
Chapter 5: Museum steam

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The Marshall Traction Engine in National Museums Scotland

The Royal Scottish Museum – predecessor of the National Museums Scotland – had long recognised the place of the traction engine in the history of engineering, and the need to represent this in its collections. Space constraints in the Victorian museum building in Chambers Street in Edinburgh precluded the museum from obtaining much full-size machinery and so, like many other museums at the time, drawings, photographs, components or models were collected instead. Among these the following items stand out. The earliest era of steam-powered road transport was represented by a fine model purchased in 1905 of Nicolas-Joseph Cugnot’s steam vehicle intended for the haulage of artillery, first paraded in Paris in 1771. In 1926 the museum commissioned a replica of the working concept model of the steam vehicle which William Murdoch built between 1784 and 1786. Three years later the museum acquired two photographs dated December 1863 showing a 1.5-horsepower traction engine made by Alexander Chaplin & Company in Glasgow. These photographs and the Murdoch model are illustrated in chapter 1. In 1950 a one-eighth scale working model traction engine of circa 1910 was acquired, complete with a set of tools and lamps. The following year the first full-size item was collected. This was the little 1886 Tuxford portable engine illustrated in chapter 3, and its diminutive size allowed it to be displayed in the Victorian Engineering gallery.

During the late 1980s a new store for the museum was established in Granton, on the northern side of Edinburgh, making possible the acquisition of a range of larger engines and machines. In 1987 the museum’s Department of Science, Technology and Working Life acquired a full-size Marshall traction engine from a private collector near Stirling. The engine then entered into a new phase of its life as a museum exhibit representing the simple, heavy steam engines used in road haulage and agriculture in Scotland in the decades around 1900. Research carried out more recently on the museum’s engine in connection with the completion of
restoration for its centenary in 2007 has made it possible to piece together a fascinating early history. These findings are set out in this chapter, which takes the form of a biography of the Marshall, exploring its design origins, manufacture, working life, and restoration twice over.

**Marshall of Gainsborough: makers of the museum’s traction engine**

The museum’s traction engine was made in 1907 by Marshall, Sons & Company Limited at their Britannia Ironworks in Gainsborough, England. In the early twentieth century Marshall was amongst the largest agricultural engineering manufacturers in Britain, and one of a number of such firms concentrated in the grain-producing regions of Lincolnshire and East Anglia. Originally established in 1848 as general millwrights, the company went on to develop a significant trade in threshing machines and steam engines to power them, both throughout Britain and around the world. These were however only a part of Marshall’s production, which extended to industrial products like stationary boilers and large steam engines for powering factories and mills, and even plant for gold-dredging and tea-processing. Thus could the firm claim in a catalogue of 1907 that their total output was ‘over 120,000 Engines, Boilers, Thrashing [sic] Machines, &c., made and supplied’. At this time the Britannia Ironworks covered 30 acres and employed 4000 men.

The first Marshall traction engine was made in 1876 and had a horizontal single-cylinder engine mounted on a frame under a locomotive-type boiler. By the following year, the more common layout had been adopted by Marshall, with the engine mounted on top of the boiler and driving through a gear train to the rear wheels. Marshall’s general purpose traction engines were made in four sizes: 5-, 6-, 7- and 8-nominal horsepower with either single or twin compound cylinders. The former were far more well-liked by buyers. In the quarter-century between 1888 and 1913, effectively the hey-day of traction engine production, five hundred 6-horsepower single-cylinder traction engines (the same size and basic design as the museum’s engine) were made by the company, compared with only seventy-four 6-horsepower compound engines. Combined production of 7- and 8-horsepower engines was about the same as the total for the 6-horsepower size over the same period, with a much smaller number of 5-horsepower engines also produced. The 6-horsepower size was clearly the most popular, sufficiently powerful to haul most loads and drive most threshing mills, and, for the British market, small enough to be reasonably manoeuvrable in country lanes and farmyards from Cornwall to Scotland.

‘Of high-class construction throughout …’: making the Marshall traction engine

Describing their general purpose traction engines, suitable for road haulage and powering machinery, Marshall wrote in its 1907 catalogue that
... they are of high-class construction throughout and embody in their manufacture the most modern improvements, combined with strength, durability, economy and handiness of working. The materials are the very best for their various purposes, and the workmanship throughout of the highest order.\textsuperscript{11}

By this time, traction engines were quite elegant in outline too, in contrast with earlier machines which often looked ungainly. This was largely as a result of the efforts of the traction engine designer William Fletcher who had worked for a number of the leading English firms including Marshall. He wrote:

\begin{quote}

Beauty of design is more easily appreciated than described. It consists of no alteration in the principle, neither does it affect the internal details of the engine, but it is brought about by an expenditure of drawing-office care in the arrangement of the parts, which gives to the whole a symmetrical and simple appearance [Fletcher's emphasis].

Every detail is made to possess perfect and graceful proportions and a pleasing outline, and the shape of one part is not allowed to be out of accord with any other part, and in no case is real efficiency [ditto] sacrificed thereby.\textsuperscript{12}
\end{quote}

MARSHALL CATALOGUE

Description of general purpose traction engine from 1907 catalogue.

(© Museum of English Rural Life, University of Reading)
Within the home market, traction engines were most often ordered singly, as few British contractors, farmers or local authorities operated on such a large scale or had access to finance to allow the purchase of more than one engine, or set of ploughing or threshing tackle, at a time. Hence engines tended to be made in response to a specific order from a customer (or sometimes a selling agent), allowing their individual requirements to be met. This custom-built approach meant that similar machines in Marshall’s erecting workshop would often exhibit detail differences to a greater or lesser degree. Mass production techniques were therefore rarely seen in British traction engine factories, although the larger firms like Marshall would manufacture components which could be standardised (such as wheels, cylinders, gears, boiler fittings and even whole boilers) in quantity to be held in stock. Export production could be another matter however; for example, the nearby firm Ruston Proctor of Lincoln produced 990 near-identical traction engines in batches for sale to the huge grain producing estates in Argentina between 1903 and 1913.\(^\text{13}\)

Contemporary information and surviving documentation relating to the museum’s traction engine allows us to sketch out the procedures and processes in the Marshall factory at this time. Each traction engine made by the firm had comprehensive details of its specification set out by a registrar in a bound ledger, but unfortunately the volume for the museum’s engine is not available.\(^\text{14}\) The various components of the engine – ranging from cylinder and boiler to small items like the lubricator and water gauge – were listed, and against each there was space for the identification numbers of the drawings used in their manufacture, with a further column giving leading dimensions, finishes, and other details. A copy survives of the pages from the note-book used by the registrar in compiling information to be included in the final specifications for the museum’s traction engine, and is dated 26 July 1907.\(^\text{15}\) The customer for whom the engine was to be made is identified as ‘J. & J. Young & Co’. The erector’s surname was Cockayne, and the erecting number was 522. The engine number is entered as 47731. The erector was in charge of
the small team (a couple of men and possibly an apprentice or boy to provide assistance) that assembled each engine. The erecting number was assigned when the instruction was given to start assembly, and remained the means of identifying the machine in the factory until it was complete when an engine number was allocated. The engine number was then engraved on a brass maker’s plate fixed to the engine, and provided an essential reference for the subsequent supply of spare parts.

All the constituent parts, made in separate departments spread across the extensive factory site, were brought together and assembled in the engine erecting shop. In the Britannia Works all sorts of machines jostled together in the erecting shop; enormous stationary steam engines, smaller portable steam engines, together with traction engines and steam rollers. The erecting shop was a tall building with a travelling gantry crane running at high level along its length. This crane was used to bring the major components together at the assembly location where the erector and his gang worked. The components were lifted onto the growing engine (where necessary using hand cranes which ran at ground level along the sides of the workshop), being hand-fitted and adjusted as required by the erecting team as they were assembled together. When the engine was finished it went to the testing shed. Here it was put in steam, the power output measured, and everything checked to see that it operated correctly. This was followed by a road test, and if all was well, the engine went to the paint shop before final despatch.

Marshall traction engines made in the 1900s were usually painted maroon with bright red wheels. Ornate narrow striping, or lining, was then applied by skilled craftsmen, in black, white, red or yellow to complement the body colour. Some of the lining on flat plate work and adjacent to the polished brass boiler bands was similar in style to that applied to railway locomotives. Other decoration, especially on the wheels and under gear, consisted of freehand patterns and curves which more closely resembled that traditionally applied to horse-drawn carts and wagons.

A distinguishing feature of Marshall traction engines
ERECTING SHOP FROM MARSHALL 1907 CATALOGUE

Two views from Marshall’s 1907 catalogue illustrating the engine erecting shop at the Britannia Ironworks, Gainsborough. The firm’s large product range is evident, with stationary and portable steam engines greatly outnumbering traction engines. The boiler barrel, hornplates and tender for a part-assembled traction engine can be seen at the very front of the left-hand image, with the bolt holes for the cylinder base visible next to the large hole in the top of the smokebox for the chimney base. These photographs would have been taken on a Saturday afternoon or Sunday when no one was at work.

(© Museum of English Rural Life, University of Reading)
was the large transfer applied usually to the side of the boiler barrel. Here a figure of Britannia, Marshall’s imperial trademark, stands symbolically on a large gear wheel, surrounded by reproductions of some of the hundreds of prize medals the firm had been awarded at agricultural and engineering shows around the globe.

With even the standard level of finish, Marshall engines were thus striking and colourful, but the quality of finish could be enhanced for engines that were destined for exhibition at trade shows and agricultural fairs, making them more attractive to potential customers. Some purchasers requested this at extra cost if they were especially proud of their engine. Then extra attention would be paid to getting an even more shiny finish on the paintwork, more ornate lining applied, and bare metal items like the valve gear, hubcaps and controls burnished to a shine. Such finish was described by Marshall as ‘Show’ or even ‘Royal Show’ depending on the amount of effort directed to it, and reflecting their perception of a hierarchy of occasions which justified such additional work.

The specification for the museum’s engine includes details of a number of items addressing the customer’s particular requirements. Marshall 47731 was to be fitted with a name-plate identifying the owner as J. & J. Young, Timber Merchants, Oakley. The engine itself was to be named ‘Sir Hector’, and this (presumably on a brass plate) was to be fixed to a wood block on the side of the boiler barrel. An injector was ordered for supplying the boiler with water, in addition to the crankshaft-driven pump supplied as standard. Rim brakes were to be fitted to the
rear wheels. Marshall traction engines usually had only a simple band brake acting on a small diameter brake drum on one rear wheel; rim brakes comprised large wooden brake blocks which acted on a larger diameter on the inside rim of both rear wheels and hence were much more effective at braking or holding the engine. In addition the cylinder was to have a ‘Polished Shield to back cover’ and a semi circle brass name plate ‘Marshall Sons & Co’ mounted on the smokebox door. The ‘Finish’ is noted as ‘Maroon & Lined Show’.

These last three points suggest that Marshall 47731 was destined for exhibition, particularly the application of ‘Show’ finish and the brass plate with maker’s name on the smokebox door. Marshall traction engines usually had an undounded smokebox door, so this addition was an effective way of emphasising their identity to show visitors and prospective purchasers. As we saw in chapter 2, Marshall was among the exhibitors at the Highland and Agricultural Society’s show held in Edinburgh in 1907, showing a 6-horsepower single-cylinder traction engine together with four threshing mills. Although this is the same size as the museum’s engine, it is not clear how it could be the same one, as the Edinburgh show was two and a half weeks earlier than the 26 July date given for 47731 in Marshall’s registrar’s notebook. Nor does Marshall’s catalogue entry for the Highland Show mention non-standard rim brakes or additional injector in the specification for the engine on show: ‘Traction Engine, single cylinder, 6 nominal HP, with water-lifter and winding-drum, fitted with steel gearing for two travelling speeds – Price £460; extras as per Catalogue.’

(MARSHALL TRACTION ENGINE

Above: Brass maker’s nameplate on the smokebox door.

Below: Britannia transfer with show medals.

(© National Museums Scotland)
In the absence of clear evidence demonstrating how Marshall 47731 might in fact have been exhibited in Edinburgh, there are three other possible explanations for its ‘Show’ appearance. Perhaps J. & J. Young simply wanted a highly finished engine, maybe as an advertisement for their business, and had been prepared to order this specially. Maybe they visited the Edinburgh show, were impressed by Marshall’s stand and 6-horsepower traction engine there, and decided to order a similar engine for themselves. Marshall must have put on a good display, as the show report in the *North British Agriculturist* described their stand as ‘a very high-class exhibit’.17 Or perhaps 47731 was exhibited at another show elsewhere that summer and then delivered to J. & J. Young.

‘Sir Hector’ at work

Oakley, where Marshall 47731 first worked, is in the south-west corner of Fife. In 1907 the gently rolling countryside surrounding the village was interspersed with coal mines. As timber merchants, J. & J. Young may have been involved in the supply of pit props for the collieries, or hauling logs from forest to sawmill for processing and then delivering cut timber for building and manufacture. It must have been quite a prosperous business, as Young’s owned two other traction engines at this time. Both had been purchased new, the first in 1883 and the second, named ‘The Rover’, in 1906. Another new engine, a steam tractor, followed in 1912.18 All these were made by John Fowler & Company of Leeds, so ‘Sir Hector’, as a Marshall product, must have stood out. The rear wheel-rim brakes fitted to ‘Sir Hector’ suggest it was intended to be used for haulage (rather than for driving stationary machinery), as these were an important fitting for a traction engine expected to move heavy loads in undulating country.

By early 1921 ‘Sir Hector’ had been sold to Raines & Company Limited, the large-scale threshing contractors operating out of Bridgehaugh, Stirling. We know this because it was registered by Raines with the local authority on 1 February that year, receiving the registration mark MS3081.19 How long the engine had been with Raines, or whether there was another owner between Young and Raines, is not known. ‘Sir Hector’ also carries a cast brass plate on its tender side proclaiming membership of the Scottish Traction Engine Owners and Users Association. Although we cannot be certain when this plate was fixed to the engine, it is certain that Raines (and likely Young) would have been members. As we have seen already Richard Raines was at one time Chairman of the Association and would no doubt have wished his company’s engines to wear the brass membership plate with pride. Unfortunately, no photographs have yet been found illustrating ‘Sir Hector’ in either firm’s ownership.

When Raines gave up contract threshing and then auctioned its engines in August 1945, Marshall 47731 was bought by James Kenny of Stirling; by now the engine was without its nameplate. In 1948 the engine was sold to Jock Mackay at Whins of Milton, near Stirling.20 Jock was an engineer and steam enthusiast, and Mar-
shall 47731 thus became one of the first traction engines to be preserved in Scotland (concurrent with Ian Fraser’s Marshall ‘Jingling Geordie’). Jock and his wife Peggy then restored the engine, repainting it green with yellow wheels. In the course of restoring Marshall 47731 they met up with Wattie Tough who had driven it for 11 years whilst working for Raines. Wattie presented them with the nameplate for ‘Sir Hector’ which he had kept as a souvenir of his time with the engine. Jock sold Marshall 47731 to the Royal Museum of Scotland in September 1987.

‘Sir Hector’ comes to the museum

The museum’s intention had always been to demonstrate its traction engine in steam, and so an early concern was the fitness of the engine for this. When the museum acquired the engine, it had not been steamed for some time, and so the boiler inspector required the boiler barrel to be stripped of its thin sheet metal covering thus allowing its condition to be thoroughly assessed.

‘Sir Hector’ was now eighty years old and not surprisingly the boiler was found to be nearing the end of its life.
serviceable life; its working pressure had been lowered from the original figure of 140 pounds per square inch (psi) to 100 psi in the mid-1970s. Initially it had been hoped to put the engine into working order by the summer of 1989, but as investigations proceeded the museum decided the correct approach would be to undertake a thorough overhaul. Ultimately a decision was made to renew the corroded inner firebox; removing the original one meant that the whole interior of the boiler was able to be seen and corroded areas identified for repair. A specialist boiler repairer in West Yorkshire tackled this job, of which making and fitting the new firebox was the most complicated part. Other plate work and boiler fittings were repaired or refurbished, and new fire tubes were fitted. At the end of this work the boiler could again be steamed safely at its original working pressure.

Attention had also to be given to the mechanical components. The engine had evidently been worked hard during its commercial life, with very worn drive gears in particular testifying to many miles travelled on the road. There is evidence of the rivets fastening the spectacle plate near the main bearings having been hammered up tight as a running repair; their coming loose was a likely result of the strains and vibration caused by sustained and arduous operation. A piece had also broken out of the end of the engine’s cast-iron trunk guide at some time, although the cause of this is not known.

The largest of the many engineering tasks undertaken was the cutting of new gears by a firm in Ayrshire. Bearings were replaced and worn components built up with new metal. Respect for the original design was a key precept for all this work, but in two areas there were important practical deviations from Marshall’s 1907 specification. Rubber strakes (the narrow plates angled across the surface of the driving wheels to give grip) were fitted to soften the ride on hard roads, in place of the thin iron strakes fitted when the engine was new. A more sensitive regulator valve was fitted to the engine to allow finer throttle control. This was designed and made by Hamish Orr-Ewing, who was the owner of another restored Marshall traction engine, and helps tame the characteristic habit of Marshall engines rearing up on their hind wheels when starting and then falling hard back down on their front wheels.
BEFORE AND AFTER
Photographs show the engine stripped, with conservator Chris Cockburn and the Boiler Inspector in 1988, and with Chris polishing the engine in 2007.
(© National Museums Scotland)
Early in the restoration the museum thought the engine was painted dark blue, having found traces of this colour on metal-work as the engine was dismantled. This blue effect may well have been the mill scale on platework underneath the original paint, as Marshall’s registrar’s notes for the engine clearly indicate it was to be painted maroon. Expert advice was sought from the Road Locomotive Society – a long-established educational charity dedicated to researching traction engine history – as to the correct colours and lining details for ‘Show’ finish in 1907. In response, pages of notes and detailed sketches were supplied by Richard Willcox, the Society’s Liveries Officer.

With changing museum priorities over the years, and the consequent ebb and flow of budgets, the restoration took twenty years to complete. It proved to be one of the most complex engineering restoration projects ever undertaken by National Museums Scotland and it was achieved through teamwork between curators and conservation staff. The impetus for final completion of the project was the engine’s impending centenary in 2007, linked to research in the museum revealing in late 2005 that a very similar engine, if not ‘Sir Hector’, had been displayed at the Highland Show in 1907. The possibility of attendance at the Highland Show would take threshing as its theme and present the newly-restored engine driving a small threshing mill made by R. Scott of Strichen. The engine and the mill attracted huge interest from visitors, especially children, and those old enough to remember such scenes from their younger days. Many anecdotes were shared with museum staff concerning steam threshing from Ayrshire to the Black Isle, reflecting its impact on peoples’ memories, and even the affection with which such machines are still remembered.

‘Sir Hector’ has since attended a number of rallies and shows, including the Scottish Traction Engine Society’s event at Balado in Kinross-shire, Selkirk Vintage Rally, ‘Harvest Home’ at the National Museum of Rural Life in Lanarkshire, and ‘Magnificent Machines’ at the National Museum of Flight in East Lothian.

The engine continues to offer exciting possibilities of acting as a travelling ambassador for National Museums Scotland, bringing a key item from its collections to communities across the nation.
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4. [NMS T.1950.6]. The model is notable for having been made by a former employee of one of the leading English traction engine makers, Robey and Company of Lincoln. It appears not to represent any particular prototype, but looks more like a Burrell traction engine than a Robey.
5. [NMS T.1951.13].
10. Ibid., pp. 55–57.
14. These bound specifications are described as ‘building books’ in the catalogues of the Museum of English Rural Life, University of Reading, where a number of surviving Marshall records are housed [reference TR MAR MP1]. The building book covering the period during which the museum’s traction engine was made is missing; the other building books are split between the Museum of English Rural Life and R. H. Crawford, Boston. The Museum of English Rural Life also holds some of Marshall’s production registers, although the register covering the period during which the museum’s traction engine was made is missing too.
15. Photocopy in NMS Object File [T.1988.17]. This was supplied to the museum on 1 February 1988 by Major H. D. Marshall of Track Marshall, Gainsborough, who then had custody of Marshall’s traction engine records. Major Marshall’s letter accompanying the photocopy explains that each entry in the note book (which has the same format as the building book) was crossed off by the registrar as he entered the information into the ‘register’ — the term Major Marshall used to describe the building books.
17. The North British Agriculturist, 11 July 1907, p. 443.
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