as Nigerian High Commissioner the gauge of the proposed line was upgraded to 3 ft 6 in., the colony's estimate of construction increased to £3,000 per mile and the experiment allowed to go ahead. In the event the line was built for £3,915 per mile in a relatively short time, as compared with other West African railways, and to a standard that was praised by the Colonial Office-appointed inspection engineer.¹³² The success of the experiment led the Colonial Office to require all future Crown colony railways to be built locally, and, at least in West Africa, to a far lower standard.¹³³

Conclusion

The Crown Agents were motivated in their choice of the departmental system by institutional and personal self-interest. The system not only held out the

promise of quality construction but increased their own work load and that of their West African consulting engineer, who was a friend and relative. Once construction began, the Agency and engineer further exploited their position. Costs were underestimated and the returns from traffic overestimated, in order to encourage Colonial Office authorisation of the works, and high standards of construction were insisted upon. Shelford, meanwhile, was paid an over-generous fee, and the method of payment and the absence of effective monitoring of his work led him to slow the speed of construction. The result was that the final cost of the lines far exceeded the initial estimates and the receipts were less than forecast. Moreover, the inexperience of Shelford, his lack of commitment to the engineering profession and the fact that he benefited from poor construction meant that many railways were badly built, which increased their running costs.

The excess costs and associated fears of higher taxes, steep railway tariffs and the frequent disruption of services led to discontent among local business communities, which was communicated to governors, themselves resentful of the departmental system's diminution of their power. Governors, in turn, complained to the Colonial Office. Since its efficient operation depended on good relations with the colonies, and severely unbalanced accounts held out the prospect of Treasury aid and the risk of Treasury intervention in the policy-making process, the Colonial Office instructed the Crown Agents, successively, to adopt contractor, private-sector and colonial construction. While sabotaging the first two, the Crown Agents could do little to impede the success of local construction, which was adopted for all subsequent West African railways.

Notes

- 1 Unlike responsible government colonies, Crown colonies possessed no representative institutions and were under the direct control of the Colonial Office.
- 2 The activities of the Agents are discussed in D. Sunderland, 'Principals and Agents: the Crown Agents, 1880-1914', Oxford University D.Phil., 1997; A. W. Abbott, *A Short History of the Crown Agents and their Office* (for private circulation, London, 1959); R. M. Kesner, *Economic Control and Colonial Development* (Oxford, 1971) and R. M. Kesner, 'Builders of empire: the role of the Crown Agents in imperial development', *Journal of Imperial and Commonwealth History* V (1977).
- 3 In responsible government colonies lines were constructed by the private sector, contractors or the local government. Indian railways were built by private companies until 1869, when the government took over construction. From the mid-1880s the private sector was again used, though State construction continued. (J. Kerr, *The Railways of the Raj, 1850-1900*, Oxford, 1995.)
- 4 Public Record Office, Kew, CO 147/172/42513, Colonial Office to Egerton, 6 January 1905.
- 5 E.g. CO 520/109/1087, report, 30 December 1910; CO 267/434/15737, consulting engineers to Crown Agents, 14 July 1897.
- 6 E.g. CO 96/412/39602, *Times*, 17 October 1903; E. A. Morel, *Affairs of Africa* (1902), pp. 30-3; Hansard, 4th series, 1906, lvxvii. 658/9; *ibid.*, 5th series, 1910, xviii. 1494.
- 7 Sir Robert Herbert defined 'Crown Agent railways' as 'the most expensive that can be made'. (CO 446/8/30397, Herbert, 20 November 1899.)
- 8 In 1912 a proposal for the Nigerian railways to be renamed the Nigerian Government Railways was abandoned amid fears that the NGR initials would cause the line to be known as the 'No Good Railway'. (CO 520/118/27127, note, 2 May 1912.)

- 9 Sir W. de Frece, *The Failure of Officialdom* (1923), pamphlet, 6; Hansard, 4th series, 1925, clxxxii. 37.
- 10 The Ceylon railway, for instance, cost 16 per cent per mile more than Indian lines, which were themselves considered expensive. (Papers laid before the Legislative Council of Ceylon, 1895, 1, appendix 1.) The colony, in 1903, complained of the poor quality of the Uda Pussellawa railway, calling for an independent engineer and a committee of enquiry to be appointed to investigate the line, and, in 1904, criticised defects in the Colombo coal-jetties, which required them to be closed during bad weather. (CO 54/685/42223, consulting engineer to Crown Agents, 12 November 1903; CO 273/313/6870, *Times of Ceylon*, 22 September 1904.)
- 11 E.g. J. R. Best, *A History of the Sierra Leone Railway, 1899–1949* (1949); R. J. Harrison Church, *The Evolution of Railways in French and British West Africa*, (Lisbon, 1952); M. F. Hill, *Permanent Way: the story of the Uganda and Kenya Railway* (1950); Francis Jaekel, *A History of the Nigerian Railway* (1997); T. N. Tamuno, 'Genesis of the Nigerian Railway', *Nigeria Magazine* 83 (1964), pp. 279–92, and 84 (1965), pp. 31–43; J. M. Carland, *The Colonial Office and Nigeria, 1898–1914* (1985); R. E. Dummett, 'Joseph Chamberlain, imperial finance and railway policy in British West Africa in the late nineteenth century', *English Historical Review* 90 (1975), pp. 289–306; Kesner, *Economic*, pp. 105–15.
- 12 Anthony Burton, *The Railway Empire* (1994), p. 209; Peter Gould, *The Development of the Transportation Pattern in Ghana* (Evanston IL, 1960), p. 24; L. H. Gann and P. Duignan, *The Rulers of British Africa, 1870–1914* (Stanford CA, 1978), p. 279.
- 13 *Parl. Papers* 1905, lvi (Cd 2325), p. 10; Public Record Office, Kew, CAOG 10/96, Shelford to Crown Agents, 14 March 1906.
- 14 E.g. CAOG 10/11, Coode to Crown Agents, 9 February 1899.
- 15 E.g. CO 54/580/5172, Crown Agents to Colonial Office, 15 March 1888; CO 54/704/31404, Crown Agents to Colonial Office, 24 August 1906.
- 16 E.g. CO 273/313/44688, Crown Agents to Colonial Office, 16 December 1903; CAOG 19/130.
- 17 *Liverpool Daily Post*, 26 June 1899.
- 18 Cameron papers (held by Lieutenant Colonel Cameron, 22 Butterfield House, Bromyard, Herts), *Memoirs of Sir M. Cameron* (unpublished, 1921) (henceforth *Cameron Memoirs*), p. 112.
- 19 *Ibid.*; CO 323/452/6740, Crown Agents to Colonial Office, 28 February 1900.
- 20 CO 96/501/6424, Crown Agents to Ellis, 11 March 1910; D. H. Porter and G. C. Clifton, 'Patronage, professional values and Victorian public works: engineering and contracting the Thames embankment', *Victorian Studies* 31, p. 192.
- 21 Hansard, 4th series, 1893, xx. 602.
- 22 CO 766/1, Colonial Office evidence.
- 23 CO 147/163/3313, Ommanney, 1 February 1902.
- 24 *Parl. Papers* 1905, lvi (Cd 2325), p. 21.
- 25 CO 520/38/22507, report, 28 May 1906.
- 26 Ballast is the crushed stone on which rails rest.
- 27 *Parl. Papers* 1905, lvi (Cd 2325), p. 18.
- 28 *Ibid.*, p. 21.
- 29 Church, *The Evolution*, p. 97, 104, 105; *West African Mail*, 11 August 1905, p. 470. They were also more expensive than those built in similar or worse conditions elsewhere. The Perak railway, for instance, which was the same length and on the same parallel of latitude as the Tarkwa–Kumasi line, but built through difficult country, with over four times the rainfall, thicker forest and a greater shortage of ballast, was constructed for 22 per cent less and to a far higher standard than the Tarkwa railway. (CO 96/427/5543, Federated Malay States to Colonial Office, 28 January 1905.)
- 30 *West Africa*, 7 November 1903, p. 503; *Parl. Papers* 1909, xvi (Cd 4474), q. 519.
- 31 CO 96/472/39103, Gold Coast to Colonial Office, 2 October 1908; CO 96/488/5213, Shelford to Crown Agents, 3 February 1909. See also CO 147/177/34063.
- 32 *Parl. Papers* 1905, lvi (Cd 2325), p. 23.
- 33 E. R. Calthrop, 'Light railways in the colonies', *Royal Colonial Institute Proceedings* 29 (1897–98), p. 100. Steep gradients and harsh curves also resulted in fewer earthworks and cuttings and lower bridges. (W. L. Webb, *Economics of Railway Construction*, 1910, pp. 230, 283–5.)
- 34 CO 520/52/39371, Shelford to Crown Agents, 1 November 1907; CO 54/685/12279, consulting engineers to Crown Agents, 19 March 1903.

- 35 CO 520/70/39569, Shelford to Crown Agents, 23 October 1908.
- 36 E.g. CO 96/301/25787, report, 30 October 1897.
- 37 E.g. CO 520/38/22507, Crown Agents to Colonial Office, 22 June 1906; CO 96/449/23032, Crown Agents to Colonial Office, 25 June 1906.
- 38 CO 96/449/23032, Shelford to Crown Agents, 21 June 1906; CO 520/51/3975, Shelford to Crown Agents, 21 January 1907; CO 96/366/22488, Crown Agents to Shelford, 15 May 1900; *ibid.*, Shelford to Crown Agents, 29 May 1900.
- 39 CO 446/67/4832, Crown Agents to Colonial Office, 7 February 1907; CO 67/136/15662, Crown Agents to Colonial Office, 28 April 1903.
- 40 F. Shelford, *Some Features of the West African Railways* (1912), p. 41.
- 41 CO 54/650/7732, Crown Agents to Colonial Office, 5 May 1898.
- 42 E. R. Calthrop, *The Economics of Light Railway Construction* (Leeds, 1896), p. 23.
- 43 R. J. Zeckhauser and J. W. Pratt, *Principal-Agent Theory* (Boston MA, 1984).
- 44 E.g. CO 520/51/197158, report, 28 May 1907.
- 45 CO 96/488/4266, Ellis, 3 March 1909.
- 46 *Dictionary of National Biography* (Oxford, 1912), p. 304.
- 47 A. Shelford, *The Life of Sir William Shelford* (for private circulation, London, 1909), p. 116; *Engineer*, 6 October 1905, p. 343; Institution of Civil Engineers, *List of Members*, 1897.
- 48 See also CO 96/488/3152, Fiddean, 16 February 1909; CO 520/32/868, Strachey, 26 April 1905; CO 520/52/37693, note, 5 November 1907; CO 520/70/35423, Butler, 1 October 1908; CO 96/501/31724, Ellis, 19 October 1910.
- 49 CO 323/492/28934, Ommanney, 20 August 1904.
- 50 CO 96/474/4194, Antrobus, 13 February 1908; CAOG 10/55, Elliott-Cooper to Crown Agents, 7 June 1915.
- 51 *Ibid.*; CO 96/301/5899, Crown Agents to Colonial Office, 20 March 1897.
- 52 Rhodes House, Oxford, Lugard papers, Mss Brit. Emp. s. 63, Girouard to Lugard, 25 January 1908.
- 53 CO 273/276/22964, Crown Agents to Colonial Office, 2 July 1901.
- 54 Shelford, *Some Features*, p. 79; W. Oyemakindo, 'Railway construction and operation in Nigeria, 1895–1911', *Journal of the Historical Society of Nigeria* 7 (1974), pp. 307, 317.
- 55 The salary continued to be paid for six months after construction had been completed to give the consulting engineers time to wind their business down, and salaries/fees were occasionally supplemented by commission for the inspection of plant and materials. (CO 96/434/17542, Crown Agents to Colonial Office, 22 May 1905. For example, CAOG 10/11, Coode to Crown Agents, 10 January 1900; CO 273/249/33676, Straits to Colonial Office, 9 November 1899.)
- 56 CAOG 10/97, Crown Agents to Colonial Office, 10 August 1905.
- 57 E.g. CO 54/685/27072, Crown Agents to Colonial Office, 20 July 1903; CO 766/1, evidence, 79; CO 147/158/22311, Crown Agents to Colonial Office, 28 June 1901; CO 267/449/1979, Grindle, 25 January 1899.
- 58 CO 323/504/28564, Crown Agents to Colonial Office, 10 August 1905.
- 59 CO 520/51/24142, Butler, 11 July 1907.
- 60 Shelford, *Some Features*, 11, 45.
- 61 *Ibid.*, p. 11; J. Talbot, *Railway Wonders of the World I* (1913–14), pp. 66–7; Jaekel, *The History*, p. 6.
- 62 Shelford, *Some Features*, p. 11; Talbot, *Railway*, p. 67. If not drained, the pits became breeding grounds for disease carrying mosquitoes. (*West Africa*, 15 August 1903, pp. 171–3.)
- 63 It was claimed that the practice was impracticable in forest or soft ground, though it was successfully adopted by the Northern Nigeria Public Works Department when it constructed the Baro–Kano line. (Oxford, Rhodes House, A. R. Seymour, 'Tropical Railway', unpublished Ms, p. 6. See also CAOG 18/630, 13.)
- 64 CAOG 18/630, 13; Shelford, *Some Features*, pp. 11, 28.
- 65 CO 96/434/17542, Crown Agents to Colonial Office, 22 May 1905; CO 520/51/10316, Crown Agents to Colonial Office, 21 March 1907.
- 66 E.g. CO 291/46/44512, Crown Agents to Colonial Office, 27 October 1902; *ibid.*, Chamberlain, 31 October 1902.
- 67 CO 96/488/4266, Antrobus, 13 May 1909; CO 96/488/4172, note, 12 February 1909.
- 68 CO 147/168/8585, report, p. 35.
- 69 CAOG 13/282, Shelford to Crown Agents, 4 September 1896; *ibid.*, Colonial Office to Crown Agents, 16 May 1899; CO 267/481/14136, Crown Agents to Colonial Office, 27 April 1905.

- 70 CO 96/434/1542, Crown Agents to Colonial Office, 22 May 1905; CO 54/672/19122, Crown Agents to Colonial Office, 3 June 1901.
- 71 CO 766/1, p. 32, Hammond to Committee, 25 August 1923.
- 72 The 1924 Ronaldshay committee believed inadequate surveys to be one of the main causes of the excessive cost of the lines. (*Parl. Papers* 1924, viii, Cmd 2016, p. 6.)
- 73 CO 766/1, evidence, p. 67.
- 74 E.g. CO 446/34/5822, Crown Agents to Colonial Office, 12 February 1903; CO 147/163/16292, Antrobus, 25 June 1902; CO 147/158/42531, Crown Agents to Colonial Office, 2 December 1901; CO 96/325/2259, Mercer, 12 February 1898.
- 75 CO 96/449/30967, Lucas, 25 August 1906.
- 76 *Ibid.*, e.g. CO 520/38/41943, Crown Agents to Colonial Office, 13 November 1906; CO 446/67/5423, Crown Agents to Colonial Office, 12 February 1907; CO 147/146/15785, Colonial Office to Crown Agents, 10 August 1899; CO 147/958/26276, Crown Agents to Colonial Office, 29 July 1901.
- 77 E.g. CO 147/101/3321, survey, 16 January 1895; CO 147/138/23134, Shelford to Crown Agents, 13 December 1898.
- 78 *Ibid.*, note, 12 January 1906; CO 96/461/20474, Coode to Crown Agents, 8 June 1907; CO 273/304/40128, Crown Agents to Colonial Office, 26 November 1904; CO 96/347/21190, Crown Agents to Colonial Office, 10 August 1899.
- 79 CO 273/276/39770, Crown Agents to Colonial Office, 11 November 1901; CO 67/136/28061, Elliott, 7 August 1903; T1/100186/18832/16865, Treasury to Colonial Office, 31 October 1903.
- 80 Hansard, 4th series, 1906, clxvii. 658; CO 323/516/45203, Lucas, 8 December 1906; CO 323/516/46914, Green, 21 December 1906.
- 81 *Ibid.*, Colonial Office to Crown Agents, 3 January 1907, margin note.
- 82 W. N. S. Pflaumer, 'The Politics of Transport Policy in Nigeria, 1890–1914', Yale University Ph.D. (1982), p. 285; Kesner, *Economic*, p. 106.
- 83 CO 267/422/14724, Chamberlain, 3 September 1895.
- 84 E.g. CO 96/449/30967, report, 9 August 1906; CO 147/101/19160, Crown Agents to Colonial Office, 31 October 1895.
- 85 CO 267/434/2673, Crown Agents to Colonial Office, 11 December 1897.
- 86 E.g. CO 267/474/5871, Shelford to Crown Agents, 15 February 1904; CO 267/474/41570, Shelford to Crown Agents, 24 November 1904.
- 87 CO 147/101/19160, Crown Agents to Colonial Office, 31 October 1895.
- 88 CO 147/158/26276, Ezechiel, 27 August 1901. See also CO 267/449/33390, Read, 21 December 1899; *ibid.*, Harris, 20 January 1890.
- 89 E.g. CO 96/347/21190, Crown Agents to Colonial Office, 10 August 1899; CO 147/101/19160, Crown Agents to Colonial Office, 31 October 1895.
- 90 E.g. CO 520/38/41943, report, 23 October 1906.
- 91 *Ibid.*; CO 267/449/33390, report, 15 November 1899.
- 92 E.g. CO 446/47/12976, report, 28 February 1905.
- 93 E.g. CO 96/449/30967, report, 9 August 1906.
- 94 CO 446/47/12976, Crown Agents to Colonial Office, 19 April 1905; CO 96/512/34704, Shelford to Crown Agents, 28 September 1911.
- 95 E.g. CO 147/101/2665, Bradford to Shelford, 26 December 1894; CO 147/101/3321, Bradford to Shelford, 16 January 1895.
- 96 CO 147/101/5136, Bradford to Shelford, 24 January 1895; CO 96/472/39103, note, 29 October 1908.
- 97 CO 446/47/12976, Antrobus, 2 October 1905.
- 98 CO 147/148/13099, MacGregor to Chamberlain, 30 March 1900; CO 267/434/26730, Mercer, 15 December 1897.
- 99 E.g. CO 96/443/24376, Gold Coast to Colonial Office, 16 June 1906; CO 96/423/11628, Daniel, 31 May 1904; *ibid.*, Shelford to Crown Agents, 11 March 1904.
- 100 CO 96/423/11628, Shelford to Crown Agents, 11 March 1904.
- 101 Demands by Ceylon for a lawsuit to be started against the engineer La Tobe Bateman for gross negligence in the design and construction of the Malayakander reservoir, for example, were rejected by the Colonial Office, because, given the technical nature of the dispute, victory would be 'doubtful'. (CO 54/580/14242, Colonial Office to Ceylon, 20 July 1888.)
- 102 CO 879/107/965, No. 24, East Africa to Colonial Office, 23 December 1910; *ibid.*, No. 74, Colonial Office to East Africa, 18 February 1911; CAOG 10/55, Elliott-Cooper to

- Crown Agents, 7 June 1915; *Engineer*, 6 August 1943, p. 111; *Times*, 2 August 1943; Rhodes House, Oxford, Shelford album of cuttings, press clipping, c. 1920.
- 103 CO 129/350/37429, note, 14 October 1908; CO 273/304/40128, Crown Agents to Colonial Office, 24 November 1904.
- 104 *Ibid.*, e.g. CO 96/412/43070, Crown Agents to Colonial Office, 27 November 1903; CO 273/304/40128, Crown Agents to Colonial Office, 24 November 1904; CO 129/350/2398, note, 28 January 1908; CO 54/685/42223, consulting engineer to Crown Agents, 12 November 1903.
- 105 Cameron Memoirs, p. 85.
- 106 *Parl. Papers* 1909, xvi (Cd 4474), q. 1123.
- 107 CO 267/449/1979, Harris, 26 January 1899; CO 129/359/28826, Crown Agents to Colonial Office, 27 August 1909.
- 108 CO 96/347/20621, Colonial Office to Gold Coast, 30 March 1900.
- 109 *Ibid.*, Harris, 13 November 1899; CO 267/460/13520, Crown Agents to Colonial Office, 17 April 1901; CO 96/347/21804, Crown Agents to Colonial Office, 17 August 1899.
- 110 E.g. CO 273/276/22964, Colonial Office to Straits, 26 July 1901; CO 273/304/25655, Crown Agents to Colonial Office, 20 July 1904. CO 267/453/28625, Sierra Leone to Colonial Office, 14 August 1900; CO 96/347/20621, Crown Agents to Colonial Office, 4 August 1899; CO 96/347/21804, Crown Agents to Colonial Office, 17 August 1899; CO 147/163/10897, Shelford to Crown Agents, 7 March 1902; CO 147/163/15038, Crown Agents to Colonial Office, 17 April 1902.
- 111 CO 273/304/25655, Crown Agents to Colonial Office, 20 July 1904; CO 273/276/22964, Colonial Office to Straits, 26 July 1901.
- 112 CO 147/172/42513, Colonial Office to Egerton, 6 January 1905.
- 113 CO 96/449/38627, Crown Agents to Colonial Office, 19 October 1906; CAOG 10/97, memo, February 1906.
- 114 *Ibid.*, memo, February 1906.
- 115 None of the British West African lines covered its cost. Comparisons with other colonies are difficult, owing to differences in government freight rate policies. But it would appear that a number of other lines performed poorly, although the Natal and Porto Novo to Sakete were deemed a success (Busschau, 'Some aspects', p. 419; Newbury, *The Western*, pp. 145-6).
- 116 *Parl. Papers* 1905, lvi (Cd 2325); *West Africa*, 20 June 1903, p. 452; CO 96/412/39602, Shelford to Crown Agents, 26 October 1903; CO 96/423/3797, Daniel, 13 February 1904; CO 147/152/4983, Ezechiel, 23 February 1900.
- 117 CO 323/516/45203, Lucas, 8 December 1906; CO 147/165/13757, Chamberlain, 16 June 1903; CO 446/58/26478, Churchill to Colonial Office, 14 July 1906.
- 118 C. F. Tsey, 'Gold Coast Railways: the making of a colonial economy, 1879-1929', Glasgow University Ph.D. thesis (1986), p. 60; CO 96/474/35026, Shelford to Crown Agents, 23 September 1908.
- 119 *Ibid.*
- 120 *Ibid.*; *Times*, 24 April 1910.
- 121 *Times*, 28, 30 April 1910.
- 122 CO 96/512/14867, note, no date; CO 96/512/41542, Fiddes, 22 January 1911.
- 123 CO 525/15/20168, Crewe, 11 June 1906; CO 525/20/16718, Just, 20 May 1907.
- 124 I.e. the height of the trackbed. CO 525/20/42640, Crown Agents to Colonial Office, 6 December 1907.
- 125 *Ibid.*, Harris, 12 December 1907.
- 126 *Ibid.*, Just, 13 December 1907.
- 127 *Ibid.*, Elgin, no date; *ibid.*, Elgin to Rees, 15 December 1907; *ibid.*, Colonial Office to Crown Agents, 17 December 1907.
- 128 CO 525/20/45056, Harris, 31 December 1907.
- 129 *Parl. Papers* 1909, xvi (Cd 4474), q. 3500.
- 130 CO 446/58/26478, Ommanney, no date; CO 446/47/12976, Crown Agents to Colonial Office, 19 November 1905.
- 131 CO 446/47/12976, report, 28 February 1905; CO 879/93/845, Crown Agents to Colonial Office, 14 September 1906.
- 132 *Parl. Papers* 1912/3, lviii (Cd 6007), p. 39; CO 446/107/10210, report, 19 February 1912.
- 133 By 1914 consulting engineers were employed only for electrical schemes, harbour works, and water and drainage projects (CO 323/902/38790, Herbert to Fiddes, 4 September 1923).

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