THE PRE-HISTORY OF RAILWAYS

with special reference to the early quarry railways of North Somerset

BY ARTHUR ELTON

All writers of railway history are in permanent debt to *A History of Railways down to the Year* 1830 (Oxford, 1938) by the late Charles Frederick Dendy Marshall, and to *The Evolution of Railways* (London, 1943) by Mr. Charles E. Lee, amplified and corrected by the same author in his Presidential Address to the Newcomen Society on the 5th October 1960. ("Some Railway Facts and Fallacies" *Trans. Newcomen Soc.* Vol. 33, p. 1-16). Writers on canal history owe as much to Mr. Charles Hadfield for his exhaustive works on this subject, and in the present case the author is particularly indebted to *The Canals of Southern England* (London, 1955).

For much patience and courtesy, I have to thank the staff of the British Museum Print Room and Map Room, the Science Museum, the Tekniska Museum, Stockholm, the Bath Public Library, the Historical Records Office of the British Transport Commission, and the Library of the Somerset Archaeological Society. Mr. F. R. Forbes Taylor, M.I.MECH.E., gave me invaluable help on the section on cranes, on which he is an authority, and allowed me access to his paper on the subject, later to be published in the *Transactions of the Newcomen Society*. Messrs. Peter Pakenham and H. J. Reade of the Stone Firms Ltd., Battersea, were helpful on the subject of Bath Stone. For other assistance, I am indebted to Miss Ralph, archivist of Bristol, Mr. Torsten Althin, Messrs. Christopher Cookson and Ian Jeffries of the Somerset Archaeological Society and Mr. Nicholas Meinertzhagen.

There are only few moments in history of which it can be said that they divide, precisely, the past from the future, the old from the new, the historic from the prehistoric, and of which nothing that came after was ever quite the same as anything gone before. One such moment came in Liverpool under a watery sun on the morning of the 15th September 1830 at twenty minutes to eleven. At about half past ten, George Stephenson had mounted the footplate of *Northumbrian*, standing with steam up at the head of a train in Edgehill Station, the new terminus of the Liverpool and Manchester Railway, waiting to lead a cortège of eight inaugural trains to Manchester, thirty miles away on the other side of the quaking Chat Moss.

Northumbrian's train included an eight-wheel car of triumph for the Duke of Wellington and a four-wheeler for guests, including William Huskisson, who an hour or so later would be cut down and killed by *Rocket*. But no premonition of this disturbed the excited, cheering crowds, clustering the line from end to end. At 10.40 exactly, the signal gun was fired. George Stephenson opened the regulator. *Northumbrian* pulled out of Edgehill through the Moorish Arch into the Olive Mount cutting. Opening the Liverpool and Manchester Railway, George Stephenson opened the railway age. "It was like the jubilee of the Jews"— said Blackwood's correspondent —"when all grievances were forgotten; emnities and heart-burnings evaporated like smoke, and the very Quakers, throwing aside their gravity, looked as gay as larks, and joined in the general joyousness."[1]

This is the point from which most railway historians make their start. Instead, on this occasion, let us leave *Northumbrian* and her seven sister engines, *Meteor*, *Comet*, *Arrow*, *Dart*, *Phoenix*, *North Star* and *Rocket*, rattling their way to Manchester, and turn back towards the distant past where railways had their origin — very distant indeed if the definition of railway by that great historian of the subject, Charles Frederick Dendy Marshall, be accepted. "The conception 'railway' "— he wrote — "contains three elements: (1) the wheel, (2) a prepared track, (3) means for lateral constraint of the motion."[2] There can be no doubt that, by this, the grooved ways of the ancients had in them the seeds of the railway. Cut into the living rock or laid in worked stone, they certainly constituted a prepared track, imposing lateral constraint on the wheels of the carts and trucks that passed along them. They reduced friction and narrowed the amount of road to be paved to the area between the grooves.

Ships were hauled across the Isthmus of Corinth on wheeled cradles running on grooved ways constructed in about 600 B.C. by Periander, the tyrant of Corinth. Later such grooved ways spread all over Europe, to Crete, Italy, Austria, France and England. Some sixty years ago, an example was uncovered at Abbey Dore near Pontrilas in Herefordshire.[3] But the most spectacular remains are in Malta. With a gauge of 4 ft. 6 ins. (centre of groove to centre), and cut by hand in the hard coralline limestone, the Maltese tracks climb

1 *Blackwood's Edinburgh Magazine*, 1830. Vol. 28, no. 173, p. 824.

2 Charles Frederick Dendy Marshall. *A History of British Railways down to the year* 1830. (Oxford, 1938), p. 1.

3 *Trans. Woolhope Naturalists' Field Club* (1900—April 1902), p. 190; *Archaeologia Cambrensis* (1909). 6th Series, Vol. 9, Part 1, pp. 154-7.

from the lowlands to the hills, now following a straight course over the surface of the rock, now sweeping round an obstacle, now skirting the seashore. They diverge, converge, and cross one another. On single lines there are turn-outs so that the up-traffic can pass the down. At one place ten grooved ways run close together, at another twelve.

The Maltese archaeologist, Sir Themistocles Zammit, shows that they date back to Neolithic times and estimates their traffic at millions of cart loads. He compares them to railroads built by a modern engineer.[4] Herman Schreiber, the historian of roads, compares them to a stone-age marshalling yard, and suggests they had their origin in Malta's severe climate of hot dry summers alternating with drenching winter rains, eroding the hills and washing the soil down to the valleys.[5] The grooves were cut so that the soil could be hauled to the uplands in carts with wheels large enough to clear the grooves, in places two foot deep.

The Dark Ages obliterated the grooved ways. After the defeat of the Romans, even the use of the wheeled vehicles must have been limited. Though there is some evidence that mine railways were introduced in the 12th century, there is no positive proof of their existence till the early 16th century, when they are illustrated in two of the first mining treatises, *Der Ursprung gemeynner Berckrecht* and *Cosmographia Universalis* by Sebastian Münster. The former is undated, and attributed by Dendy Marshall to about 1530 and by Charles E. Lee to 1519. The first edition of the latter appeared in 1544, but the illustration not till 1550.[6] Both show small trucks with, respectively, wooden and iron disc wheels (wheels without flanges) running on baulks of timber and guided by battens.

But the first detailed account of a railway in history is in *De Re Metallica*, an illustrated encyclopaedia of mining practice by the great engineer and scholar, Georgius Agricola (1494-1555). Educated at Leipzig and in Italy, at first a schoolmaster, he later became a

[4] Sir Themistocles Zammit, C.M.G., M.D., D.LITT., "Prehistoric Cart-tracks in Malta." *Antiquity*, 1928. pp. 18-25. *Malta. The Islands and their History*. (Valetta, 1929). 2nd ed. pp. 34-7.

[5] Hermann Schreiber. *The History of Roads*. (Translated from the German by Stewart Thomas). (London, 1961). pp. 6; 102.

[6] Dendy Marshall, *Op. cit.* p. 1; Charles E. Lee, *The Evolution of Railways*. (London, 1943). 2nd ed. p. 11.

physician at Joachimsthal in 1527 and at Chemnitz in Saxony in 1533, both centres of the medieval mining industry. Though *De Re Metallica* was not published, at Basle, till 1556, the year after Agricola's death, it is known that he started work on it in about 1530 and finished it in 1550. Running into several editions in Latin, Italian and German, it had a great influence all over Europe well into the 17th century.[7]

Agricola describes mining practice in the Erz Mountains and the Carpathians. He gives a picture of poverty, hard work, hardship, danger and disease. The mine tunnels were narrow, rectangular slots, 7½ feet high and only 3¾ feet wide. Ore was usually moved from the working face in wheel-barrows, but in the longest tunnels, Agricola says that wooden railways were in use. The trucks, rectangular and bound with iron and half as large again as a wheel-barrow, were called "dogs" because they made a noise like a dog barking. The disc wheels, of wood, revolved on fixed iron axles and were kept in position by iron keys. One pair of wheels was relatively large and ran on baulks of timber. The other pair was relatively small, mounted centrally on each side of a tongue of iron projecting downwards into a groove or slot, so keeping the truck on the track and affording lateral constraint of movement.

At this time, it appears, such railways were confined to the interior workings of the mines. The miners either carried the ore from the adits and shaft heads down the mountains to the crushing mills, washeries and smelters on horse-back or even dog-back, or dragged it down on sledges and carts.

An important reason for lateral constraint was that the boys who pushed the trucks needed a method of guiding them in the dark. This point emerges in an account[8] of the gold mines in Chremnitz [*sic*], visited in 1669 by Dr. Edward Browne, F.R.S. (1644-1708), son of Sir Thomas Browne. Dealing with trucks of the kind described by Agricola, he states that, the miners "carry their Ore under ground from one place to another; or to the bottom of the Pit whence it is

7 Information drawn from the great commentary and translation of *De Re Metallica* by Herbert Clark Hoover, mining engineer and President of the United States, and his son, Lou Henry Hoover. (New York, 1950).

8 Edward Brown(e), M.D., E.R.S. *A Brief Account of some travels in Hungaria, Thessaly, Austria, Styria, Carinthia, Carniola and Friuli. As also some observations on the Gold, Silver, Copper, Quick-silver, Baths and Mineral Waters in those parts.* (London, 1673). pp. 100-1.

drawn out, in a Box or Chest which they call a Hundt or Dog; this runs upon four wheels, is higher behind then before, and hath a tongue of Iron at the bottom, which being fitted into a channel of wood framed in the middle of the bottom of each passage, it can no ways deviate, but keeps allwayes in the middle; and by this means a little Boy will run full speed with three or four hundred pound weight of Ore or Earth before him, wherever you command him, without any light, through those dismal dark passages of the Mine: and it was very new to me to hear the rattling they make in the Mine, and the alteration of the sound as they are nearer or further from us; and to see them come with that swiftness out of the Rocks[,] overturn their little Charriot, where they are to leave their Ore, then turn again and enter those dark Caves with such a force and swiftness."

By the time of Browne's visit, over a century after Agricola, railways had spread beyond the mine workings. Moreover, the trucks on these external railways had wooden wheels with flanges, on the principle one day to become universally adopted but which was perhaps new to Browne. At any rate, he went to pains to explain it in detail as if his readers were unlikely to have heard of it before. "Not much unlike this [tongue-guided railway]"— he writes —"is another instrument they have to bring the Ore from the mouth of the Mine, or from the Hills down to the *Buchworke* [*Pochwerk* or stamping mill] where they pound it and wash it; but instead of a tongue it has eight wheels or four rowlers and four wheels, and the way is made with Firre in such manner and at such a distance that the rowlers rowle upon the woode of the Firre-trees. And these rowlers and wheels are so contrived, that these Chests can never overturn nor go out of the way, and a child draweth them, and sometimes a dog serves the turn. To one *Buchworke* alone, they carry every week three or four hundred of these Chests full, and each Chest holdeth four hundred pound weight."

Browne is speaking, not of an eight-wheeled truck, but of a four-wheeled one, each wheel having two parts, a rowler kept in place on the track by a larger wheel threaded on the same shaft and acting as a flange. Had Agricola known of the flanged wheel, it is unlikely he would have omitted it from such a detailed, exhaustive work as *De Re Metallica*. So its invention may be dated with some certainty between the middle of the 16th century when *De Re Metallica* was completed, and 1669, the year Browne visited "Chremnitz".

At the Verkehrs-und-Baumuseum in Berlin is exhibited a wooden mining waggon from an Hungarian gold-mine, with flanged wheels in one piece on an iron axle. Though the truck is said to go back to the 16th century, this date lacks precise proof.[9] Since the wheels appear to be a development of those described by Browne, and would have required a fairly substantial lathe for their construction, the late 17th century may be a better estimate. If so, this truck may represent the highest development of mine railways on the mainland of Europe, for after this time they appear to have declined.

The next stage of growth took place in England, where mine railways may have been introduced at the beginning of the 17th century for the carriage of coal in the Midlands and on the North-East coast. Whether they were used inside the mines themselves is not known, for the few references to them, mainly in legal documents, way-leaves and surveys, refer exclusively to lines from the pits to points of navigation where the coal was loaded onto boats. The rails or "trams" were of wood, in the 18th century occasionally reinforced by strips of cast iron laid on their top surfaces.[10] The waggons, called chaldrons, were also of wood. They had tapering rectangular bodies, hinged bottoms so that their load could be dropped into the hold of a ship, and four small flanged wheels, one pair braked by a baulk of timber called a "tiller" or "convoy" pressed down upon their rim.

Details of the construction and working of these railways are sparse, for they were workaday ancillaries to the mines and taken for granted, except as sources of revenue for the landowners over whose land they passed on their way to river wharf or coastal port.

For the second detailed description of a railway in history after *De Re Metallica* it is necessary to turn to Somerset, where one was conceived and laid as an essential part of the planning and building of 18th century Bath by a brilliant and remarkable group of men, among them Ralph Allen (1694-1764), Post Master, Quarry Owner and Patron of Literature; John Wood (1705 ?-1754), Yorkshire builder turned architect and speculator; John Padmore (*fl.*1731-*c.*1742), Bristol engineer and crane-builder; and Richard Jones (1703-*c.*1773), Allen's Clerk of Works, foreman of his quarries and master mason.

9 Lee, "Some Railway Facts and Fallacies". *Trans. Newcomen Soc.* (1960-61). Vol. 33. p. 6.

10 Lee, *Evolution*, p. 57.

The son of a Cornish inn-keeper, Ralph Allen was born in 1694. At the age of twenty-one, he obtained the post of clerk in the Bath Post Office, and later was made Post Master. Gaining the support of Marshal Wade, presumably for political services, in about 1718 he married the Marshal's illegitimate daughter, Miss Earl, who is said to have brought him a large fortune. In 1719 he offered to farm the by- and cross-posts, that is, to pay an annual sum for the right to carry letters between provincial towns not passing through London. The contract was awarded him in 1720 for £4,000 a year, and renewed in 1727 for £6,000 a year, and thereafter at intervals almost to the end of Allen's life in 1764.[11]

Meanwhile, Bath was growing. Richard Nash, a Public Relations operator in the grand manner, had been appointed Master of Ceremonies in 1705. He set out systematically to publicise the city, and to improve its amenities. Under his guidance, Bath became less a centre of health than of social life, gambling and gossip. When he visited the city some time before 1725, Daniel Defoe observed, "But now we may say it is the Resort of the Sound, rather than the Sick; the Bathing is made more a Sport and Diversion, than a Physical Prescription for Health; and the Town is taken up in Raffling, Gameing, Visiting, and in a Word, all sorts of Gallantry and Levity."[12]

However, the development of the city was hampered by miserably poor communications. The River Avon could not be navigated beyond Hanham Mills just above Bristol. The roads were appalling and the hills precipitous. "There is nothing in the Neighbourhood of this City worth notice . . ." remarks Defoe.

Though the Bath Corporation had petitioned Parliament for powers in 1699 to open up the Avon to navigation, the Bill was defeated by the gentry, farmers and traders who feared the competition of cheap goods brought in by water. A second Bill was passed in May 1712 for "the clearing, making and effecting a Passage for Boats, Lighters and other Vessels upon the River Avon." But even this was frustrated till 1724, when John Hobbs, a Bristol Deal Merchant and 31 others, with — significantly — Ralph Allen as one

11 Richard Graves, *The Triflers* (1806). pp. 62-3. Howard Robinson, *The British Post Office* (Princeton, 1948). pp. 101-2.

12 Daniel Defoe, *A Tour thro' the whole Island of Great Britain.* (London, 1725). 1st ed. Vol. 2, Letter III, pp. 51; 53.

of the three treasurers, formed a company to acquire the Bath Corporation's interest. Work was begun immediately on six locks between Bath and Bristol, and in just over three years the Avon was made navigable to the weir just below what was later to be the site of Pulteney Bridge. The first barge was brought up to Bath on the 15th December 1727, loaded with "Deal-Boards, Pig-Lead, and Meal".[13]

As soon as he was convinced that the navigation would be brought to completion, John Wood began to think about improving the city. In the summer of 1725 a plan of it was sent up to him in Yorkshire, and he began to design a regal lay-out for various land owners, incorporating not only a grand place of assembly to be called the *Royal Forum*, but a *Grand Circus* "for the Exhibition of Sports" and an *Imperial Gymnasium* "for the Practise of medicinal Excercises". In November 1726, he signed a contract to build Berton Street. A few months later, he decided to become his own building contractor, importing labourers formerly employed on the Chelsea Water-Works. In March 1727 he undertook to build a group of houses for the Duke of Chandos and to complete the navigation of the Avon by digging a canal.[14]

At the same time, in about 1727, Ralph Allen married again. His second wife was Elizabeth Holder of Bathampton Manor, where Allen went to live in 1730. The Manor belonged to Elizabeth's brother Charles, who was in financial difficulties. Allen assisted him and, in return, obtained rights over the Manor (which he purchased outright in 1742) including Bathampton Down. He also acquired rights from another member of the Holder family on Combe Down, which he purchased in 1752.[15]

Both Bathampton Down and Combe Down contained beds of fine Bath Stone on which the growth of Bath depended. Moreover, the new Avon navigation established communication not only with Bristol, but with the Bristol Channel, opening up possibilities of coastal trade and of export to the rising cities of Dublin and Belfast. It followed as a matter of course that a man as vigorous, versatile and imaginative as Allen would exploit this new asset.

13 John Wood, *An essay towards a Description of Bath* (London, 1749). Vol. I, p. 232; Vol. 2, p. 368.

14 Wood, *Op. cit.* Vol. 1, p. 232; Vol. 2, pp. 240-1.

15 R. E. M. Peach, *The Life and Times of Ralph Allen.* (London, 1895). pp.71-2; 76.

At first, Allen developed old workings on Bathampton Down, where he may have made experiments with a railway before 1731. According to R. E. M. Peach, who had access to the Allen family papers, "a series of short trams were laid on to a centre, where was constructed a large drum worked by some kind of machinery, but we cannot quite tell what. A tramline or way was constructed, extending from the drum along the Down, then descending the slope to the edge of a rather steep gorge. The stone was here unladen and conveyed to Allen's stoneyard and basin, but what was the precise mode of conveyance is not clear."[16] Rather than a major system of rail communications between Bathampton Down and the river, this sounds more like a small industrial system of railways within the quarry and thence to the brow of the hill above Bath. A short cutting a little distance north-west of the most westerly quarry workings on the path down to St. George's Hill just possibly marks part of its course. Whatever it was, this first venture seems to have been a failure, and Wood reports that there were so many accidents in the "Old Subterraneous Quarries" that Allen decided "to dig for Stone from a new Quarry, open from the Top."[17] This was evidently the one on Combe Down which eventually supplied a great portion of the stone for building the new Bath.

The best Bath Stone lies in beds, which may reach an aggregate thickness of from 20 to 30 feet, below the Upper Ragstone, a coarse, brown, shelly limestone. It is often some 70 to 100 feet below the surface, so it must be mined rather than quarried, and the workings are approached by adits in the hillside or from above down steep inclined planes.

In its pristine condition, Bath Stone is a warm, yellow stone, perfectly uniform in colour and of fine texture. It is soft and easy to cut, and is extracted from its bed in large blocks, each usually weighing several tons. These must be stacked to allow the moisture or "quarry sap" to dry out, when the stone becomes hard and white. On exposure it gradually develops a hard skin, and often weathers to a beautiful honey colour. In winter the blocks are seasoned underground out of reach of frost. In summer they may be seasoned above ground. Though modern methods often enable the blocks to be cut to size at the quarry, in former times it was necessary wherever

[16] Peach, *Op. cit.* pp. 76-7.

[17] Wood, *Op. cit.*, Vol. 2, pp. 424-5.

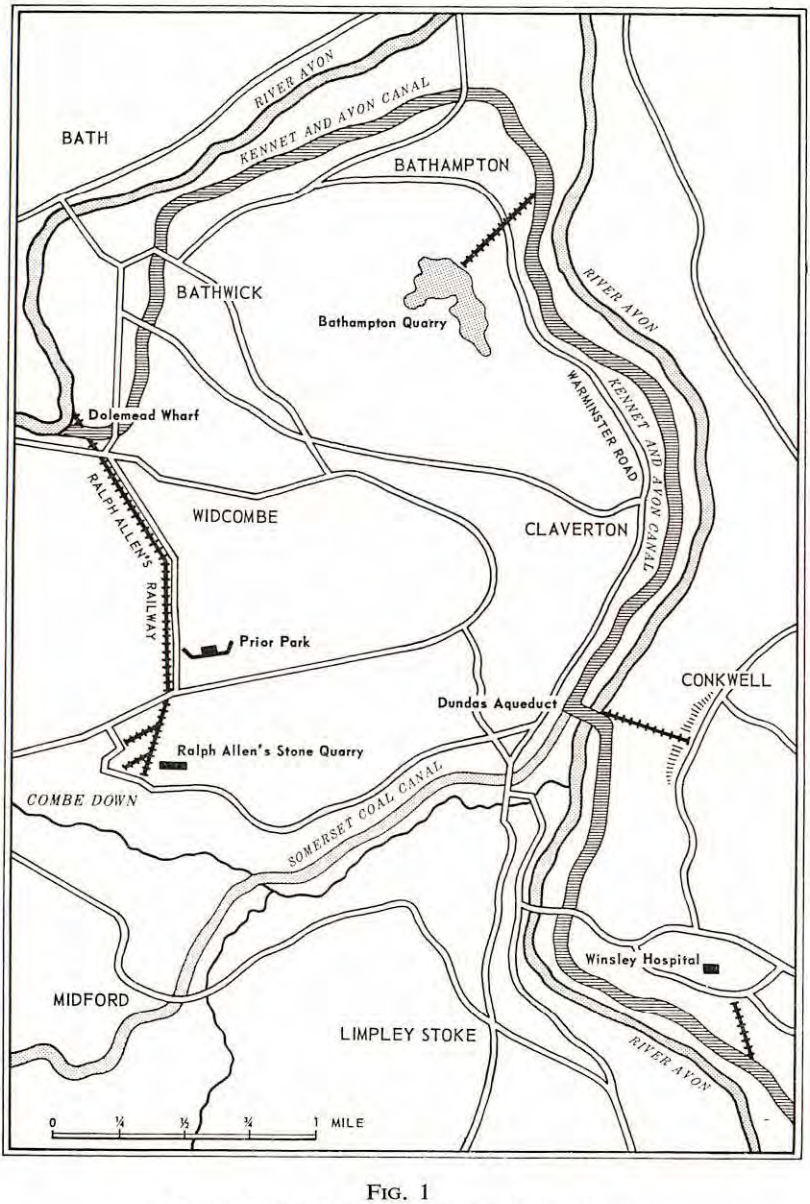


FIG. 1
EARLY STONE RAILWAYS IN THE BATH AREA

possible to transport the blocks to the building site and there to cut them as the various jobs demanded.

To make a success of his new quarries, Allen had to solve the problem of the big-scale movement of large blocks of stone from Combe Down down the Widcombe Valley to a wharf he had established on the Avon at Dolemead, only a mile and a half away, but some 500 feet below. The steepness of the Widcombe Valley, the weight of the blocks, and the nearly impassable state of the roads in the neighbourhood of Bath made conventional methods of transport by horse and cart or sledge nearly impracticable and very expensive. Allen chose perhaps the only solution open to him, a new and radical one — the construction of a railway from the top of Combe Down to the bottom on a scale much larger than his earlier line on Bathampton Down. He appears to have got the idea of doing so from the coal railways in Northumberland which he may have seen on his travels in connection with his postal services. At any rate, Wood states that he decided to make a railroad such "as the Gentlemen in the North of *England* had made between their Collieries and the River *Tyne*, that heavy Carriages might be drawn along it with such little Strength, as would reduce the transportation of the Stone to the Water Side, to half the Price of carrying it down in common Waggons." Allen procured models of such roads and carriages from "the late Mr. *Hedworth*" and engaged a resourceful Bristol engineer, John Padmore, "whose natural Genius for Mechanicks enabled him to improve upon the Original, and to Execute the intended Road, as well as the Carriages to be Worked upon it, so as to answer the Purpose for which both were Designed . . ."[18]

John Padmore is first heard of when he was summoned to do an emergency repair to St. Nicholas Church, Bristol, which was in danger of collapse owing to the settlement of one of its piers. Padmore contrived "a cast iron machine to screw up the neighbouring pillars to their capitals." As might have been expected, this was a failure, and John Wood was called in to overcome the difficulty in a more orthodox way.[19] This was in 1731, the year in which Allen's

18 *Ibid.*

19 John Latimer, *The Annals of Bristol in the 18th Century* (Privately printed, 1893), p. 180. Padmore is spelt Podmore. The papers quoted by Latimer have disappeared and St. Nicholas was burnt out in the blitz.

railway was built.[20] In this year, too, Allen engaged Richard Jones, the son of a Bath cordwainer, as his Clerk of the Works. His "autobiography"[21] throws much light on the working of the line, as Mr. P. W. Gentry, historian of the West Country tram, has pointed out in an article in *The Somerset Countryman* for 1960-61.

Charles de Labelye, the architect of Westminster Bridge, sent a detailed description of the railway to J. T. Desaguliers, F.R.S. (1683-1744) who amplified it and gave it great prominence in Volume I of his *A Course of Experimental Philosophy*, published in 1734, so providing the first detailed description of a railway in the English language,[22] and the second in history after *De Re Metallica*.

Padmore's rails were scantlings of timber, probably oak, six inches deep with a bearing surface five inches wide. The gauge was 3 ft. 9 ins. The waggons were a great advance on the Newcastle chaldrons. Built of stout oak timbers, they were three foot six wide and about 13 foot long, flat in order to carry the blocks of stone, with short, upright ends and long, low detachable sides. They had four cast-iron spoked wheels with deep flanges, themselves an innovation, for cast-iron wheels had only recently been patented by Elias Thornhill of Sunderland.[23] In appearance they were the precursors of the modern low-sided goods waggon. (Fig. 2).

The trucks were worked by horses, only two being necessary to handle a loaded truck on the level or an empty one uphill to Combe Down. The loaded trucks descended the incline by gravity. They were never turned round and always faced in the same direction.

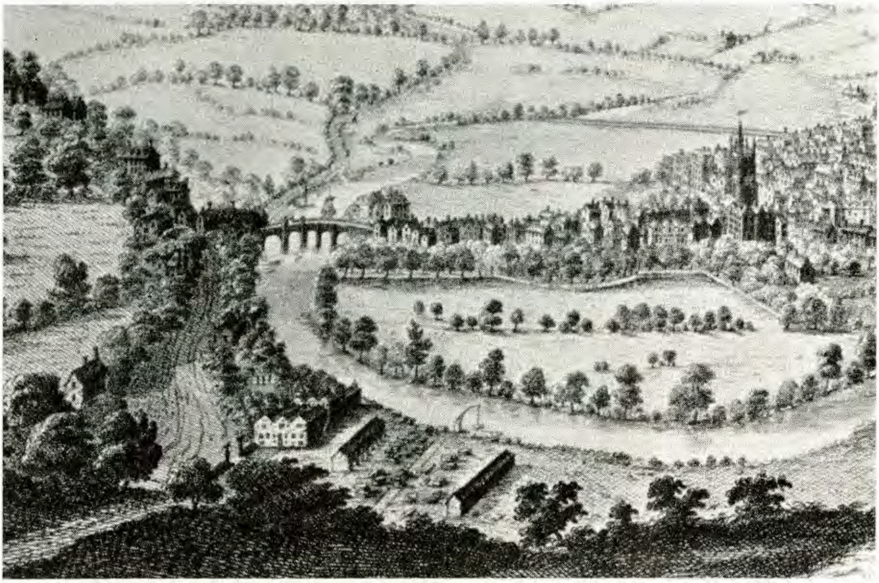
20 Peach, *Op. cit.*, p. 81. The dating of the railway formerly presented a difficulty because, elsewhere on the same page, Peach quotes an indenture of the 20th March 1730, containing a reference to the railway as "lately made and cut". Lee has provided the explanation. Till 1750, the end of the legal and civil year in England was the 25th March. So before 1750, the 20th March 1731 by the modern calendar fell in 1730. Peach has converted the date to the modern calendar, a point supported by other circumstantial evidence. *See* Lee, *Evolution*, p. 45.

21 Reproduced from the original MS by William Gregory in *Ralph Allen and Prior Park. Compiled from various sources by W. Gregory.* (Bath, 1886). pp. 33-42.

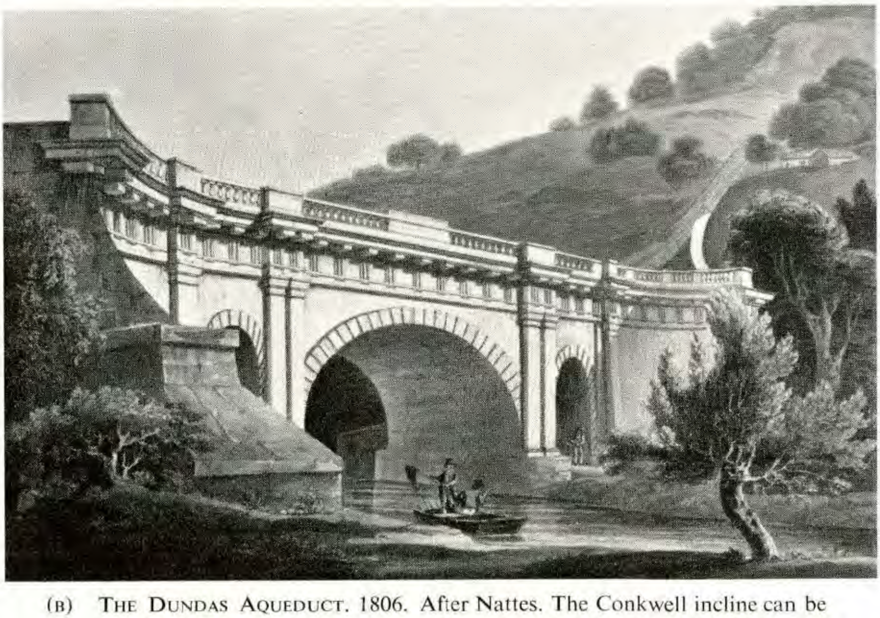
22 John Theophilus Desaguliers, F.R.S., *A Course of Experimental Philosophy.* Vol. 1 (1734). pp. 274-9. Plates 21, 22 and 23. (Vol. 2 was not published till 1744). This account was issued in a condensed form in the *Universal Magazine* for May 1754, p. 194, which attributes the original, wrongly, to the Supplement to the *New and Universal Dictionary of Arts and Sciences.*

23 Specification no. 529. 30th May 1731.

PLATE I



(A) DOLEMEAD WHARF. After Buck. (Portion only). John Padmore's rat-tail crane is lowering a block of a stone into a barge.



(B) THE DUNDAS AQUEDUCT. 1806. After Nattes. The Conkwell incline can be seen above the parapet on the right beside the sail of the barge.

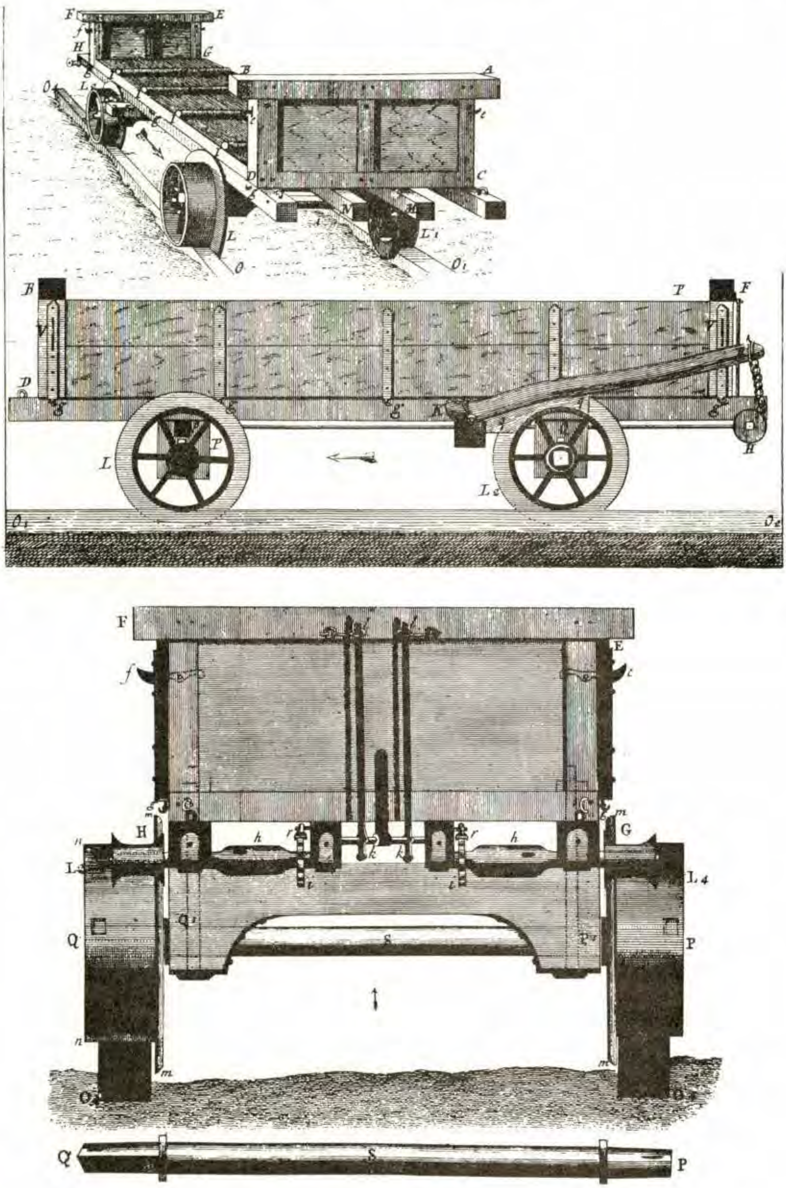


FIG. 2
JOHN PADMORE'S RAILWAY WAGGON. After Desaguliers.

Either front wheel could be locked by bolts passing through the spokes, manipulated by iron rods leading to handles at the back. Either hind wheel could be braked by a "Jigg Pole" pressed down by a chain which could be tightened from the back and held by a ratchet and pawl. By bringing all the controls together, a truck could be controlled and if necessary stopped on the steepest part of the run by one man from behind. According to Desaguliers, their load was "upwards of four tons".[24] Wood says the blocks seldom weighed "less than five or six Tun at a time".[25] Ralph Allen told de Labelye that each truck cost "upwards of 30 pounds".

By the use of the railway, stone could be delivered at Dolemead for 7/6d. a ton, 2/6d. a ton cheaper than was possible before it was built. The commercial success of the operation was assured. Soon, the total weight of stone handled at Dolemead each year was 1,800 tons,[26] and Allen had difficulty in meeting his commitments out of Bristol owing to a shortage of ships.[27]

Nearly as important as John Padmore's railway were his cranes. He erected one at Combe Down for handling heavy blocks with a gib swinging through a semi-circle. The lift was provided by a capstan with two or four projecting arms. There was no protective mechanism, so if the load got out of control, the men on the capstan would have to jump for their lives. Since the gib would tend to slew of its own accord as it took the load, Padmore added a device to control it through a powerful reducing gear.[28]

Jones states that there were four horse cranes "in the hill", used perhaps to haul the blocks of stone away from the working face Another crane, presumably Padmore's, stood "in the centre of two roads to lay the stone down to square it."[29] It is illustrated both by Desaguliers and by William Halfpenny in his *Perspective made easy*, where it is shown housed in a shed above ground.[30] (Fig. 3).

24 Desaguliers, *Op. cit.*, p. 276.

25 Wood. Marginal note on "A Plan of the City of Bath", surveyed in 1735 and published by J. Leake in 1736.

26 Gregory, *Op. cit.*, p. 34.

27 J. F. Meehan, *Famous Houses of Bath and District* (Bath, 1901). p. 37. Letter from Allen to Earl of Leicester.

28 Desaguliers, *Op. cit.*, pp. 120-2; 179. Plate 12.

29 Gregory, *Op. cit.*, p. 34.

30 Desaguliers, *Op. cit.*, pp. 179-80. Plate 16. William Halfpenny. *Perspective made easy* (London, 1731). Plate 19. "Geometrical and perspective plans of a stone-quarry to raise stones belonging to Mr. Allen's stone-works . . ."

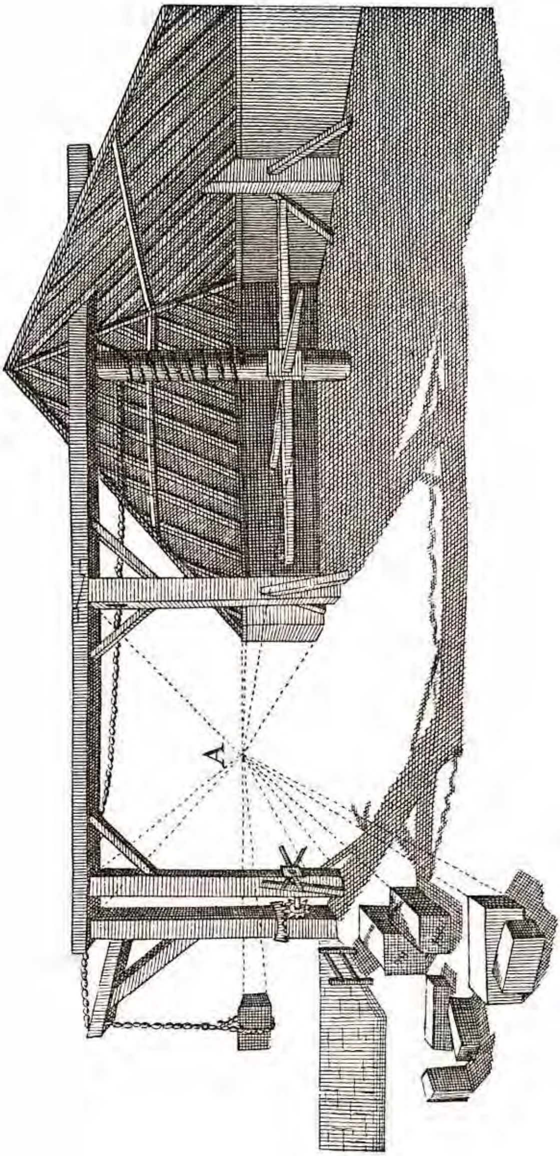


FIG. 3

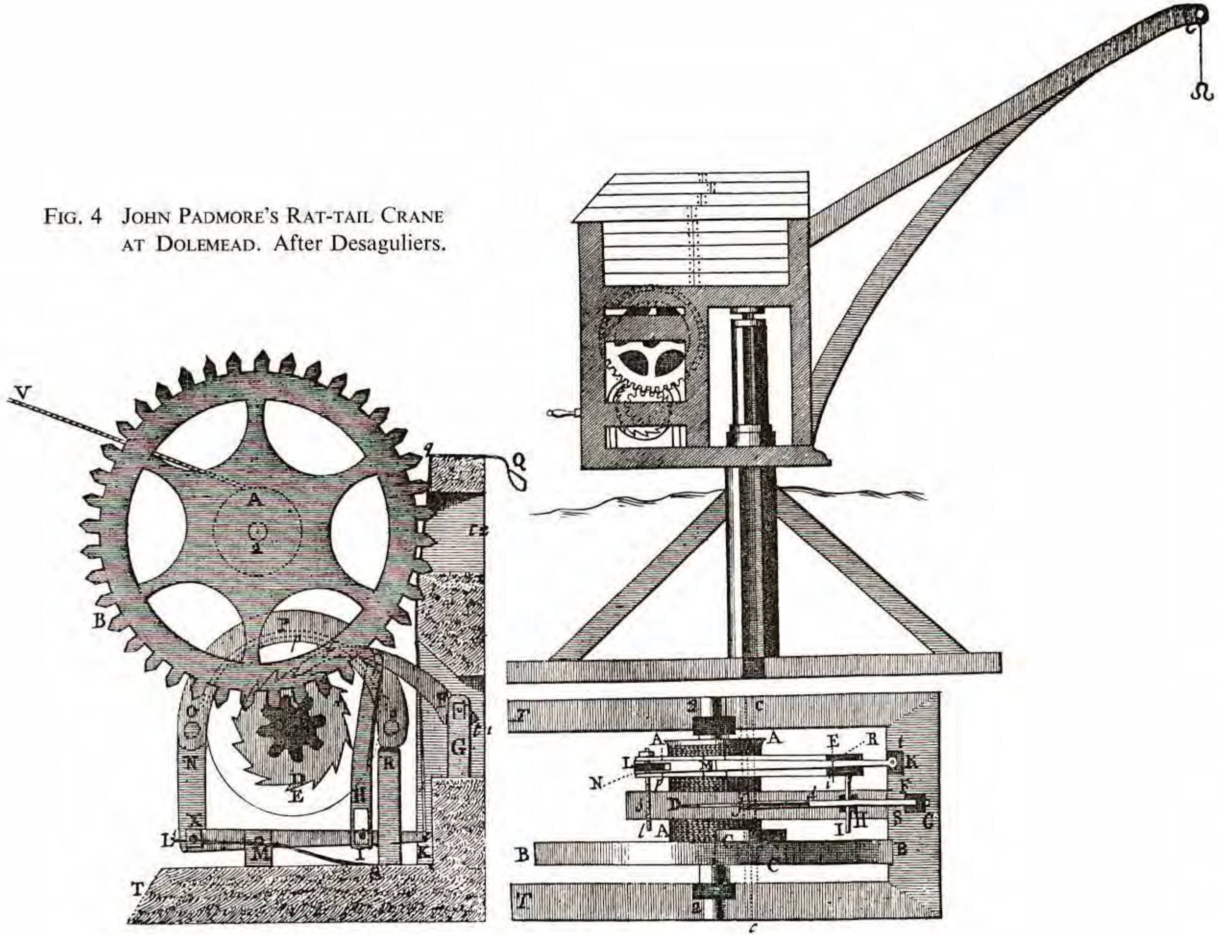
JOHN PADMORE'S CRANE AT COMBE DOWN, 1731. After William Halfpenny

Of greater interest was Padmore's rat-tailed crane for lowering blocks on to barges moored at the wharf. The whole crane turned on an upright shaft, and the gib was fixed. But in this case, Padmore designed protective gear to prevent the load getting out of control, a combination of brake and brake-drum with a ratchet and pinion. John Wood states that, with this crane, "the motion of lowering the Stone is the most Expeditious of anything of its kind, and allowed by the Curious to be a Master piece of Mechanism."[31] Today, mechanisms are used which afford greater protection, but, as Desaguliers recognised, Padmore's combination of brake and ratchet and pawl was an important advance. (Fig. 4).

(At the other end of the Avon navigation, at Bristol, Padmore built a machine known as the Great Crane by the side of the Mud Dock, an indentation in the wharf known as "The Grove", south of Queen Square. Mentioned in many contemporary guidebooks and maps, the Great Crane was a development of the Combe Down quarry crane, with the control mechanism from the Dolemead crane added, but on a much bigger scale and driven by a treadmill. To give height, it was supported on fourteen columns, variously represented as being made of cast-iron or wood. Among other duties, it may have been used to offload blocks of stone from the barges from Bath. It was probably built towards the end of Padmore's life some time before 1742, when it features, for the first time, in Roque's *A Plan of the City of Bristol.* The same map-maker illustrated it in a vignette in his Map of Bristol of 1745. In the 1742 edition of the *Tour*, Defoe refers to it as being of "the Workmanship of the late ingenious Mr. *Padmore*, which is not to be equalled in Europe. The Merchants"—he says—"are greatly benefited by it, in the extraordinary Dispatch it gives to the discharging of their ships." James Ferguson, the astronomer, described it in detail in his *Lectures*, published in 1760, with an illustration, drawn from memory after a single visit some twelve years previously. In consequence, Ferguson failed to do justice to the control mechanism, as he admits in a footnote inserted in the second edition of 1764. Unfortunately, he did not insert a new illustration, and the imperfect one was reproduced in nearly every subsequent reference book, including Chambers's *Cyclopaedia*, the

[31] Wood. *Loc. cit.*

Fig. 4 John Padmore's Rat-tail Crane at Dolemead. After Desaguliers.



Encyclopaedia Britannica and Rees's *Cyclopaedia*.)[32]

The course of Ralph Allen's railway is shown on Thomas Thorpe's *An Actual Survey of the City of Bath . . . and of five Miles round*, made in 1742. Comparison of Thorpe with the various 6 inch to the mile Ordnance Surveys of the district and a study of the ground shows that the railway started just short of what is called today De Montalt Road, and passed straight along The Avenue beside Firs Field to the head of the Widcombe Valley. Firs Field lies over the old quarry workings, and a clump of straggly trees, north west of the war memorial, marks the site of one of the many ventilating shafts, formerly in this area and now filled in. A branch of the railway crossed Firs Field diagonally, towards the road now called The Firs. A footpath between two swing gates still appears to mark its course. Another short branch diverged to the unnamed lane behind the building of the Bath Co-operative Society which stands on the place where it left the main line. The quarries themselves, nearly concealed by houses, lie in a deep depression at the back of the row of houses along The Firs. The entrance to the underground workings can still be seen leading to passages running north or north-east under Firs Field.

The length of the line from its terminus to the brow of the hill above Bath was roughly 350 yards. Thence it plunged down the side of the Widcombe Valley along a road Allen built to accommodate it, now called Ralph Allen Drive, to the Warminster Road at the bottom, a distance of a little over a mile, at a ruling gradient of 1 in 10. Crossing the Warminster Road, where a gap in the houses opposite the bottom of what is today Prior Park Road still marks its course, it passed over what was later to be the line of the Kennet and Avon Canal, and terminated at a wharf in Dolemead, a little downstream of what is now the eastern abuttment of St. James's Bridge, carrying the Great Western Railway over the Avon to Bath Station. Its total length from end to end was a little over a mile and a half. Dolemead Wharf, the railway and Padmore's crane appear in the foreground of Samuel and Nathaniel Buck's *South East Prospect of the City of Bath*, engraved in 1734. (Pl. IA). On the east

32 Defoe. *Op. cit.* 1842. 3rd ed. Vol. 2, Part 2 p. 271; James Ferguson, F.R.S., *Lectures on Select Subjects.* 1st ed. (London, 1760), p. 95, Pl. 8, figs. 1 and 2; 2nd ed. (1764) p. 55 n. The Bristol maps show that the crane disappeared between 1725 and 1833. Its site still remains, just east of Prince's Bridge.

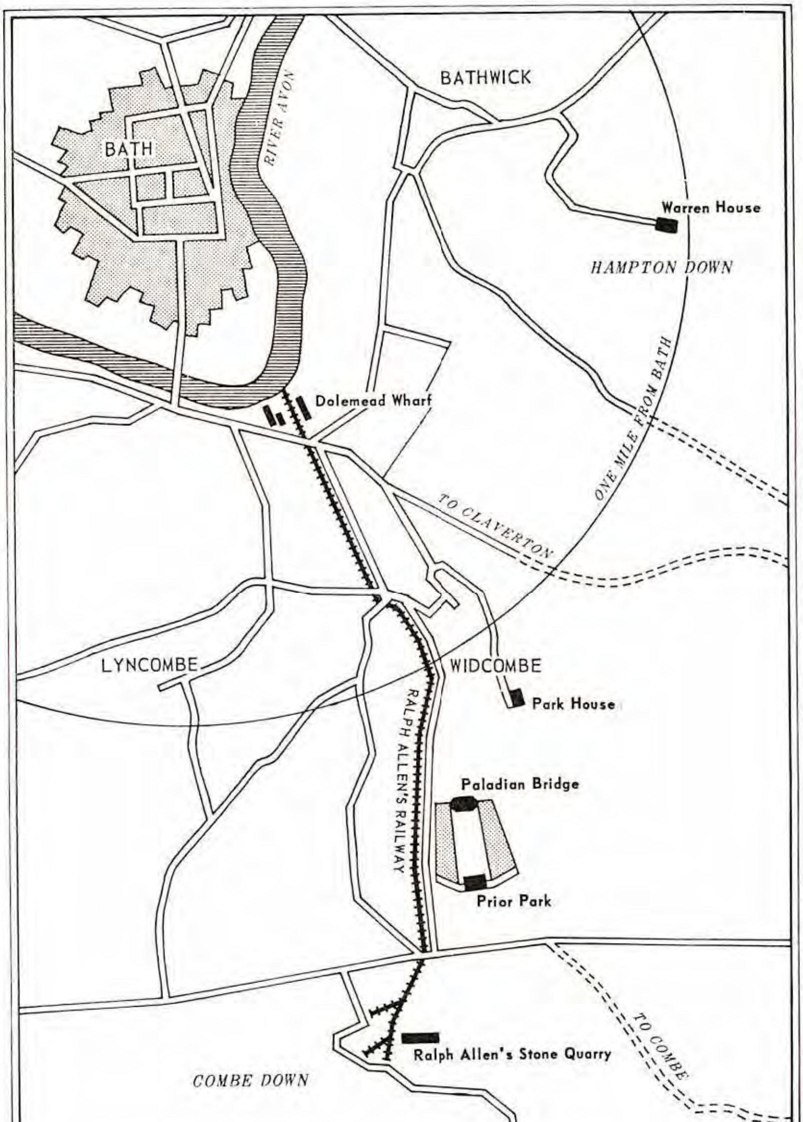


FIG. 5
RALPH ALLEN'S RAILWAY
(After Thorpe's *Survey of Bath*, 1742)

side of the yard was a line of sheds, roughly where Regent Terrace stands to day, and there was another line of sheds on the other side. These buildings and the site of the crane feature on most of the contemporary maps of the city.

When the building of North Parade and South Parade started in 1739, on what was formerly Batt's Garden, rails were laid on the north side of the river and loaded trucks, barged over from Dolemead in pairs, were hauled up by capstan. There were two barges and each made four trips in a day. At this time, there were in use "4 carriages going the hill constant and over the water, 4 ditto loading on the hill, 2 ditto loading blocks to Dolemeads, 1 ditto spare if any misfortune should happen . . ."[33]

Ralph Allen's railway became one of the wonders of the country-side. It appears as a kind of side-show surrounded by elegantly dressed men and women in the foreground of the famous print of Prior Park engraved on copper in 1750 by Anthony Walker. The Bath guidebooks which came out at frequent intervals strongly recommend it to sight-seers, and it is often noted in diaries and letters of the time.[34] Mary Chandler, the Bath poetess, eulogised it in 1736 in her *Description of Bath*:[35]

> "The lovely *Landscape* and the silent *Stream*,
> Inspire the *Poet*, and present the *Theme* . . .
> View the brown *Shadows* of yon *pathless Woods*;
> And craggy *Hills*, irregular and rude!
> Where Nature sports romantic; Hence is seen
> The *New Made Road*, and wonderful *Machine*,
> *Self-moving* downward from the Mountain's height,
> A *rock* its Burden of a Mountain's Weight."

"Mr. *Allen*, who is the Genius of the Place"— wrote Defoe —"and whose Works and Inventions there, next to the Waters, are better worth the Attention of the Curious, than anything in *Bath*, has a fine Wharf, and other convenient Places, to shape, to work, to imbark the Stones of many Tons Weight, which he digs from the Quarry, on the adjacent Hill. This he does by a wonderful Contrivance and Machine, which runs down the Hill by Grooves plac'd in the Ground,

33 Gregory, *Op. cit*., p. 37.

34 *E.g.* John Evelyn in 1738 and Daniel Meinertzhagen in 1756. See, respectively Helen Evelyn, *The History of the Evelyn Family* (London, 1915), p. 179; Georgina Meinertzhagen, *A Bremen Family* (London, 1912), p. 63.

35 Mary Chandler, *A Description of Bath*. (London, 1736). 3rd ed. p. 16.

without Horses or any other Help, than one Man to guide it, who also by a Particular Spring can stop in the steepest Part of the Hill, and in the swiftest Part of its Progress."[36]

Even the quarries were spectacular, and Pierce Egan's description of them published in 1819 would have applied equally when Ralph Allen was alive. "The visitor, if inclination permit him"— he wrote —"may descend into the stone-quarries at *Combe Down*, opened and worked by Mr. Allen. This sudden contrast is extremely pleasing: the vast depth of freestone which has been excavated from the Earth; the lofty arches or pillars, remaining in a craggy state, left by the excavators to let in light to the subterraneous passages and caverns which extend for a considerable way under the earth, most interestingly claim the attention of the explorer . . ."[37]

In 1755, Ralph Allen laid the foundation stone of the famous Palladian Bridge below Prior Park, modelled on the one at Wilton. It was sited down in the valley, well below the line of the railway. To reach it, Jones put in a self-acting incline, a full truck descending drawing up an empty one. He found this, he says, an "exceeding good contrivance, and was . . . by *my* plan."[38] If Jones is correct, and there is no reason to doubt it, this may have been the first double self-acting incline built in Britain, though the principle had been described as early as 1596 by the Italian military engineer, Buonaiuto Lorini,[39] and one was built in Sweden before 1729 by Christopher Polhem for raising iron ore at the Humboberg Mines.[40] The idea was not applied on a big scale in Britain till William

36 Defoe, *Op. cit.*, 1738, 2nd ed. Vol. 2, p. 246. The reference to "Grooves" is a mistake commonly made at a time when flanged wheels running on rails were outside normal experience and so difficult to visualise or understand. The confusion persisted till railways were commonplace. *Cf.* Tennyson's 'ringing grooves of change' in *Locksley Hall*, a false analogy arising, he explains in a footnote, because he had not seen the wheels during his first train ride in 1830, so naturally supposed they ran in grooves.

37 Pierce Egan, *Walks through Bath* (Bath, 1819), p. 202.

38 Gregory, *Op. cit.*, p. 37. Peach states, wrongly, that the main railway was a self-acting incline (*Op. cit.*, p. 81).

39 Buonaiuto Lorini, *De Fortificatione* (Venice, 1609), pp. 219-221.

40 A drawing of this device by C. J. Cronstedt, dated 1729, is in the Tekniska Museum at Stockholm.

Reynolds built one in 1789 for lowering barges from the Ketley Canal to the Severn.[41]

Ralph Allen died on the 20th September 1764 at the age of 66. Shortly afterwards, and much to the indignation of Richard Jones, the cranes were sold and the railway dismantled.[42] It evidently ceased working between the third edition of *The New Bath Guide* of 1764, which records Allen's death but continues to recommend visitors to see his railway, and the fourth edition of 1766, which drops the railway and merely inserts a statement that stone is dug from quarries near Bath. Its abandonment may have been due to the great improvement in the roads that had taken place since 1731. The fourth edition of Defoe's *Tour* announces that access to the hills round Bath "grows every Day better and better by the Prudence and good Management of the Commissioners of the Turn-pike roads",[43] and a *Picturesque Guide to Bath . . . the River Avon and the adjacent Country*, published in 1793, states "that the present improved state of the roads all round Bath, has superceded the use of the machine invented by Mr. Allen, for the safe conveyance of masses of stone &c."[44] For the stone trade continued to flourish, and sailing barges did a brisk trade, bringing iron, copper, wire, timber and many other articles up the Avon from Bristol and generally returning laden with large blocks of freestone, the use of which was increasing in Bristol at the end of the 18th century.[45]

Meanwhile, railways continued to develop elsewhere, though slowly. Towards the end of the 18th century there was a general change-over from wooden to cast-iron rails, of two contrasted types —"edge-rails" for trucks with flanged wheels of the kind today universal, and "plate-rails" of L-shaped section for vehicles with flangeless wheels. The cast-iron edge-rail appears to have been introduced by William Jessop in about 1790 and consisted of short

41 Joseph Plymley, *General View of the Agriculture of Shropshire*. (London, 1813). 2nd ed., pp. 291-7.

42 Gregory, *Op. cit.*, p. 40.

43 Defoe, *Op. cit.* (1748). 4th ed. Vol. 2, p. 297.

44 Julius Caesar Ibbetson, John Laporte and John Hassell. *A Picturesque Guide to Bath, Bristol, Hot-Wells, the River Avon and the Adjacent Country*. (London, 1793), p. 146.

45 W. Matthews, *The new History, Survey and Description of the City and Suburbs of Bristol*. (Bristol, 1794), p. 33.

three-foot rails, fish-bellied to give them strength, supported on iron chairs fastened down to stone blocks or transverse stone sleepers. Their general adoption was impeded by constant trouble from breakage, a problem not completely resolved till the successful introduction of wrought-iron rails in about 1825.

Though the disadvantages of plate-rails were considerable, including increased friction and the accumulation of dirt and stones in the angle, their form gave them an inherent strength, and they could be afforded continuous support on baulks of timber. First introduced in about 1788, for a time plate-ways spread all over the country, the north-east coast excepted. They were particularly popular in South Wales, and were employed on the Surrey Iron Railway, the first railway in London, opened in 1803.

To the 18th century industrialist, railways were essentially short-distance links between his coal mines and the sea or, during the last two decades of his age, feeder lines to the canals. Along them passed a succession of small single waggons, each requiring the services of a man and a horse, trundling their way to staithe or wharf to drop their loads into the hold of coastal vessels, or to tip them into a waiting barge. Only towards the end of the century were the trucks coupled together into short trains.

The 18th century answer to long-distance transport was, not the railway, but the canal, linking London to the great centres of industry and population and these centres to the sea. One of the greatest of the trunk canals was the Kennet and Avon, putting London into direct communication with Bath and Bristol. Planned and engineered by John Rennie (1761-1821), work was started on it at Bradford-on-Avon in October 1794.[46]

The principal engineering features of the canal were two flights of locks — one at Devizes joining the western sector to the eastern, and the other at Bath, and two great aqueducts, the Avoncliffe at Bradford-on-Avon, and the Dundas between Limpley Stoke and Claverton. (Pl. Ib). The Somersetshire Coal Canal, with branches to Camerton and Radstock, and fed by numerous plate-ways from the pits, joined it at the west end of Dundas Aqueduct.

46 This and other references are drawn from the Minute Books, Reports and other papers of the Kennet and Avon Canal kindly put at the author's disposal by the Historical Records Office of British Railways.

The Kennet and Avon Canal demanded great quantities of masonry, not only for the Avoncliffe and Dundas aqueducts, but for several smaller ones towards Devizes, as well as locks, quays, wharfs and bridges. The proprietors seem to have taken for granted that Bath Stone would be employed exclusively, though Rennie pointed out that this would mean a temporary railway to transport blocks of stone across the gap at Devizes between the eastern and western sectors, something which the use of brick would avoid. Undeterred, the contractors began to dig stone at Bradford-on-Avon, Monkton Combe and apparently anywhere else where it was found conveniently to hand. Plate-rails and waggons for the Devizes gap, ordered from Barnes of Merthyr Tydvil, were imported through Bath in 1802.

Properly selected, quarried, seasoned and laid, Bath Stone is a splendid building material, but it is a difficult stone for the inexperienced or the unwary. It is essential to avoid stone which weathers badly or does not stand up to frost; it is necessary to select particular qualities of stone for particular purposes; once selected, the stone must be properly seasoned; it must be laid in the position it occupied in the original bed or it will crumple up like a book turned on end and pressed down.

These rules seem to have been neglected in the building of the Kennet and Avon with disastrous results to the masonry. By the middle of 1801, the situation had got so bad that the proprietors decided to open their own quarry at Conkwell, on the brow of the hill on the Wiltshire side of Dundas Aqueduct. A steep, double self-acting railway incline about 700 yards long with an average gradient of about 1 in 5 was put in to lower the stone to the canal below. Nattes described it in his book on Bath, published in 1806. "Immediately above one end of . . . [Dundas Aqueduct] . . ."— he wrote —"is an inclined plane for the purpose of bringing down stone &c. from the neighbouring hill: as the full waggons descend, the empty ones are drawn up by means of a connecting chain [actually a rope]. The accumulated velocity of the descending loaded ones is retarded and regulated by a friction wheel at the commencement of the plane."[47]

Why Conkwell was selected is a mystery, for the stone there was as defective as anything dug by the contractors, and it was aban-

[47] John Claude Nattes, *Bath, illustrated by a series of Views.* (London, 1806), p. 49. The inclined plane is featured in Plate 25–"Aqueduct Bridge, Claverton".

doned in a short time. Even if Ralph Allen's old quarries on Combe Down were worked out, and this is not certain, there were supplies of stone on Claverton Down and Bathampton Down. Perhaps the canal proprietors could not agree a price with the quarry-owners. Whatever the reason, by March 1802 negotiations had been started with a Mr. Stafford Smith for stone on Claverton Down. James Mills, one of the agents of the canal, who was subsequently dismissed for financial peculation, was instructed to survey the ground for a rail road, "from Claverton Down Quarry to the line of lockage." This line does not appear to have been laid. Instead a mile-long inclined plane was built from Bathampton Down to a point on the canal near Holcombe Farm, at a gradient of about 1 in 5. It features in the first Ordnance Survey of 1808-9 and may well date back to 1802. Peach states[48] that the incline was part of Ralph Allen's original experimental line. This cannot be so. Though its top end may have connected with the old line, the incline itself was clearly planned as a feeder to the canal. For the same reason, Dendy Marshall's suggestion that it may date back to 1724 cannot be sustained.[49]

Pierce Egan was greatly impressed by this incline when he passed it in 1819, walking along the tow-path from Dundas Aqueduct to Bath, "on the left side of which an iron rail-way, from an immense steep height, is to be seen. It is curious to observe the iron carriages sent up and down, without horses; and by the aid of machinery the vehicles change their positions midway, the full one running down to the barge in the canal, and the empty one taking its way to the top again to receive its load."[50]

The course of the incline is still easily traced. Double rows of stone blocks, three foot apart centre to centre, each with a 5 inch flat with a $1\frac{1}{2}$ inch hole for an oak plug, prove it to have been a plate-way. The plate-rails were three foot long, and pinned to the stone blocks by spikes driven into the plugs. They were laid flange inwards about 41 inches apart. So, assuming a flange thickness of about 1 inch, the gauge would have been about 43 inches. The blocks were staggered to prevent the rail joints falling opposite each other.

The plate-rails appear to have started at the lip of the precipitous slope down to the Kennet and Avon Canal far below. At least, there

48 Peach, *Op. cit.*, p. 207.

49 Dendy Marshall, *Op. cit.*, p. 66.

50 Pierce Egan, *Op. cit.*, p. 207.

are no signs of stone blocks between this point and the entrances to the quarries some way in towards the hill. No doubt the flanges, projecting 5 inches or so above the level of the ground, would have formed troublesome obstructions. So it is likely that the trucks were drawn by horses along ordinary paved roads from the workings across the level ground to the head of the incline, and there pushed on to the plate-way.

About half-way down the line was carried over the Warminster Road on the "Dry Arch" at the point where it turned south towards Claverton. With a width of eighteen feet and a span of twelve, by-passed by a new stretch of road, it still stands abandoned behind trees and dense undergrowth.

In general construction, the Bathampton incline probably resembled the Penydarren plate-way in South Wales, opened in 1800 to carry iron from Merthyr to Aberdare, and later the site of the first trial in history of a locomotive designed to run on rails. However, the Penydarren line was of heavier construction, with a distance between the flanges of 53 inches. The plates were reinforced by buttresses cast integrally with them and which, judging from the blocks, were absent from Bathampton.

The opening of the Bathampton incline was too late to save the situation. Nothing could now rescue the Kennet and Avon from the effects of faulty stone and bad masonry. Though it was hoped to complete the locks at Bath by the summer of 1803, Jonathan Thomas, the Superintendent of the Works, suspended construction in September 1802. He argued it would be better to allow the stone to lie fallow the whole winter so that "if any faulty materials be brought . . . they may fall to pieces before they are placed in the building." (In fact, owing to poor masonry and the shortage of water, no connection was made with the Avon till 1810.)

In March 1803, Rennie begged the proprietors to cut their losses and to go over to brick for which, he assured them, there was plenty of clay between Devizes and Bedwyn. Bricks would cost less and, he added, "I am fully persuaded they are better suited to such Works than the best Stone which can be procured about Bath." But the proprietors stuck to stone, partly perhaps so as not to offend the quarries from which they hoped to earn revenue in the years to come by shipping block to London and Bristol. Indeed, another quarry was opened in 1803 below the present site of the Winsley Chest

Hospital, and a contract was placed in March of that year for "a wooden Rail Road" down to the canal at Murhill, about two miles east of the Dundas Aqueduct. This is the only reference to wooden rails in the Kennet and Avon Canal papers and they would have necessitated the use of trucks with flanged wheels. The course of this line can still be traced.

In June 1803 Thomas reported "We still keep a sett of Masons repairing the Work which have been torn to pieces by the Frost on the Western District." On the 12th December of the same year, Rennie reported that the flight of locks down to the Avon was in a shocking condition. The retaining walls were badly built, and there were many cracks in the masonry. Fifteen months later, on the 25th March 1805, Rennie reported that the cost of finishing the Western sector from Seend to Bath would be over £87,000 — more than three times the estimate for completion made in 1800. Though he gave several reasons for the overspending, including the rise of the cost of labour, the principal explanation was bad quality stone "requiring great & expensive repairs". More than two years later, on the 20th June 1807, Rennie gave a last, despairing piece of advice — Use bricks!

The canal struggled open from end to end on the 28th December 1810, at a cost of just under £1,000,000. It was gobbled up by the Great Western Railway in 1852 for less than a quarter of a million.

Almost eight years before the opening throughout of the Kennet and Avon canal, there took place a few miles north an event which was destined to change the history of the world. Steam replaced the horse for the first time. On Monday, the 13th February 1804, the first locomotive in the world ever to run on rails ground herself along the Penydarren plate-way in South Wales. A week later, she brought a train of trucks loaded with ten tons of bar iron and carrying some seventy onlookers nine miles from the Penydarren ironworks to the Glamorgan Canal. The weight of the engine broke the plates and she was withdrawn, but not before she had proved in a few hours that the day of the horse railway was nearly over. Built by that imaginative, frustrated genius, Richard Trevithick (1771-1833), her descendants would one day squeeze nearly out of existence the canals on which so much energy, skill and capital had been lavished. But Trevithick was not destined to enjoy the rewards of his invention. After one or two abortive efforts, including a demonstration in 1808 on a circular track near the junction of Gower Street and what is now Euston Road, he gave up his locomotive in despair for other men to develop and perfect.

The first locomotive at all to penetrate into public consciousness was one built to the design of John Blenkinsop (1782-1831). Propelling herself forward by pinions working in a rack, she was put to work in 1812 at Brandling's Middleton Colliery near Leeds, two years before George Stephenson (1781-1848) built his first locomotive at the Killingworth Colliery near Newcastle. This so struck the imagination of Sir Richard Phillips, editor of *The Monthly Magazine*, that he became one of the first people to realise that railways might have applications wider than the carriage of coal and stone. "I felt renewed delight"— he wrote in 1814 —"on witnessing [at Wandsworth] the economy of horse-labour on the [Surrey] iron rail-way; and a heavy sigh escaped me, as I thought of the inconceivable millions which had been spent about *Malta*, four or five of which might have been the means of extending *double lines of iron rail-way* from London to Edinburgh, Glasgow, Holyhead, Milford, Falmouth, Yarmouth, Dover and Portsmouth! . . . and we might, ere this, have witnessed our mail coaches running at the rate of ten miles an hour, drawn by a single horse, or impelled fifteen miles by Blenkinsop's steam-engine! Such would have been a legitimate motive for overstepping the income of the nation, and the completion of so great and useful a work would have afforded *rational* grounds for public triumph in general jubilee!"[51]

In 1825 the Stockton and Darlington Railway, engineered by George Stephenson, was opened for coal traffic, the line being shared by locomotives and horses. The same year Stephenson was appointed engineer to *The Liverpool and Manchester Railway*. In 1829, Stephenson's *Rocket* won the celebrated Locomotive Trials held at Rainhill between Liverpool and Manchester, and the decision was taken to use steam locomotives exclusively. A year later the Liverpool and Manchester Railway was opened officially, as we saw at the beginning of this paper, at twenty to eleven on the 15th September 1830, when an inaugural cortège of trains set out for Manchester.

51 Sir Richard Phillips, "A Morning's Walk to Kew." *The Monthly Magazine*, September 1814. Vol. 38, p. 118. Reprinted as a separate volume in 1817.

Now is it the end of a very disturbing day. For at a stop for water at Parkside, Huskisson has been cut down by *Rocket* and mortally injured as he was advancing to shake hands with the Duke of Wellington. At first the Duke decided to call off the celebrations and to return to Liverpool, but he was persuaded to proceed to Manchester, where there was an unprecedented concourse of people. The peace of the city would be endangered, he was told, if the mob was disappointed. Crawling over the Irwell Bridge, the trains dragged their way into Liverpool Road Station, Manchester, at a quarter to three in the pouring rain. In spite of the accident and the muddles and the rain, the half-million people who had witnessed the procession seemed dimly to realise that something had happened which would change for ever the lives and living of every person in the kingdom. "But no words . . . can convey an adequate notion of the magnificence (I cannot use a smaller word) of our progress"— wrote Blackwood's correspondent. "At first it was comparatively slow; but soon we felt that we were indeed GOING and then it was that every person to whom the conveyance was new, must have been sensible that the adaptation of locomotive power was establishing a fresh era in the state of society; the final results of which it is impossible to contemplate."[52]

52 Blackwood, *Op. cit.*, p. 825.