Brunel had formally agreed accommodation works with Sanford, Thomas, Sparrow, Nattriss and others before Gravatt took up his post as Resident Engineer on the B&ER; it still remained to be seen just how much freedom and responsibility he was prepared to let Gravatt exercise in matters such as these. As far as progress in the design, setting out and construction of the works is concerned, there is little direct evidence in the primary sources before July 1839 when Charles Fripp, newly appointed 'Inspecting Director,' began reporting regularly on progress to the B&ER Board. The start dates of the various contracts that were let before Fripp's appointment, and a very rough indication of rates of construction, can be estimated from entries in the B&ER general ledger, but it is necessary to rely on fortuitous references in the Board Minutes and the reports of the Board to the General Meetings for anything approaching detailed evidence of progress.

Brunel reported to the B&ER Board at the end of June 1836 that he now felt the gradients either side of Ashton Watering could be reduced to the extent that the stationary engine on the one approach and the assistant engine on the other could be dispensed with, without significantly deviating from the parliamentary line.¹ Later he would say:

… with regard to the general question of gradients, he had uniformly acted on the principle that unless it was palpable that the expense would be comparatively trifling, and the advantage great, he never recommended any alteration.²

This suggests he did not anticipate that altering the gradients at Ashton would cost a significant amount. On 28 June 1836 he recorded in his diary, 'First flag of B&E hoisted.'³ Presumably he used the phrase in its engineering sense: that of setting out the line with staves bearing triangular 'flags.' The connotation here is unclear, but Brunel earlier used a similar phrase, 'we shall have our flags flying over the Brent Valley

¹ Brunel's report has not been found, but when he was later questioned about the reduced costs of working a line which had been made 'as perfect as a bowling-green,' he observed that the savings might be 10 or 15 per cent by having 'favourable gradients' and this he thought was a sufficient reason for the alteration sanctioned in 1836 by the B&ER Directors: Bristol Mercury 4 Sep 1841.
² Quoted in: Gravatt W., Letter (1841).
³ BUL DD 1836, Brunel's Office Diary, 28 Jun 1836.
tomorrow,' in a letter he wrote in September 1835 to the GWR's lawyers confirming that
the Directors had instructed him to set out the line.\(^1\) It is possible he was now using
the phrase to signify the B&ER Board's endorsement of his report on the inclines. Whatever
the case, at the first B&ER General Meeting on 2 July 1836 the Directors were able to
report that the gradients up to the summit level at Ashton Watering could be eased:

\[
\text{… in which case, nearly the whole extent of the Railway by Clevedon,}
\text{Weston-super-Mare, Uphill, Burnham, etc. to Bridgwater and Taunton,}
\text{will be the most level in the United Kingdom.}
\]

They reported that Brunel confidently believed that the line would be opened from
Bristol to Taunton and from Exeter to Cullompton in the spring of 1838, less than two
years ahead, and opened throughout by the end of 1840.\(^2\)

\textbf{MAP 3.1 THE SUMMIT AT ASHTON WATERING}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{map3-1.png}
\caption{Base map: 'Walker's Somersetshire' 1835.
A – B: Rising incline 1 in 76
B – C: Summit level
C – D: Descending incline 1 in 103}
\end{figure}

Three assistants joined Gravatt in the 'Engineering and Surveying Department' in
July 1836: William Froude, John England and R.A. Welsh.\(^3\) Froude, who was then aged
26, was a brilliant scholar who had taken a first in Mathematics and a third in Classics at

\(^1\) Brunel to Osborne & Ward, 3 Sep 1835: TNA/PRO RAIL 1149/2, Brunel's GWR
Letter Book.
\(^2\) TNA/PRO RAIL 75/1, Board Minutes, 1 Jul 1836; TNA/PRO RAIL 75/49, Minutes of
General Meeting, 2 Jul 1836.
\(^3\) TNA/PRO RAIL 75/95, Journal of Transactions, 31 Dec 1836.
Oriel College, Oxford. He became a pupil of H.R. Palmer and was engaged on preliminary surveys for the South Eastern Railway before taking up his B&ER post as 'Assistant Engineer at Exeter' on a salary of £350.¹ John England, who was 23 when he was engaged as an assistant engineer on the B&ER at a salary of £200, had served an apprenticeship under Bryan Donkin during which time he had supervised the installation of millwork in Italy.² Nothing has been discovered about the earlier life and career of R.A. Welsh, who was taken on as an assistant surveyor at 2 guineas per week. At this period Froude, unlike England, was not paid travelling expenses, suggesting that Froude's higher salary was deemed to cover his expenses as well as relatively more onerous responsibilities. The team immediately set about 'ascertaining and setting out the line' and supervising the making of trial pits and boreholes along the line in north Somerset.³

By mid-August 1836 terms had been agreed for rented premises for Gravatt and his staff in Coronation Road, Bedminster, 'near the Ashton Toll Bar.'⁴ William Peniston was taken on at that time as another assistant engineer at a salary of £200; he was then aged about 21, had been trained under Timothy Bramah, and had been employed for at least ten weeks on the GWR since late 1835.⁵ An assistant surveyor, J. Pinkerton, started at about the same time as Peniston, but the details are unclear; nothing is known of his previous activities.⁶ George Henry Layard, a cousin of Lady Charlotte Guest, joined the

¹ Anon, 'William Froude' (obituary notice) Minutes Proceedings Institution of Civil Engineers Vol.60 (1880), pp.395-404; 'William Froude (1810-1879),' BDCE2, pp.319-320.
³ TNA/PRO RAIL 75/95, Journal of Transactions, 31 Dec 1836. The wages of 'labourers and others' employed to assist the surveyors and to dig the trial pits totalled £980 4s. 6d. up to 31 December 1836. In September 1836 Marc Brunel lent £1 to 'a Borer employed by Gravatt ... to return to Gravatt': ICE TT/BD/1836, Marc Brunel's Diary, 15 Sep 1836.
⁴ TNA/PRO RAIL 75/1, Board Minutes, 9,16 Aug 1836. The period was to be for four years, with an option to extend to 14 years, at an annual rent of £30. In September 1841, and probably for a considerable time before that, Gravatt had a house adjoining the Coronation Road office: Gravatt W., Letter (1841).
⁵ Brunel to the GWR Directors, 7 Jan 1836: TNA/PRO RAIL 250/82; TNA/PRO RAIL 75/95, Journal of Transactions, 31 Dec 1836; 'William Michael Peniston (c.1815-1869),' BDCE2, p.612.
⁶ TNA/PRO RAIL 75/95, Journal of Transactions, 31 Dec 1836, 31 Mar 1837. Pinkerton was paid a total of £47 for the period ending 31 December 1836, of which £27 was for 9 weeks at £3 per week, and the balance of £22 at an unspecified salary. However, his salary was paid at the increased rate of £4 per week during the first quarter of 1837, and it is possible the £22 was also paid at the increased rate. The calculation is also complicated by the fact that a 'Mr. Pinkerton - Engineer' was paid £30 in October 1836.
team at the beginning of September as an assistant engineer at the age of 30, on a salary of £200.¹ Despite his privileged upbringing and respectable connections he was said to be 'not at all presuming.' He had served as a lieutenant in the 89th Foot but was forced to retire through ill health and had then joined the Metropolitan Police Force. In 1833 he was engaged as Superintendent of the Otmoor Police Force in Oxfordshire during a period of rioting and public resistance to the enclosure of Otmoor Common. He was discharged in September 1835 when order had been restored, due in the main, according to the authorities, to Layard's firm, fair and efficient handling of the situation.² His relationship with the Guests probably helped secure his employment by Brunel on the B&ER. From 10 September 1836 an unspecified number of draughtsmen were taken on to prepare drawings for the first contracts, and two more assistant surveyors started in October: Thomas Barnes at £3 per week, and Charles Richardson at 3 guineas.³ Nothing more is known of Barnes. Richardson was 22 years old; while articled to Brunel he had been involved in work on the Thames Tunnel, the Clifton Suspension Bridge and the GWR.⁴

Gravatt told the Board on 6 September that he could get advertisements ready for the first two contracts, 1A and 2A, 'as soon as he had been enabled to avail himself of the assistance & direction of Mr. Brunel.' The Board ordered that the advertisements should not be published until Brunel had approved them, and it is plain that his approval was quickly given as the published notice inviting tenders was dated 7 September 1836.⁵

by the Parrett Navigation Co for 'taking levels, measuring, etc.' for an unspecified period during the second half of 1836: SRO D/RA 3/2/1, PNC Management Committee Accounts, 19, 20 Oct 1836. Assuming that this is the same man – a reasonable assumption in view of Gravatt's role in the PNC, and Pinkerton's B&ER salary appearing to have been paid for two discrete periods up to 31 December 1836 – it is likely he assisted Gravatt for a period on the Parrett Navigation.

¹ TNA/PRO RAIL 75/95, Journal of Transactions, 31 Dec 1836.
³ TNA/PRO RAIL 75/95, Journal of Transactions, 31 Dec 1836. Draughtsmen's salaries for the period from 10 September to 31 December totalled £574 5s. 1d. Assuming a weekly rate equivalent to that of an assistant surveyor, this equates to the surprisingly high average of a dozen or so draughtsmen in employment at any one time.
⁴ Brunel to the GWR Directors, 4 Jan 1836: TNA/PRO RAIL 250/82; Anon, 'Charles Richardson' (obituary notice) Minutes Proceedings Institution of Civil Engineers Vol.124 (1896), p.417.
⁵ TNA/PRO RAIL 75/1, Board Minutes, 6 Sep 1836; notice inviting tenders, dated 7 September 1836: Felix Farley's Bristol Journal 10 Sep 1836; Bristol Mirror 14 Sep 1836; Taunton Courier 14 Sep 1836.
Two weeks later the Board resolved that Gravatt should attend their meetings 'only at such times as circumstances rendered necessary,' but it is not clear whether this was because they felt his presence was of little consequence or that they recognised that his burgeoning workload meant that his time was now at a premium. The advertisements for contracts 1A and 2A appeared in mid-September 1836; 1A was said to be about 4½ miles long, running from the London Road (alias Bath Road) in Bedminster to the summit at Ashton Watering; 2A was about 5¼ miles long, running down from Ashton Watering to the edge of the north Somerset Levels near Claverham Court in Yatton parish. The earthworks and bridge works on both contracts were heavy. From the London Road to just beyond Yanley Lane in Long Ashton parish there were several cuttings and embankments up to ¾ mile long and 30ft. deep and high. Next came the 65ft. deep Ashton cutting, which was over a mile long and extended to Bourton Lane in Contract 2A. This was followed by the Bourton cutting, about a mile long and up to 40ft. deep. The next major earthwork was a 2½ mile-long embankment across Kenn Moor. There were to be at least forty road and accommodation bridges.

MAP 3.2 CONTRACTS 1A AND 2A

Base map: 'Walker's Somersetshire' 1835
A – B: Contract 1A;  B – C: Contract 2A

The advertised work covered the complete construction of the line except ballasting and track laying. Drawings and specifications would not be available for inspection until 10 October, suggesting that the design of the works and the preparation

1 TNA/PRO RAIL 75/1, Board Minutes, 20 Sep 1836.
of drawings was still ongoing.\textsuperscript{1} Indeed, it is possible that the vertical alignment through 1A and 2A had not been finally determined by that time, as the earliest mention to have been found that the gradients up to Ashton Watering had actually been redesigned to enable locomotive power alone to be used was not until February 1837.\textsuperscript{2}

While commending the 'zeal and energy' of the Directors in progressing the project to the stage of advertising for tenders, the \textit{Bristol Mirror} reported:

\textquote{The examination of the strata in the valley of Long Ashton is said to have been far more satisfactory than had been anticipated. And that a tract of nearly the same extent from Exeter towards Cullompton will be included in the third contract which is to be got ready without delay.}\textsuperscript{3}

Certainly, Froude was setting out the line between Cullompton and Exeter by early November 1836.\textsuperscript{4} Later both Gravatt and Froude described their own design and setting out procedures for transition curves which they used in the 1830s.\textsuperscript{5} Gravatt claimed that he had first demonstrated in the early 1830s that the correct curve for the transition between a straight line and a circular arc, or between circular arcs of 'contrary flexure,' was one which increased and decreased in a regular manner so that 'cant' or super-elevation could be applied gradually. He favoured the sinusoidal or 'elastic' curve which he set out using what he termed a 'skeletal plan' of stakes:

\textquote{… driven into the ground nearly in the course of the intended line, expressing their position by columns of figures with reference to two co-ordinates; thus obtaining a numerical accuracy far greater than that of any drawn plan. By using a table of sines and cosines, a few hours' calculation would save many days' labour in the field, besides ensuring an accuracy not otherwise to be obtained.}

Froude preferred the cubic parabola which was simple and easy to apply, so that:

\textsuperscript{1} Notice inviting tenders, dated 7 September 1836: \textit{Felix Farley's Bristol Journal} 10 Sep 1836; \textit{Bristol Mirror} 14 Sep 1836; \textit{Taunton Courier} 14 Sep 1836. Fripp later gave the lengths as 4 miles 75 chains and 5 miles 55 chains respectively: TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839. There is evidence of some site activity going on in Bedminster parish during September 1836, when Osborne & Ward took legal action against a land occupier for committing an aggravated assault on some of Gravatt's staff: TNA/PRO RAIL 75/1, Board Minutes, 13 Sep 1836.

\textsuperscript{2} PRO RAIL 75/49, Directors' report to General Meeting, 23 Feb 1837.

\textsuperscript{3} \textit{Bristol Mirror}, quoted in \textit{Taunton Courier} 14 Sep 1836.

\textsuperscript{4} \textit{Felix Farley's Bristol Journal}, 5,26 Nov 1836.

... with the assistance of a few calculated tables, the process of setting out a true curve was rendered as easy in practice as setting out a circular arc.¹

On 8 November Brunel prepared estimates for 1A (£75,500) and 2A (£63,000) as an aid in evaluating the tenders that were to be opened later that day.² His estimate for 1A included £800 for a bridge to carry the Bridgewater Road over the line at Bedminster instead of the tunnel shown on the deposited plan, presumably one of the beneficial consequences of altering the gradients. A week later the Board accepted William Ranger's tender for 1A in the sum of £75,500 – identical to Brunel's estimate and suggestive that some bargaining had taken place in the meantime.³ Samuel Hemming's tender of £68,000 for 2A was accepted.⁴ Brunel's estimate of £63,000 for 2A included £2,200 for 110yds. of 'Arching', presumably referring to a tunnel at the summit near Ashton Watering; this is the earliest mention of a tunnel in contract 2A to have been found. In the event, the impact of the general financial recession, exacerbated by a cholera epidemic, forced the Board to postpone the start of construction on 1A and 2A.⁵

Gravatt later claimed credit for an innovative form of construction that was first used in ten of the bridges in Contracts 1A and 2A that carried roads over cuttings:

¹ Froude contrasted his 'definite and well-grounded' method with the 'rules of thumb' usually employed:
When a simple change of radius occurs, the maxim which governs the proceeding is 'humour it in.' But when the direction of the curvature is reversed, the expedient of 'putting in a bit of straight,' as a common tangent to both circles, is usually thrown into the bargain to 'make things pleasant.' And thanks to the experienced eyes and skilful hands that are usually engaged in the operation, the result obtained is, for the most part, not unsatisfactory:

² BUL DM 162/25, Brunel's 'General Calculation Book,' 8 Nov 1836, pp.154-155.
³ Earlier in the year Ranger had been awarded four contracts at the Bristol end of the GWR. For biographical details of William Ranger (1800-1863) see BDCE1, pp.543-544.
⁴ TNA/PRO RAIL 75/1, Board Minutes, 15 Nov 1836; Osborne & Ward to William Ogle Hunt, 18 Nov 1836: BRO 12167/31; TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839; TNA/PRO RAIL 1149/44, Tenders for GWR contracts, undated. Hemming was currently working on three contracts at the Birmingham end of the L&BR and he also had Contract 1C on the GWR. For biographical details of Samuel Hemming (1799-1876) see BDCE2, pp.396-397.
⁵ Hemming's contract for 2A was eventually sealed on 11 April 1837, and Ranger's for 1A a week later: TNA/PRO RAIL 75/1, Board Minutes, 11, 18 Apr 1837. Ranger's is the only B&ER contract to have been found: TNA/PRO RAIL 75/162, 'Contract No. 1A: The Bristol and Exeter Railway Company and Mr. Wm. Ranger,' 18 Apr 1837.
By contriving the peculiar sort of bridges, now known by the name of Flying Bridges, I very materially reduced (in some cases I halved) the quantity of masonry throughout the Line.¹

Figure 3.1 Typical B&ER 'Flying Bridges'

I. Brunel noted that this class of bridge of 'striking outline' was first used on the B&ER and subsequently on many other railways. He described the principle of their construction thus:

Instead of arches resting on piers and abutments, the bridge has a single arch, reaching from one side of the cutting to the other, and springing from the slopes.

In addition to the savings in masonry, the expense of lofty scaffolding and falsework was avoided as the centering could be supported directly off the trimmed surface of the

¹ Gravatt W., Letter (1841).
### Table 3.1  The B&ER 'Flying Bridges'  

<table>
<thead>
<tr>
<th>Cont</th>
<th>Grid ref</th>
<th>Name</th>
<th>Note on drawing</th>
<th>Dated</th>
<th>Approx Span</th>
<th>Head-room</th>
<th>Approx start date</th>
<th>Approx completion</th>
<th>Still extant?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>581 709</td>
<td>Lock's Mill Lane</td>
<td>'As drawn'</td>
<td>1840-04-21</td>
<td>63ft.</td>
<td>&gt;21ft.</td>
<td>1839-08-16</td>
<td>1840-06-25</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>578 707</td>
<td>Parson's Street</td>
<td></td>
<td></td>
<td>62ft.</td>
<td>15ft. 3ins.</td>
<td>Not built</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>546 700</td>
<td>Sir John Smith's</td>
<td>'As drawn'</td>
<td>&lt;1839-08-16</td>
<td>69ft.</td>
<td>&gt;28ft.</td>
<td>1840-07-24</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>542 699</td>
<td>Bridge H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1840-06-25</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>540 699</td>
<td>Gouldstone's</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1840-06-25</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>537 698</td>
<td>Lewis'</td>
<td>'As drawn'</td>
<td></td>
<td>76ft.</td>
<td>&gt;30ft.</td>
<td>1840-06-25</td>
<td>1841-08-26</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>533 697</td>
<td>Holder's Lane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1840-06-25</td>
<td>Yes</td>
</tr>
<tr>
<td>2A</td>
<td>510 698</td>
<td>Bourton Lane</td>
<td></td>
<td>1838-08-24</td>
<td>67ft.</td>
<td>15ft. 3ins.</td>
<td>&lt;1839-07-10</td>
<td>1839-09-12</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>505 698</td>
<td>Vowles'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1839-08-16</td>
<td>1840-03-12</td>
<td>Yes</td>
</tr>
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<td></td>
<td>501 697</td>
<td>Park Lane</td>
<td></td>
<td></td>
<td>58ft.</td>
<td>16ft. 9ins.</td>
<td>&lt;1841-01-29</td>
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<td>Yes</td>
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<tr>
<td>3A</td>
<td>426 662</td>
<td>Yatton Street</td>
<td>'Office copy'</td>
<td>138-08-24</td>
<td>59ft.</td>
<td>15ft. 3ins.</td>
<td>1840-01-23</td>
<td>1840-06-25</td>
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</tr>
<tr>
<td>4A</td>
<td>327 581</td>
<td>Bleadon Rd, Devil's</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1840-07-24</td>
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<tr>
<td>3B</td>
<td>314 417</td>
<td>Old Bridgewater Rd</td>
<td></td>
<td></td>
<td>64ft.</td>
<td>Not given</td>
<td>1840-09-18</td>
<td>1841-03-18</td>
<td>Yes</td>
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<td>314 414</td>
<td>Puriton Rd</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2C</td>
<td>306 282</td>
<td>Outwood</td>
<td></td>
<td></td>
<td>60ft.</td>
<td>15ft. 9ins.</td>
<td>1841-07-22</td>
<td>1842-05-12</td>
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<tr>
<td></td>
<td>305 281</td>
<td>Boroughbridge Rd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1842-03-18</td>
<td>Yes</td>
</tr>
<tr>
<td>3C</td>
<td>273 254</td>
<td>Creech Rd</td>
<td></td>
<td>&lt;1842-04-14</td>
<td>60ft.</td>
<td>15ft. 9ins.</td>
<td>&lt;1842-06-09</td>
<td></td>
<td>No</td>
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<tr>
<td>1D</td>
<td>168 237</td>
<td>Milverton Rd</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>1842-08-05</td>
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</tr>
<tr>
<td>2D</td>
<td>153 221</td>
<td>West Buckland Rd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1842-12-08</td>
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<tr>
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<td>134 215</td>
<td>Thomas'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1842-11-03</td>
<td>Yes</td>
</tr>
<tr>
<td>3D</td>
<td>124 204</td>
<td>Row Green</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1842-09-08</td>
<td>Yes</td>
</tr>
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</table>

*Names in **bold** denote that a drawing of the bridge has been found at NRRC*

*'Head-room' denotes the minimum clearance over the outer rail*
unexcavated cutting.\textsuperscript{1} Drawings for ten of the 21 flying bridges that were designed for the B&ER in Somerset have been found at NRRC (see Figure 3.1 and Table 3.1).\textsuperscript{2} The drawings for Locks Mill Lane and Yatton Street bridges have been signed by Gravatt.

On 26 November 1836 Felix Farley's Bristol Journal noted that Gravatt was actively engaged at Exeter in making final arrangements for a contract extending from Exeter to Stoke Canon.\textsuperscript{3} The article referred to him as 'Mr. Gravatt, the engineer,' not merely as Brunel's 'assistant engineer,' and it mentioned his 'well-known talents.' It seems it was the common view that Gravatt's standing in the B&ER was on the rise: in another instance, in early January 1837 George Gibbs, a landowner near Flax Bourton, wrote that he was startled to hear the opinion of Mr. Matthews his neighbour who, while speaking 'rather slightingly' of Brunel:

\begin{quote}
… attributes any thing good that comes from [Brunel] to his man at the Exeter [ie. B&ER], whose name I forget just now ... I never heard Brunel's superiority as an engineer questioned before, and I suppose it is beyond all doubt, is it not?\textsuperscript{4}
\end{quote}

There can be no doubt that Brunel's 'man at the Exeter' was in fact Gravatt, who seems to have done nothing to correct the general misconception.

Gravatt took on two pupils of his own in 1837: William Cobbe and Richard Hassard. Gravatt's sister Ann had married Charles Henry Cobbe, whose cousin William Cobbe failed his examinations after four years training at the Royal Military College, Sandhurst. By early 1837 the Cobbe family was finding it difficult to obtain appropriate employment for him, now aged 21, and so Gravatt agreed to take him on trial as a pupil.\textsuperscript{5} Richard Hassard, then aged about 17, had been born in County Cavan and educated in Exeter.\textsuperscript{6} Gravatt would later take on at least two other pupils: Peter Margary was articled

\begin{footnotes}
\item[2] The generic intrados profile as-drawn was based on a 7-centred arch: the radius for a 13ft. long arc either side of the crown was 70ft., the next 10ft. long arc on each side was 52ft. 6ins. radius, the next 8ft. arc was 42ft. 6ins. radius, and any remaining arc beyond that was 35ft. radius; the overall shape approximated to a segment of an ellipse. The spans as-drawn vary from 58ft. and 76ft.
\end{footnotes}
to him in 1838 at the age of 18, and Charles Harcourt White, who was originally articed to George Bush, is said to have been 'transferred' to Gravatt in 1842 when Bush died.¹

There were some changes among Gravatt's B&ER staff in early 1837. Charles Richardson had left at the end of 1836, Welsh was henceforward referred to as a clerk and Pinkerton's salary was raised to £4 per week. G. Cumming and W.R. Neale were taken on as assistant surveyors/overlookers' at 2 guineas per week; nothing more is known of either. Pinkerton had left the B&ER by April 1837 and Cumming by July 1837.²

A progress report that was said to have been given by Brunel and Gravatt to the Board on 22 February 1837 has not been found but it is likely that the main topic concerned lowering the gradients at Long Ashton and elsewhere, about which the Directors reported to the second General Meeting the following day. The line between Bristol and Taunton would now consist of 4½ miles at 1 in 352, 5 miles at 1 in 440 and about 35 miles of level, 'an amendment which must be regarded as most essential, affecting so materially as it does the future economy of the working of the line.' The upbeat mood was boosted by the news that Ranger and Hemming had now made a start on their contracts, and that the results from trial shafts on the line of White Ball tunnel were very favourable. However, Brunel was forced to concede that the line would not now be opened to Taunton, 'or at all events considerably beyond Bridgwater,' before September 1838, six months later than his assurance to the previous General Meeting in July 1836.³

Advertisements for contracts 3A and 4A appeared in late March 1837; Hemming was awarded both contracts when tenders were opened on 2 May 1837.⁴ 3A was about 5 5 miles 30 chains long, from the end of 2A to the Banwell Road in Worle parish; 4A was

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³ TNA/PRO RAIL 75/1, Board Minutes, 22 Feb 1837; TNA/PRO RAIL 75/49, Directors' report to General Meeting, 23 Feb 1837; Taunton Courier 3 Mar 1837. Brunel gave Hemming notice to commence work on 12 June 1837, and the first contract payment was dated 2 August 1837: Brunel to Samuel Hemming, 12 Jun 1837: BUL PLB 1; TNA/PRO RAIL 75/76, General Ledger No.1, 2 Aug 1837. Ranger was not given formal notice to start until 28 August 1837, and Fripp later recorded that 1A commenced in October 1837: Brunel to William Ranger, 26 Aug 1837: BUL PLB 1; TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839.

⁴ Notice inviting tenders, dated 14 March 1837: Taunton Courier 22 Mar 1837; Brunel to Samuel Hemming, 11 May 1837: TNA/PRO RAIL 1149/2, Brunel's GWR Letter Book; TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839.
about 6 miles and 60 chains long, from 3A to just south of the river Axe in South Brent parish. The earthworks on 3A were light, consisting principally of a low embankment or causeway across the Levels, formed from material excavated from side ditches, and a small cutting at Yatton. The earthworks across the Levels on 4A were similar, plus a half-mile-long cutting up to 70ft. deep at Uphill. On 3A there were to be two small river bridges, a flying bridge over the Yatton cutting, and another four road bridges over the line on the Levels. There were to be six road bridges over the line across the Levels on 4A, plus a flying bridge over the Uphill cutting and a bridge to carry the line over the river Axe. All the road bridges on the Levels along 3A and 4A, and later contracts in due course, would require long and high approach ramps; bridges of this type are termed 'Levels' bridges for the purposes of this study.

MAP 3.3 CONTRACTS 3A and 4A

When Gravatt came to the B&ER as Resident Engineer in July 1836 he had just spent eight months or so working for Brunel on the GWR, superintending 'the making the designs and drawings which would otherwise have occupied the respective engineers
An investigation into the extent of Gravatt's involvement in the design of the GWR bridges (Appendix 2) has concluded that he almost certainly designed all the 'ordinary' bridges on the GWR. These 'ordinary' bridges would include the single 30ft. span semi-elliptical arch bridges carrying roads over the line where the rail level was at or near ground level (see Figure 3.2). Drawings of nine B&ER 'Levels' bridges have been found at NRRC (Table 3.2), and not surprisingly the

1 Brunel to the GWR Directors, 7 Jan 1836: TNA/PRO RAIL 250/82, Brunel's GWR reports, copy in: BUL PLB 2.
2 Rob Kinchin-Smith has fittingly described these 'ordinary bridges as:
   … examples of a single generic bridge type, constructed in the United Kingdom in thousands during the 18th and 19th Centuries, in order to carry lesser roads and lanes over canals and railways:
style of the bridges is generally similar to that of the 'ordinary' bridges on the GWR. All are drawn as 30ft. span semi-elliptical arches with a rise of 7ft. giving a clearance over the outer rail of 14ft. 3ins. (see Figure 3.3).

Table 3.2 The B&ER 'Levels' Bridges

<table>
<thead>
<tr>
<th>Cont</th>
<th>Grid Ref</th>
<th>Name</th>
<th>Sig</th>
<th>Approx. start date</th>
<th>Approx. date taken down</th>
<th>Why taken down</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>463 684</td>
<td>Chelvey</td>
<td></td>
<td>1839-07-10</td>
<td>Still extant</td>
<td>N/A</td>
</tr>
<tr>
<td>2A</td>
<td>447 675</td>
<td>Kenmoor Lane</td>
<td></td>
<td>1839-07-10</td>
<td>Still extant</td>
<td>N/A</td>
</tr>
<tr>
<td>3A</td>
<td>390 639</td>
<td>Hardwick's</td>
<td></td>
<td>1840-09-18</td>
<td>1841-04-16</td>
<td>Collapsed</td>
</tr>
<tr>
<td>3A</td>
<td>371 627</td>
<td>Weston Road</td>
<td></td>
<td>1839-08-16</td>
<td>1841-02-19</td>
<td>Settled</td>
</tr>
<tr>
<td>3A</td>
<td>365 623</td>
<td>Banwell Road</td>
<td></td>
<td>1840-01-23</td>
<td>1841-04-16</td>
<td>Unknown</td>
</tr>
<tr>
<td>4A</td>
<td>360 620</td>
<td>Worle Moor</td>
<td></td>
<td>1840-01-23</td>
<td>1841-04-16</td>
<td>Unknown</td>
</tr>
<tr>
<td>4A</td>
<td>349 612</td>
<td>Locking Road</td>
<td></td>
<td>1839-12-12</td>
<td>1841-04-16</td>
<td>Settled</td>
</tr>
<tr>
<td>4A</td>
<td>343 607</td>
<td>Hutton Moor</td>
<td></td>
<td>1839-10-24</td>
<td>1841-02-19</td>
<td>Settled</td>
</tr>
<tr>
<td>4A</td>
<td>335 598</td>
<td>Hutton Road</td>
<td></td>
<td>1839-12-12</td>
<td>Not known</td>
<td>Unknown</td>
</tr>
<tr>
<td>4A</td>
<td>325 568</td>
<td>Bleadon Drove</td>
<td></td>
<td>1840-01-23</td>
<td>1841-04-16</td>
<td>Collapsed</td>
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<tr>
<td>4A</td>
<td>324 551</td>
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<tr>
<td>1B</td>
<td>324 544</td>
<td>Cripp's Farm</td>
<td></td>
<td>1840-01-23</td>
<td>1842-11-03</td>
<td>Unknown</td>
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<td>1B</td>
<td>324 530</td>
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<td></td>
<td>1839-10-24</td>
<td>1843-09-14</td>
<td>Unknown</td>
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<tr>
<td>1B</td>
<td>324 523</td>
<td>Middle Street</td>
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<td>1840-04-23</td>
<td>1842-11-03</td>
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<tr>
<td>1B</td>
<td>324 515</td>
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<td>Collapsed</td>
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<td>324 511</td>
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<td></td>
<td>1839-10-24</td>
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<td>Settled</td>
</tr>
<tr>
<td>2B</td>
<td>324 497</td>
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<td></td>
<td>1839-10-24</td>
<td>1843-09-14</td>
<td>Unknown</td>
</tr>
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<td>323 483</td>
<td>Worston Farm</td>
<td></td>
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<td>1842-12-08</td>
<td>Settled</td>
</tr>
<tr>
<td>3B</td>
<td>323 478</td>
<td>Bristol Road</td>
<td></td>
<td>1839-07-10</td>
<td>1842-10-06</td>
<td>Settled</td>
</tr>
<tr>
<td>3B</td>
<td>322 471</td>
<td>Mark Road</td>
<td></td>
<td>1839-07-10</td>
<td>1841-06-18</td>
<td>Settled</td>
</tr>
<tr>
<td>3B</td>
<td>321 460</td>
<td>Batts Bow</td>
<td></td>
<td>1839-12-12</td>
<td>1843-08-04</td>
<td>Unknown</td>
</tr>
<tr>
<td>3B</td>
<td>319 449</td>
<td>Withy Road</td>
<td></td>
<td>1839-07-10</td>
<td>1843-08-04</td>
<td>Unknown</td>
</tr>
<tr>
<td>3B</td>
<td>317 436</td>
<td>Puriton Drove</td>
<td></td>
<td>1839-09-12</td>
<td>1841-03-18</td>
<td>Unknown</td>
</tr>
<tr>
<td>3B</td>
<td>308 377</td>
<td>Bath Road</td>
<td></td>
<td>1839-07-10</td>
<td>Still extant</td>
<td>N/A</td>
</tr>
<tr>
<td>2C</td>
<td>316 299</td>
<td>Bankland</td>
<td></td>
<td>1841-08-26</td>
<td>1842-03-18</td>
<td>Collapsed</td>
</tr>
</tbody>
</table>

Key
'Cont' = Contract No.
'Grid Ref' = O.S. Grid Reference (ST)
'Name' = Name customarily used in B&ER papers; name in **bold** indicates that a drawing of the bridge has been found at NRRC
'Sig' indicates that Gravatt initialled the drawing
'Approx. start date' is the date of Fripp's report in which the construction of the bridge is first mentioned.

When the works were set out through contract 4A the centre-line was deviated by 99 yds. to avoid cutting into Charles Payne's paddock at Uphill, to avoid the £5,000 penalty that the Provisional Committee had agreed with him in early 1836. Payne, who was a barrister and whose notoriously confrontational and litigious attitude is said to
have earned him the nickname 'Devil' Payne, obtained an injunction *ex parte*, supported by an affidavit that the deviation was considerably more than the Act empowered the B&ER to make, in that it was now impossible to construct the railway within the lateral extent of 100 yds. either side of the parliamentary line. In defence, Brunel and Gravatt stated that it was 'universally understood' that the permitted deviation of 100 yds. was measured from the parliamentary line to the centreline of the deviation, that is to say it did not define a 200 yds. wide corridor within which the works were to be confined. Eventually, in 1840 the Court of Exchequer unanimously decided the question in favour of the B&ER, in a judgement that had national repercussions.

Another of the Provisional Committee's pledges resurfaced in July 1837 when Sanford reminded the Board of Brunel's assurance that the new bridge at Nynehead would be completed by the July following the Act; Gravatt was directed to start its construction immediately. At about the same time, Gravatt agreed with James Sparrow's agent that the company would build an occupation bridge over the Bourton cutting. Similar arrangements were of course being made between the B&ER and other landowners but Sparrow's is the only such case to have been found where Gravatt

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1 The derivation of Payne's nickname is among the often fanciful and contrived 'recollections' of elderly inhabitants of Weston super Mare that were recorded in the 1880s by Ernest Baker, a local historian, and which were occasionally published in contemporary and later editions of the *Weston Mercury*. A version of the 'Devil' Payne story was recently re-published: *Weston Mercury* 18 Jun 2007.
2 *The Times* 4 Aug 1837, 19 Feb 1840. In the opinion of the Court: [The 100yds.] ought to be measured in a horizontal line commencing at the centre of the 22 yards allowed by the act for the original line of railway … It is clear that all the powers which are incidental to the making of the original line must be applied to the new line, and as the defendants are allowed to exceed 22 yards where cuttings and embankments occur, it follows that they are within the terms and powers of their act, even though the cuttings and embankments rendered necessary for the deviated line may run out beyond the 100 yards so measured.

According to Simmons & Biddle, the unresolved issue of definition was a common cause of controversy and litigation in railway projects up to this time: Simmons J. & Biddle G. (eds.), *The Oxford Companion to British Railway History* (Oxford, 1997), p.368. Michael Quick has recently published a detailed account of the circumstances surrounding the dispute: Quick M., 'The Railway at Uphill – Legend and Reality' *Journal Railway & Canal Historical Society*, Vol.204 (March 2009). I am grateful to Denis Dodd for bringing this article to my attention.
3 TNA/PRO RAIL 75/1, Board Minutes, 5,19 Jul, 1837.
4 SRO DD/WY 163/8, 17 Jul 1837; TNA/PRO RAIL 75/158, Fripp's report, 16 Aug 1839. Most of a large tract of pasture owned by Sparrow along both sides of the line through Bourton parish was occupied by William Vowles, and access across the line was essential for his business; the bridge became known as 'Vowles Bridge.'
personally agreed the details. Brunel was, naturally enough, still attending to the major issues that were besetting the B&ER at that time. There were two urgent problems to address. Firstly, the company was faced with a financial crisis as the general recession began to bite. In August 1837 Brunel asked Gravatt to send him estimated costs of the works between Bristol and Bridgwater, excluding the bridges over the New Cut near Temple Meads and over the Parrett for which he had himself already made estimates.¹ He needed them to help him put together a recommendation to the Board on how best to phase the works, and although one of the Parrett bridges was actually beyond Bridgwater it was of sufficient magnitude that its cost and the length of time to construct it would be matters of importance in any debate about retrenchment and re-programming. Five days later, and on the basis of Brunel's recommendation, the Board reported to the General Meeting on how they intended to proceed.² Their strategy would be, in essence, to use their available means to the greatest effect by 'not operating on too large a surface at a time.' They emphasised that they were still fully determined to complete the line to Exeter, and would open the line in stages, firstly to Weston and Uphill, then to Bridgwater, and finally to Taunton, 'so that Investment and Return may, in a good degree, keep pace with each other.' They instanced the carriage of coal from the North Somerset coalfield the short distance to the B&ER's Bristol terminus, and the establishment of a steam-packet station at Uphill, as examples of the commercial possibilities offered once the line was opened to Uphill.³

Brunel's second major problem concerned Ranger who was getting into serious difficulty with his contracts on the GWR, a state of affairs which would of course affect his performance on B&ER contract 1A. Brunel cautioned Gravatt not to give Ranger any reason to accuse the B&ER of breaching the contract: 'If coercion should become necessary we must have done nothing of which he can complain or take advantage.'⁴ On 13 September the Board approved Brunel's suggestion that he should try to persuade

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¹ Brunel to Gravatt, 26 Aug 1837: BUL PLB 1; BUL DM 162/25, Brunel's 'General Calculation Book,' pp.52-53, undated [circa Dec 1835].
² TNA/PRO RAIL 75/49, Directors' Report to General Meeting, 31 Aug 1837.
³ The establishment of a steam-packet station at the mouth of the Axe would occupy the minds of the Board on and off for the next three years; land acquisition negotiations were started, but by September 1840 the scheme had been dropped: TNA/PRO RAIL 75/49, Directors' reports to General Meetings, 31 Aug 1837, 5 Mar, 14 Aug 1838, 5 Mar, 27 Aug 1839, 2 Sep 1840. Michael Quick has recently reviewed the evidence relating to the abortive proposals: Quick M., 'The Railway at Uphill – Legend and Reality' Journal Railway & Canal Historical Society, Vol.204 (March 2009).
⁴ Brunel to Gravatt, 10 Sep 1837: BUL PLB 1.
Ranger to transfer his contract to another contractor.¹ As far as Brunel was concerned, the greater difficulty would be to find a successor. He felt that Hemming had quite enough in hand already, but Hugh McIntosh, another GWR contractor, initially expressed interest.² Ranger agreed in principle to a transfer of his contract, and both Hemming and McIntosh were invited to tender. Brunel's estimate for the contract was £75,000; in the event, McIntosh refused to go below £90,000. Having originally tendered £85,000, Hemming finally agreed on £80,000 with some minor amendments to the conditions.³ Ranger's deed of release was dated 17 October 1837; the first, and indeed only, contract payment to him was made the same day in the sum of £563 4s.,⁴ an indication of just how little had been accomplished by that date, bearing in mind that fortnightly payments to Hemming for contract 1A from the first payment on 6 November 1837 through to 26 February 1838 averaged £580 and were never less than £450.⁵ There is further evidence that little progress had been made, in an instruction from Brunel to Gravatt in September 1837 to proceed immediately with the construction of any bridges or culverts 'which may affect the commencement of the works [on 1A] & to look well about for any spoil ground that may be required.'⁶

Land acquisition along the route was still far from complete. Clause 256 of the B&ER Act limited the company's powers of compulsorily acquisition to two years, ie. until 19 May 1838. The Board therefore instructed their solicitors on 11 October 1837 to prepare an application for parliamentary powers to extend the period of time for completing land purchase. This provided an opportunity to alter and add some minor items relating to financing the works and levying tolls, and to empower the company to make branches to Nailsea, Weston-super-Mare, Bleadon and Burnham. Also, they

¹ TNA/PRO RAIL 75/1, Board Minutes, 13 Sep 1837.
² Brunel to Samuel Waring, 16 Sep 1837: BUL PLB 1. McIntosh's interest was not on his own account but for a relative: according to Brunel he had several relatives who managed his contracts, 'and appear to be in some measure partners.'
³ Same to Frederick Ricketts, 28 Sep 1837: ibid; same to James Badham, 28 Sep 1837: ibid; same to Gravatt, 28 Sep 1837: ibid; TNA/PRO RAIL 75/1, Board Minutes, 28 Sep, 10,11 Oct 1837. For biographical details of Hugh McIntosh (1768-1840) see BDCE1, pp.418-422; and for David McIntosh (1799-1856) see BDCE2, pp.505-506.
⁴ TNA/PRO RAIL 75/164, mutual release between the B&ER and William Ranger, 17 Oct 1837; TNA/PRO RAIL 75/76, General Ledger No.1, 17 Oct 1837. The Board had authorised the drawing of a cheque for £600, towards paying Ranger whatever sum Brunel would ultimately certify: TNA/PRO RAIL 75/1, Board Minutes, 17 Oct 1837.
⁵ TNA/PRO RAIL 75/76, General Ledger No.1, 6 Nov 1837 – 26 Feb 1838 passim.
⁶ Brunel to Gravatt, 29 Sep 1837: BUL PLB 1.
wished to seek powers to resolve a land acquisition issue at Bankland, North Petherton.¹ A parliamentary plan, signed by Gravatt, that showed the proposed branches and the deviation at Bankland was deposited on 30 November 1837.² The plan also showed 'the line as actually set out or authorized to be made by the [original] Act' along three portions of the line, which gave a good indication of the current state of progress in setting out the line: from Temple Meads to the southern end of contract 4A; from Fordgate in North Petherton parish to the Durston/Creech St. Michael parish boundary; and from Rewe to Exeter. Neither the branches nor the length at the Exeter end are considered relevant to the present study. There were three significant deviations from the parliamentary line between Temple Meads and the end of 4A; though substantial, they were all within the permitted limit. The first, near Temple Meads,. made possible a square crossing of the New Cut and a less severely skew crossing of the London Road. Then there was a southward deviation of the line through the whole of Long Ashton parish which clearly represented a compromise between Brunel's aspiration to slacken the gradient up to the summit and the constraints imposed by the agreement with James Sparrow. Finally, the deviation which triggered the dispute between the B&ER and 'Devil' Payne in 1837 began in the parish of Hutton and ran on the east of the parliamentary line for about a mile through the whole length of Uphill parish, before rejoining the parliamentary line close to the Axe crossing. Further south, the objective of the deviation at North Petherton was to move the line as far away as practicable from Bankland Farm on account of a failure to agree terms with a landowner.³

For reasons that have not been established it was not until December 1837 that the Board accepted a tender in the sum of £591 11s. 4d. for Sandford's Nynehead Court drive bridge, contract 1W, from the Wellington contractors Tozer, Stubbs & Thorne. Construction began in January 1838 and the final contract payment was not made until September 1839; the total cost was £991 7s. 9d.⁴ This was an extremely expensive

¹ TNA/PRO RAIL 75/1, Board Minutes, 11 Oct 1837.
² SRO Q/RUp 137, 'B&ER Plan of the Proposed New Branches and Deviations', deposited 30 Nov 1837.
³ An 'amicable arrangement' was reached in early 1838 and the line was eventually constructed along the parliamentary line there: TNA/PRO RAIL 75/49, Directors' report to General Meeting, 5 Mar 1838.
⁴ TNA/PRO RAIL 75/1, Board Minutes, 19 Dec 1837; TNA/PRO RAIL 75/158, Fripp's reports, 10 Jul, 24 Oct 1839; TNA/PRO RAIL 75/95, Journal of Transactions, 31 Jul 1840. The other tenderers were White & Norman of Taunton (£725) and John Nurcombe of Milverton (£913 8s.). The bridge, which incorporated a lodge, is still extant although much repaired.
obligation, although in reality the Board had little option in view of Sanford's status and influence; the only consoling factor was its valuable public relations benefit as it signalled an early and strong commitment to completing the line beyond Taunton. In similar fashion, the Board was later able to cite the letting of a contract for the bridge over the Parrett south of Bridgwater as 'the best evidence of their anxiety to reach Taunton.'

The severe winter weather, about which the Directors reported to the General Meeting on 5 March 1838, hindered work on the Nynehead bridge, as it did on all other fronts. The Directors also bore testimony to 'the talent and unwearied devotedness of their Resident Engineer, Mr. Gravatt'; after the meeting Gravatt took a large party of shareholders to Flax Bourton on a tour of the works. Two locomotives were at work, conveying earth and other materials, and it was noted that the sides of the cutting, 30ft. deep by that time, were in excellent order despite the heavy rain and frost: 'The undertaking is proceeding with much spirit.' Brunel was not mentioned in the newspaper reports of the meeting. He was particularly busy at the time dealing with problems on the GWR and SS Great Western, and may have felt Gravatt was competent to field any engineering questions.

On 31 March Brunel was seriously injured in an accident aboard the SS Great Western; it is probable that he took no active part in B&ER matters during April at...

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1 TNA/PRO RAIL 75/49, Directors' report to General Meeting, 5 Mar 1839.
2 Ibid, 5 Mar 1838.
3 Taunton Courier 14 Mar 1838. A month later the locomotives, together with other plant and construction materials, featured in a schedule of Hemming's property which had been mortgaged to a Mr. Williams: TNA/PRO RAIL 75/1, Board Minutes, 3 Apr 1838. Anecdotal evidence of the locomotives working is provided by George Henry Gibbs, writing to his sister while visiting 'dear old Belmont,' his cousin George's house near Flax Bourton:

> The only sound I hear ought to be that of the birds singing amongst their branches, but, alas for the beauty of my period, another sound reaches my ears of a less rural character, that of the locomotive engine in the distance conveying the wagons backwards and forwards on the B & E Railway. By the repeated return of the engine it is evident that the work is going on with great activity, and though the sound is not so musical as that of the blackbird's song nor sufficiently pleasing to justify me in applying to the words of Sterne, 'they were the sweetest notes I ever heard', yet I assure you there was nothing which the most fastidious ear could object to and a great deal which fell with a very harmonious cadence on the tympanums of six railway directors:

G.H. Gibbs to Harriett Gibbs, 16 Aug 1838, quoted in: Simmons J. (ed.), op.cit., p.74, emphasis as in the original.
least.¹ He was not at the Board meeting on 17 April, as it was Gravatt who presented the contract certificates for payment. The Board resolved at that meeting to advertise for contracts 1B, 2B and 3B, which would complete the line to Bridgwater. They further resolved that at this stage they would advertise for one contract beyond Bridgwater (4B) which would be for a length of the line 'from the termination of 3B to a point to be determined by the Engineer, [to] be advertised as soon as the Engineer can fix the latter limit,' hinting not only that Brunel was absent but also that they did not consider Gravatt was competent to 'fix the ... limit.'² By the time they met on 1 May Gravatt had sent them a draft specification for 4B from London; they had directed him to attend there to assist in procuring the passage of a Bill to build a new road bridge over the Floating Harbour at St. Philips, Bristol.³ The B&ER, the GWR and the Bristol & Gloucester Railway had agreed to contribute £4,000 between them towards the additional costs of making the centre span of a proposed three-span bridge an opening span. In that way, the potential for commercial development of the Temple Meads area would not be compromised by interference to navigation.

Hemming was eventually given notice in March 1838 to commence work on 3A and 4A, with a view to 'proceeding vigorously with the works at Uphill.'⁴ No detailed evidence has been found relating to actual progress on the contracts that had already been let by this time, but it is clear the Directors were far from satisfied with the contractors' performance. In an attempt to accelerate progress, on 8 May the Board constituted a Works Committee whose role seems to have been merely to inspect the works, give monthly progress reports and make recommendations to the Board. Their reports were, in fact, brief and sporadic, and there seems to have been little to show for their efforts.⁵ However, they did tackle the long standing problem of the considerable

¹ I. Brunel wrote that his father was 'landed on Canvey Island, where he remained some weeks,' whereas G.H. Gibbs recorded having met him at Paddington on 21 April, 'appearing better than I expected'; Gibbs also stated that Brunel was well enough to be at Maidenhead on 1 May on the occasion of the first GWR locomotive trials: Brunel I., op.cit., pp.241-243; Simmons J. (ed.), op.cit., pp.35-36.
² TNA/PRO RAIL 75/1, Board Minutes, 17 Apr 1838.
³ Ibid, 24 Apr, 1 May 1838.
⁴ Osborne & Ward to Gravatt, 3 Mar 1838: BRO 12167/31, TNA/PRO RAIL 75/1, Board Minutes, 27 Mar 1838. The first payments on both contracts were made on 18 June 1838: TNA/PRO RAIL 75/76, General Ledger No.1, 18 Jun 1838; TNA/PRO RAIL 75/95, Journal of Transactions, 18 Jun 1838.
⁵ TNA/PRO RAIL 75/1, Board Minutes, 8 May – 16 Oct 1838 passim. In June 1838 the Railway Magazine reported that three Directors, the Company Secretary and 'the engineer' had lately been inspecting the progress, adding, with a touch of sarcasm:
delays in authorising contract payments caused by Brunel's inability to sign the payment certificates in a timely manner due to his commitments elsewhere: on the committee's recommendation, the solicitors were instructed in July 1838 to insert a clause in all future contracts to the effect that the signature of either the Engineer or the Resident Engineer was sufficient authentication – perhaps another indication of the high regard in which the Board still held Gravatt, despite the imposition of a condition that:

… the signature of the latter be taken only in cases where the Certificates signed by the Principal Engineer may not arrive in due time for the Meeting of the Board.\(^1\)

Advertisements for 1B, 2B, 3B and 4B appeared in mid-May 1838. Contract 1B was said to be just over two miles long, from the end of 4A to near Cripp's Farm; 2B was about 2 miles 7 chains, from 1B to near the Bristol Road in Burnham parish; and 3B was about 6¾ miles from 2B to near the proposed Bridgwater 'Depot' (Map 3.4). The earthworks in 1B, 2B and 3B were similar to those in 3A: essentially the formation of a causeway from one to four feet high, formed from material excavated from side ditches, but there was also a short cutting at Puriton on 3B. There were to be four 'Levels' bridges in 1B, another two in 2B and a further six in 3B, where there was also a bridge over the Brue. Three of the 'Levels' bridges in 3B were said to carry turnpike roads: the Bristol Road at Highbridge and the Bath Road at Bridgwater, both being roads of the Bridgwater Trust, and the Wells Road at Highbridge which was also described as a turnpike road, although John Bentley and Brian Murless have stated that the Wells, Highbridge & Cheddar Trust was not incorporated until 1841.\(^2\) Gravatt's draft specification for 4B, referred to earlier, has not been found but it is clear from the advertisement that either Gravatt or, more likely, Brunel had restricted the extent of the work: Contract 4B was limited to 'the erection of a bridge, of 100 feet span, across the River Parrett, a short distance above the town of Bridgwater.' The tenders were opened on 29 May: contract 3B was awarded to Edwin Down, a Bridgwater architect and

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1. TNA/PRO RAIL 75/1, Board Minutes, 3 Jul 1838.
2. Notice inviting tenders, dated 17 Apr 1838: Somerset County Gazette, 12 May 1838; Bentley J.B. & Murless B.J., op.cit., p.59. Fripp gave the lengths as 2 miles 9 chains, 2 miles 8 chains and 6 miles 61 chains respectively: TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839.
Base map: 'Walker's Somersetshire' 1835.

A – B: Contract 1B;  B – C: Contract 2B;  C – D: Contract 3B;  E – F: Contract 4B
builder, in the sum of £33,600, but new tenders were called for 1B, 2B and 4B.

Samuel Bromhead, a Bristol builder, successfully re-tendered for the three contracts. His tender sums for 1B and 2B were £6,960 and £6,550 respectively; his tender of £4,900 for 4B was stated to be for 'Contract No. 4B Somerset Bridge over the River Parrott [sic]. This is the earliest use of the name 'Somerset Bridge' to have been found during this study.

A clause in the B&ER Act regulated the construction of the intended bridges carrying the main line and the Bridgwater branch line over 'part of the said River Tone which is commonly called the Parrett.' The B&ER Co was required to build:

… two good firm and substantial bridges or viaducts of brick, stone or iron over the said river … each of the said bridges shall be so constructed as to leave within the abutments of the arch thereof a free open and uninterrupted waterway, at least ten feet wider than the waterway of the present town bridge over the same river at Bridgwater, together with a towing-path of five feet in width, to be carried out upon piles … and the height under the soffit of the arch of each of the said bridges shall not be less than the height under the soffit of the arch of the said present town bridge.

Bridgwater Town Bridge was then a semi-elliptical cast-iron arch bridge with a span of 75ft.; the minimum permissible span of the B&ER bridges was therefore 90ft. At NRRC there is a set of contract documents and a specification for contract 4B signed by Samuel Bromhead on 4 July 1838, and three drawings titled 'Contract No. 4B – Somerset Bridge,' signed the same day by both Bromhead and Brunel. Drawing No.1 is a land plan of the area around the bridge; drawing No.2 comprises an elevation and plan of the bridge (Figure 3.4); and No.3 comprises a longitudinal section and several cross sections. All three drawings are signed near the bottom with the initials 'WG', indicating that it was Gravatt who had signed them off. The bridge depicted in the drawings was a circular-segmental single-span masonry arch with a span of 100ft. and a rise of 12ft.,

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1 TNA/PRO RAIL 75/1, Board Minutes, 29 May 1838. Down started work on 3B in the autumn of 1838: TNA/PRO RAIL 75/76, General Ledger No.1, 8 Nov 1838; TNA/PRO RAIL 75/95, Journal of Transactions, 8 Nov 1838.
2 TNA/PRO RAIL 75/1, Board Minutes, 12 Jun 1838. His rival tenderers for both contracts were David Harris and Richard Hodges, about whom nothing is known. The first contract payments were not made until 6 June 1839 for 2B and so late as 4 December 1839 for 1B: TNA/PRO RAIL 75/76, General Ledger No.1, 6 Jun, 4 Dec 1839.
3 NRRC 18516.
4 SRO DD/X/WI 62, 'Elevation of Bridgwater Bridge, The Arch 75 feet Span, 23 feet Rise, Road 24 feet Wide in the Clear; Publish'd as the Act directs by Thos. Gregory, July 8th 1797.'
5 NRRC 18516.
with masonry abutments on concrete spread-foundations; the formation level below the underside of the foundations was shown at 5ft. below the river bed level. The contract documents stated that the logs of trial borings were available for the contractor's inspection, but these logs have not been found. The arch barrel was to be 3ft. thick, with horizontal haunching over the outside 1/8th of the span and longitudinal voids in the spandrels. There are insufficient detailed dimensions on the drawings to be able to set out and construct the bridge, suggesting that the design was incomplete and that the drawings were intended to give merely a general impression of the work required to be done. All the masonry in the arch with the exception of the face voussoirs was specified to be of blue lias, whereas all the visible masonry on the Bridgwater (west) elevation was to be of white lias, and all that on the Langport (east) elevation to be of white or blue lias at the contractor's option, presumably in recognition of the likely sources of suitable building stone and the potential transport, delivery and site storage problems caused by the arch centering obstructing the waterway. Under the terms of the contract, the work was to be completed within eighteen months. Within a week of signing the contract Bromhead wrote to the Board, 'pressing for land for the Bridge near Bridgwater,' but despite this ostensible display of eagerness to make a start work did not actually get underway until October 1838.  

1 TNA/PRO RAIL 75/1, Board Minutes, 10 Jul 1838; TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839.
The Act for further powers received the Royal Assent on 11 June 1838; in the event, the only branch to be made at this period was the Weston branch which the Board directed Brunel to set out in June 1840.\(^1\) By that time all intentions of constructing the Bridgwater branch had been abandoned, although the date of the decision to drop it, and the reasons, are not known. The Directors reported to the General Meeting on 14 August 1838 that land had been acquired for the Bridgwater station. A final decision on the form of the permanent way would be deferred until the 'practical results' of the different systems in use on the GWR and other lines could be compared.\(^2\) After the meeting Gravatt took 40 shareholders on a tour of the works in several wagons fitted out with seats; the party was hauled by the contractor's locomotive for three miles along the temporary rails. Gravatt's health was drunk at the subsequent dinner at Congresbury. In returning thanks he said that much more had been done during the last six months than appeared at first view, and in the next six months much more would appear to be done than perhaps actually would be:

… for the fact was, they had now done their difficult work, and the impediments arising from the purchase of land having been removed, they could at once lay down their rails on the whole of the level district which some of the gentlemen had seen that morning (cheers).\(^3\)

At a site meeting in August 1838 Gravatt and J.M. Tucker agreed the arrangements for constructing bridges and culverts over watercourses in the Yatton area, which were ratified and extended to cover all the other drainage districts at a Court of Sewers on 13 September 1838, attended by Gravatt. Within a month the Surveyor of the North Western Division was complaining to the Court that the railway works were obstructing the drainage at several unspecified places, resulting in a presentment for a nuisance being issued against the company.\(^4\)

In November the Board consented to Brunel's request that Gravatt should design and supervise the construction of the new bridge over the Avon at St. Philips.\(^5\)

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1 1&2 Vict, c.26: An Act for making several Branches in the County of Somerset, from the Line of the Bristol & Exeter Railway, and for amending the Act relating to such Railway (11 Jun 1838); TNA/PRO RAIL 75/3, Board Minutes, 26 Jun 1840.
2 TNA/PRO RAIL 75/49, B&ER Directors' report to General Meeting, 14 Aug 1838.
3 Taunton Courier 22 Aug 1838.
4 SRO D/RA 1/7/2, Sewers Sessions Orders for the North Western Division, 29 Dec 1837, 31 Oct 1838; J.M. Tucker to Robert Bryant, 18 Aug 1838; SRO D/RA 1/2/14, Court Papers for the Northern Division; Robert Tucker to Thomas Robins, 24 Aug 1838: ibid; TNA/PRO RAIL 75/1, Board Minutes, 18 Sep 1838. The Commissioners later re-engaged Tucker to safeguard their interests during construction of the Axe bridge.
5 TNA/PRO RAIL 75/3, Board Minutes, 27 Nov 1838.
Binding has recorded what little is known about the subsequent construction and operation of the bridge: in summary, by August 1840 the works were well advanced, and the Mayor of Bristol formally opened the bridge on 1 December 1841. Binding concluded:

On balance, it would appear from the available evidence that in the long run the Railway Companies were put to some considerable expense in protecting their interests in the Floating Harbour with, perhaps, little significant return.1

By the end of 1838 John England was based at Puriton and William Peniston at Uphill.2 At about that time the Board transferred part of the reporting role of the ineffectual Works Committee to Gravatt, who was directed to give monthly progress reports including a summary of the contract payments and the numbers of men, horses and locomotives at work on each contract. He used the occasion of his first report in January 1839 to appeal for the Board's support in his attempts to get Hemming to add another 600 men to the 200 who were already at work at the Ashton and Bourton cuttings, a measure which he considered was 'absolutely necessary for the interest of the Undertaking.'3 Hemming was coming under increasing pressure from Gravatt and his assistants who had adopted a confrontational attitude, particularly in respect of the payment for work, and in February Hemming applied to the Board for what were described as 'additional payments on account of his contracts.' It is not stated what these payments were being claimed for, but apparently Brunel considered a sum of £1,800 might be paid although he stressed that Hemming was not entitled to the payment as of right.4 It is probable that Gravatt had allowed, or even directed, his staff to apply the contract terms regarding measurement and payment unnecessarily rigorously, whereas Brunel clearly recognised that a less strict approach would ease Hemming's cash-flow problems and encourage him to improve his performance, to the benefit of all parties.5

3 TNA/PRO RAIL 75/3, Board Minutes, 15,29 Jan 1839. In similar vein, the Board's report to the General Meeting in March 1839 was less up-beat than previously, principally on account of Hemming's poor progress in the cuttings: TNA/PRO RAIL 75/49, Minutes of General Meeting, 5 Mar 1839.
4 TNA/PRO RAIL 75/3, Board Minutes, 12,19 Feb 1839.
5 At the B&ER General Meeting on 2 September 1841 Brunel raised as an issue the payment of advances to contractors:
Things came to a head in early April 1839 when Hemming wrote to the Board, asking to be released from his contracts on the grounds of unreasonable hostility and undue severity directed against him, particularly by Gravatt and, it later emerged, Peniston. Brunel intercepted the letter before James Badham, who had replaced Thomas Osler as Company Secretary in May 1837, could circulate it to the Directors. Brunel induced Hemming to withdraw his request to be relieved, and then he set about agreeing arrangements with Hemming for accelerating the works.¹

Brunel next took up the matter with Gravatt, expressing in a long, critical letter his views on Gravatt's performance and attitude, and pointing out 'the course which for the future I must strongly urge upon you and must request you to adopt.'² He stressed the importance of treating contractors, and particularly Hemming whose contracts were the most important on the line, with:

... the utmost tenderness ... otherwise the work suffers & thereby the Company suffers ... he is the horse we have in harness and upon which we must depend ... it is in our interest not to overdrive him or to starve him & to be contented with his utmost altho' this may fall short of what we originally calculated upon.

Brunel felt that Gravatt's assistants had progressed from an original position of ignorance of the pressures under which Hemming laboured, to that of a definite prejudice against him, exemplified by their tendency to abuse the arbitrary powers which the contract gave them:

The fact is, Gravatt, that you, like others in your position and still more your assistants, though you may work hard, like a comfortable life of peace & comparative irresponsibility and do not know what real anxiety of mind is ... It is useless to expect to find in the class of young men who generally form the Assistants that nice discrimination which would enable them to adopt just the requisite degree of strictness to insure the best attainable performance of the contract ... without undue severity.

He put the blame on Gravatt for not keeping sufficient check on them. Gravatt should immediately and personally allay Hemming's fears and make a fresh start. In future he must personally scrutinize and determine all payments to Hemming on the basis of a simple, strictly correct measurement or estimate and an impartial representation of the

¹ Brunel to Gravatt, 15 Apr 1839: BUL PLB 1.
² Ibid.
facts being made to him by the assistants. The assistants should be constantly reminded that they themselves were of much less importance to the Company than the contractors over whom they were placed, and a 'kindly feeling' towards Hemming and the other contractors should be instilled into their minds:

A contractor should have his mind at ease and above all … he should be able to calculate with confidence upon all payments & upon the fairness of those whose arbitrary decisions govern those payments.

Brunel then raised the issue of Gravatt's perception of his own status and responsibilities:

And now as regards yourself, some change must also take place, or rather a return to the more careful observance of the relative position in which we stand.

While acknowledging that some of the decisions and actions taken by Gravatt without reference to Brunel probably resulted from Gravatt's desire not to over-burden Brunel, there had been many cases where this principle led to 'inconveniences of various sorts.' In future Gravatt was to keep him fully informed on the state of the works, on disputes with the contractors, and on departures from agreed plans; in particular, in his dealings with the Directors Gravatt should avoid:

… advancing opinions upon new subjects until you have communicated with me & … bear in mind that upon me must ultimately fall in the event of any difficulties the responsibility of any acts either of you or your assistants and the failure of any plans whoever they may have originated with.

There is a hint here that Brunel suspected Gravatt of latent subversion. And, rather than correcting the generally held misconception about his standing in the B&ER, there is evidence elsewhere that Gravatt was in fact taking positive steps at this time to reinforce it. Under examination before the Commons Committee on the Parrett Navigation Bill (further powers) in March 1839 he was asked if he was the Resident Engineer of the B&ER. He replied, 'Yes, acting Engineer,' implying that he was performing a more responsible role than that of merely an assistant of Brunel's.¹ In a parliamentary brief that was prepared the following month in preparation for the Lords Committee on the same Bill, Gravatt's draft proof originally described him as being inter alia 'Resident

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¹ TPA HC/CL/PB/2/5/14, evidence taken before the Commons Committee on the Parrett Navigation Bill (further powers), William Gravatt, 15 Mar 1839, p.1.
Engineer for the Bristol and Exeter Railway'; the word 'Resident' was subsequently crossed out.¹

At the end of April the Board asked for plans and estimates for the bridge over the New Cut and for the Temple Meads terminus buildings, to be ready for their meeting on 10 May. In the event, Brunel had to tell them that their production had been delayed as Gravatt had been injured, and it was not until 17 May that Brunel presented two designs for the façade of Temple Meads station, 'one Gothic, the other Italian'; the Board preferred the former. At the same meeting the Board agreed that contract 1T, for constructing the New Cut bridge, should be immediately advertised.²

Meanwhile, in recognition of the Works Committee's inability to devote sufficient time to their task, and also perhaps as an indication of their waning confidence in Gravatt's capability and dependability, the Board resolved on 3 May to appoint a full-time Managing or 'Inspecting' Director:

… whose time shall be largely devoted to inspecting the Works, superintending the Affairs & constantly communicating with the Board on the General Business of the Company.

Their preferred nominee, Charles Bowles Fripp, was not a B&ER Director; instead, he was a leading GWR Director, and the B&ER Board's choice of him was governed to a large degree by their desire to strengthen their ties with their 'elder & more powerful ally,' the GWR. He was to be granted a seat on the B&ER Board as soon as a vacancy occurred, with a salary of £500 to be paid out of the Directors' compensation fund of £1,600 per year. Thomas Carlisle immediately offered to resign to make way for Fripp, who was elected to the Board on 10 May 1839.³

Fripp's appointment marked a step-change in the relationships between the Board and the engineering staff, and between the Board and the contractors; it also established an important primary source which has been extensively utilised during this part of the study, in the form of a remarkable series of 50 or so monthly progress reports which he presented to the Board between July 1839 and April 1844. The reports typically comprise a description and valuation of the work carried out on each contract since the

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¹ SRO D/RA 3/3/5/1, draft brief for the promoters of the Parrett Navigation Bill (further powers), draft proof of William Gravatt, undated [Apr 1839], p.52.
² TNA/PRO RAIL 75/3, Board Minutes, 26 Apr, 17 May 1839; TNA/PRO RAIL 75/64, Works Committee Minutes, 27 Apr 1839; notice inviting tenders: Felix Farley's Bristol Journal 25 May 1839. The Board preferred the Gothic design.
³ TNA/PRO RAIL 75/3, Board Minutes, 3,10 May 1839; TNA/PRO RAIL 75/49, Director's report to General Meeting, 27 Aug 1839.

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previous report, under the headings 'Earthwork' and 'Masonry,' with observations on the contractor's performance, and occasional thinly-veiled critical comments regarding the engineering staff. They contain information that would otherwise have gone unrecorded and uncommented or, if it had been recorded elsewhere, was later lost. The Board intended that Fripp's role should be a very pro-active one, and that is precisely how he set about it. For example, he quickly applied himself to resolving a long-running deadlock over the arrangements at the awkward crossing of the London Road at Bedminster. Whilst acknowledging Gravatt's assistance, at the end of May 1839 Fripp announced he had settled the matter to the mutual satisfaction of the company and the trustees, unfortunately without detailing the arrangements that had been agreed.¹

Gravatt's unexpected absence from a Board meeting on 18 June 1839 resulted in a reminder that he should always give them notice if he left Bristol. Brunel was also absent, but he had sent in a favourable report about the practicability and advisability of laying a single line of rails to Bridgwater in the first instance. At the same meeting the Board accepted Samuel Bromhead's tender of £8,200 for the New Cut bridge, contract 1T, and resolved that the bridge would be called 'Exeter Bridge.'² Bromhead commenced coffer-damming and excavating for the north abutment during the first week in July.³ Fripp's reports cover the whole of the construction phase of Exeter Bridge and provide much detail of the progress and problems encountered; by contrast, no contemporary evidence has been found relating to the consultation process and design phase leading up to the start of construction, there are no specific protective clauses in the B&ER Act and there is little reliable evidence relating to such fundamental data as the dimensions, form and shape of the bridge. Writing in 1870 I. Brunel described it as a large single span masonry arch bridge, having a 120ft. span and 20 ft. rise.⁴ These leading dimensions match those written on an undated, untitled, unsigned and unfinished drawing at NRRC. This shows, in half elevation and half longitudinal section, a bridge with a voided segmental arch, carried on timber-piled foundations; the architectural style and constructional details are similar to those portrayed on the drawings of Somerset Bridge.

¹ TNA/PRO RAIL 75/3, Board Minutes, 31 May 1839.
² Ibid, 18 Jun 1839; Osborne & Ward to Gravatt, 20 Jun 1839: BRO 12167/33. The unsuccessful tenderers were: Isaac Brown & Son, £8,350; R. & G. Hill, £10,774; Henry James, £12,000; Wilkins & Honeycombe, £22,284 17s. 9d. Brunel's earlier 'rough estimate' for the bridge was £8,000: BUL DM 162/25, Brunel's 'General Calculation Book,' pp.52-53, undated [circa Dec 1835].
³ TNA/PRO RAIL 75/158, Fripp's report, 16 Aug 1839.
⁴ Brunel I., op.cit., p.175.
In 1871 Robert Brereton was clearly referring to Exeter Bridge when he gave details of 'a large railway segmental arch of 120 feet span, with a rise of 1/5th [ie. 24ft.] … built in the year 1841.'\footnote{Brereton R.P., in discussion of: Gaudard J., 'On the Theory and Details of Construction of Metal and Timber Arches' Minutes Proceedings Institution Civil Engineers Vol.31 (1871), pp.158-159.} A commentator in 1842 said of the bridge, 'Though I do not admire a segmental arch, where, I think, a semi-ellipse would have been far preferable, it is a very neat structure.'\footnote{Taunton Courier 12 Jan 1842.} Although all these sources agree that the arch was segmental, none of them describe its actual geometrical profile and there are no clues on the NRRC drawing; the presumption would be that the profile was a circular segment. On the other hand, John Binding has described Exeter Bridge as 'a handsome single arch of an unusual form – two sections of an ellipse meeting in a just perceptible point,' but the reference he has cited for this information, namely an article in the Great Western Railway Magazine, makes no mention of the geometrical profile of the arch. It is possible that Binding was actually describing the GWR bridge over the Avon just downstream of Netham weir of which he included an illustration and which appears to be consistent with his description.\footnote{Binding J., op.cit., pp.16, 120; Shackle C.E., 'Interesting Bridgework on the Bristol (Temple Meads) Improvement Scheme' Great Western Railway Magazine (1935), p.643.}

By June 1839 William Froude was working in the Bristol office, all work at the Exeter end of the line having been suspended.\footnote{Osborne & Ward to William Froude at 'Bristol & Exeter Railway Office, Coronation Road,' 15 Jun 1839: BRO 12167/33.} The following month Fripp complained to Brunel about the attitude and behaviour of Gravatt's two other assistant engineers, England and Peniston. He asked Brunel to dismiss England for acting, or at least appearing to act, disrespectfully to the Directors. Brunel replied on 9 July 1839, in a very ingenuous and revealing letter, that he had already considered dismissing England, but had concluded that his fault was one that was common among the assistants: 'He is too apt to think the feeling of independence is shewn by an abrupt way of talking & acting, which Directors might misconstrue.' However, if the Board wished, he could see no real objection to England's dismissal but, in the event, England stayed on. The antipathy between Hemming and Peniston was Fripp's other concern. Brunel had tried unsuccessfully to find out what Hemming's complaint about Peniston actually amounted to, and he considered that Hemming himself was guilty of:
… great provocation, repeated neglect of orders [and] a very loose way of speaking amounting practically, though not I think premeditatedly, to frequent falsehoods.

Peniston's fault was another one common among even the 'best assistants'; he had 'failed in softening down … [so that] when strong measures have been necessary he has not taken pains to prevent them appearing harsh.' Brunel felt there was little point in replacing Peniston unless Hemming came up with a tangible complaint. He accepted that his letter to Gravatt had not had the desired effect, and he would have to take up the matter again:

… and rather more strongly. It is exactly the subject which gives me more trouble than even conducting the works: the management of my assistants. I cannot explain my feelings better to you than by sending you a copy of my last letter to Gravatt about it – this you will have the goodness to consider as private.

This 'last letter to Gravatt' was presumably that of 15 April 1839, as its contents are relevant. Brunel's openness with Fripp placed Gravatt in a potentially very difficult position: Fripp would now be aware of Brunel's perception of Gravatt's faults and shortcomings. Brunel concluded his letter with the news that he had induced William Chadwick, another GWR contractor,\(^1\) to tender for building the Axe bridge.\(^2\) The transfer of this contract was to form part of the arrangement for accelerating the works that Brunel and Hemming had begun negotiating in April 1839. Chadwick's tender for completing the works by 15 April 1840 was accepted at a Board meeting on 19 July 1839.\(^3\)

Fripp's first report, dated 10 July 1839, was tabled at the same meeting.\(^4\) It was in effect a status report and thus gives a good indication of progress up to that date on the contracts that were then underway. Earthworks on Hemming's four contracts were generally proceeding 'with regularity and speed' with the exception of the big cuttings at Ashton and Uphill. Twenty nine bridges were completed or under construction,

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\(^1\) TNA/PRO RAIL 1149/44, Tenders for GWR contracts, passim. The GWR Maidenhead Bridge, Chadwick's most celebrated GWR contract, was opened to rail traffic on 1 July 1839.

\(^2\) Brunel to C.B. Fripp, 9 Jul 1839; BUL PLB 1.

\(^3\) TNA/PRO RAIL 75/3, Board Minutes, 19 Jul 1839. Chadwick's tender sum was not disclosed in the Board minutes, but from later evidence it appears that he offered to carry out the work for £8,150 if using lime mortar in the masonry, or for £8,746 using cement: TNA/PRO RAIL 1149/13, Brunel's 'Volume of Facts,' undated [c.1840], p.147. Brunel's earlier 'rough estimate' for the bridge was £4,000: BUL DM 162/25, Brunel's 'General Calculation Book,' pp.52-53, undated [circa Dec 1835].

\(^4\) TNA/PRO RAIL 75/158, Fripp's report, 10 Jul 1839.
including three flying bridges. Nothing material had been done on Bromhead's contracts 1B and 2B, but piling was underway at Somerset Bridge, Bromhead's contract 4B. Edwin Down was progressing well on 3B and Fripp remarked on the excellent work apparent in the six bridges under construction there. He commented that all the 'Levels' bridges required:

... approaches of considerable magnitude, which are being formed from side-cutting ... The construction of these Bridges over the Railway upon a dead level, is a very heavy charge, in consequence of the expensive approaches which they require'.

Hemming defaulted in paying a sub-contractor working in the Uphill cutting at about that time. Fripp and Brunel used this dispute as an opportunity to persuade Hemming that he should 'voluntarily' relinquish the whole of contracts 3A and 4A, except for some minor unfinished earthworks near Yatton; Hemming sent in a proposal to that effect on 30 July. Fripp's hope was that the works could be re-let as one package to a respectable contractor:

Almost any alternative however is preferable to that of leaving them to be prosecuted with the same irregularity & lethargy that have lately checked their progress.

In the meantime the company employed direct labour to maintain progress in the works.¹

Major changes in the design of Somerset Bridge had been made in the twelve months between the contract being signed in July 1838 and Fripp's report in July 1839. Fripp reported that both coffer-dams were complete and that piling was almost complete for the south foundation and would soon be commenced in the north coffer-dam. This is the earliest dated reference to piling at Somerset Bridge that has been found. Based on Bromhead's subsequent progress with piling on the north side, it seems reasonable to assume that it would have taken at least two months of piling operations to get to the stage as reported on by Fripp, and the decision to change from spread foundations to piled foundations must therefore have been taken in the spring of 1839 at the latest. The reason for the change from spread to piled foundations was not stated.

Fripp went on to report that, as the piling progressed in the south coffer-dam, a first layer of balk timbers was laid over the piles and infilled with concrete. A second layer of balks, laid at right angles over the first to form a grillage, was completed in time for a foundation-stone-laying ceremony at the end of July 1839. The Directors did not

¹ TNA/PRO RAIL 75/158, Fripp's reports, 10 Jul, 16 Aug 1839; TNA/PRO RAIL 75/3, Board Minutes, 2 Aug 1839.
publicise this potentially momentous but, in the event, low-key ceremony as they felt that it would otherwise attract an undesirably large number of Bridgwater residents, to whom, according to the *Somerset County Gazette*, 'the rapid progress of the works near [the] town is now become a matter of great interest.'\(^1\) Gravatt was conspicuously absent from the foundation-laying ceremony; it was his assistant, John England, who joined the Directors to give 'a parting blessing' to the foundation stone, when Fripp gave the assembled staff and workmen an appropriate address, concluding with a sincere hope that:

… the work now commenced might be brought to a successful issue, without loss of life or accidents, and that the workmen would maintain good order and union amongst themselves.\(^2\)

The Directors' report to the General Meeting on 27 August 1839 was another subdued affair. They acknowledged that many causes beyond the control of themselves and Hemming had resulted in further delays – not just the unusually wet summer but also the unexpectedly poor state of the ground in several of the cuttings, which necessitated flatter side-slopes. Although the works were being constructed sufficiently wide for a double line of rails, for the time being they proposed to lay only a single line to Bridgwater; the cost savings would go some way towards extending the line to Taunton. They then moved on to explain their motive for appointing Fripp:

… as the most effectual means of securing that exact and timely knowledge of the condition of every part of the Works, which can only be attained by constant personal communication with the Engineer and other executive officers of the Company … Looking to the great importance of every week that can be saved in completing the Works, and in making the Line productive, the Directors feel assured the appointment of one of their Body to the special duties of an Inspector is a measure of true economy.

C.E. Bernard, a major shareholder, fiercely disagreed. He asked what Fripp's duties were to be:

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\(^1\) *Somerset County Gazette* 3 Aug 1839. Curiously, various dates are quoted for the ceremony: Fripp, who laid the stone in the presence of two other Directors – William Browne and John Browne – gave the date in his monthly progress report as 23 July; the minutes of the Board meeting on 2 August stated 26 July; while the *Somerset County Gazette* and the *Bristol Journal* gave 30 July: TNA/PRO RAIL 75/158, Fripp's report, 16 Aug 1839; TNA/PRO RAIL 75/3, Board Minutes, 2 Aug 1839; *Somerset County Gazette* 3 Aug 1839; *Bristol Journal* quoted in *Civil Engineer & Architect's Journal*, Sep 1839.

\(^2\) *Somerset County Gazette* 3 Aug 1839.
Was he to inspect the directors, or control the labourers, or interfere with the contractors? If they could not trust their engineers let them get rid of them. (Cheers from the lower end of the room) … There was no power in the act by which the directors could make an appointment, and he should take the opinion of the meeting as to the propriety of taking such a course (Hear, hear).

Bernard was particularly riled by the Board's decision to grant Fripp a salary of £500. He went on to ask for the relative costs of a single and a double line to Bridgwater, and the same to Taunton. Brunel refused to give estimated costs as he felt it was imprudent to do so at that stage; Frederick Ricketts, the chairman, supported Brunel's refusal but added that the single line to Bridgwater would save at least £90,000. The meeting debated these and similar issues for a considerable time; finally Bernard conceded that the general feeling was against pursuing the discussion further, and he withdrew his objection.¹

The Board once again reminded Gravatt that his attendance at their meetings was always expected, after he failed to turn up on 13 September 1839. Brunel sent a message to say that an important report on the cost-saving possibilities of altering the gradients along part of the line was not ready, 'in consequence of Mr. Gravatt having been unexpectedly detained from home.' It is not clear whether Gravatt was the main author of the report or merely assisting Brunel. Whatever the case, Gravatt took the Board's admonishment badly: evidently he wrote to explain the cause of his absence and to raise the issue of their confidence in himself; probably he had detected a veiled criticism in the Board's reminder. Badham was instructed to respond that the Board readily accepted his explanation – they had simply intended to lay emphasis on their previous instructions that his attendance was specially required on this particular occasion and:

…in transmitting this communication to Mr. Gravatt it is the desire of the Board to assure him of their continued high estimation of his services.²

Brunel reported a week later on the gradient alterations. The Board considered it was momentous enough to call a special meeting on 27 September 1839, at which it was resolved that the line through the Ashton cutting should be steepened to 1 in 200.³ The report has not been found and the Board minutes gave no details of the issues debated during the special meeting, so one can only speculate about the reasons that led Brunel to recommend that the gradient should be steepened. Reference has already been made

¹ TNA/PRO RAIL 75/49, Minutes of B&ER General Meeting, 27 Aug 1839; Taunton Courier, 4 Sep 1839.
² TNA/PRO RAIL 75/3, Board Minutes, 13,20 Sep 1839.
³ Ibid, 20,27 Sep 1839.
to a later observation he made when discussing the reduced costs of working a line which had been made 'as perfect as a bowling-green': that the savings might be 10 or 15 per cent, which he felt was sufficient reason for the B&ER Directors to have sanctioned reducing the gradients at Ashton in 1836.1 Now, in 1839, he was recommending steepening them, with the net effect of reduced construction time and costs but increased working costs. Certainly the immediate savings would be a great boon; indeed Fripp was pleased to report in October 1839 that Hemming was confident he could complete what remained to be excavated west of the Cambridge Batch tunnel in six or eight weeks if the gradient there was fixed at 1 in 200.2

Fripp's hope that contracts 3A and 4A could be re-let as one package proved fruitless and in September 1839 tenders were sought for individual works. The two most significant works were the Uphill cutting which was let to Robert Chesterfield, and 'Devil's Bridge' which was let to William Nash.3 This is the earliest known reference to 'Devil's Bridge'; it refers to the flying bridge intended to carry the Bleadon Road across Uphill cutting, near the paddock which featured in 'Devil' Payne's dispute with the B&ER. It was, and still is, called 'Devil's Bridge' both locally and on O.S. maps, but soon became 'Bleadon Road Bridge' or 'Uphill Bridge' in B&ER records.4 No contemporary drawing of the bridge has been found but a span of 115ft. 6ins. has been quoted,5 which is long enough to suggest that the generic intrados profile rules adopted for the other flying bridges are unlikely to have been applied here.

By the time Fripp presented his fourth report in October 1839 the Bourton Lane flying bridge was almost complete and several other flying bridges were under construction; none of the Ashton cutting flying bridges had been started but, according to Fripp, Hemming had expressed his readiness to begin them 'as soon as the Engineers

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1 Bristol Mercury 4 Sep 1841.
2 TNA/PRO RAIL 75/158, Fripp's report, 24 Oct 1839.
3 Ibid, 12 Sep, 24 Oct 1839. John Holmes, Uriah Gooder and Robert Smith were the contractors for the other bridges.
4 For example, in an address to the Somerset Archaeological & Natural History Society in 1905, J.R. Bramble noted:

> There is a considerable upheaval of igneous 'trap' in the cutting at Uphill. But this has no reference to the popular name of the bridge over this cutting – the 'Devil's Bridge.' I learn on excellent authority that a much more modern individual, who some sixty years ago was a great opponent of the Bristol and Exeter Railway, is entitled to this honor:

can determine their position,' perhaps a veiled criticism of Gravatt's tardy performance. More of the 'Levels' bridges were underway, and piling was just about to start at the Axe bridge. Earthworks generally were being delayed by heavy rain, but Chesterfield was progressing steadily at the Uphill cutting.\(^1\) The Bleadon Road crossed the cutting towards its southern end, effectively dividing it into two discrete and unconnected cuttings, separated from each other by a block of unexcavated material supporting the road until Devil's Bridge could be built and the road diverted over it. Very little fill was required along the line to the north – the low embankments that were within reasonable carting distance were already being constructed from side cuttings. On the other hand, large quantities of material were required a mile or so south of the cutting for use in embanking around the Axe bridge and for forming a base for the proposed wharves there. The company acquired land adjacent to the Uphill cutting on the north side of the Bleadon Road in which to dispose of surplus spoil arising at that end.\(^2\) Other temporary spoil banks were made in the northern end of the cutting itself, until the bank carrying the Bleadon Road could be removed and the material could then be waggoned down to the Axe.

In mid-November John England's office-cum-residence was relocated from Uphill to Bridgwater.\(^3\) At the same time, an up-beat item appeared in the *Somerset County Gazette*, no doubt as part of an exercise to bolster public confidence in the B&ER's intentions, reporting that Gravatt, 'the talented Engineer of the [B&ER] Company', had visited Taunton during the previous week to inspect the proposed line from Bridgwater to Taunton, 'which is to be set out and completed forthwith.'\(^4\) This assertion was a little premature, as it would be another six months before the Board instructed Brunel to set out the line. Following quickly on the heels of this, in early December 1839 Gravatt was once again exhibiting symptoms of the 'great fault' that Brunel had identified in him during the Thames Tunnel years – namely his hurt pride. The cause of the problem is not stated, but it may have been connected with the reproof he received for missing the September Board meeting; the nearest Brunel gets to describing it is in a letter to Fripp which makes reference to:

\(^1\) TNA/PRO RAIL 75/158, Fripp's report, 24 Oct 1839.
\(^2\) During October 1839 a temporary bridge was erected over the Uphill to Banwell road at a sufficient height that a deep spoil bank could be formed in a plot of glebe land that was detached from the other acquired plots: TNA/PRO RAIL 75/158, Fripp's report, 24 Oct 1839.
\(^3\) TNA/PRO RAIL 75/3, Board Minutes, 15 Nov 1839.
\(^4\) *Somerset County Gazette* 16 Nov 1839.
… the indirect effect of the opinion which [Gravatt] assumes to be entertained by Badham … unquestionably the little source of irritation does exist, & tho’ it would not annoy me, to a man of his constitution it is most trying.¹

Brunel told Gravatt he had heard that Gravatt had made:

… a direct communication to the Directors, the exact object of which I cannot correctly gather from yourself but which … did amount to this, that from some circumstance or other, the position in which you were placed was not such as you wished it to be, & that although you did not resign, you wished the Directors to, or suggested to the Directors that they should, dismiss you.

As far as Brunel was concerned, the 'peculiar difficulties and annoyances which you fancy surround & beset you' were imaginary. Brunel told Gravatt he had three options. Firstly, if he considered his declaration to the Directors was unjustified, then his duty was clear – he should withdraw it and express his regret at making it. Secondly, if he still wished to be dismissed, and would state the grounds of his complaint, then Brunel would support him by insisting on a full enquiry:

… but remember it will be done with the painful conviction on my mind, that it will appear that you have suffered your imagination to magnify ordinary difficulties & ordinary annoyances, till they have appeared insupportable & thus have in fact created that which you complain of.

Or thirdly, if he still insisted on dismissal but would not state the reasons clearly, then Brunel would take the lead: ‘I must if necessary prevent the Directors from passing the matter by in silence.’ Brunel described the third option as ‘a suicidal act’:

I tell you that I think you would be committing a most unprofessional act, & sacrificing your duty to the Compy to me & to yourself, entirely to feelings … which I … consider quite improper to be indulged in. I think you would injure yourself seriously, that you have placed yourself quite in the wrong … and would leave not merely without credit but with all the evils of unexplained & imprecise circumstances, and this at a moment when the profession is overfilled, and numbers of talented men compelled to seek for employment.

Naturally, Brunel recommended the first option and it is evident that Gravatt withdrew his request to be dismissed.² Regrettably, not only is the cause of the problem not stated, but Gravatt’s reaction and response are also not recorded. Brunel’s warning that the profession was ‘overfilled’ was corroborated a year later by the President of the ICE (see Appendix 1).

¹ Brunel to C.B. Fripp, 3 Dec 1839: BUL PLB 2a.
² Same to Gravatt, 3 Dec 1839: BUL PLB 2a.
In mid-December Fripp reported that appalling weather conditions were causing delays in the earthworks and bridge works, adding that he was unable to view the works between Uphill and Highbridge due to the sodden ground conditions. Exeter Bridge and Somerset Bridge were particularly badly affected by river floods. In this and two later reports Fripp again singled out for praise the quality of Edwin Down's bridge work on contract 3B; Gravatt's familiarity with Down's performance on 3B was doubtless the reason he was invited in February 1840 to tender for the construction of Langport Bridge on the Parrett Navigation (see Chapter 7).¹ Fripp also noted that two large slips in the Pylle Hill cutting near the London Road would make it necessary to 'lighten the upper part of the slope'; further evidence of the unexpectedly poor state of the ground in some of the cuttings. That the ground conditions should now be found adverse and necessitate flatter side-slopes seems to be an admission of something bordering on incompetence, and indeed this was an issue that Gravatt would raise later. Ominously, Fripp reported that the abutments of one of the 'Levels' bridges were settling.² This was the first sign that all was not well with the choice of design for the road bridges on the Levels.

B&ER and GWR sub-committees opened preliminary negotiations on 18 December 1839 regarding leasing the line. They were told that a single line could be opened from Bristol to Bridgwater in August 1840 at an estimated cost of £700,000; a single line extension to Taunton might be completed in the summer of 1842. Doubling the line to Bridgwater would cost an additional £112,000.³ On 18 January 1840 Brunel formally reported his views on single line working to the GWR Board. He stressed at the outset that neither the advantages nor the disadvantages could be accurately assessed or even compared by a common standard, but whatever the case:

> I assume that whatever advantage the Bristol & Exeter Railway Company may derive by a Postponement of Expenditure upon the part of the Line which may insure a more early extension & completion of the whole Line will be indirectly felt to an equal extent by the Great Western Railway Company.

¹ 'The abutments of [Puriton Drove] Bridge are a beautiful specimen of work': TNA/PRO RAIL 75/158, Fripp's report, 12 Dec 1839; 'Bath Road Bridge ... is a very handsome piece of work & its execution is highly creditable to the Contractor': ibid, 23 Jan 1840; 'River Brue Bridge ... Like all the rest of Mr. Downe's [sic] masonry, it is both a substantial & handsome piece of work': ibid, 12 Mar 1840.
² TNA/PRO RAIL 75/158, Fripp's report, 12 Dec 1839.
³ TNA/PRO RAIL 250/82, memorandum of conference, 18 Dec 1839. The B&ER sub-committee had met for the first time on 30 December 1839 'to investigate the Traffic & other matters': TNA/PRO RAIL 75/3, Board Minutes, 29 Nov 1839.
He felt the disadvantages fell into two classes – one real, such as the operational limitations on the speed and number of trains for safety reasons, and the consequential difficulties of timing the trains to meet GWR connecting trains at Bristol or to run through Bristol onto the GWR; and the other 'imaginary,' such as a public prejudice against the perceived dangers and the expectation that journeys would be subject to long delays:

... a prejudice which it would be the Interest of so many to foster – Coachmen, Inkeepers & even other Railway Proprieters, whose present business might be injured or destroyed by the opening of this Line.

The disadvantages would be much lessened if the B&ER line were to be worked as an extension of the GWR, rather than as a branch. However, the form of junction between the two lines at Temple Meads had still to be determined.¹

During January 1840 a second 'Levels' bridge showed symptoms of subsidence. By that time a heading was at last being driven for the Cambridge Batch tunnel; a disheartening consequence of the decision to alter the gradients of the line was that parts of Ashton cutting were now being back-filled. While reporting these events, Fripp noted that a good opportunity now existed for getting the centres for Devil's Bridge made under Peniston's direction; he then added, perhaps tellingly, '... but he has not yet got the plan of them.'²

In March 1840 the Directors were compelled to report that construction was several months behind programme due to the combination of atrocious weather and the inability of many shareholders to meet the heavier calls during the current financial depression. The Directors sought the sanction of the General Meeting to resume the leasing negotiations with the GWR; Brunel's latest estimate for finishing a single line to Bridgwater was now £720,000, and a double line £800,000. Following a heated discussion, a motion was passed unanimously in favour of a proposal that the Board should proceed with the negotiations and submit the agreed terms to the shareholders for sanction.³ During the discussion Thomas Coulson asked the Chairman if Gravatt had applied to him 'for power to enable him to put more men on the Ashton cutting,' before launching into a criticism of the Board's decision to appoint a salaried Managing

¹ TNA/PRO RAIL 250/82, Brunel's report to the GWR Board, 18 Jan 1840.
² TNA/PRO RAIL 75/158, Fripp's report, 23 Jan 1840.
³ TNA/PRO RAIL 75/50, Minutes of General Meeting, 3 Mar 1840.
Director. This led Brunel to suspect that Gravatt might somehow have been behind Coulson's actions and was acting subversively again.¹

By the time Fripp reported in mid-March 1840, the line was in a drier and sounder state than he had ever seen it and as a result progress had generally been steady. Brunel and McAdam had agreed the form and alignment of a bridge for crossing the Bridgwater Road at Bedminster and Fripp now implied that Gravatt was being dilatory in getting out tenders for a temporary bridge: 'The matter rests entirely with the Resident Engineer.' However, it seems likely that Gravatt had been biding his time while he prepared a more favourable scheme; he met the Bristol trustees in early April to discuss an amended arrangement for the permanent bridge, which the B&ER Board adopted the following day.²

The four small contractors for the bridges on the former contracts 3A and 4A failed one by one. On 20 March 1840 selected contractors were invited to tender for constructing Devil's Bridge, conformable with drawings Gravatt had shown the Board that day; presumably these drawings were necessary because the bridge details had been altered since contract 4A had been let, probably as a result of re-assessing the ground conditions at the cutting. The contract was let in July to William Chadwick who had tendered in the sum of £2,350. The 'Levels' bridges were let to various small contractors in early May.³ The two bridges showing signs of settlement were taken down almost immediately, to be rebuilt in brick as before. Virtually all the 'Levels' bridges along the line were under construction by mid-June, when Fripp reported that two more were settling and many of the approach ramps were starting to slip:

¹ Taunton Courier 11 Mar 1840. Brunel had asked Gravatt to meet him at 5am on the morning of the meeting:

Got up at ¼ 5 - Gravatt did not come to 6 - wrote my B&E report - attended Board at 9½ - then general meeting at 12 - all tolerably quiet except Tom Colston [sic] foolery asking some silly questions which told a tale of no good wish to me, a bad feeling toward Fripp and a strange symptom of communication with Gravatt - perhaps mere impudence on the part of G - but - :

BUL PriD 4, Brunel's Private Diary, 3 Mar 1840.

² TNA/PRO RAIL 75/158, Fripp's report, 12 Mar 1840; TNA/PRO RAIL 75/3, Board Minutes, 3 Apr 1840. The permanent bridge had been set out by Gravatt's assistants by the end of April 1840, and the foundations were being dug a month later: TNA/PRO RAIL 75/158, Fripp's reports, 23 Apr, 22 May 1840.

³ TNA/PRO RAIL 75/3, Board Minutes, 20 Mar, 24 Apr, 1 May, 26 Jun, 3 Jul 1840; TNA/PRO RAIL 1149/13, Brunel's 'Volume of Facts,' undated [c.1840], p.147.
Whether the damage will extend further or not, it seems impossible to foresee, but there can be no doubt it would have been prevented had the Bridge Pits been excavated at a greater distance from the Ramps.¹

In May 1840 the Board directed Brunel to set out the line to Taunton. Gravatt completed the property plans between Bridgwater and Taunton by mid-July and Brunel was then instructed to set out the rest of the line to Exeter.² On 22 July, as Gravatt began designing the works and preparing the documents for the contracts to Taunton, Fripp alerted Brunel to some indiscretions on Gravatt’s part which this time bore clear signs of subversion and lobbying against Brunel. Gravatt had privately disclosed to certain Board members his views and opinions on ‘important engineering questions’ which cast doubt on the ‘correctness’ of Brunel’s views; he had backed up his statements with data and calculations. Brunel immediately asked for a special Board meeting to be called on 25 July to enquire into the matter and he asked six particular Board members to bring with them any information that Gravatt had given them.³ The next day Brunel wrote, in a letter in which the first two words of the original opening, ‘My dear Gravatt,’ have been meaningfully crossed out (in the copy at least), that unless the allegations were completely untrue then they must entirely destroy Brunel’s confidence in him. From what he had heard, Gravatt’s views and opinions differed very much from his own which, according to Brunel, had been settled by the Board as forming ‘part of the plan of construction’ of the B&ER:

In this there might be nothing extraordinary but that connected as we have been as intimate friends of long standing, acting as my assistant in this concern for 4 or 5 years, constantly at my side when these subjects have been discussed in public or at the board, that you should never have hinted to me that you differed and that I should hear of it now for the first time and indirectly is extraordinary.

He was astonished that it appeared Gravatt was now putting forward figures and calculations which he must have known differed from Brunel’s own, that he had asked for no information on a subject on which he was ignorant, and that he had not openly addressed the whole Board:

Can this be true? Is it the conduct of a friend, of a gentleman, of a subaltern trusted & confided in by the man above him?

¹ TNA/PRO RAIL 75/158, Fripp’s report, 25 Jun 1840. In this instance Fripp used the term ‘bridge pits’ in reference to the pits from which the material that was deposited into the ramps was excavated; elsewhere in his reports he used it to refer to the foundation excavations.
² TNA/PRO RAIL 75/3, Board Minutes, 22 May, 10,17 Jul 1840.
³ Brunel to unnamed Directors, 22 Jul 1840: BUL PLB 2a.
If it were merely himself who was involved he would submit to the insult; but as it affected B&ER affairs he must insist that the Board enquire into the matter immediately. In doing so, he felt he was giving Gravatt every advantage; he was himself comparatively uninformed and could have delayed approaching the Board until he had collected sufficient supporting evidence:

… but I could not keep up the appearance of friendship & intimacy while secretly engaged in collecting evidence against a man.

He concluded his letter with an interesting reference to the permanent way:

I was on the line yesterday and have much to say to you, as there appear to me many grounds of dissatisfaction, some of which you c'd probably remove by explanation, amongst them was the singular state of the proposed piece of permanent way at Uphill.¹

By this time over a mile of the line between the uncompleted Uphill cutting and the Axe bridge had been ballasted and all the timbers and rails for framing and laying the permanent way had been delivered to the site. Fripp reported that Gravatt had laid a temporary railway so that spoil from the cutting could be waggoned to the Axe for use in embanking the river and forming a base for the proposed wharves but:

… as the temporary rails have been laid partly on the west & partly on the east side of the road, the permanent way cannot at present be proceeded with.²

Brunel and Gravatt attended the special meeting on 25 July 1840. The Board resolved unanimously that they wished to express their unshaken confidence in the principles recommended by Brunel for constructing the line. In a unanimous show of support for Brunel, and by implication a censure of Gravatt's underhand actions, they deemed 'unity of action & cordial co-operation throughout his department to be indispensable.'³ The Board gave no instruction to Brunel on how he was to ensure 'unity of action' but there is a strong presumption that they expected him to dismiss Gravatt. However, in a letter written ten days later Brunel recommended to the Board what he called a 'less decisive' course of action. He acknowledged that his confidence in Gravatt was destroyed and that he could place no reliance on Gravatt unless that confidence was

¹ Brunel to Gravatt, 23 Jul 1840: BUL PLB 2a, emphasis as in the original.
² TNA/PRO RAIL 75/158, Fripp's reports, 25 Jun, 24 Jul 1840. By mid-September the framing of the timbers for a single line of permanent way was almost complete over this length, and the rails were about to be laid, so the temporary arrangement must have been short-lived: ibid, 18 Sep 1840.
³ TNA/PRO RAIL 75/3, Board Minutes, 25 Jul 1840.
restored. He therefore proposed to limit Gravatt's construction supervision duties to completing the line to Bridgwater, 'exclusive of the permanent way':

As regards the superintendence of the laying the permanent way, it will not surprise the Directors that I should consider it essential to have some person whose wishes & opinions are known to be connected with the successful result of his work, and as this work even upon the Great Western Railway has been superintended by district assistants, though under the resident engineer, the only difference that I should propose on the Exeter will be that such assistants should act more immediately under myself.

The line to Exeter could be set out without Gravatt's assistance; indeed, he had found that it was more economical to contract out the work to surveyors accustomed to setting out:

… while in the final examination of the ground & the selection of the line & determination of the works &c. I am not in the habit of trusting anybody.¹

Brunel copied this letter to Gravatt with the expressed hope that Gravatt would:

… adopt a totally different course in future … although I fear that other feelings & particularly a vanity almost incapacitating you from occupying the place of second to any man have been too powerful.

By proceeding as Brunel had proposed, Gravatt's assistants need know nothing. Brunel stressed that he was most anxious for Gravatt to superintend the completion of the line to Exeter 'if … you shall have regained the whole or a portion of the confidence I formerly placed in you':

It must be understood for the present, that you give your word that you will neither directly or indirectly, either by your Acts or by the mode of omitting to act, express opinions or raise doubts against me or my views ... and that you will serve me faithfully according to my actions of fidelity – and if you find you cannot or think you ought not to do what I require, you will tell me so.

He subscribed himself, 'Your sincere well wisher.'² As in so many other instances, it is regrettable that evidence of Gravatt's reaction and response has not been found. Suffice at this stage that Gravatt continued to act as Resident Engineer.

Work on the Pylle Hill cutting had been temporarily suspended in May 1840 while Brunel settled terms with Hemming for carting the spoil to the site of the B&ER station at Temple Meads. As Hemming began excavating again in July the side-slopes

¹ Brunel to the B&ER Board, 4 Aug 1840: BUL PLB 2a. The letter was read at the Board meeting that day: TNA/PRO RAIL 75/3, Board Minutes, 4 Aug 1840.
² Brunel to Gravatt, 4 Aug 1840: BUL PLB 2a, emphasis as in the original.
showed further signs of slipping and in October he was directed to flatten the slopes considerably. The London Road bridge was finished and opened to traffic by the time Fripp reported in September 1840. By then, Chesterfield had united the two parts of Uphill cutting by tunnelling through the bank supporting the Bleadon Road. Devil's Bridge would cross the cutting about 100yds. south of the old road, and platforms of material had been left unexcavated on which the centering for the flying bridge was now being erected. Bromhead had only just commenced turning the arch of Exeter Bridge.1

Brunel's report to the General Meeting on 2 September 1840 was a fine display of optimism, concluding with a confident assertion that the line would be opened to Bridgwater by April 1841 at the latest. The meeting itself was a particularly animated affair as the Directors reported on the outcome of their discussions about the leasing arrangements with the GWR. The majority of the Directors were said to be in favour of accepting the terms provisionally agreed on, which would run from the opening date of the line to Bridgwater until five years after the opening to Exeter. The B&ER would undertake to lay a double line from Bristol to Exeter and a single line along the Weston branch; in return the GWR would lease the line for £30,000 a year and pay a toll of a farthing a mile for each passenger or ton of goods in the first instance, with proportionate increases as the line extended. The supporting faction pointed to the B&ER's current difficulty in raising capital; it might be five years before they could complete the line unaided, whereas the lease would enable them immediately to 'get command of money.' Their opponents argued that the projected traffic figures produced in the B&ER's early days demonstrated that it was financially sounder and more profitable to persevere alone. In Fripp's view they were now in a dilemma: if the traffic figures were right, the lease ought not to be accepted; if they did accept the lease, they showed their traffic figures could not be relied on. For himself, he had no hesitation in stating that the figures could not now be supported: like other railway companies, 'the Bristol and Exeter had fallen into the error of over-estimating their strength.' With no consensus in sight the meeting was adjourned; the agreement was subsequently confirmed on 29 September by a majority of more than the requisite three-eighths.2

In November 1840 Bromhead was awarded contract 3T, the 'Temple Meads Viaduct' which would carry the short length of line across Temple Meads to the junction with the GWR. The plans for the viaduct itself were not ready despite the eagerness of

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1 TNA/PRO RAIL 75/158, Fripp's reports, 22 May, 24 Jul, 18 Sep, 22 Oct 1840.
2 Taunton Courier 9 Sep, 7 Oct 1840.
both the Board and Bromhead to get on with construction. In the event it was not until March 1841 that Brunel reported he had given Bromhead the necessary instructions for proceeding with the work.\footnote{Taunton Courier 26 Nov, 31 Dec 1840; TNA/PRO RAIL 75/64, Works Committee Minutes, 6 Mar 1841. The Board had asked Brunel for comparative estimates of the cost of embankment and viaduct alternatives as long ago as January 1840: TNA/PRO RAIL 75/3, Board Minutes, 24 Jan 1840.} Progress on Exeter Bridge and Somerset Bridge had been very slow, and it was not until December 1840 that both arches were finally keyed-in. In the event, a land-arch was built behind each abutment of Somerset Bridge, serving as towpath bridges under the line and thus removing the necessity for a piled towpath under the main arch.\footnote{TNA/PRO RAIL 75/158, Fripp's reports, 25 Jun, 24 Jul, 31 Dec 1840.} Elsewhere, completion of the Uphill cutting had been seriously compromised by delays in getting construction of Devil's Bridge underway, due to frost and a shortage of building stone. As a precaution, a temporary bridge for the Bleadon Road had been erected by December 1840 so that the supporting bank could be excavated and the slopes trimmed off. From October 1840 about 240 waggon-loads of spoil were transported every day from the temporary heaps in the cutting to the Axe where it was tipped on both sides of the bridge in an attempt to form the railway embankment, to stabilise the river bed and banks, and to raise flood banks. By the end of December 1840 30,000 cu. yds. had been tipped but according to Fripp:

... the subsidence of the embankment is so great that although upwards of 2,000 cu. yds. per week are tipped in, there is little apparent progress in the work. As the weight of the embankment increases, the alluvium of the river channel is more & more pressed out, & this process must go on until a new bed is formed by the material injected.\footnote{Ibid, 22 Oct, 26 Nov, 31 Dec 1840, 29 Jan 1841.}

All the 'Levels' bridges were now under construction or completed. More of them began to show signs of settlement, prompting Fripp to call the Board's attention to the manifest unsuitability of this type of masonry arch design on the Levels and to recommend the substitution of a lighter, more flexible form of construction.\footnote{Ibid, 31 Dec 1840.}

Tenders for the contracts between Bridgwater and Taunton were advertised in February 1841 (Table 3.3 and Map 3.5).\footnote{Notice inviting tenders, dated 5 February 1841: Taunton Courier 17 Feb 1841; TNA/PRO RAIL 75/159, Fripp's reports, 13 May, 18 Jun, 22 Jul, 26 Aug 1841.} The most important structural work along this section occurred at Bathpool. The parliamentary line runs on the north side of the navigable Tone through West Monkton parish, except at Bathpool where it twice crosses a meander; the Bridgwater road of the Taunton Trust is crossed once, close to the
western (upstream) end of the meander. The B&ER Bill as printed in February 1836 made no direct mention of the bridges required at Bathpool and Brunel did not refer to them in his evidence in March 1836. However, among the clauses inserted in the Bill by
### Table 3.3 Contracts between Bridgwater and Taunton

<table>
<thead>
<tr>
<th>Contract</th>
<th>Description</th>
<th>Contractor</th>
<th>Start date</th>
</tr>
</thead>
<tbody>
<tr>
<td>8B</td>
<td>Embankment from the end of 3B to the north approach of Somerset Bridge; one bridge carrying the Langport Road of the Bridgwater Turnpike Trust.</td>
<td>Samuel Garratt</td>
<td>April 1841</td>
</tr>
<tr>
<td>1C</td>
<td>Low embankment from the south approach of Somerset Bridge to Bankland Farm, North Petherton; two parish road bridges and numerous culverts.</td>
<td>Thomas Townshend</td>
<td>July 1841</td>
</tr>
<tr>
<td>2C</td>
<td>From 1C to Charlton, mostly low embankment but with a deep cutting at Outwood hill; crossed by two parish road bridges and one bridge carrying the Glastonbury Road of the Taunton Trust.</td>
<td>Thomas Townshend</td>
<td>June 1841</td>
</tr>
<tr>
<td>3C</td>
<td>From 2C to Bathpool Green, mostly low embankment but with a cutting at Creech St. Michael; crossed by one parish road bridge and the aqueduct for the Chard Canal.</td>
<td>Thomas Townshend</td>
<td>August 1841</td>
</tr>
<tr>
<td>4C</td>
<td>From 3C to Bathpool Mill; a diversion of the river Tone and construction of bridges over the line and the diverted Tone.</td>
<td>Samuel Bromhead</td>
<td>July 1841</td>
</tr>
<tr>
<td>5C</td>
<td>From 4C to the Kingston Road of the Taunton Trust; mostly low embankment, with two accommodation underbridges and a bridge over the B&amp;TC.</td>
<td>Taylor &amp; Hutchinson</td>
<td>June 1841</td>
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the Parliamentary Committee,\(^1\) and later included in the Act, was one that regulated the construction of the two river crossings. The wording was generally similar to that for Somerset Bridge except for the waterway details: each bridge at Bathpool was to have an uninterrupted waterway width of 60ft. together with a 5ft. wide towing-path. Other general clauses stipulated the maximum gradient on the approaches to bridges carrying turnpike roads over the B&ER, and the minimum headroom clearance of bridges over turnpike roads or navigable waterways. These constraints posed a dilemma at Bathpool. On the one hand, if the B&ER crossed over the road, then the resultant railway embankment across the flood plain of the Tone on either side of the bridge would be

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\(^1\) ‘A Bill (as amended by the Committee) for making a Railway from Bristol to Exeter, with Branches to the Towns of Bridgwater in the County of Somerset, and Tiverton in the County of Devon,’ undated [1836].
about 18ft. high. On the other hand, if the rail level was kept as low as the navigation headway would permit, and the B&ER crossed under the road, then the embankment on the approach to the road bridge would be up to 25ft. high, just at the point where it was
closest to the river. Neither option was desirable, and it seems that the design was shelved until its resolution became urgent. In October 1840 the Tone Conservators accepted an alternative scheme designed by Gravatt, whereby the river was diverted into a new navigable course running parallel, and to the south side of, the railway. The meander was effectively cut off, and the Bridgwater road was carried over the new navigable diversion and the railway; a practical solution all round. The structure as designed by Gravatt was in effect a viaduct with three disparate arches: the southern arch, over the New Cut, was a circular segment spanning 72ft. square (80ft. skew) with a rise of 13ft. 6ins.; next there was a semi-elliptical land arch serving as a tow-path bridge; the northern arch, over the railway, was essentially a 'Levels' bridge spanning 30ft. square (33ft. 4ins. skew).

Writing in September 1841 Gravatt made an unambiguous claim to have:

... got out all the contracts from Bridgewater to Taunton with a view to the strictest economy; and with the exception of No. 3C, I set them fairly at work.

He hinted at some undefined mismanagement in getting contract 3C let:

I fear that additional expenses have been incurred, and have yet to be incurred in consequence of neglect as to No. 3C ... though I had the contract completed as soon as any of the others: namely, on the 15th of February last; and the most particular part of the work was made a separate contract of, and let to a very respectable contractor so long ago as the 5th of February last.°

It is probable that the 'particular part of the work' was the Chard Canal trough at Creech St. Michael.  

Despite his optimistic forecast in September 1840 that the line would be opened to Bridgwater by April 1841 at the latest, Brunel's report to the General Meeting on 4 March 1841 was yet another expression of regret for the delays and poor progress, particularly in Contract 1A, which he now felt would put the opening back to mid-May.° Fripp's reports for the first quarter of 1841 flesh out some of the detail. About seven miles out of the total of 33 miles of the Exeter-bound ('South Line') timber framing and

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1 SRO DD/TC 3, Tone Conservators' Minutes, 12 Oct 1840.
2 Gravatt W., Letter (1841).
3 On 30 January 1841 Gravatt explained to the recently reconstituted Works Committee the details of a cast-iron trough intended to carry the Chard Canal over the line at Creech. For unstated reasons the Board suspended fabrication of the trough soon after the contract was awarded: TNA/PRO RAIL 75/64, Works Committee Minutes, 30 Jan 1841; TNA/PRO RAIL 75/5, Board Minutes, 18 Feb 1841.
4 TNA/PRO RAIL 75/50, Minutes of General Meeting, 4 Mar 1841.
rails had been laid, and about 16 miles of the Bristol-bound ('North Line'). Construction of the Temple Meads viaduct had still not started, and Devil's Bridge and two other flying arches were still unfinished. Considerable lengths of the Ashton and Uphill cuttings were still not down to formation level, but the tunnel at Cambridge Batch was completed by mid-March. At the Axe embankment, 'The subsidence of the banks on each side goes on nearly in proportion to the new material thrown in'; about 280 waggon-loads a day were being tipped and Fripp was hopeful that the rate could be increased by the introduction of night working when the severe frosts eased. All 24 of the 'Levels' bridges had been completed, but by mid-March three had been taken down and rebuilt with timber decks on masonry abutments. At about that time it was discovered that some of the 'Levels' bridges had in fact been built 1ft. too low in the first place despite, according to Brunel, Gravatt having been told repeatedly that the clearance over the outside rail must be 15ft. 3ins., as on the GWR. The nine NRRC drawings of bridges in contracts 1B, 2B and 3B were clearly detailed for a clearance of only 14ft. 3ins.; five of these drawings were signed by Gravatt.

It was also during early March 1841 that Gravatt engaged his pupil William Cobbe as an assistant engineer on the B&ER without consulting the Works Committee, who felt duty bound to recommend that Brunel should submit all such appointments to the Board for approval. Cobbe had recently been paid off by the PNC after having superintended the construction of Langport Bridge (see Chapter 7). According to Brunel, not only had Gravatt concealed the appointment from him but it was also contrary to his instructions as the engineering staff's prospects were uncertain at that time. Froude was the only assistant he intended to keep on, and in April Brunel directed Gravatt to tell the other assistants that their services might not be wanted. Gravatt apparently misconstrued Brunel's meaning and told only Peniston that there was 'no probability of his continuing,' in a letter which gave the impression that the decision was Gravatt's. Consequently Peniston told Brunel he intended to leave of his own accord, prompting at least one Director to raise concerns that Gravatt had overstepped his authority. Brunel succeeded in allaying Peniston's fears to some extent by explaining more clearly his intentions and emphasising that the responsibility for staff management was his, not Gravatt's: 'This uncertainty will exist for some little time to come – but you shall know as soon as you

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1 TNA/PRO RAIL 75/159, Fripp's reports, 29 Jan, 19 Feb, 18 Mar 1841.
2 Brunel to Gravatt, 18 Jun 1841: BUL PLB 2a.
3 TNA/PRO RAIL 75/64, Works Committee Minutes, 6 Mar 1841.
4 Brunel to Gravatt, 18 Jun 1841: BUL PLB 2a.
possibly can what I determine upon.' Brunel then turned his attention to Gravatt himself. He reminded him that in such cases 'you are acting as the organ of communication, not as the principal.' Then in a long postscript he expanded on the theme of Gravatt's practice of 'talking & writing as if all orders or determinations originated with you.' It did not bother himself unduly, he said, but 'others bore me about it, and I confess that instances do come very frequently before me.' He instanced Sir John Guest's belief, based on Gravatt's behaviour, that the B&ER was Gravatt's own project.

However say no more of the past, but pray acquire as quickly as you can the habit of remembering that in Bristol & Exeter matters you act as my assistant – and that every thing done for which I can be made responsible must be done in my name.

He then made a metaphorical reference, part of which would return to haunt him:

This is a weathercock which may be wrong, and I am sure that I shouldn't take the trouble to look at it – but every weather cock points the same way and people around me bore me by pointing them out.

He advised Gravatt that, by appearing to place himself lower in the scale than he actually was, he would run less risk of making people think he was 'top Sawyer':

… and when they have accidentally discovered that you were not quite so, they have by contrast immediately dropped you into a bricklayer's labourer.

In a post postscriptum, Brunel stated he intended to ease the centering of Exeter Bridge within a week, if it had not already been done, adding 'Is every thing ready?' Gravatt's reply is not known; in the light of later events, it is probable that he did not respond at all at this time.¹

By mid-April another five 'Levels' bridges had collapsed or were being taken down. The Temple Meads viaduct was now under construction, work had started on the Weston branch and the foundations were in for the Bridgwater station. About two-thirds of the permanent way had been laid, including lengths through the Uphill cutting and over the Axe embankment.² The centering of Exeter Bridge was eventually eased during

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¹ Brunel to Gravatt, 6 Apr 1841: BUL PLB 2a; same to William Peniston, 6 Apr 1841: ibid.
² TNA/PRO RAIL 75/159, Fripp's report, 16 Apr 1841. Writing about the Axe drainage in 1854, J.A. Clark commented:

The peculiar nature of the morass subsoil of this district below the alluvial deposit was remarkably shown by the difficulties encountered in the erection of this [Axe] bridge. Such an erection was considered an impossibility by an eminent authority; but the [B&ER's] Engineer, with his usual energy, caused immense quantities of stone from the
the last week in April and when the news was relayed to Brunel on 1 May he was told that 'the settlement has not exceeded what was allowed.' This was only partly true: Fripp reported in mid-May that most of the centering had been removed from the river and the arch had indeed settled very little, but 'some of the Arch stones ... have been injured by the close compression of the edges, & must be replaced in parts.'

Brunel's expectation that the line would be ready for opening in mid-May proved to be over-optimistic: the Temple Meads viaduct was still incomplete and there were still unfinished lengths in the Ashton cutting. Three-quarters of the permanent way was now laid and the remainder was only being delayed due to logistical problems of delivering materials to the more remote locations. Ten 'Levels' bridges had now been rebuilt with timber decks on masonry abutments. The first locomotive, Javelin, was delivered on 11 May, and the following day Fripp, accompanied by Daniel Gooch and Gravatt, travelled on it from Backwell to Highbridge and back: 'No high speed was attempted, but the result was very satisfactory as to the state of the road for steadiness & smoothness.'

Gravatt failed to report to Brunel that the settlement and spawling at Exeter Bridge were in fact serious and getting worse. Unaware of the problems, Brunel was finalising preparations for the public opening, which had been rescheduled to 31 May, when he finally discovered:

… quite by accident, that this bridge is & had been in an alarming condition, that the settlement is most unequal, that the stones of the bridge are crushed in a frightful manner, that this has been going on for weeks and not a word hinted to me.

He immediately ordered that the ballast over the arch be removed and the space backfilled with faggots to prevent vibration from the trains, otherwise 'the bridge would have been in the river or considered as unsafe.'

neighbouring limestone hills to be thrown into the soil at the proposed site. These were successively swallowed up by the morass, until, long after many utterly despairéd of success, the last load thrown in overnight was found not to have sunk; the bottom was found, and the bridge completed:


1 TNA/PRO RAIL 75/159, Fripp's report, 13 May 1841; Brunel to Gravatt, 18 Jun 1841: BUL PLB 2a.
2 TNA/PRO RAIL 75/159, Fripp's report, 13 May 1841.
3 Brunel to Gravatt, 18 Jun 1841: BUL PLB 2a; TNA/PRO RAIL 75/159, Fripp's report, 18 Jun 1841. Shackle wrote that during the demolition of the bridge in 1935:

… on the arch was found a layer of faggots, still in good preservation, and these in turn had been covered with three-inch planks across the arch
Sir Frederic Smith, the Board of Trade Inspector, ordered a postponement of the public opening until minor defects along the line were rectified, but the Board decided to go ahead with the arrangements for a formal opening journey and celebratory breakfast for themselves and shareholders on 31 May regardless. On the eve of the proposed opening Javelin was derailed and damaged to such an extent that the decision was taken to postpone the opening run until 1 June. Unfortunately the news was not transmitted to Bridgwater and on 31 May thousands of inhabitants took advantage of the local public holiday that had been called for the proposed opening day and flocked to the Bridgwater terminus. Eventually a message reached John Browne, the B&ER Resident Director in Bridgwater, who passed on the news that the opening train would now leave Bristol at nine o'clock the following day. By way of consolation, those who stayed on at Bridgwater for the rest of the day saw Badham and Richard Ball, the Taunton Resident Director, arrive at 4p.m. on Fire Ball, which had been hastily borrowed from the GWR to tow Javelin back to Bristol. On 1 June 1841 Brunel took charge of the inaugural train, which comprised Fire Ball and eight carriages crowded with shareholders; Gravatt joined Brunel on Fire Ball. On the train's arrival at Bridgwater those local inhabitants who were able to attend the rescheduled event witnessed the Directors and shareholders quickly disappearing into a marquee. Following the customary speeches, John Browne's toast to Brunel – 'Long life to him, and may he live to witness the prosperity of those lines which his genius has been instrumental in projecting' – was drunk with great enthusiasm. It fell to Badham, of all people, to propose Gravatt's health. Clearly not at ease under the spotlight, particularly in the company of Brunel, Fripp and Badham, Gravatt responded succinctly:

As our time is very short I will make a very short speech. I am much obliged to you for drinking my health, and I beg to drink all your good healths in return. (Cheers and laughter).

On the advice of Brunel the Board resolved on 4 June to give notice to the GWR that the works at Temple Meads would be sufficiently advanced by 14 June to permit the GWR to begin working the line that day.¹

¹ TNA/PRO RAIL 75/5, Board Minutes, 1,4 Jun 1841; Somerset County Gazette 5 Jun 1841. Badham told the Board that Javelin was brought back 'without any considerable
Brunel now turned on Gravatt; on 4 June he wrote:

How could you leave me uninformed of the deplorable state of the bridge over the New Cut? … The simple fact that a stone bridge … should now in the course of a few days become [more] alarmingly, deplorably spawled & cracked than any bridge I ever saw, was one to be communicated to me instantly … You must feel what a serious responsibility you take upon yourself… With the public all the blame will of course, and I admit justly, fall upon me. I am vexed, I am harassed beyond measure. There have been very many things lately about which I have felt hurt & distressed – I have deferred all judgement as well as all explanation upon them until the hurry & excitemt which I am subjected to at the present moment should be over – and I shall do so upon the subject of the bridge.

He asked Gravatt to find out immediately the state of the centering, but he also instructed Froude to monitor movements in the bridge daily and report them directly to himself. Froude had already told Brunel that the voussoirs were 'no great depth, and the rest made up with the backing in thinner courses,' despite Brunel having directed Gravatt to 'add something considerable in the thickness of the voussoirs,' so it seems probable that Froude had already been actively involved in the supervision of the bridge's construction. Regrettably, Gravatt's response to Brunel's letter has not been found but clearly it did not satisfy Brunel:

Not to reply a few words might mislead you & induce you to suppose I felt satisfied by your letter – this is by no means the case. I find everybody else knew the bridge had spawled dreadfully … You knew this and must either have wilfully concealed it or shut your eyes to it – in spite of the strongest evidence. I do not believe you would premeditatedly conceal it from me, but I must then & do believe that your infatuation is so great as to render you unfit for the business of this busy life. You cannot see anything wrong in that which you have done – that is your failing & a serious & fatal weakness it is.

The line to Bridgwater and the branch to Weston opened to the public on 14 June; Gravatt's probation, imposed by Brunel on 4 August 1840, was now at an end. The day after the public opening of the line Brunel wrote again to Gravatt, 'with great reluctance and regret':

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1 Brunel to Gravatt, 4 Jun 1841: BUL PLB 2a, emphasis as in the original.
2 Same to same, undated but bracketed by letters dated 4 Jun and 15 Jun 1841: ibid, emphasis as in the original.
3 Notice announcing the proposed opening, dated 4 June 1841: The Times 9 Jun 1841.
I feel that I cannot with justice to myself or to the Company take upon myself the responsibility of continuing to conduct the works through you as my Assistant. You do not represent me in any respect &, without questioning either your integrity in the ordinary sense of the term or your talents, I cannot confide in you in the least degree either for carrying out my views & following my directions or for keeping me properly & correctly informed upon all matters which ought to come under my observation … So far from having recovered any part of the confidence in you which I then [August 1840] stated I had lost, I have gradually & reluctantly come to the conclusion that we must part – and have determined that nothing shall ever again induce me to attempt to carry on the works through you. My past conduct towards you for nearly 15 years, & particularly on several occasions, must satisfy you, though you may not admit the justice of my decision, that nothing but a very strong sense on my part of its justice & necessity could have driven me to this.

He said that Gravatt still had an opportunity to resign with a simple statement to the effect that he did so because the works on which he was engaged were complete, and thus maintain his reputation. He then made another statement that would return to haunt him:

If you resign without raising a question as to the cause you may depend upon my silence and you may consider this letter as private. If you determine otherwise you must let me know, that I may follow such course as I may think advisable ... It is a subject which … for both our sakes it is desirable to settle quickly.¹

Gravatt refused to resign.

With the line open, the Board felt that the current levels of engineering staff could not be justified and on 18 June they directed Brunel to review the staffing arrangements, not merely with an eye to economy but 'above all [to] secure to this Company the advantage in a greater degree of his personal services,' doubtless a veiled reference to Brunel's ostensibly excessive delegation of responsibility to Gravatt. Brunel was not at their meeting in the morning of 18 June, but apparently Gravatt attended, 'to meet what charges Mr. Brunel might bring against me.' That afternoon, in Gravatt's absence and apparently without his knowledge, Brunel explained to the Board the instructions he had given Gravatt relating to the height of the bridges which had led to a 'misunderstanding' between them of so serious a nature 'as to preclude … the possibility of their acting together'; regrettably the Board minutes gave no details of Brunel's explanation or his instructions to Gravatt. Understandably, the Board did not wish to get involved in the dispute between the two engineers, and gave Brunel a free hand in

¹ Brunel to Gravatt, 15 Jun 1841: BUL PLB 2a.
dealing with Gravatt by resolving that it should be left entirely to him to make whatever staff changes he felt would be in the company's best interests. The resolution also provided that Brunel should be given a copy of the Board's resolution, presumably as a symbol of authority if Gravatt caused trouble.¹

Brunel wrote immediately to Gravatt urging him to reconsider his refusal to resign, in a long letter² which he made clear he intended to copy to the Board; evidently he was concerned that his motives and high principles should be understood by all parties and, perhaps more importantly, he wanted a written copy of his version of events to be deposited with the Board in case Gravatt should refuse to resign quietly. He bluntly reiterated the general circumstances which had led to the current stand-off, including his belief that Gravatt was 'incapable of acting as second, at all events under me or any person who has opinions & views of their own.' He then quoted three examples that were clearly chosen to support his case to the Board but which he stated, apparently ingenuously, were to

remind you of ... the most recent of numerous specimens of the general conduct which has made me determine that I never again will trust my character or my interests in your hands.

The first was a detailed account of Gravatt's attempt to 'dismiss' Peniston in April 1841; the second was the Exeter Bridge fiasco which, again, Brunel detailed at length. The third concerned the 'Levels' bridges that had been built too low; although he accepted that the fault rested with himself, 'I ought not to have trusted to any verbal communication to you upon such a point.' If Gravatt had told him as soon as he found out the error, then early corrective action could have been taken 'and this disgraceful exposure of mismanagement avoided,' but it was too late. In conclusion Brunel reiterated his chivalrous motives, before formally dismissing Gravatt:

¹ TNA/PRO RAIL 75/5, Board Minutes, 18 Jun 1841; Felix Farley's Bristol Journal 4 Sep 1841, report of the General Meeting on 2 September 1841. According to the newspaper report, Gravatt claimed:

On the 18th [June] there was to be a meeting of the Board; I attended there to meet what charges Mr Brunel might bring against me; Mr Brunel never came to meet me. I went home, and the next day Mr Brunel put into my hands a resolution of the Board, to the effect that Mr Brunel, as engineer-in-chief to the Company, had entire control over the appointment of engineers under him. Now, I was there and attended the Board; Mr Brunel was not there; and there must have been, after the Board broke up, an adjourned Board at which this resolution was passed.

² Brunel to Gravatt, 18 Jun 1841: BUL PLB 2a.
After such a course of deception or concealment, such constant neglect or perversions of my orders, I should act the part of a fool towards myself and a Knave towards the Company if I pretended that I had in you an assistant. I have only a screen that has prevented my seeing what was going on and a medium that has entirely intercepted or perverted all my instructions & plans. I cannot allow old feelings of friendship so entirely to supersede all sense of prudence or duty to others as to induce me [to] continue such a state of things. I should have wished that you, knowing my feelings, would have resigned & precluded the necessity of my laying the whole matter before the board. You have not chosen to do so … and I have now to inform you that … you must consider that you cease from this day to be in the service of the Bristol & Exeter Railway Company.

He held off copying to the Board this letter and the previous one in order to give Gravatt time to reconsider, but after a final fruitless appeal to Gravatt to heed his advice he sent the letters in time for a Board meeting on 25 June 1841. Brunel himself was absent from the meeting, but Gravatt attended and gave a verbal, but unrecorded, statement of his version of events which the Board felt provided nothing to make them change their position; his dismissal was tacitly sanctioned.¹

Three weeks later Gravatt wrote the Board a letter, regrettably now missing, containing certain 'imputations' concerning the conduct of themselves and Brunel. In support of his allegations he enclosed a copy of Brunel's letter of 6 April 1841 containing the metaphorical 'weathercocks' and the phrase 'people around me bore me by pointing them out,' around which it appears Gravatt had concocted an imagined conspiracy against himself. If Brunel had attended the Board meeting on 16 July when the allegations were read out it is likely he would have quickly defused the situation, but in his absence the Board resolved that they required a full investigation as the allegations concerned the conduct of members of the Board as well as of Brunel himself.² Brunel interpreted this resolution as an affront to his character, and he was further piqued when only three members of the Works Committee turned up to investigate the issues on 17 July.³ He told them he acquitted Gravatt of any intentional misrepresentation and declared that none of the things alleged to have been said to or by himself or the Directors had in fact been said, but that he himself had alluded to 'opinions expressed by other friends of his,' clearly a reference to the 'people around me who bore me by pointing them out' that were mentioned in his letter of 6 April.

¹ Brunel to Gravatt, 22 Jun 1841: BUL PLB 2a; TNA/PRO RAIL 75/5, Board Minutes, 25 Jun 1841. Brunel concluded his letter to Gravatt: 'I subscribe myself still, Yours faithfully …'
² TNA/PRO RAIL 75/5, Board Minutes, 16 Jul 1841.
³ TNA/PRO RAIL 75/64, Works Committee Minutes, 17 Jul 1841.
Two days later Brunel turned to Badham for help in making his feelings known to the Board. In a long letter to the Company Secretary, he began with an expression of regret that the Board should even consider Gravatt's 'hasty & intemperate attack' worthy of investigation. He appealed to the Directors' common sense and their knowledge of his integrity, and asserted, 'I cannot consent to place myself in the position to have the value of my word weighed & estimated in comparison with my man's.' He referred to his letter of 6 April of which the Board now had a copy and in which:

… I told [Gravatt] that my friends (but there was no allusion to Directors) did upbraid me for putting up with his conduct, or something to that effect.

Here seems to be the origin of Gravatt's conspiracy theory. Brunel went on to refer to other allegations in Gravatt's letter which, although he did not elucidate them, seem to suggest that Gravatt had criticised Brunel's conduct and even his integrity in a manner similar to that which led to Gravatt being put on probation after he made known his differing views and opinions on 'important engineering questions' in July 1840. Brunel now referred to:

… the sweeping imputation of falsehood, the intemperate, vague, unintelligible accusation of neglect of the interests of the Company and, by false & careless representations, of plunging the Company into frightful expences ... but all of which even in the language is such utter nonsense & so contradictory, that I can regard it only as the painful wanderings of an overexcited mind.

If the Board considered that 'the ravings of a madman without a single fact or alleged fact to give form & substance to the imputation' required investigation, then Brunel felt compelled to comply:

… altho' I cannot but feel that I am forced, certainly against my own conviction of what is right ... into a most unequal contest ... [in which] I must, however repugnant to my feelings, stoop to disprove falsehoods & imputations against which my character ought I think to have been sufficient protection.

With hindsight he saw he should have acted with more caution when dealing with Gravatt, whom he had always dealt with as:

... a younger friend, whom I had frequently protected & withdrawn, by my advice & assistance, from difficulties into which his temper has betrayed him.

He now regretted not having kept copies of all his letters to Gravatt, from whom he had received few written acknowledgements:
… his seldom replying by writing to any such letters was a circumstance which often struck me as peculiar & which whether accidental or not now renders a reference to the past very difficult.

He would much have preferred to treat this present 'wild attack' with perfect indifference:

… at all events it would have excited in me no other feeling than that of sincere regret, that a man whom I once esteemed should have been driven into such a bad state of mind & by the consequences of his own conduct.¹

Before Brunel sent this letter, Badham received another from Gravatt, also dated 19 July; regrettably, this is another potentially crucial piece of evidence which appears not to have survived. Brunel described it as a 'mad letter' which had compelled him now to say that he could not allow himself to be:

… forced into the field to contend with a madman, because in his ravings he has thrown out disconnected, almost unintelligible, imputations against me which I consider unworthy of notice.

Again, the 'imputations' were not spelt out but it is evident that Gravatt wrote it in angry response to Brunel’s request for copies of the letters exchanged between them during their various disagreements; Brunel considered them to be official B&ER correspondence but Gravatt claimed they were private papers. In an imprudent attempt to circumvent Gravatt and thus avoid confrontation, Brunel had made the request to G.H. Layard, the former assistant engineer who was by now an 'intimate friend' of Gravatt's and seemingly acting as his clerk and factotum. Brunel now gave the Board an ultimatum:

If the Directors as a body or any individual member could believe for a moment that there was a possibility of there being any foundation for his accusations … they ought to call for investigation, and it would be my painful duty having first resigned my office, the holding of which implies perfect confidence, to assist them in the investigation but I should still decline to defend myself – as I cannot admit that my character requires it.²

A special Board meeting on 27 July unanimously expressed 'unabated' confidence in Brunel; he had exercised sound discretion in dismissing Gravatt, whose allegations were either disproved or too vague to be investigated. Copies of the resolutions were to be transmitted to Brunel and Gravatt with a statement that was clearly intended to draw a line under the whole disagreeable episode:

¹ Brunel to James Badham, 19 Jul 1841: BUL PLB 2a, emphasis as in the original.
² Same to the B&ER Board, 22 Jul 1841: ibid.
... while they all sincerely lament the manner in which Mr. Gravatt's connection with the Company has terminated, they cannot again interfere.¹

¹ TNA/PRO RAIL 75/5, Board Minutes, 27 Jul 1841.