The Liverpool and Manchester Railway

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The Liverpool and Manchester Railway.

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(Read at Caxton Hall, Westminster, November 16th, 1921.)

SECTION I.—GENERAL HISTORY.

In the first quarter of the nineteenth century, owing to the importation of cotton from America, and its manufacture in Lancashire, the need for increased facilities of inland communication in that part of the country became very urgent. Between the years 1780 and 1824 the population of Liverpool increased from 26,000 to 125,000, and that of Manchester in the same period from 22,000 to 160,000. Goods were conveyed between them by road, and by two canals, the Irwell and Mersey Navigation, and the Bridgewater. The disadvantage of these canals was that they were liable to obstruction by drought in summer and ice in winter, and ended at Runcorn, about sixteen miles from Liverpool, the remaining passage of the Mersey estuary being difficult and dangerous in bad weather. In addition to these natural inconveniences, the canal companies profited scandalously, and there appears to have been no end of pilfering, while the delays were interminable.

In 1797 William Jessop had suggested that a tramroad to be worked by horses should be laid down between these two towns, and surveyed a route. The following year Benjamin Outram made another survey for a line, but nothing came of either proposal. Thomas Gray, in his "Observations on a General Iron Railway," first published in 1820, advocated commencing with one between Liverpool and Manchester, but the credit for the earliest practical scheme is due to William James. Born in 1771, he took up the business of land agency, later becoming the proprietor of a number of collieries, and the manager of others. As early as the beginning of the following century he had projected many railways, some of which were constructed, chiefly in connection with the mines in which he was interested, and the estates which were under his supervision. About the year 1808 he put forward a proposal for a "general railroad company," with a capital of a million pounds, also one for a tunnel under the Thames. He had the foresight to advocate the use of locomotives, and to realise the possibilities of profit arising from passenger traffic, in both of which ideas he was well in advance of the times.

In 1821 he drew up a plan, based on a preliminary survey, for a "Line of Engine Railroad from Liverpool to Manchester," in which he succeeded in interesting Joseph Sandars, a Liverpool merchant, who became one of the most active

promoters of the line, and subsequently (1824) published a pamphlet in its favour. The first survey, in which Charles B. Vignoles took part, was very imperfect, and a second was made in 1822, with the assistance of Robert Stephenson. Soon afterwards, owing to ill-health and financial embarrassments, James became incapable of proceeding further with the matter, and the committee which had been established to carry out the project appointed George Stephenson as engineer. A company was formed, and in October, 1824, the first prospectus was issued.

An improved survey was carried out, in the teeth of great opposition from the landowners, and early in 1825 an Act of Parliament was applied for, the application being unsuccessful. However, the promoters determined to try again the following session, after introducing certain modifications which avoided some of the worst of the difficulties they had experienced.

In the place of George Stephenson they appointed George and John Rennie as engineers, who had an established reputation, and employed Charles Vignoles to prepare the fresh plans. The new line avoided the properties of its most powerful opponents as far as possible, and entered Liverpool by means of a tunnel and steep gradient, so as to obviate the necessity for crossing streets, which had been strongly objected to. The Marquis of Stafford was diplomatically approached, and induced to become a large shareholder, which caused the opposition of the Bridgewater trustees to be withdrawn. The result was that the Act was obtained in April, 1826. Construction was immediately commenced, and proceeded with during the next four years and a half, all difficulties being eventually overcome by the resourcefulness and determination with which they were assailed.

The appointment of a chief engineer was taken into consideration immediately after the passing of the Act. The directors proposed to give the post to George Stephenson, under the superintendence of the Rennies. The latter, however, preferred to appoint their own resident engineer, suggesting that Stephenson should be placed in charge of the locomotive department, to be distinct from the other works. The Board then made up their minds to place Stephenson in sole charge, dispensing altogether with the Rennies. His assistants were Joseph Locke, William Allcard, and John Dixon, also, for a few months, Vignoles.

While the work was going on, much discussion took place on the subject of motive power. After a visit to the Northumberland and Durham Railways in 1826, the directors came to the conclusion that horses were out of the question, which was therefore narrowed down to locomotives *versus* stationary engines.

Early in 1829, being still unable to agree on this very vital subject, the Board decided to seek outside professional advice, and applied to Mr. Walker of Limehouse, and Mr. Rastrick of Stourbridge, for a report as to the respective merits of locomotive and fixed engines. Both were engineers of standing, Walker after-

wards becoming the engineer for the Blackfriars bridge, while Rastrick had built the "Stourbridge Lion," which was the first engine to run on rails in America.

In March, after visiting and observing the methods of working on the Bolton, Middleton, Stockton and Darlington, Hetton, Killingworth, and Brunton and Shields railways, they issued a report. It contains a mass of detail which is of little interest at the present time, and, although on the whole recommending the employment of stationary engines, cannot be said to be very decided on the point. In fact, Lardner says that it was in favour of locomotives. They estimated the capital cost as less for locomotives, and the annual expense as in favour of fixed engines, but did not omit to point out that the locomotive system could be easily expanded to meet increased requirements in the future, and that there was more ground for expecting improvements in their case. These two considerations alone seem almost of sufficient weight to turn the scale, but even yet the directors did not feel able to come to a decision.

With a view of giving the locomotive one more chance, so to speak, they resolved to invite a competition with a prize of £500, the conditions being advertised in April, 1829, and the trial taking place in October. The construction of the "Rocket" was at once begun, being the nineteenth locomotive built by the firm of R. Stephenson and Co.

The story of the contest has been told over and over again. The success of the "Rocket"—setting aside the fact that she did not break down, which her rivals did—was due to the combination of the tubular boiler, and a suitably proportioned blast pipe (or perhaps pair of blast nozzles), which supplemented one another, as the tubes would have had little effect without a strong draught, and a powerful blast in the old type of boiler would have pulled the fire through and sent it up the chimney. The tubes were adopted at the suggestion of Henry Booth, the treasurer of the company, and the arrangement worked out so happily by the Stephensons is in universal use at the present day.

There was no longer any doubt as to the desirability of having locomotives, and several were ordered immediately, eight being ready for the opening ceremony, which took place the 15th September, 1830. The proceedings, together with the unhappy accident to Mr. Huskisson, have been frequently described, the greatest detail being given in a pamphlet published by J. F. Cannell. It is rather fortunate than no further accident occurred, as the victim was conveyed to Eccles by the "Northumbrian" at the rate of 36 miles an hour, and the Duke of Wellington's carriage, being left without an engine, was towed the rest of the way to Manchester by a train running on the other line! This carriage, which conveyed the principal guests, ran on eight wheels, and was a wonderful affair, 32 feet long,

with a canopy supported on gilt pillars, more like a triumphal car in a circus than a railway vehicle. On the return journey most of the passengers were made to walk up the "inclined plane" at Sutton.

The length of the line was 31 miles. It was double throughout, 18 miles being at first laid on stone blocks, and 18 on oak or larch sleepers, these being employed on the embankments.

The cost was about £800,000, of which the principal amounts in round figures were: Bridges, £100,000; cuttings and embankments, £200,000; land, £100,000; parliamentary and law expenses, £28,000.

The line commenced at Wapping close to the docks, thence through a tunnel 1,980 yards long up a gradient of 1 in 48, where stationary engines were used to pull the trains up to Edgehill. After a short level piece, there was a down grade of 1 in 1,092 for five miles, passing through the Olive Mount cutting, along the Broad Green embankment, to the Whiston plane, which was $1\frac{1}{2}$ miles of 1 in 96 up. It was intended to use fixed engines for this gradient, and at the corresponding one called Sutton, and according to the description published by Cannell, they were actually erected, but this is doubtful, and the climbs were usually surmounted by means of piloting. The line then passed along the Rainhill level, where the competition had been held, under the celebrated skew bridge, which is still in its original state, and down the Sutton incline, also of 1 in 96. Crossing Parr Moss on a solid embankment, slightly falling, it went over the Sankey Valley on a viaduct of nine arches, then descending $6\frac{3}{4}$ miles of 1 in 880, it passed over Chat Moss on a "floating" embankment $4\frac{3}{4}$ miles long rising 1 in 1,200, the run into Manchester being a level $4\frac{3}{4}$ miles, finally crossing a street called Water Street by an iron bridge which is still just as it was when built.

The greatest difficulties, in fact the only really serious ones, were encountered in the formation of the section over Chat Moss, which was one of the last remnants of a line of fen, uncultivated mosses and morasses, stretching across England as late as the 16th century, from the mouth of the Ouse at Lynn to the Mersey. How these difficulties were overcome is set forth in considerable detail by Smiles.

The arrangements at Liverpool, which were designed so as to disarm opposition by keeping the railway as little in evidence as possible, were inadequate and inconvenient, and within a few years of the opening a new large station was built at Lime Street, where the station is at the present day, connecting with Edgehill by means of a fresh tunnel, a new station being also made at Edgehill, a little farther away. The tunnel has since been almost entirely opened up, and the line now runs in a cutting.

A contemporary account of the carriages says: "The most costly and elegant contain three apartments, and resemble the body of a coach (in the middle) and

two chaises, one at each end—the whole joined together. Another resembles an oblong square of church pews, panelled at each end, and the rail which supports the back so contrived that it may be turned over, so that the passengers may face either way.”

There were three classes, the first and second being closed carriages with separate numbered seats, but differing in the space allowed to each passenger. The third were completely open at first, but were furnished with roofs by 1833, the sides being still left unprotected. Some writers call the three classes mails, first and second. The trains were also divided into first and second class; the latter of which appear to have been those which included open carriages, and altogether there is some little ambiguity as to the exact use of the names.

The fares given in “Bradshaw” for 1840 and 1842 are as follows: “First class train, 4 inside, royal mail, 6/6; ditto, 6 inside, glass coach, 6/-. Second class train, glass coaches, 6/-; ditto, open carriages, 4/6.”

Signalling was at first done entirely by hand. A description in 1833 says: “The Company keep a police establishment who have station houses at intervals of about a mile along the road. These stations also form depôts for passengers and goods from or to any of the intervening places. . . . When a train approaches within a certain distance of a station, the policeman presents himself, and signifies a clear road by assuming an erect posture with his arm outstretched: should he take the position of ‘stand at ease,’ the engineer is aware that some obstruction exists. When a passenger is waiting at the station a red flag is hoisted by day, and a swinging lamp exhibited at night.”

About 1838 pivoted boards were introduced for use in the daytime, being turned across or parallel to the track, according to whether the line was blocked or clear. It appears to have been assumed to be the latter about four minutes after the passage of a train.

A tremendous revolution in social habits was brought about by this railway. The promoters had in view principally the carriage of goods, not anticipating that passenger traffic would be of much importance. Yet in the year 1831 the receipts from passengers amounted to nearly half a million pounds, the goods traffic being carried on “with the few engines that can be spared,” as one account states. The rapid development that took place is well exemplified in a comparison of the primitive arrangements shown in the illustrations of 1831 and the view of Lime Street Station published in 1836.

The subsequent history of the line can be summed up in a few words by saying that it joined with the Grand Junction in 1845, and in 1846 the combined system was amalgamated with the London and Birmingham under the name of London and North Western Railway.

SECTION II.—THE LOCOMOTIVES.

1.—Engines used during the construction of the line.

One was the "Lancashire Witch." She had four wheels coupled together, with cylinders at the back, steeply inclined downwards, working the leading pair of wheels direct. The boiler had two flues, each containing a fire, the total weight being about twelve tons. Forced draught was supplied by a fan on the tender. She was afterwards employed on the Bolton and Leigh Railway.

Another was a curious engine, specially constructed for steep gradients, with two boilers and chimneys, named the "Twin Sisters." She ran on six-coupled wheels with inclined direct acting cylinders. Subsequently to the completion of the line she was used by the contractors who supplied coke to the railway.

Several other early engines, including the "Rocket" and "Novelty," were also used.

2.—Competitors at Rainhill.

(a) "Rocket." Built in 1829 by R. Stephenson and Co. Four wheels, the drivers, which were 4 feet 8½ inches in diameter, leading. The cylinders, 8 by 17, were at the rear end, inclined forwards and downwards at an angle of 37 degrees. Steam pressure, 50 lb. per square inch; 25 3-inch tubes; heating surface 117.75 sq. feet; fire box, 20; total, 137.75 sq. feet. Weight in working order: engine, 4 ton 5 cwt.; tender, 3 ton 4 cwt.; total, 7 ton 9 cwt.

On the day of the trial she was painted yellow and black, with the chimney white. She is said to have been fitted with a smokebox and shorter chimney before the opening. Subsequently the cylinders were lowered to an angle of 8 degrees, being changed over, so as to bring the valves above instead of below. She worked on the L. and M. Ry. till 1836, and was then transferred to the Midgeholme line, near Carlisle, ceasing work in 1844, being brought to South Kensington in 1862.

(b) "Novelty," by Braithwaite and Ericsson. This engine, which was built in six or seven weeks, Vignoles helping to provide the money, had four equal wheels, of the suspension type, at first coupled with a chain, which was removed almost at once, being considered unnecessary. The cylinders were vertical, working upwards, and actuated the rear pair of wheels by means of bell cranks. She was painted dark blue, and embellished with burnished copper. The weight was only 2 tons 15 cwt. It is probable that she afterwards worked on the St. Helens and Runcorn Gap Railway, of which Vignoles was the engineer, which became part of the North Union.

(c) "Sanspareil," by Timothy Hackworth. Four wheels coupled, the cylinders working vertically downwards on the rear pair. Weight 4 tons 15 cwt. 2 qrs. After the trial she was purchased by the directors for £500, and sold in

1832 to the Bolton and Leigh Railway for £110, where she worked until 1844, and was then employed at a colliery as a pumping and winding engine until 1863. Now in South Kensington Museum.

(d) "Perseverance," by Burstall of Leith. Details of this engine, which was a failure, are almost entirely lacking from the accounts of the competition. Hebert states that the arrangement was similar to that of a steam road coach, built by the same engineer in 1824. The coach had vertical cylinders, acting upwards, and driving the wheels through grasshopper beams. An old print of the Rainhill competition shows a sketchy representation of the "Perseverance," which agrees with the above account, resembling "Puffing Billy" in general arrangement. She was fitted with a feedwater heater.

3.—Locomotives used for working the railway.

A.—List of engines down to 1840.

No.	Name	Date	Makers	Driving Wheels		Cylinders	Design
				Ft.	In.		
1	Rocket	1829	R. Stephenson & Co.	4	8½	8 x 17	'Rocket'
2	Meteor	1830	"	5	0	10 x 16	'Northumbrian'
3	Comet	"	"	"	"	"	"
4	Arrow	"	"	"	"	"	"
5	Dart	"	"	"	"	"	"
6	Phoenix	"	"	"	"	"	"
7	North Star	"	"	"	"	"	"
8	Northumbrian	"	"	"	"	"	"
9	Planet	"	"	"	"	"	'Planet'
10	Majestic	"	"	"	"	"	'Northumbrian'
11	Mercury	"	"	"	"	"	'Planet'
12	Mars	"	"	"	"	"	"
13	Samson	1831	"	4	6	14 x 16	4 wheels coupled
14	Jupiter	"	"	5	0	11 x 16	'Planet'
15	Goliath	"	"	4	6	14 x 16	'Samson'
16	Saturn	"	"	5	0	11 x 16	'Planet'
17	Sun	"	"	"	"	"	"
18	Venus	"	"	"	"	"	"
19	Vulcan	"	Fenton, Murray & Co.	"	"	"	"
20	Etna	"	R. Stephenson & Co.	"	"	"	"
21	Fury	"	Fenton, Murray & Co.	"	"	"	"
22	Victory	"	R. Stephenson & Co.	"	"	"	"
23	Atlas	1832	"	"	"	12 x 16	'Samson'
24	Vesta	"	R. Stephenson & Co.	5	0	11 x 16	'Planet'

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No.	Name	Date	Makers	Driving Wheels Ft. In.	Cylinders	Design
25	Milo	1832	R. Stephenson & Co.	5 0	12 X 16	'Samson'
26	Liver	"	E. Bury & Co.	"	11 X 16	'Planet'
27	Pluto	"	R. Stephenson & Co.	"	12 X 16	"
28	Caledonian	"	Galloway & Co.	"	"	4 wheels coupled
29	Ajax	"	R. Stephenson & Co.	"	11 X 18	'Planet'
30	Leeds	"	Fenton, Murray & Co.	"	11 X 16	"
31	Firefly	1833	R. Stephenson & Co.	"	11 X 18	"
32	Experiment	"	Sharp, Roberts & Co.	"	11 X 10	Vertical cylinders
33	Patentee	1834	R. Stephenson & Co.	"	12 X 16	6 wheels; single drivers
34	Titan	"	Tayleur & Co.	"	11 X 20	6 wheels; four coupled
35	Orion	"	"	"	"	"
36	Swiftsure	"	Forrester & Co.	"	11 X 18	4 wheels; out- side cylinders
37	Rapid	1836	Tayleur & Co.	"	11 X 16	6 wheels; single
38	Speedwell	"	"	"	12½ X 16	" "
39	Hercules	1836	Mather, Dixon & Co.	"	15 X 16	4 wheels; coupled
40	Eclipse	"	Tayleur & Co.	"	12 X 18	6 wheels; single
41	Star	"	"	"	14 X 12	4 wheels "
42	York	"	"	"	12 X 18	6 wheels "
43	Vesuvius	"	Haigh Foundry	"	12½ X 16	" "
44	Thunderer	"	Mather, Dixon & Co.	"	13 X 16	" "
45	Lightning	"	Haigh Foundry	"	12½ X 16	" "
46	Cyclops	"	"	"	"	" "
47	Milo	"	Tayleur & Co.	"	14 X 12	" "
48	Phoenix	"	"	"	"	" "
49	Dart	1837	Mather, Dixon & Co.	"	"	" "
50	Majestic	"	Tayleur & Co.	"	"	" "
51	Etna	"	"	"	"	" "
52	Arrow	"	Mather, Dixon & Co.	"	"	" "
53	Sun	"	R. & W. Haw- thorn	"	"	" "
54	Meteor	"	Mather, Dixon & Co.	"	"	" "
55	Comet	"	"	"	"	" "
56	Vesta	"	R. & W. Haw- thorn	"	"	" "

THE LIVERPOOL AND MANCHESTER RAILWAY.

No.	Name	Date	Makers	Driving Wheels Ft. in.	Cylinders	Design
57	Lion	1838	Todd & Co.	5 0	11 X 20	6 wheels; four coupled
58	Tiger	"	"	"	11 " 18	" "
59	Rokeby	"	Rothwell & Co.	"	11 X 18	6 wheels; single
60	Roderic	"	"	"	12 " 18	" "
61	Mammoth	1839	T. Banks & Co.	"	12 X 18	6 wheels; four coupled
62	Leopard	"	Todd & Co.	"	11½ X 18	6 wheels, single
63	Mastodon	"	T. Banks & Co.	"	12 X 18	"
64	Panther	"	Todd & Co.	"	11½ X 18	"
65	Elephant	"	"	"	14 X 20	6 wheels; four coupled
66	Samson	"	Benjamin Hick	"	11 X 20	"
67	Buffalo	"	Todd & Co.	"	14 X 20	"
68	Goliath	"	Benjamin Hick	"	11 X 20	"
69	Victoria	"	Mather, Dixon & Co.	4 6	12½ X 18	"

B.—List of engines in use during 1844.

Coaching engines.		Luggage engines.		Jobbing engines.	
Heron	(130)	30 Owl	(134) 1842	23 Atlas	(140)
Kingfisher	(131)	31 Bat	(135) "	65 Mastodon	(119)
Pelican	(132)	32 Raven	(144)	59 Rokeby	(-)
Ostrich	(133) 1842	33 Crow	(145)	62 Leopard	(-)
Stork	(136) "	65 Elephant	(113)	Ludwing	(-)
Crane	(137) "	67 Buffalo	(121)	41 Star	(165)
Pheasant	(141)	57 Lion	(116)		
Partridge	(-)	58 Tiger	(117)		
60 Roderic	(118)	68 Goliath	(122)		
27 Pluto	(-)	38 Bittern	(142)		
Swallow	(128)	39 Lapwing	(143)		
Martin	(129)	40 Petrel	(149)		
Swan	(138) 1842	41 Penguin	(148)		
Cygnnet	(139) "				
Redwing	(146)				
55 Comet	(166)				
54 Meteor	(115)				
43 Vesuvius	(-)				
45 Lightning	(114)				
52 Arrow	(-)				

The numbers in brackets are those which the engines bore when taken over by the L. & N.W.R. Two not included in the above list which they also acquired were 53 Sun (164), and 69 Victoria (123). The North Western numbers of engines officially stated to have come from the L. & M. Ry. were 113 to 166, except 124 and 127, which were Bolton and Leigh engines.

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C.—List of engines subsequent to 1844.

Woodlark	...	Passenger	...	1845	...	(147)
Linnet	...	"		"		(150)
Goldfinch	...	"		"		(151)
Bullfinch	...	"		"		(152)
Chaffinch	...	"		June	"	(153)

(The following ten engines were of the 2.4.0. outside cylinder Allan type. Parts of each were made at Crewe, and parts by Rothwell & Co. Probably they had been ordered for the L. & M. line, but never received L. & M. numbers.)

154	Starling	July, 1845
155	Ousel	"
156	Redstart	Jan., 1846
157	Redbreast	Feb., 1846
158	Condor	March, "
159	Adjutant	" "
160	Flamingo	April "
161	Cuckoo	May "
162	Albatross	" "
163	Osprey	July "

Another engine, details and date unknown, was said to have been the Soho, being the first locomotive built by Peel, Williams & Peel, of Soho Works, Ancoats.

The first eight engines took part in the opening procession on the 15th Sept., 1830, the "Northumbrian" leading.

The fast running done by the "Rocket" at Rainhill brought out the unsteadiness produced by her steeply-inclined cylinders, and in the rest of the class they were placed nearly horizontal. It is possible that she underwent this alteration during the period of nearly a year between the competition and the opening.

The detached firebox was retained down to the "North Star," No. 7, also the truck and barrel tender, the "Northumbrian" being the first to have a firebox integral with the boiler barrel, a buffer beam in front, and a respectable-looking tender. It is quite likely she was also the first to have a smokebox. As originally made, this appears to have been square in cross section; it is drawn thus on a jug showing the opening procession. No other representations of the engine in this state are known which are in perspective, but the shadow indicated in sketches in the *Mechanics' Magazine* of 16th October, 1830, and in *The Engineer* for 7th November, 1884, corroborates the evidence of the jug, which by itself would perhaps hardly go for much. In Shaw's etching of 1831 the smokebox is normal. A contemporary handkerchief also exists showing the "Comet" with a square smokebox.

The subsequent history of the engines, in cases where the company parted with them, is usually impossible to trace. As time went on there would be a brisk demand among contractors for light engines to use on construction work, and probably a number were sold for this purpose. In a list of 1836, Nos. 3, 7, 15, 17, 20 and 25 are marked "sold," 5, 6 and 16 "broken up," and 8 and 10 "done with." By 1840 all that remained of the first 32 engines were Nos. 9, 11, 19, 21, 22, 23, 27, 29, 30 and 31. It will be noticed that many of the old names were repeated as time went on. Though the "Sanspareil" was purchased, and retained for a couple of years, she does not figure in the lists as part of the regular stock.

The "Planet" was a great step in advance, the cylinders being inside under the smokebox, with the driving wheels in the rear. This engine has been illustrated in more than one book on the locomotive with the frame passing under the driving axle and over the leading, a libel that is based on an old official drawing which has unfortunately survived, and evidently represents a design either never put into execution or abandoned before completion. Some of the contemporary sketches of this engine show a splashers over the driving wheel, with the name on it in large letters, in a curve.

No. 11, "Mercury," received the addition of a pair of trailing wheels at the end of 1833; possibly others of the class were similarly treated. In 1831 a new design appeared with four coupled wheels, the cylinders being dropped so as to clear the leading axle, the first engine being named the "Samson," intended for goods traffic. The "Atlas" was fitted with an additional pair of wheels which could be lifted off the rails by a steam cylinder.

No. 26, "Liver," was the only one of Bury's make which was actually purchased. She had single driving wheels and outside frames. Previously two earlier ones, named "Dreadnought" and "Liverpool," had been tried upon the line, but were not taken over.

No. 28, "Caledonian," by Galloway and Co., had vertical cylinders working upwards, with return connecting rods actuating a dummy shaft centrally disposed between the two axles, to which it was coupled. This is the form, anticipating Crampton, in which it is shown in a contemporary lithograph, and is therefore more likely to be correct than the design given by Stretton, in which the cylinders are ahead of the smoke box.

No. 32, "Experiment," by Sharp, Roberts, also had vertical cylinders, but over the leading wheels, operating the rear ones by means of bell cranks. Though alterations were made, it proved a complete failure.

In the next engine, "Patentee," we have the prototype of a favourite form

of express engine for half a century. It was produced by lengthening the "Planet" design, and adding a pair of trailing wheels, and was highly successful. The feature of the patent was the omission of flanges on the driving wheels.

Nos. 34 and 35 were goods engines resembling the "Samson," with the addition of a pair of small trailing wheels.

No. 36, "Swiftsure," by Forrester and Co., was originally a four-wheeled engine with outside frames and outside horizontal cylinders, being the first engine with cylinders in this position. Drawings have been frequently given of her with six wheels, which was not her original condition. Owing to the wide spacing of the cylinders, this engine, and three similar ones supplied to the Dublin and Kingstown Railway, were very unsteady in running, being known familiarly as "boxers." In 1836 and 1837 an extraordinary fashion for short stroke set in (only 12 inches), which was not continued.

The list of engines in use during 1844, which is taken from the *Engineer* for 6th February, 1885, and supplemented by details supplied by Mr. Ahrons, shows that the life of these early engines was a very short one, less than half of them being as much as five years old. The above information is all that the author has been able to obtain.

A list of the engines in use on the L. and M. Ry. during the first half of 1845, is given in the appendix to the report of the Gauge Commissioners, 1846, but does not add anything material, except that "Samson" (66) is included among the "jobbing engines."

4.—Engines tried on the railway but not taken over.

It is probable that the "Novelty" was used to some extent at first. After the competition her makers, Messrs. Braithwaite and Ericsson, contracted to supply two locomotives to take 40 tons to Manchester in two hours on half a pound of coke per ton mile, which was about half the amount required by the other engines, the price being £1,000 each. They were named "William IV." and "Queen Adelaide," the first being put on the line about a week after the opening, and were enlarged editions of the "Novelty," with tenders. They were unable to perform the appointed task, and withdrawn by the builders, the failure being attributed by Ericsson to the fact that the fan for urging the draught was put at the top of the boiler, instead of blowing into the ashpan, as was done in the "Novelty." Ackermann's print of the bridge carrying the St. Helens Railway over the L. and M.R. shows one of them working on the former line.

Another remarkable engine which ran on the line for a time in the early days was the "Liverpool," by Edward Bury. The first engine he built, the "Dreadnought," which was also tried on the railway, was a failure. He then produced the "Liverpool" on quite different lines, the design being so good that he was able

to employ it without substantial modifications for about fifteen years. She was of the well-known "Bury" type, with coupled wheels, of no less than 6 feet diameter, and worked on the L. and M.R. for some time, at last being rejected and sent to the Bolton and Leigh Railway.

It is interesting to note that negotiations were entered into by the Board with Goldsworthy Gurney, with a view to his supplying a locomotive, but these came to nothing, as the parties were unable to agree on the subject of terms.

SECTION III.—BRANCH AND CONNECTING LINES.

1.—Bolton and Leigh Railway.

In 1825 an Act was obtained for constructing a railway from Bolton to Leigh, followed in 1829 by one authorising the extension of the line to Kenyon, where it connected with the Liverpool and Manchester. It was opened 1st August, 1828 (Kenyon extension, 13th June, 1831). The total distance was 9 miles 6 furlongs. In 1840 it was leased to Mr. Hargreaves, of Bolton, who found the rolling stock, except a few engines for ballasting which belonged to the Company.

In 1840, in which year it was taken over by the Grand Junction Railway, it possessed 14 engines, one of which was the "Sanspareil." Three, named the "Victoria," "Utilis," and "Castle," were built by Hargreaves, the "Utilis" having eight wheels.

2.—St. Helens and Runcorn Gap Railway.

The Act for this line, which crossed, and connected by means of spurs with, the L. and M.R., was obtained in 1850, Vignoles being the engineer. The crossing was effected by a handsome stone bridge (see Pl. IX), which has since been superseded by an iron girder structure. The line afterwards formed part of the North Union Railway.

Information about this railway is difficult to obtain, but it is almost certain that the "Novelty" and her successors, the "William IV" and the "Queen Adelaide," were employed here. Vignoles was closely associated with Braithwaite and Ericsson, the builders.

3.—Warrington and Newton Railway.

This was a short line opened in 1833, Robert Stephenson being the engineer. It possessed three locomotives, the "Vulcan," afterwards "Achilles," "Warrington," and "Newton," built by Tayleur & Co., of the "Planet" type. In 1824 an attempt was made to obtain an Act for a railway between Birmingham and Birkenhead, to be called the Birmingham and Liverpool Railway, the year before the L. & M. made their first application to Parliament. Owing to the frantic opposition of landowners and canal companies the bill was thrown out, a second

one sharing the same fate in 1826, in which year the L. and M. Railway were successful. After another failure in 1830, the promoters in 1833 obtained an Act empowering them to construct a line from Birmingham to Warrington, and to take over the Warrington and Newton, thus connecting with the L. and M. about the middle of its length, the junction now being called Earlestown. It was then named the Grand Junction Railway, as it formed the connecting link between the L. and M. and the projected London and Birmingham line.

In 1840 the G.J.R. possessed 64 engines, all with six wheels.

In 1845 it amalgamated with the L. and M.R., and the following year became part of the L. and N.W.R.

4.—Wigan Branch Railway.

This line, the Act for which received the Royal Assent the 29th May, 1830, ran from Parkside on the L. and M. to Wigan, a distance of about 7 miles. On the 22nd April, 1831, an Act was obtained for a line from Preston to Wigan, and the two were afterwards united in 1834 under the name of North Union Railway, which in 1846 was leased to the L. and N.W.R. and Lancashire and Yorkshire jointly, being finally dissolved in 1888. Vignoles was the engineer.

In 1840 there were 13 engines of the "Bury" type, without names.

SECTION IV.—DESCRIPTION OF THE EARLY VIEWS OF THE LINE.

The interest aroused by the railway led to the publication of a considerable number of illustrations, the demand for which appears to have lasted for about three years. The most beautiful series was that published by Ackermann. They were hand-coloured aquatints, produced at the time when this process was beginning to be superseded by the very inferior one of lithography.

Early in 1831 a set of seven was issued, 10 by 8 inches in size. They were drawn by T.T. Bury, and engraved by H. Pyall. After a certain number had been printed off, the titles and publication lines were erased, and a Spanish edition was printed, with titles in that language, without publication lines. The English titles and publication lines were then replaced, naturally showing small differences.

In July, 1831, six more plates were issued in a separate section, with eight pages of descriptive text.

Towards the end of the year two oblong plates were brought out, measuring 26 by 8 inches, each containing a representation of two trains.

In 1832 the thirteen small ones were published together, and another was added to the series, measuring 17 by 10½ inches. The small plates were retouched from time to time, alterations to the buildings, etc., being worked in. The later impressions, dated 1833, are very inferior. Two of the Pyall plates were replaced by new ones engraved by S. G. Hughes.

The title page of the first issue in February, 1831, was as follows:

"Six coloured views on the Liverpool and Manchester Railway, with a plate of the coaches, machines, &c. From drawings made on the spot by Mr. T. T. Bury. Price twelve shillings. London: Published by R. Ackermann, 96, Strand, and sold by R. Ackermann, Jun., 191, Regent St.; Printsellers in ordinary to His Majesty. 1831."

The succeeding English issues had the title page altered by the elimination of the word "six," and the addition of "With descriptive particulars, serving as a guide to travellers on the railway."

The title page to the Spanish edition was as follows:—"Seis vistas iluminadas del Camino de Hierro de Liverpool a Manchester con otra lamina de Coches, Maquinas, &c., &c., &c."

Londres: Lo Publica R. Ackermann, 96, Strand. MDCCCXXXI."

The description and titles to the plates were all in Spanish.

After the English edition of 1833, there was an Italian one of the two oblong plates, with titles in that language.

Publication lines on the prints:

- A. Published Feby. 1, 1831, by R. Ackermann, 96, Strand.
- B. London: Published Feby., 1831, by R. Ackermann, 96, Strand.
- C. London: Published by R. Ackermann, Novr., 1831.
- D. London: Pubd. by R. Ackermann, 96, Strand, 1831.
- E. London: Published by Ackermann and Co., Strand, 1832.
- F. Published Jany., 1833 by Ackermann and Co., 96, Strand, London.
- G. London: Published by Ackermann and Co., Strand, Jany., 1833.
- H. London: Published Feby. 1, 1833, by Ackermann and Co., 96, Strand.
- J. London: Published Feby., 1833, by Ackermann and Co., 96, Strand.
- K. London: Published by Ackermann and Co., Strand, 1833.
- L. London: Pubd. by Ackermann and Co., 96, Strand, 1833.
- M. London: Pubd. by Ackermann and Co., Strand, 1833.
- N. London: Published 1834, by Ackermann and Co., 96, Strand.
- O. London: Published 1832 by R. Ackermann, No. 96, Strand, and J. and J. Mawdsley, Liverpool.
- P. London: Published Sept. 30th, 1836, by Ackermann and Co., and Henry Lacey, 64, Bold St., Liverpool.
- Q. Milano: presso gli Editori Pietro e Giuseppi Vallardi' Conta di' Sa. Margherita N. 1101.

STATES OF THE PLATES.

1.—The Tunnel.

State 1.—"Plate 1." Pub. line A (67 mm. long). "H. Pyall, sculpt." Two figures to left, three to right. A locomotive in the distance.

State 2.—As last, but trucks substituted for the locomotive, and hauling ropes added.

State 3.—Spanish.

State 4.—English title, etc., re-engraved. Pub. line A, 76 mm. long.

State 5.—Pub. line H (1833). The three figures to right have been removed. There is a new single figure in the foreground. The train is considerably lengthened, with heavily-laden trucks about the centre of the foreground. In this case the word "Plate" was retained all through.

2.—Entrance of the Railway at Edgehill, Liverpool.

State 1.—"Plate 2." Pub. line A (curled end to the top of L in title). "H. Pyall, sculpt." The left chimney is only about one third built, and is surrounded by scaffolding. No balustrades to stairs.

State 2.—Spanish. ("Plate" deleted).

State 3.—"2." Pub. line B (L in title not curled).

State 4.—"2." As last, but chimney complete, and scaffolding removed.

New plate. "Plate II." Pub. line F (1833). "S. G. Hughes, sculpt." Spiral lines round chimneys. Does not show opening at further end of central tunnel, nor the locomotive emerging therefrom. Balustrades; five lamps.

3.—Excavation of Olive Mount (four miles from Liverpool).

(This one is upright instead of oblong.)

State 1.—"Plate 3." Pub. line B. Title 115 mm. "H. Pyall, sculpt."

State 2.—"3." Spanish.

State 3.—"3." Pub. line B. Title 131 mm. "Four" instead of "4."

New plate. "Plate III." Pub. line F (1833). "S. G. Hughes, sculpt." The left side is similar to the previous plate. The rock wall on right is finished. Some small trees show over the bridge; there is no train going away, and another bridge is seen in the distance.

4.—Viaduct across the Sankey Valley.

State 1.—"Plate 4." Pub. line B (65 mm.). "H. Pyall, sculpt."

State 2.—"4." Spanish.

State 3.—"4." Pub. line B (69 mm.).

State 4.—"4." Pub. line J (1833).

5.—View of the Railway across Chat Moss.

State 1.—"Plate 5." Curved end to V. Pub. line B (62 mm.). "H. Pyall, sculpt."

State 2.—"5." Spanish. Plate worked up in background.

State 3.—"5." V ends in a dot. Pub. line B (73 mm.).

State 4.—"5." Pub. line J (1833).

6.—Entrance into Manchester across Water Street.

State 1.—“Plate 6.” Title reads “Bridge Street,” evidently an error. Pub. line B (67 mm.). “H. Pyall, sculpt.”

State 2.—As last, but title altered to “Water Street.”

State 3.—“6.” Spanish.

State 4.—“6.” Pub. line A (75 mm.).

State 5.—“6.” Pub. line H (1833). No engraver's name. A tall chimney has been added at the top of the elevated water tank. Another chimney shows in the distance to the rear of train. Three figures in central foreground instead of five. Lamp post on right. No windows in house at extreme right.

The bridge shown in this print presents practically the same appearance to-day.

7.—Coaches, etc., employed on the Railway.

State 1.—“Plate 7.” Pub. line B (68 mm.). “H. Pyall, sculpt.”

The ss in “Passengers” both short.

State 2.—“7.” Spanish.

State 3.—“7.” Pub. line B (75 mm.). Long s in “Passengers.”

State 4.—“7.” Pub. line J (1833).

8.—Railway Office, Liverpool.

This is the station at Crown Street. Since the opening of Lime Street Station in 1836 it has only been used for goods.

State 1.—“Plate 8.” Pub. line D. “S. G. Hughes, sculpt.”

State 2.—“Plate 8.” Pub. line M (1833).

The triangular space under the roof has been boarded in on the front. The entrance to the tunnel is considerably widened, the joints in the masonry being delineated, and the railway carriages in the distance taken out. The pillar at the extreme right has been shortened, over the top of which now shows a lean-to shed. Three lamps have been added, and two notices on the wall to right.

9.—Warehouses, &c., at the end of the Tunnel towards Wapping.

State 1.—“9.” Pub. line D. S. G. Hughes, sculpt.

State 2.—“9.” Pub. line K (1833).

10.—Moorish Arch, looking from the Tunnel.

State 1.—“Plate 10.” Pub. line D. “S. G. Hughes, sculpt.” Wide piers to arch, the characteristic contraction at the springing being strongly marked. No balustrades. Only one lamp, on the left side.

State 2.—“Plate 10.” Pub. line E (1832).

The piers have been reduced, the arch being now only very slightly contracted, showing more of the bridge in the distance. Iron balustrades have been added to

the staircases, and the platform on the first floor. Six lamps have been provided. A high wall appears at the top of the right side.

11.—Near Liverpool, looking towards Manchester.

State 1.—“ 11.” Pub. line D. “ H. Pyall, sculpt.”

State 2.—“ 11.” Pub. line K. (1833).

12.—Rainhill Bridge.

State 1.—“ 12.” Pub. line D. “ H. Pyall, sculpt.”

State 2.—“ 12.” Pub. line K. (1833).

There is a great deal of shading spread over the bridge, taking off the newness, and giving it a weathered appearance. This admirable bridge is in exactly the same state to-day. The plates were usually coloured by artists who were not aware that it was built of red sandstone, and depicted it as if made of grey or yellow stone.

13.—Parkside (The station where Mr. Huskisson fell).

State 1.—“ Plate 13.” Pub. line D. “ H. Pyall, sculpt.”

There is an open space behind the masonry close to the central water column. The tops of the chimneys of the old cottage (presumably utilised as station buildings) are out of repair.

State 2.—Similar to last, but title altered to “ Taking in Water at Parkside.”

State 3.—“ Plate 13.” Pub. line L. (1833).

An engine shed has been built in the open space referred to above, and a tall chimney added on the right. The cottage chimneys have been repaired with neat caps.

We now come to the well-known pair of oblong plates, 26 inches by 8. Both are entitled “ Travelling on the Liverpool and Manchester Railway,” and depict two trains, one above the other. At the foot they are inscribed “ Drawn by I. Shaw, Liverpool,” and “ Aquatd. by S. G. Hughes.”

“ Plate 1.” Above the upper train, “ A Train of the First Class of Carriages, with the Mail ”; below the lower train, “ A Train of the Second Class, for outside Passengers.”

State 1.—Pub. line C. The upper train is drawn by the “ Jupiter,” of the “ Planet ” class, incorrectly shown with four equal wheels, with a comparatively modern-looking four-wheeled tender, and consists of five similar carriages, usually coloured yellow, terminated by a red one carrying the mail. The lower train is hauled by the “ North Star,” an improved “ Rocket,” with the primitive water barrel tender. There are six open carriages, crammed with passengers, the first three of which are entered by doors, and the other three by means of open spaces in the middle.

State 2.—Pub. line G. (1833). The upper train has only four ordinary

coaches, the "Royal Mail" having been moved one forward. At the rear is a private carriage on a truck, containing its owners and servants. Instead of the three carriages forming the last part of the lower train there are two like charr-a-banc, and canopies have been added to them all.

State 3.—Pub. line Q. The plate has been retouched practically all over. The titling is in Italian.

Plate 2.—Above the upper train, "A Train of Waggons with Goods, &c., &c." Below the lower one, "A Train of Carriages with Cattle." The upper engine is of the "Bury" type named "Liverpool," with coupled wheels. This engine ran on the line for some little time in the early days, but never became the property of the company. Only one engine of Bury's make was actually purchased, the "Liver" in 1832, which had small leading wheels. The lower engine is an excellent representation of the "Fury," which has a splash on the driving wheels, and a respectable tender, with a cast iron frame.

State 1.—Pub. line C. The last vehicle of the lower train is a double-decked sheep truck.

State 2.—Pub. line G (1833). An open horse box is substituted for the above mentioned.

State 3.—Italian edition, corresponding to the third state of Plate I.

A smaller edition of the last two plates were brought out by the same publishers in 1834, measuring 17 by 9 inches. There is a copy of the second in the Science Museum, South Kensington, the title being "Railway Conveyances from Liverpool to Manchester," publication line N. The engine of the goods train is the "North Star," of the cattle train, "Jupiter."

Sir David Salomon's collection includes a large coloured lithograph with all four trains on it, published by Engelmann et fils, Mulhouse. The English imitations are legion.

The St. Helens and Runcorn Gap Railway crossed over the L. and M. at right angles by an elegant stone-faced bridge designed by Vignoles, which forms the subject of a beautiful and rare plate, measuring 17 by 10½ inches. The title is as follows:—"View of the Intersection Bridge on the line of the St. Helens and Runcorn Gap Railway, crossing the Liverpool and Manchester Railway near the foot of the Sutton inclined plane.

"Erected by Charles Vignoles, Esqre., C.E., F.R.A.S., M.I.C.E.

"Dedicated by permission to Edward Greenall, Esq., of Wilderspool, Cheshire."

Pub. line O. No draughtsman's name. "S. G. Hughes, Aquatd."

The engine of the train crossing the bridge is either the "William IV." or the "Queen Adelaide." See *ante*.

After the L. and M. line was extended to Lime Street at the Liverpool end, which took place in 1836, a plate was issued with three views on it, drawn by S. Kelper and engraved by John Harris. The two upper ones, which are 8 by 4 $\frac{3}{4}$ inches, show the interior of Lime Street Station, and the new Edgehill Station, the lower one, 18 $\frac{1}{2}$ by 6 inches, giving the front elevation of Lime Street Station.

The above comprise all the views published by Ackermann which the author has been able to discover. Unfortunately no records have been kept by the firm of the engravings they issued.

Another set of illustrations, inferior in beauty, but fully equal in interest, are a series of etchings executed and published by I. Shaw, of Liverpool, in two parts, entitled:—

“A new and complete work of the Liverpool and Manchester Railway; comprising all the most interesting views on the line of Railway, and every other object of public interest connected with it; from drawings taken on the spot expressly for the work, and engraved by I. Shaw, late of Soho Square, London.

“Liverpool: Published by I. Shaw, Post Office Place; and Grundy & Fox, Exchange St., Manchester, MDCCCXXXI.

Part 1 contains (with a description)

1.—The opening of the Liverpool and Manchester Railway, Sept. 15th, 1830, with the Moorish arch at Edgehill as it appeared on that day. (See Pl. X.)

2.—The Viaduct over the Sankey Canal.

3.—Newton Church and Village.

(Pub. line of above, “Published Jany. 1, 1831, by I. Shaw, Post Office Place, Liverpool, and Grundy & Fox, Manchester.”)

4.—The “Northumbrian” engine.

(Pub. line similar, but without date).

Part 2 (also with description).

5.—Chat Moss.

6.—Olive Mount.

7.—Rainhill Bridge.

8.—“Planet” engine.

(Pub. line “Published March 13th, 1831, by I. Shaw, Post Office Place, Liverpool.”)

On the back of the cover is an announcement that Part III would be published 1st May, with four more views. This does not seem to have appeared. A coloured aquatint by Havell, after a drawing by Calvert, measuring 12 by 8 $\frac{1}{2}$ inches, was issued by some publisher unknown. It is more artistic than accurate. Title: “View of the Manchester and Liverpool Railway. Taken at Newton.”

All the following are lithographs, uncoloured unless otherwise described.

1.—A set of small ones, $5\frac{1}{4}$ by 4, were issued by W. Crane, of Chester. Those seen are:—Moorish Arch; Olive Mount; Sankey Viaduct; Newtown Viaduct; Bridge over Water Street, Manchester.

2.—Coloured lithograph of three trains, $14\frac{3}{4}$ by $8\frac{3}{4}$ inches; 1st class, 2nd class, and goods. Engines, "Northumbrian," "Jupiter," and "Liverpool."

3.—Coloured lithograph of locomotive "Phoenix" attached to a single carriage. $11\frac{3}{4}$ by $6\frac{1}{4}$ inches. These two are also by Crane, of Chester.

The pamphlet published by Cannell contains an advertisement of three lithographed views after drawings by A. B. Clayton. Probably they are the following, though published by Engelmann, Graf, and Coindet, namely, "Moorish Arch" and "Olive Mount Cutting," "on stone by Alfred Clayton," and "View of the Liverpool and Manchester Rail Road at the point where it crosses the Duke of Bridgewater's Canal." "A. B. Clayton, del. On stone by G. F. Nicholson." Size of these three 13 by $9\frac{1}{8}$ inches.

Lithograph $25\frac{1}{2}$ by $16\frac{7}{8}$ inches. Viaduct over the Sankey Canal and Valley. Drawn on stone by W. Smoult, Civil Engr. Feb. 3, 1830. Printed from stone by George Smith, Liverpool.

16 by 10 inches. Olive Mount. Drawn by Wm. Smoult, printed by George Smith.

$28\frac{1}{8}$ by $11\frac{5}{8}$ inches. Bridge crossing the Liverpool and Manchester Railway. From a design by H. S. Merrett, Architect and Surveyor. Lithographed by George Smith.

There is an engine of the "Planet" type on the upper line, drawing a coach with "St. Helens Railway" on it.

Lithograph, 10 by $6\frac{3}{8}$ inches. A train drawn by the "Planet," with a splasher bearing the name curved in large letters, H. Austen, del. Lithd. by Baird, Soth. John St., Liverpool.

11 by $6\frac{1}{4}$ inches. Published by Thomas Kay, 30, Castle St. (Liverpool), 1838.

Railway Station at Lime Street, Liverpool (view of exterior). Drawn by R. Barrow, London; Lithographed by W. Crane, Chester.

There is also an old print, entitled the "Rocket," reproduced in Moyaux' book on medals, which appears to have been sketched from the "Northumbrian." Sundry illustrations exist in books and pamphlets of the period, among which the set of ten lithographs contained in "The Railway Companion" of 1833, published by Effingham Wilson, are worthy of special mention. One of them gives the only known contemporary sketch of the "Caledonian."

SECTION V.—COMMEMORATIVE MEDALS, AND MISCELLANEOUS OBJECTS.

A.—Medals.

1.—Bronze and pewter. 46 mm. diam. (See Pl. XI.)

Obverse: Head of George Stephenson. Inscr., "Geo. Stephenson, Esq., Engineer."

Reverse: View of a bridge of four arches, over which a train is passing, drawn by a locomotive of the "Killingworth" type. Inscr., "Bridge at Newton, Liverpool & Manchester Railway opened Sept. 15, 1830."

2.—Silver, bronze, and pewter. 48 mm. diam.

Obverse: View of the "Moorish Arch," looking towards the original Edgehill Station. Inscr., "Entrance to the Liverpool Station & Tunnels. Published by T. Woolfield, Bazaar, Liverpool."

Reverse: View of the Sankey Viaduct with a train on it, drawn by the "Rocket." Inscr., at the top, in one curved line, "Viaduct over the Sankey Canal & Valley." Below, in five straight lines, "To Commemorate the Opening of the Liverpool and Manchester Railroad, Sep. 15, 1830. Signed Halliday, S."

3.—Pewter. 45 mm. diam.

Obverse: Between two palms, in fourteen lines, the legend, "The Liverpool and Manchester Railroad. This grand national undertaking had the Royal Assent April 12th, 1827, opened September 15th, 1830, in the presence of His Grace the Duke of Wellington and other distinguished personages." At foot, "Ottley."

Reverse: Similar to that of No. 2, but with small differences. Inscr., "Viaduct over the Sankey Canal & Valley, 14½ miles from Liverpool," in three curved lines. At foot, "G. Stephenson, Esq., Engineer."

4.—Bronze. 45 mm. diam.

Obverse: The King's head. Inscr., "William III ascended the British Throne June 26, 1830, in the 65 year of his age."

Reverse: As No. 3.

5.—Pewter, 45 mm. diam.

Similar to No. 4, but with the head of the Duke of Wellington instead of the King.

The following three medals were struck to commemorate the opening of the Grand Junction Railway in 1837, but also refer to the L. and M.

6.—Pewter. 49 mm. diam.

Obverse: A viaduct of ten arches, with a city behind it. Inscr.: Above, "Part of the viaduct of 28 arches at Birmingham." Below: "On the Liverpool, Manchester, & Birmingham Grand Junction Railway, opened July 4th, 1837. Signed, Halliday, F."

Reverse: The outside of Lime Street Station. Inscr.: "New Grand Entrance of the Railway Station at Liverpool. T. Halliday, Fecit."

7.—Pewter. 55 mm. diam.

Obverse: A viaduct of 19 arches with two trains on it. Inscr.: Above, "Viaduct over the Valley of the Weaver." Below, "Published to Commemorate the Opening of the Grand Junction Railway, July 4, 1837. By W. B. Promoli, late Thos. Woolfield, Church Street, Liverpool. Signed T. Halliday, Fecit."

Reverse: Similar to No. 6, but inscr., "Grand Façade of the New Railway Station at Liverpool."

8.—Pewter. 47 mm. diam.

Obverse: View of two converging viaducts, which appear to be intended to represent the junction of the London and Birmingham and the Grand Junction lines at Birmingham. Inscr.: Above, "Birmingham, Liverpool, & Manchester." Below, "Grand Junction Railway. Begun 1835, opened July 4, 1837. Cost £1,500,000. J. Locke, Engr. Signed: "Heeley and Coy., T.W.I."

The reverse consists of a time table, giving the times at which the first class left Birmingham, Liverpool, and Manchester, and the mileage and time taken to reach eight stations from Birmingham, Liverpool, and Manchester are both given as $97\frac{1}{2}$ miles, the time required being $4\frac{1}{8}$ hours.

9.—Several medals were struck to commemorate the Stephenson Centenary in 1881, all poorly executed. One shows the "Rocket."

B.—Miscellaneous Articles.

1.—Pottery jugs, decorated with transfer representations of the railway under the "Moorish Arch," entitled "Entrance to the Liverpool and Manchester Railway." On the other side, a fanciful representation of a train drawn by the "Novelty." These are known in three sizes.

2.—A pottery jug with transfer representation of the opening procession, showing a train drawn by the "Northumbrian," with a vehicle containing a band, and the triumphal car for the distinguished visitors. Marked underneath, "Liverpool and Manchester Railway." (See Pl. XI.)

3.—Pottery mugs of various sizes, bearing transfers of a train, usually drawn by the "Fury."

4.—Plate with transfer of the "Moorish Arch." Marked "E. W. & S." "Railway." Probably by Enoch Wood & Sons, of Burslem.

5.—Cotton handkerchief, printed with a caricature showing horses dancing and playing musical instruments, entitled "Effects of the Rail Road on the Brute Creation." The border consists of the following views: A train drawn by the "Queen Adelaide"; the Sankey Viaduct; a train drawn by the "Comet"; and

the suspension bridge on the Middlesborough branch of the Stockton and Darlington Railway.

6.—Cotton handkerchief, printed with views of the line in sepia (copied from the Ackermann prints); in the centre a representation of an engine of the "Samson" type. The main title is in English, French, and German. Probably made in Manchester.

SECTION VI.—BIBLIOGRAPHY.

Hardly a book has been written about railways which does not refer to the Liverpool and Manchester. The following list is only intended to include the more important ones dealing with the subject, omitting accounts which are merely copied from previous works, and do not add anything material in the way of information.

1824.—Letter on the projected railroad between Liverpool and Manchester: By Joseph Sandars. Liverpool: Printed by W. Wales and Co., Castle-street.

The author was one of the keenest advocates of the railway, and afterwards became a Director. This is an ably written tract of 32 pp. addressed to the Members of Parliament, to merchants, and to others interested in the conveyance of goods between Liverpool and Manchester. It gives an account of the high charges and general inconveniences of the canal system. There were at least two editions.

1828.—Report on Railroads and Locomotive Engines. Addressed to the Chairman of the Committee of the Liverpool and Manchester projected Railroad. By Charles Sylvester, Civil Engineer, Liverpool. Printed by Thomas Kaye.

This was a semi-official report, as an introductory letter, dated 15 December, 1824, addressed to the Chairman (Charles Lawrence), commences, "Having been requested by a friend, a Member of your Committee, to inspect," &c. It is in favour of locomotives. There were two editions, both 1825.

1829.—Walker's and Rastrick's Reports. First Edition. Together: 500 printed by order of the Board.

Report to the Directors on the Comparative Merits of Locomotive and Fixed Engines as a Moving Power. By Jas. Walker and J. U. Rastrick, Esqrs., Civil Engineers. Liverpool: Printed by Wales and Baines, Castle Street, 1829.

Walker's report (42 pp.) precedes Rastrick's, which is paged 43-80.

Second editions, "corrected," of both reports were published separately—Walker's by John and Arthur Arch, Cornhill, 1829 (50 pp.) Rastrick's, by R. Wrightson, Athenæum, New St. (Birmingham), with two other names in addition, 1829.

1829, &c.—The "Mechanics' Magazine" for this and the two subsequent years contains a quantity of information, not always perfectly reliable.

It mentions that the velocity of the "Novelty" ($1\frac{1}{2}$ miles in 3 minutes) was so great that "we could scarcely distinguish objects as we passed by them" (17 Oct., 1829). In the number dated 31 Oct., 1829, it says that the "Perseverance" carried the boiler and furnace on a separate carriage. There appears to be a confusion here with a steam coach, as it goes on to describe the "mode of steering the front wheels." It states (19th March, 1831) that when the "Novelty" first appeared the wheels were coupled with a chain, which was found superfluous and removed.

1830.—Observations on the comparative merits of locomotives and fixed engines as applied to railways; being a reply to the report of Mr. James Walker to the Directors of the Liverpool and Manchester Railway compiled from the reports of Mr. George Stephenson, with an account of the competition of locomotive engines at Rainhill in October, 1829, and of the subsequent experiments. By Robert Stephenson and Joseph Locke, civil engineers. Liverpool: Printed by Wales and Baines.

1830.—An account of the Liverpool and Manchester Railway, comprising a history of the Parliamentary proceedings, preparatory to the passing of the Act, a description of the railway, in an excursion from Liverpool to Manchester, and a popular illustration of the mechanical principles applicable to railways. Also an abstract of the expenditure from the commencement of the undertaking, with observations on the same. By Henry Booth, Treasurer to the Company. Liverpool: Printed by Wales and Baines.

The scope of this work is fairly adequately set forth in the title. It forms the principal mine in which most subsequent writers have dug. The author suggested the multitubular principle, which was embodied in the boiler of the "Rocket" for the first time in this country. He also invented the screw coupling.

The second edition is dated 1831, in which year there was also one issued in Philadelphia.

1830.—An accurate description of the Liverpool and Manchester Railway—the tunnel, the bridges, and other works throughout the line: with a sketch of the objects it presents interesting to the traveller or tourist. By James Scott Walker. Liverpool: Printed and Published by J. F. Cannell, 81, Lord Street. 46 pp., folding frontispiece with lith. view of Sankey Viaduct, map, and section of the line. Published before the opening (15 Sept., 1830).

Second Edition. Enlarged, with an account of the accident. 51 pp. "Note" to second edition is dated October 1st, 1830. Frontispiece as before, with an additional lithographic view of the bridge over Water Street, Manchester.

Third Edition. There were three impressions, all differing. Instead of the previous illustrations, all have Shaw's etchings of Rainhill Bridge and Olive Mount.

In print (a) "Third Edition" is in lower case type. Date 1831.

In (b) "The Third Edition" is in italic caps. 1831.

In (c) an account of the branch railways is added, and the title-page is dated and priced "1832, price one shilling." (The price of (b), which was on the cover only, was 1s. 6d.).

1831.—Descriptive and historical account of the Liverpool and Manchester Railway. By Joseph Kirwan. Glasgow: Published by McPhun.

A pamphlet of 32 pages, giving a good, and in places very amusing, account of the line. The frontispiece consists of a beautiful line engraving of Braithwaite and Ericsson's "William the Fourth." Reprinted in *Glasgow Mechanics' Magazine*, Vol. V. (1834).

1831.—Description raisonnée et vues pittoresques du chemin de fer de Liverpool à Manchester. Par P. Moreau, mis en ordre par A. Notré, 98 pp., 4to, map and 2 folding plates with 9 etchings on india paper. Paris: C. Goeury.

An interesting description. One of the folding plates shows a "Planet" locomotive, the other details of rails, points, etc. The etchings are all copied from Ackermann prints, except one, which is from Shaw's illustration of the opening.

1832.—A history and description of the Liverpool and Manchester Railway. Published by Thomas Taylor, 1832.

This is a small pamphlet, 16mo, 72 pages.

1832.—A Practical Treatise on Railroads. By Nicholas Wood. Second edition.

The first edition of this work was published in 1825. The second was much enlarged, and contained a full description of the Rainhill contest, the author being one of the judges. A third edition appeared in 1838.

1832.—Liverpool and Manchester Railway.

Answer of the directors to an article in the *Edinburgh Review* for October, 1832. Liverpool: Wales and Baines.

There is some interesting information to be gathered from this reply to certain criticisms which had been made against the management of the railway. The "William IV." and "Queen Adelaide" are described as "large and beautiful engines." No goods were carried until January, 1831, owing to the unexpected rush of passenger traffic.

1832.—Remarks on the comparative merits of cast metal and malleable iron railways, and an account of the Stockton and Darlington Railway and the Liverpool and Manchester Railway, etc., etc. Newcastle: Printed by C. H. Cook, 1832 (probably 4th edition). The portions of this work relating to the L. & M.R.

consist of a beautiful engraving of a "Planet" type engine; a short account of the commencement of the line and the Rainhill competition, together with the "Answer" of the directors just mentioned.

1833.—The Railway Companion, describing an excursion along the Liverpool line, accompanied with a succinct and popular history of the rise and progress of rail roads, illustrated by several lithographic views. By a Tourist. London: Published for the Author, by Effingham Wilson, Royal Exchange, and James Fraser, 215, Regent Street. 1833.

This is a pamphlet of 46 pages similar in character to the earlier ones by Walker and Kirwan, but in many respects more interesting. The historical sketch, which occupies half of it, is excellent, also the illustrations, which consist of five folding plates containing ten views, lithographed by E. Colyer, London. The locomotive selected for exhibition on this occasion is the "Caledonian," which appears to have been incorrectly depicted in subsequent works.

1833.—Voyage de Manchester à Liverpool par le Raill-way (*sic*) et la voiture à vapeur. Extrait d'un voyage on Angleterre pendant l'année 1831 par M. Cuchetet. Louviers: Ch. Achaintre.

A pamphlet of 25 pages.

1834.—Descriptive Catalogue of the Padorama (*sic*) of the Liverpool and Manchester Rail-road; now exhibiting at Baker Street, Portman Square. 8vo, with 12 lith. views. Printed by E. Colyer. The views are nearly identical with those in the "Railway Companion" of 1833.

The "Padorama" contained 10,000 square feet of canvas, on which the scenery at the principal points of interest was depicted, and was accompanied by "correct" models of the engines and carriages.

1835.—Description des locomotives Stephenson circulant en Angleterre et en France, etc. Avec 6 planches. Bruxelles: J. B. Champon.

This little book has been mentioned here because it contains the remarkable statement (p. 16) that recently on the L. and M. Ry. a locomotive of Sharp Roberts' ran a mile in 57 seconds, a league in 2 minutes 22 seconds, and 25 leagues an hour. As this engine must have been the "Experiment," which had vertical cylinders, someone must have been drawing the long bow.

1836.—History and Progress of the Steam Engine. By Elijah Galloway, to which is added an extensive appendix by Luke Hebert. London: Printed for Thomas Kelly.

Thirty-eight pages are devoted to the L. and M. Ry., with drawings of all the engines competing at Rainhill, except the "Perseverance."

1836.—A Practical Treatise on Locomotive Engines upon railways. By the Chev. F.M.G. de Pambour. English edition published by John Weale, London.

An American edition was brought out the same year by Carey and Hart of Philadelphia.

This work, which had been published the year previous in French, gives the results of an elaborate series of experiments carried out by this engineer on the L. and M. Railway. It includes a description and drawings of an engine of the "Planet" type.

Second enlarged editions were published both in French and English in 1840.

1838.—Cornish's Strangers' Guide to Liverpool and Manchester, with the Traveller's Companion on the Railroad, and an accurate engraving of the line of road, a section of the line, etc.

This is a small paper-bound book of 108 pages, only 20 of which are devoted to the railway, the rest consisting of guides to Liverpool and Manchester. A similar one had been issued in 1837, which included the Grand Junction Railway as well.

1838.—The Iron Road Book and Railway Companion from London to Birmingham, Manchester and Liverpool. By Francis Coghlan. London: A. H. Bailey and Co.

This is a little book of the same nature as the last, but, as the title indicates, more extensive in scope.

1839.—A Practical Treatise on Railways. By Lieut. Peter Lecount.

An interesting early account. The author says that the "Planet" was in the Mersey, but not landed when the railway opened.

1840.—The Railways of Great Britain and Ireland. By Francis Whishaw, M.I.C.E. London: Simpkin, Marshall and Co.

An account of the L. and M. Ry. is given, together with a copy of the working regulations, and a list of locomotives in 1840.

1851.—A History of the English Railway. By John Francis. London: Longman, Brown, Green and Longmans.

Three chapters are devoted to the L. and M. Railway.

1852.—Our Iron Roads. By F. S. Williams. London: Ingram, Cooke and Co.

There is here a chapter mostly devoted to the L. and M. line, and an appendix of over 40 pages, consisting of an abstract of the parliamentary proceedings in connection with the first Bill.

A second and enlarged edition appeared in 1883.

1855.—Railway Machinery. By D. K. Clark: Blackie and Son.

The historical section contains details of the early locomotives of the L. and M. Railway.

1857.—Life of George Stephenson. By Samuel Smiles. London: John Murray.

Contains a very full and much-quoted account of the difficulties attending the obtaining of the Act and the making of the railway. It would perhaps be untrue to say that Smiles has exaggerated the importance of the part played by George Stephenson in connection with this, the first railway as we understand the term, because that would be almost impossible; nevertheless, the fact remains that he does not give sufficient credit either to James or to Vignoles, the latter being hardly mentioned, although a considerable amount of the work was carried out by him.

1861.—The Two Jame's (*sic*) and the Two Stephensons. By E. M. S. P. London: Printed by G. Phipps.

This is a small book written to put forward the claim of William James to the title of the "Father of Railways," by his daughter. She complains that Smiles does not do adequate justice to the part he played in the early stages of the Liverpool and Manchester undertaking, which is no doubt true, but is an eager, sometimes bitter, partisan.

1862.—The Life of Joseph Locke. By Joseph Devey. London: E. Bentley.

Though Locke was one of the engineers employed on the Liverpool and Manchester Railway, there is little to be gathered from this work on the subject, it being mostly devoted to his later achievements, commencing with the Grand Junction Railway, which he constructed.

1863.—The Life of Robert Stephenson. By J. C. Jeafferson. London: Longman, Green.

This biography contains a considerable amount of information relating to the L. and M.R. not given by Smiles, especially in connection with the subjects of tubes in boilers, and the draught. A letter is quoted from George to Robert Stephenson of April, 1828, in which he proposes to turn part of the exhaust into the firebox. An engine was constructed about this time with a breeches flue, which was a failure.

1869.—Memoir of the late Henry Booth, of the Liverpool and Manchester, and afterwards of the London and North Western Railway. By Robert Smiles. London: Printed for private circulation by Wyman and Sons.

This book is interesting, but does not contain any information of special value on the subject of the railway.

1871.—Locomotive Engineering. By Z. Colburn, continued by D. K. Clark. London and Glasgow: Wm. Collins, Sons, and Co.

The early locomotives are described at the beginning of this work, and the Rainhill trial. The subjects of tubular boilers and the blastpipe are treated at some length.

1875.—Autobiography of Sir John Rennie. London: H. and F. N. Spon.

Although the Rennies played for a time an important part in the promotion of the L. and M. Ry., the subject is only dealt with briefly. They considered that the directors treated them badly. The most interesting item of information is that if their services had been retained the gauge would have been 5 ft. 6 in.

1886.—An outline of the growth of the locomotive engines and a few early railway carriages. By Theodore West.

A set of large lithographed sheets containing hundreds of outlines of locomotives. There are only a few L. and M.

1889.—Life of Charles Blacker Vignoles, F.R.S., etc. By his son, C. J. Vignoles. London: Longman, Green and Co.

The ninth and tenth chapters consist of an account of Vignoles's work in connection with the L. and M. Railway. He made the first survey, and was appointed principal resident engineer in 1825. He resigned early in 1827 owing to disagreements with Stephenson. Immediately after leaving the service of the railway he projected a tunnel under the Mersey.

1890.—The Life of John Ericsson. By William Conant Church. London: Sampson Low.

There is an interesting chapter dealing with the Rainhill competition and the Braithwaite and Ericsson locomotives. The "Novelty" closely resembled a steam fire engine (horse-drawn), which Ericsson had built in 1828. The firm failed by 1857. In 1839 Ericsson went to the United States. Braithwaite afterwards became chief engineer of the Eastern Counties Railway.

1892.—The Locomotive Engine and its Development. By Clement E. Stretton. London: Crosby, Lockwood and Son.

Much information, not all of it accurate, is conveyed in the early part of this work on the subject of L. and M. engines. It includes a list of them down to 1836.

1898.—The Evolution of the Steam Locomotive. By G. A. Sekon.

This is an interesting book, comprising some useful information. Like Stretton's, it is for popular consumption. A second edition appeared in 1899.

1905.—Les Chemins de Fer autrefois et aujourd'hui et leurs médailles commémoratives. Par Auguste Moyaux. Brussels: Ch. Dupries.

This magnificent work deals primarily with the subject of railway medals, of which, including those given in a supplement published in 1910, some seven hundred are described. It commences with a delightful historical section, accompanied by interesting illustrations. There is a reproduction of an old print of the Rainhill competition, which gives, in a sketchy form, perhaps the only known delineation of the "Perseverance."

1914.—The History of the London and North Western Railway. By Wilfred L. Steel. London: "The Railway and Travel Monthly."

The first chapter gives an account of the L. and M. Railway. It includes a few details of interest not given by Smiles.

There is, of course, much information scattered about in the old files of the engineering press, especially in back numbers of *The Engineer*. A valuable series of articles appeared from time to time in that journal entitled "Links in the History of the Locomotive," the most important, dealing with the L. and M. Ry., being in the numbers of the following dates: 30 June, 1876; 17 Sept., 1880; 18 March, 1881; 23 Feb. and 2 March, 1883. A fierce and wordy warfare on the subject of the blast pipe was waged from July to October, 1857. During 1884 and 1885 there was much correspondence on the subject of the "Rocket."

In conclusion, the author desires to express his cordial thanks for kind assistance to Sir David Salomons and Mr. E. L. Ahrons; to Captain Beames and Mr. Graseman, of the L. and N.W.R.; Mr. J. G. H. Warren, of Messrs. Robert Stephenson and Co.; Mr. H. W. Dickinson and Mr. E. A. Forward, of the Science Museum, South Kensington; Messrs. Shaw and Robertson, of the Public Library, Liverpool; Messrs. Ackermann and Son and Messrs. Rimell and Co., of London; and Messrs. Henry Young and Sons, Liverpool.

Mr. Dendy Marshall contented himself by reading an abstract¹ of the above paper, which was available to members at the meeting, and then went on to draw attention to the principal features of interest in the engravings, articles of pottery, medals, etc., that he had brought from his private collection and arranged in the room. With these were a model of a "Planet" type locomotive shown by Mr. Lowy (Member), and models of the "Rocket" and "Northumbrian," kindly lent by Mrs. Knight of Farnham. A Liverpool and Manchester coke sheet of 1842 was shown by Mr. Ahrons (Member). Illustrations of a few of the objects are given (pl. IX. to XIII.)

After an interval, to give members an opportunity of examining these objects closely, a vote of thanks to the author was moved by Mr. W. A. Young, seconded by Sir George Greenhill, and carried by acclamation.

DISCUSSION.

Mr. Young said he was specially struck with the useful bibliography. Sir George Greenhill claimed to be a link with the period under discussion, as he had known John Braithwaite personally. Sir George gave some reminiscences of the latter, and mentioned that his works were in New Road (now the Euston Road). The engine "Novelty" was named after a theatre. The name

¹This abstract appeared in "The Engineer," November 18th, 1921.

"Rocket" was the outcome of a barrister's would-be jibe: "People would as soon mount one of Colonel Congreve's rockets as one of these railway coaches."

Mr. S. Russell remarked that the link motion had been claimed for Ericsson,² as well as for Howe. In this connection Mr. D. Brownlie said there was an engine at Clay Cross still in existence that had on it one of the earliest link motions by Howe.

Mr. Lough Pendred thought the two locomotives "Lancashire Witch" and "Twin Sisters" were of great interest, and he would like to know more about them. The derivation of the word "clinked" in the expression "tubes are clinked" required explanation.

Mr. Rhys Jenkins said this came from the same root as clinch.

Mr. R. Young felt inclined to doubt the statement that the "Swiftsure," of Forrester, was the first locomotive with outside horizontal cylinders, but he was not prepared with definite evidence on this point.

Mr. E. A. Forward said that Liverpool and Manchester made the railway, and the railway practically made the locomotive. Adverting to Mr. Pendred's remarks, he said that of the "Lancashire Witch" and "Twin Sisters" little was known, but they were forerunners of the "Rocket." All three owed their inception more to Robert than to George Stephenson. The original construction of the firebox in the "Rocket" was still doubtful, but all the evidence pointed in one direction. He doubted the square smoke-box of the "Northumbrian." As regards boiler tubes, ferruling and beading over were possibly hit on almost at once. Simon Goodrich recorded, on March 26th, 1830, when at Stephenson's works, that "an iron ferrule is inserted into the end of each pipe and rivetted with it into the boiler end." The "Planet" was the greatest single step in progress, and all succeeding engines followed on its lines.

Eng. Capt. E. C. Smith said he had no experience of locomotive boilers, but in marine boilers the leaky tube was ever present. He had records, in the early days, of dung, potatoes, or even a sack of oatmeal being put into the boiler to stop leakage! He found that the diameter of tubes at this period increased according to the size of the boiler.

Mr. A. Legros, Mr. J. Russell, Mr. Lancaster Burne, and Mr. Butt-Gow also joined in the discussion.

The author, replying, said that the statement about Ericsson and the link motion could not be substantiated. As to outside horizontal cylinders,³ he must

²Church. Life of John Ericsson. I. 62.

³This statement, in the abstract of the paper published in "The Engineer," gave rise to some correspondence, but elicited no further facts.—Ed.

let the statement stand till evidence to the contrary was forthcoming. He agreed as to the important influence on design of the " Lancashire Witch " and " Twin Sisters." He was unable to add anything about the evolution of the firebox ; the square smoke-box on the " Northumbrian," shown on the jug (Pl. XI), was probably taken from the engraving, and so, perhaps, did not add to the evidence. As regards the diameter of locomotive boiler tubes, he believed they had only varied within narrow limits.

Fig. 3.—COMMON SEAL
of the Liverpool and Manchester Railway Co.
Actual size.

The block for the illustration of the Jug, Pl. XI., has been kindly lent by the Editor of "The Engineer"; that of the locomotive "Liverpool" by the Editor of "The Locomotive Magazine."

PLATE IX.

BRIDGE OVER THE LIVERPOOL AND MANCHESTER RAILWAY AT SUTTON
Showing the "William" the Fourth "Locomotive."
From the Aquatint by Hughes, 1832.

PLATE X.

OPENING OF THE LIVERPOOL AND MANCHESTER RAILWAY, 1830
From the Engraving by Shaw, 1831.

PLATE XI.

MEDAL
COMMEMORATING OPENING OF LIVERPOOL AND MANCHESTER RAILWAY.
Struck 1830. Actual size.

POTTERY JUG
REPRESENTING OPENING PROCESSION, LIVERPOOL AND MANCHESTER RAILWAY, 1830.

LOCOMOTIVE ENGINE AND CARRIAGE

PHENIX LOCOMOTIVE, TENDER AND PASSENGER COACH, 1831.
From the Lithograph by Crane.

PLATE XIII.

BURY'S LOCOMOTIVE, LIVERPOOL.
From an Original Drawing by Edward Bury.