

**I.K. BRUNEL AND WILLIAM GRAVATT, 1826-1841:
THEIR PROFESSIONAL AND PERSONAL RELATIONSHIP**

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DECLARATION

Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

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ABSTRACT

Title: I.K. Brunel and William Gravatt, 1826-1841: Their professional and personal relationship.

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The study concerns the personal and working relationship between Isambard Kingdom Brunel and William Gravatt during the design and construction of civil engineering projects in which they were jointly involved between 1826 and 1841.

Brunel and Gravatt first worked together on the Thames Tunnel construction in 1826-1828 where, according to Brunel, they became 'intimate friends.' Subsequently Brunel employed Gravatt to assist him during the parliamentary process leading up to the passage of the second Great Western Railway Bill in August 1835. Gravatt then superintended, under Brunel, the design of bridges in the early stages of construction of the GWR. Having accepted the position of Engineer to the promoters of a railway from Bristol to Exeter in October 1835, Brunel selected Gravatt to manage the parliamentary survey for the line. Afterwards he engaged him as his Resident Engineer on the B&ER when construction of the line began in 1836. Meanwhile, the promoters of a scheme to improve navigation on the river Parrett engaged Brunel in late 1835 to appraise their proposals and to assist them in gaining their Act in 1836. On Brunel's recommendation, the newly incorporated Parrett Navigation Company engaged Gravatt as their Engineer. By 1839 Brunel and Gravatt were arguing vehemently over 'important engineering questions' affecting the B&ER. Their personal relationship deteriorated rapidly, culminating in Brunel dismissing Gravatt from the B&ER in June 1841.

The study examines evidence of their working and personal relationship, with three objectives: firstly to establish their particular roles in the projects, secondly to establish the circumstances that led to the breakdown in their relationship, and thirdly to evaluate aspects of Brunel's leadership qualities based on the evidence of his professional and personal relationship with Gravatt.

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Spelling, Quoting, Terminology and Units of Measurement

The surname 'Brunel,' when used without a first name or initial, refers to Isambard Kingdom Brunel.

In quoting from contemporary sources, the original spelling and punctuation have been retained unless stated otherwise.

The modern spelling of place-names has been used in the captions of maps and figures.

In accordance with modern usage, 'left bank,' 'right bank,' 'upstream' and 'downstream' are as viewed looking in the direction of fresh water flow.

Imperial units of measurement have been used throughout.

Abbreviations

B&ER	Bristol & Exeter Railway
B&TC	Bridgwater & Taunton Canal
<u>BDCE1</u>	Skempton A.W., Chrimes M.M., Cox R.C, Cross-Rudkin P.S.M., Rennison R.W. & Ruddock E.C. (eds.), <u>Biographical Dictionary of Civil Engineers Vol.1: 1500-1830</u> (2002)
<u>BDCE2</u>	Cross-Rudkin P. & Chrimes M.M. (eds.), <u>Biographical Dictionary of Civil Engineers Vol.2: 1830-1890</u> (2008)
Buchanan R.A., <u>The Engineers</u>	Buchanan R.A., <u>The Engineers: A History of the Engineering Profession in Britain, 1750-1914</u> (1989)
Buchanan R.A., <u>Brunel</u>	Buchanan R.A., <u>Brunel: The Life and Times of Isambard Kingdom Brunel</u> (2002)
C&HN	Calder & Hebble Navigation

Epip	Epiphany Quarter Sessions
Estr	Easter Quarter Sessions
Gravatt W., <u>Letter</u> (1841)	Gravatt W., <u>A Letter to the Shareholders of the Bristol & Exeter Railway</u> (1841)
GWR	Great Western Railway
Hadfield E.C.R., <u>SW England</u>	Hadfield E.C.R., <u>The Canals of South West England</u> (Newton Abbot, 1967)
Hadfield E.C.R., <u>NE England</u>	Hadfield E.C.R., <u>The Canals of Yorkshire & North East England</u> (Newton Abbot, 1972)
ICE	Institution of Civil Engineers
L&BR	London & Birmingham Railway
L&SR	London & Southampton Railway
Mids	Midsummer Quarter Sessions
Mmas	Michaelmas Quarter Sessions
NRRC	Network Rail Record Centre, Swindon.
<u>Obit</u>	Anon, 'William Gravatt' (obituary notice) <u>Minutes Proceedings Institution of Civil Engineers</u> Vol.21 (1867), pp.565-575
PNC	Parrett Navigation Company
TTC	Thames Tunnel Company
Vaughan A., <u>Brunel</u> (1991)	Vaughan A., <u>Isambard Kingdom Brunel: Engineering Knight-Errant</u> (1991)
Vaughan A., <u>Brunel</u> (2006)	Vaughan A., <u>Brunel: An Engineering Biography</u> (Hersham, 2006)
<u>VCH3</u>	Dunning R.W. (ed.), <u>A History of the County of Somerset Vol.3</u> (1974)
<u>VCH4</u>	Dunning R.W. (ed.), <u>A History of the County of Somerset Vol.4</u> (1978)
<u>VCH6</u>	Dunning R.W. & Elrington C.R (eds.), <u>A History of the County of Somerset Vol.6</u> (1992)
<u>VCH8</u>	Dunning R.W. (ed.), <u>A History of the County of Somerset Vol.8</u> (2004)
Williams M., <u>Draining</u> (1970)	Williams M., <u>The Draining of the Somerset Levels</u> (Cambridge, 1970)

INTRODUCTION

When Isambard Kingdom Brunel died in 1859 he was widely acknowledged as one of the great engineers of his day. As a result his life and times have been the subjects of much interest among laymen, engineers and historians alike ever since. Professor Angus Buchanan has pointed out that a skewed approach to engineering biographical history led to a tendency to over-adulation of the leading engineers who were active during the 'Heroic Age' before 1860, in consequence of which innumerable lesser engineers disappeared into anonymity.¹ Increasing interest in historical engineering has resulted in the recent publication of two volumes of civil engineering biographies – comprehensive, authoritative and well-researched – which have done much to redress the balance; details of the lives and times of a large number of the lesser engineers are now readily accessible.² Among these lesser engineers is William Gravatt, who died in depressed circumstances seven years after Brunel.

In September 1826 Brunel's father, the eminent engineer Marc Isambard Brunel, engaged Gravatt to assist his son during the construction of the Thames Tunnel; both Brunel and Gravatt were just twenty years old. Subsequently Brunel himself employed Gravatt as an assistant in the design and construction of major civil engineering projects. In the relatively small body of secondary sources that were available when this study was begun, there are clear signs that their association, which Brunel characterized as 'intimate friends of long standing,' disintegrated in acrimony in 1841. In addition to the customary anecdotal accounts of his life and brief information about his career, Gravatt's obituary that was published in the Proceedings of the Institution of Civil Engineers in 1867 contains an astonishingly candid character assessment, extracts from which are reproduced here:

Capable of the warmest and most persistent friendship, Mr. Gravatt was also susceptible of strong resentment. This was, for the most part, based on a perception of wrong, as such, and expressed his strong and clear disapprobation of wrong doing. It was also sometimes tinged with personal feelings, and ... as a natural consequence, it was at such times often unjust ... [He was] a remarkable man; peculiar to a degree which may fairly be called extraordinary ... Finding himself passed in the race

¹ Buchanan R.A., The Engineers: A History of the Engineering Profession in Britain, 1750-1914 (1989), pp.19-20.

² Skempton A.W., Chrimes M.M., Cox R.C, Cross-Rudkin P.S.M., Rennison R.W. & Ruddock E.C. (eds.), Biographical Dictionary of Civil Engineers Vol.1: 1500-1830 (2002); Cross-Rudkin P. & Chrimes M.M. (eds.), Biographical Dictionary of Civil Engineers Vol.2: 1830-1890 (2008).

of life by men who did not possess his qualifications, he was led to the inference that they did so, not because they were sounder mechanics than he, but because they were more men of the world. There was in Mr. Gravatt all the material to make an engineer; he possessed great acquirements, succeeded in almost everything that he undertook, was full of high, chivalrous and honourable feelings, he had a kind heart and generous mind; and he ought to have taken a very high position in his profession; but in this he failed because he could not, or would not, conform to the ordinary ways of the men among whom his lot was cast.¹

The circumstances and dynamics that shaped the interrelationships between Brunel and Gravatt were selected as the topics of research for this thesis as it was felt that they would lead to new information that could make a significant contribution to this field of study. The following account of activities and events in which Brunel and Gravatt were jointly involved summarises the published literature that was available at the start of the study, comprising what might be described as 'standard works' dealing with the lives of the Brunels, augmented by railway and canal histories and Gravatt's ICE obituary.

Born on 9 April 1806, Brunel's education up to the age of 14 was supplemented by an early introduction to technical matters by his father. During the next three years he was in France, studying at the College of Caen and the Lycée Henri Quatre in Paris and serving a period of apprenticeship with a maker of scientific instruments and chronometers. On his return to England in 1822 he spent some time at engineering works, and he assisted his father in a variety of engineering projects which culminated in the design of the tunnelling shield for the Thames Tunnel. Brunel assisted John Armstrong, the Resident Engineer on the tunnel works, until Armstrong resigned due to ill health in August 1826 and Brunel was made acting Resident Engineer at the age of only 20. Soon after, Marc took on 28 year old Richard Beamish as a 'volunteer'; Beamish had served in the Coldstream Guards and was at that time studying to become a civil engineer. Marc then engaged another assistant, William Gravatt, who was already recognised as a promising young engineer, having been elected an Associate of the ICE. Gravatt was three months younger than Brunel; his father was an officer in the Royal Engineers and had planned Gravatt's education and early training with a view to a career in engineering, including an apprenticeship with the eminent engineer Bryan Donkin. In November 1826 Marc took on another assistant, named Riley, who had also been educated for the engineering profession. The following month Brunel was formally

¹ Anon, 'William Gravatt' (obituary notice) Minutes Proceedings Institution of Civil Engineers Vol.21 (1867), pp.565-575.

appointed as Resident Engineer, assisted by Gravatt and Riley. After Riley died of fever at the end of January 1827, aged 24, Beamish was appointed to replace him.¹

Beamish's biography of Marc Brunel, published in 1862, contains a graphic account of the dangers and hardships confronting all those involved in the tunnel works during the next two years. Beamish portrayed his own role as carrying neither more nor less responsibility than did Gravatt's, and there are few clues as to the personal relationships among the engineering staff. However, Paul Clements' account of events following the tunnel inundation in January 1828, drawn partly from Brunel's letters, hints that the relationships between the assistants were not always affable. Brunel was seriously injured in the inundation and, according to Clements, Marc delegated his son's authority to Beamish whom Marc considered to be the more dependable of the two assistants. When Gravatt threatened to resign in protest, Brunel wrote to him in conciliatory fashion from his sick-bed, suggesting that the problem was merely a result of Gravatt's pride having been slighted, '... your pride, which entre nous is your great fault.' It took several mollifying letters from Brunel before Gravatt finally recovered his composure.² It is evident that not only had Brunel identified an objectionable character trait in Gravatt, but also that he had the persuasory skills to deal with it proficiently.

The five years that followed the closure of the Thames Tunnel in July 1828 were lean years for Brunel; Rolt has represented it as a period of activity, but it seems that nothing substantial was actually achieved. Brunel was appointed Engineer to the Clifton Suspension Bridge project in 1831, but work soon stopped when investors became reluctant to risk their money following serious rioting in Bristol, prompted by the failure of the Reform Bill. Potential commissions for dock works at Monkwearmouth, Woolwich and Bristol were delayed or abandoned; in Brunel's own words, 'So many irons and none of them hot.' However, his fortunes changed dramatically for the better when he was appointed Engineer to the 'Bristol Railway' in March 1833, renamed the 'Great Western Railway' five months later. By December 1835 he was Engineer to ten major construction projects, with a total capital value of over £5 million.³

What then of Gravatt? During 1829 he and Brunel occasionally attended learned society meetings and dined together, but nothing relating to his career is noted in the

¹ Beamish R., Memoir of the Life of Sir Marc Isambard Brunel (1862), pp.211-240 passim; Obit, p.572; Noble C.B., The Brunels: Father and Son (1938), pp.46-47; Rolt L.T.C., Isambard Kingdom Brunel (1957), pp.32-39.

² Clements P., Marc Isambard Brunel (1970), p.170.

³ Rolt L.T.C., *op.cit.*, pp.62-105 passim, 119.

published literature until he was appointed in 1832 as Engineer to the Calder & Hebble Navigation. He designed and supervised the construction of some innovative long-span laminated timber arch bridges over the navigation, but he was dismissed in 1833 in favour of someone with 'more experience in the management of workmen in this part of the country,' although it was acknowledged that his talents were 'unquestionably of a superior order.' He then moved into railway engineering; he was employed for a time on the London and Dover Railway survey, followed by a period designing bridges on the GWR for Brunel. During this period he was developing the design of the 'Dumpy' level that would subsequently become the favoured surveying instrument of railway engineers.¹

In 1835 Brunel engaged Gravatt to superintend the parliamentary survey for the 75 miles of line of the Bristol & Exeter Railway, which was completed in the remarkably short time of one month. Brunel was appointed Engineer to the B&ER in 1836, with Gravatt as his Resident Engineer.² Just before Gravatt took up his post he was a guest at Brunel's wedding, where his awkwardness in genteel company was noted by Brunel's new in-laws.³

Two years into construction of the B&ER in Somerset one of the contractors complained that Gravatt and his assistants were acting with such hostility towards him that he felt unable to complete his contract and he asked to be released. Brunel induced him to withdraw his request and directed Gravatt to apologise personally to the contractor. He also reminded Gravatt of his subordinate responsibilities and status in the B&ER, implying that Gravatt had been routinely overstepping his authority. In 1839 there were indications that Gravatt had been lobbying against Brunel, when he made some unspecified complaints to the B&ER Directors and threatened to resign. Brunel warned Gravatt that he was acting most unprofessionally:

... sacrificing your duty to the Company, to me and to yourself, entirely to feelings, feelings which I ... consider quite improper to be indulged in.

As in the comparable episode during the Thames Tunnel works, Brunel persuaded him to stay on. Despite them having been, in Brunel's words, 'connected ... as intimate friends of long standing,' by mid-1840 their relationship had deteriorated to the point where Brunel not only acknowledged that they disagreed over 'important engineering

¹ *Obit*, pp.567-568; Hadfield E.C.R., *NE England*, p.199.

² *Obit*, p.570; MacDermot E.T., *History of the Great Western Railway Vol.2: 1863-1921* (1931), revised edition by Clinker C.R. (1964), p.72.

³ Vaughan A., *Brunel* (1991), p.59.

questions' but he also suspected that Gravatt was again acting subversively. The B&ER Board agreed to Brunel's recommendation that Gravatt's role in the works should be restricted to completing the line to Bridgwater. Just before the official opening to Bridgwater in May 1841, Brunel discovered that the long-span masonry arch bridge carrying the line over the river Avon New Cut, near Temple Meads, was in a 'deplorable' condition; also, many of the over-bridges had been built too low. Gravatt had concealed the problems from Brunel, who now asked him to resign quietly; Gravatt refused and so Brunel dismissed him in June 1841, 'with great reluctance and regret.' The problems did not stop there; immediately after Gravatt's dismissal Brunel was obliged to order that the centering should be left under the arch of the very flat, long-span masonry railway bridge over the navigable river Parrett near Bridgwater which was showing signs of settlement. Eventually the Board ordered Brunel to remove the arch after three fatalities had occurred in two separate accidents when barges struck the centering and sank.¹

Elsewhere in Somerset, Brunel and Gravatt were involved with a project to improve and extend navigation on the Parrett: Brunel gave parliamentary evidence in support of the Parrett Navigation Bill in 1836 and Gravatt was subsequently engaged as Engineer to the Parrett Navigation Company.² However, neither the circumstances surrounding their engagements in the project nor their precise roles were known.

In response to the tenor of the character appraisal in Gravatt's ICE obituary and an assessment of the findings from the literature review, the chronological and thematic boundaries of this study were set such that three major themes could be explored: firstly the particular roles of Brunel and Gravatt in the various projects in which they were jointly involved, secondly the circumstances that led to the break-down in their personal and professional relationships, and thirdly aspects of Brunel's leadership qualities brought to light by the evidence relating to his relationship with Gravatt. The study is substantially based on the surviving diaries, journals and correspondence of the Brunels and Richard Beamish, and the records of pertinent companies, institutions and other bodies and individuals. Original material has been supplemented by reference to contemporary newspapers and journal articles. The principal source of evidence

¹ MacDermot E.T., *op.cit.*, p.73; Owen J.B.B., 'Arch Bridges,' in: Pugsley A. (ed.), The Works of Isambard Kingdom Brunel (1976), pp.91, 100-102; Murless B.J., Bridgwater Docks and the River Parrett (Taunton, 1983), pp.21-23; Buchanan R.A., Brunel: The Life and Times of Isambard Kingdom Brunel (2002), pp.156-157; Vaughan A., Brunel (2006), pp.82-87.

² Hadfield E.C.R., SW England, pp.85-86; Body G. & Gallop R., Parrett River Trade (Bristol, 2006), pp.12-18.

regarding Gravatt's life and career is his ICE obituary; apart from a few letters among the Brunels' papers, no single collection of Gravatt's personal papers, diaries and the like is known to exist.¹ As a result there are major lacunae in the available evidence, which introduces the possibility of imbalance since the relatively large Brunel archive will likely give a biased perspective of events. However, it is felt that the study has brought together sufficient primary evidence from adequately diverse sources to enable objective conclusions to be reached.

Chapter 1 examines the formative years and early careers of Brunel and Gravatt during the period leading up to the passage of the GWR Bill in August 1835. Particular emphasis is given to primary evidence relating to facets of Gravatt's behaviour which appear to have had a significant bearing on his developing relationship with Brunel. Chapter 2 provides an insight to the period from October 1835 when the B&ER promoters' first requested Brunel's 'engineering direction' in their project, through to Gravatt's appointment as Resident Engineer on the B&ER in July 1836. The construction phase of the B&ER between 1836 and 1841 is described in Chapter 3 and the aftermath of Gravatt's dismissal is examined in Chapter 4. The primary evidence relating to this period has been explored in detail, as it spans the crucial episode of the breakdown in the relationship. Of great importance to this part of the study are the monthly progress reports of Charles Fripp, the B&ER's Managing Director, which catalogue and describe construction operations during the period between July 1839 and April 1844. They contain much detailed information that would otherwise have gone unrecorded and uncommented or, if it had been recorded elsewhere, was later lost. They are a potentially fertile source of primary material for future researchers.

It was recognised from the outset that there was insufficient secondary material relating to the Parrett Navigation Company, and to earlier projects that might have significantly influenced its origins and evolution, on which to base an evaluation of the contributions made by Brunel and Gravatt to the undertaking. Consequently, Chapter 5 explores the underlying problems affecting navigation on the Parrett and its tributaries, and examines primary material concerning improvement schemes that were promoted before 1830, when an enclosure project re-kindled determined attempts to improve and extend the navigation. Developments up to the passage of the Parrett Navigation Bill in July 1836 are dealt with in Chapter 6; the works carried out by the PNC are described in

¹ However, there is a passing reference in Brunel's Thames Tunnel journal to Gravatt writing up his own journal: BUL DM 1306 I.3.i, Brunel's Journal, 12 Feb 1827.

Chapter 7. These three chapters are also dealt with in detail, as they illustrate the practical problems and conflicting interests faced by small navigation concerns, drainage authorities and riparian interests, outside the mainstream waterway network and with little engineering expertise available locally. This part of the study has drawn heavily on the papers of the former Somerset River Authority, its forerunners and associated concerns such as the PNC, complemented by the papers of major riparian landowners and the County Sessions. Together these constitute a remarkably large corpus of primary evidence and, as with Fripp's B&ER report, they have not been previously investigated in depth from an historical engineering perspective.

The study spans a period of great transformation both within the civil engineering industry generally and the ICE itself. Accordingly Appendix 1 summarises the early history and development of the ICE to provide a context in which to set the circumstances and events described in the main body of the study. Appendix 2 explores evidence relating to the GWR, with an eye to Gravatt's involvement in the design of bridges. Appendix 3 discusses the significance of the 'self-acting' flood-gates that were constructed to Gravatt's design on the PNC, and the subsequent careers of Gravatt and his associates are summarised in Appendix 4. A final chapter discusses the body of evidence and draws reflective conclusions.