GEORGE STEPHENSON.

THE

STORY OF THE LIFE

OF

GEORGE STEPHENSON,

RAILWAY ENGINEER.

ABRIDGED BY THE AUTHOR FROM THE ORIGINAL AND LARGER WORK.

By SAMUEL SMILES.

THIRTEENTH THOUSAND.

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THE

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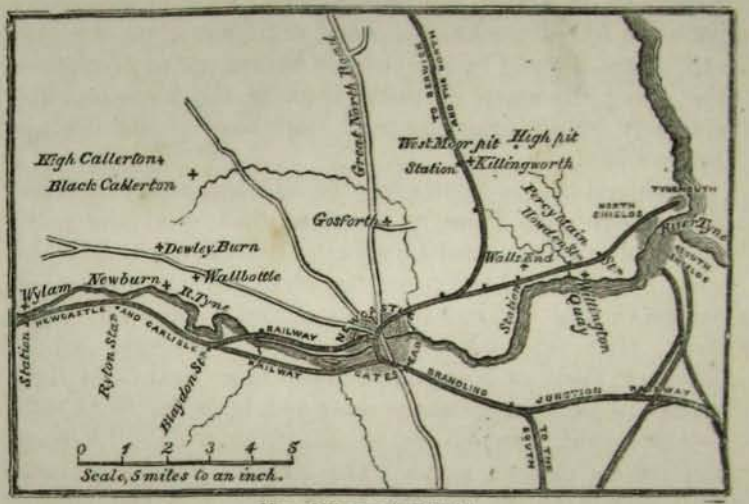


Map of Newcastle District.

CHAPTER I.

THE NEWCASTLE COAL DISTRICT — VILLAGE OF WYLAM — GEORGE STEPHENSON'S EARLY YEARS.

THE great northern coal-field of Durham and Northumberland extends in an almost unbroken direction from the Tees to the Tweed. It runs along, and indeed dips under, the coast-line of the German Ocean, extending irregularly inwards into both counties, in some parts to a considerable distance. This immense field underlies some eight hundred square miles of country; and the working of the coal from the various seams gives employment to a large number of workpeople.

Newcastle may be regarded as the capital of the district, though there are many other important towns in the neighbourhood, such as Sunderland, Shields (North and South), Hartlepool, and Middlesborough, the prosperity of which depends in a great measure on the sale and shipment of the coal to London and other ports at home and abroad. Newcastle is a very curious old town: its more ancient parts are full of crooked lanes and narrow streets, of wynds and chares, formed by tall antique houses, rising tier above tier along the steep northern bank of the Tyne; as the similarly precipitous streets of Gateshead crowd the opposite shore.

Eighteen hundred years ago the Romans, under Hadrian, first bridged the Tyne by the Pons Ælii, near the point occupied by the present Low Level Bridge, erecting at the same time a fortification on the Moot Hill, now occupied by the Central Railway Station. About a thousand years later, after repeated immigrations of Norsemen, whose Eorls or Earls of Northumberland made Newcastle their principal seat, the Normans came and built the *New* Castle —now eight hundred years old—from which the town derives its modern name. The keep of the New Castle still stands entire, though black with age and smoke, almost directly opposite the line of the noble High Level Bridge—the warlike relic of the older civilization thus confronting the utilitarian offspring of the new.

The town has in the mean time grown immensely, having expanded in all directions far beyond its ancient boundaries. It is no longer a border fortress—the "shield and defence against the invasions and frequent insults of the Scots," as described in ancient charters,—but a busy centre of peaceful industry, the fountain of a vast amount of steam power, which is exported, in the form of coal, to all parts of the world.

A dense cloud of smoke constantly hangs over the town, almost obscuring the sun's light. North and south, the atmosphere is similarly murky, and the surface of the soil everywhere exhibits the signs of extensive underground

workings. In all directions are to be seen swollen heaps of ashes and refuse, coals and slag—the rubbish of old abandoned pits, as well as the pumping engines and machinery of new. As you pass through the country by night, the earth looks as if it were bursting with fire at many points —the blaze of coke ovens, iron furnaces, and coal heaps reddening the sky to such a distance that the horizon seems to be a glowing belt of fire.

The Northumbrian people, generally, exhibit many striking and characteristic qualities, inherited most probably from the hardy and energetic Norsemen who settled in such numbers along the coast many centuries ago. Taking them as a whole, they are bigger as well as hardier men, and of more marked individuality, than the inhabitants of our more southern counties. They are less flexible, graceful, and polished, but full of rough shrewdness and mother-wit, and possessed of considerable strength of character, of which, indeed, their remarkable guttural speech is but a type. The Northumbrian dialect is a sort of mixture of Lowland Scotch and North-country English, pervaded by the strong *burr* peculiar to Northumberland. It is related of a Scotch lass who took service in Newcastle that when asked how she got on with the language, she replied that she managed it very well by "swallowing the R's and giein them a bit chow i' the middle." This description of the Newcastle dialect might, no doubt, be improved, but we will not venture upon a task so difficult.

The classes of the Northumbrian population more particularly referred to in the course of the following pages, are those connected with the coal trade. The number of workpeople employed in the Durham and Northumberland collieries, above and below ground, is about forty thousand—the above-ground workmen being nearly half the number of those employed under the surface. Besides these there is about an equal number of keelmen and sailors employed in the transport of the coal; the shipping connected with the trade, as is well known,

having for hundreds of years formed the principal nursery of our seamen.

The pitmen, who work out the coal below ground, or "the lads belaw," as they call themselves, are a peculiar class, quite distinct from the workmen employed on the surface. They are a people with peculiar habits, manners, and character, as much so as fishermen and sailors, to whom, indeed, they are supposed, perhaps from the dangerous nature of their calling, to bear a considerable resemblance. Some forty or fifty years ago they were a very much rougher and worse-educated class than they are now; hard workers, but very wild and uncouth; much given to "steeks," or strikes; and distinguished, in their hours of leisure and on pay-nights, for their love of cock-fighting, dog-fighting, hard drinking, and cuddy races. The pay-night was a fortnightly saturnalia, in which the pitman's character was fully brought out, especially when the "yel" was good. Though earning much higher wages than the ordinary labouring population of the upper soil, the latter did not mix nor intermarry with them; so that they were left to form their own communities, and hence their marked peculiarities as a class. Indeed, a sort of traditional disrepute seems long to have clung to the pitmen, perhaps arising from the nature of their employment, and from the circumstance that the colliers were amongst the last classes enfranchised in England, as they were certainly the last in Scotland, where they continued bondmen down to the end of last century.

The last thirty years, however, have worked a great improvement in the moral condition of the pitmen; the abolition of the twelve months' bond to the mine, and the substitution of a month's notice previous to leaving, having given them greater freedom and opportunity for obtaining employment; and day schools and Sunday schools, together with the important influences of railways, have brought them fully up to a level with the other classes of the labouring population. The Newcastle colliery class can even boast of having produced amongst their number many

distinguished men, such as Dr. Hutton the geologist, originally a hewer at Long Benton; and Thomas Bewick, the first English wood engraver. One of Bewick's earliest recollections was that of lying for hours on his side between dismal strata of coal, and plying the pick by the light of a glimmering candle for bread.

Amongst the upper-ground workmen connected with a colliery are the firemen, enginemen, and brakesmen, who fire and work the engines, and superintend the machinery employed to draw coals out of the pits and keep them clear of water. Previous to the introduction of the steam-engine the usual machine employed for the purpose was what is called a "gin." The gin consists of a large drum placed horizontally, round which ropes attached to buckets and corves are wound, which are thus drawn up or sent down the shafts by a horse travelling in a circular track or "gin race." This method was employed for drawing up both coals and water, and it is still used for the same purpose in small collieries; but where the quantity of water to be raised is great, the gin is found quite insufficient, and then pumps worked by steam power are called into requisition.

Newcomen's atmospheric engine was first made use of to work the pumps; and it continued to be so employed long after the more powerful and economical condensing engine of Watt had been introduced. In the Newcomen or "fire engine," as it was called, the power is produced by the pressure of the atmosphere forcing down the piston in the cylinder, on a vacuum being produced within it by condensation of the contained steam by means of cold water injection. The piston rod is attached to one end of a lever, whilst the pump rod works in connexion with the other. The hydraulic action employed to raise the water is exactly similar to that of a common sucking pump.

The working of a Newcomen engine is a clumsy and apparently a very painful process, accompanied by an extraordinary amount of wheezing, sighing, creaking, and bumping. When the pump descends, there is heard a plunge,

a heavy sigh, and a loud bump: then, as it rises, and the sucker begins to act, there is heard a creak, a wheeze, another bump, and then a loud rush of water as it is lifted and poured out. Where engines of a more powerful and improved description are used, the quantity of water raised is enormous—as much as a million and a half gallons in the twenty-four hours.

Another engine, early employed for the purpose of winding the coal out of the pits, was that called a Whimsey. In working this machine, the engine-tenter, or brakesman, stood with his hand, or foot, upon a lever, to stay the action of the whole the moment he saw the corfe or basket full of coals above ground, when it was landed by the banksman on the pit-head. The total power of the engines employed in pumping and winding in the Northern collieries is now considerably upwards of twenty thousand horses.

The necessity which existed for conveying, in the easiest and cheapest manner, large quantities of coal from the pits to the shipping places along the Tyne and Wear, early led to the invention of levelled tracks laid with stone, along which the waggons were dragged by horses. Then wooden planks or rails were in course of time introduced, by which the resistance of friction was still further diminished; but, as the wood soon became worn out, the rails were protected by flat iron plates nailed upon their upper edges; and eventually the whole rail was made of cast-iron plates, whence the road came to be denominated the "plate-way."

These roads led down to the staiths erected along the river side; the waggons sometimes descending by their own gravity along inclined planes, the waggoner standing behind to check the speed by means of a convoy or wooden brake bearing upon the rims of the wheels. Arrived at the staiths, the waggons were emptied at once into the ships alongside waiting for cargo. Any one who has sailed down the Tyne from Newcastle Bridge cannot but have been struck with the appearance of the immense staiths, constructed of timber, which are erected at short distances from each other on both sides of the river.

But a great deal of the coal shipped from the Tyne comes from above-bridge, where sea-going craft cannot reach, and is floated down the river in "keels," in which the coals are sometimes piled up according to convenience when large, or, when the coal is small or tender, it is conveyed in tubs to prevent breakage. These keels are of a very ancient model,—perhaps the oldest extant in England: they are even said to be of the same build as those in which the Norsemen navigated the Tyne centuries ago. The keel is a tubby, grim-looking craft, rounded fore and aft, with a single large square sail, which the keel-bullies, as the Tyne watermen are called, manage with great dexterity; the vessel being guided by the aid of the "swape," or great oar, which is used as a kind of rudder at the stern of the vessel. These keelmen are an exceedingly hardy class of workmen, not by any means so quarrelsome as their designation of "bully" would imply—the word being merely derived from the obsolete term "boolie," or beloved, an appellation still in familiar use amongst brother workers in the coal districts. One of the most curious sights upon the Tyne is the fleet of hundreds of these black-sailed, black-hulled keels, bringing down at each tide their black cargoes for the ships at anchor in the deep water at Shields and other parts of the river below Newcastle.

These preliminary observations will perhaps be sufficient to explain the meaning of many of the occupations alluded to, and the phrases employed, in the course of the following narrative, some of which might otherwise have been comparatively unintelligible to the general reader.

THE colliery of Wylam forms the nucleus of the village of the same name, situated on the north bank of the Tyne, some eight miles west of Newcastle. About the end of last century the colliery belonged to Mr. Blackett, a gentleman of considerable celebrity in coal mining, but probably then better known to the general public as the proprietor of the *Globe* newspaper. The village of Wylam, like most

other colliery villages, consists of an unsightly pumping engine surrounded by heaps of ashes, coal dust, and slag; an iron-furnace, smoking and blazing by night and day; and a collection of labourers' dwellings of a very humble order. The place is more remarkable for the amount of its population than for its cleanness or neatness as a village — the houses, as in all colliery villages, being the property of the owners or lessees, who employ them for the temporary purpose of accommodating the workpeople, against whose earnings there is a weekly set-off of so much for house and coals. This village of Wylam would be altogether uninteresting but for the fact that in its immediate neighbourhood was born one of the most remarkable men of this century—George Stephenson, the Railway Engineer.

His father, Robert Stephenson, or "Old Bob," as the neighbours termed him, worked for several years as engineman at the Wylam Pit. The old pumping engine has long since been pulled down; but the house still stands in which Robert Stephenson lived, and in which his son George was born. It is situated a few hundred yards from the eastern extremity of the village, and is known by the name of High Street House. It is a common two storied, red-tiled, rubble house, portioned off into four labourers' compartments. It served the same use then which it does still—that of an ordinary labourer's dwelling. Its walls are still unplastered, its floor is of clay, and the bare rafters are exposed over head.

The lower room on the west end of this cottage was for some years the home of the Stephenson family; and there George Stephenson was born on the 9th of June, 1781, as appears from the record in the family Bible, which is still preserved. It does not appear that his birth was registered in the parish books, the author having made an unsuccessful search in the registers of Ovingham and Heddon-on-the-Wall to ascertain the fact. Though the village of Wylam is within the parish of Ovingham, High Street House stands exactly beyond its boundary and within that of Heddon. But the parish church was a long way off and the registry

of births was not then so well organized as it has since become.

Robert Stephenson had lived and worked at Walbottle, a village situated about midway between Wylam and

High Street House.

Newcastle, during the earlier part of his life; and he removed from thence to Wylam as engineman. A tradition is preserved in the family, that Robert Stephenson's father and mother came from beyond the Scottish Border, on the loss of considerable property, and a suit was even commenced for its recovery, but was dropped for want of the means to prosecute it. Certain it is, however, that Robert's position throughout life was that of a humble workman. His wife, Mabel Carr, was a native of Ovingham, the daughter of one Robert Carr, a dyer. The Carrs were, for several generations, the owners of a house in that village adjoining the churchyard; and the family tombstone may still be seen standing against the east end of the chancel of the parish church, underneath the centre lancet window; as the

tombstone of Thomas Bewick, the wood-engraver, occupies the western gable. The neighbours who remember Mabel Stephenson describe her as a woman of delicate constitution, and of extremely nervous temperament; but they concur in averring of her that "she was a real canny body." And a woman of whom this can be said by general consent in the Newcastle district may be pronounced a worthy person indeed; for it is about the highest praise of a woman which Northumbrians can express.

Old Robert was a general favourite in the village, especially amongst the children, whom he was accustomed to draw about him whilst tending the engine-fire, and to feast their young imaginations with his tales of Sinbad the Sailor and Robinson Crusoe, besides others of his own invention; and "Bob's engine-fire" came to be the most popular resort in the village. Another feature in his character, by which he was long remembered, was his affection for birds and animals; and he had many tame favourites of both sorts, which were as fond of resorting to his engine-fire as the boys and girls themselves. In the winter time he had usually a flock of tame robins about him; and they would come hopping familiarly to his feet, to pick up the crumbs which he had saved for them out of his slender dinner. At his cottage he was rarely without one or more tame blackbirds, which flew at liberty about the house, and in and out at the door. In summer time he would go a-birdnesting with his children; and one day he took his little boy George to see a blackbird's nest for the first time. Holding him up in his arms, he let the wondering boy peep down, through the branches held aside for the purpose, into a nest full of young birds,—a sight which the boy never forgot, but used to speak of with delight to his intimate friends when he himself had grown an old man.

The earnings of old Robert were very small—they amounted to not more than twelve shillings a week; and as there was a growing family of six children to maintain,

of whom George was the second, the family, during their stay at Wylam, were in very straitened circumstances. As an old neighbour said of them, "They had little to come and go upon; they were honest folk, but sore haudden doon in the world." The father's earnings being barely sufficient, even with the most rigid economy, for the sustenance of the family, there was little to spare for their clothing, and nothing for their schooling, so none of the children were sent to school.

The boy George led the ordinary life of working people's children. He played about the doors; went birdnesting when he could; and ran errands to the village. He was also an eager listener, with the other children, to his father's curious tales; and he early imbibed from him that affection for birds and animals which continued throughout his life. In course of time he was promoted to the office of carrying his father's dinner to him while at work, and it was on such occasions his great delight to see the little robins fed. At home he helped to nurse, and that with a careful hand, his younger brothers and sisters. One of his duties was to see that the younger children were kept out of the way of the chaldron waggons, which were then dragged by horses along the wooden tramroad immediately in front of the cottage door. This waggon-way was the first in the Northern district on which the experiment of a locomotive engine was tried. But at the time of which we speak, the locomotive had scarcely been dreamt of in England as a practicable working power; horses only were used to haul the coal; and one of the first sights with which the boy was familiar was the coal-waggons dragged by them along the wooden railway at Wylam.

Thus eight years passed; after which, the coal having been worked out on the north side, the old engine, which had grown "fearsome to look at," as an old workman described it, was pulled down; and then old Robert, having obtained employment at the Dewley Burn Colliery as a fireman of the engine, removed with his family to that place. Dewley Burn, at this day, consists of a few old-

fashioned low-roofed cottages, standing on either side of a babbling little stream. They are connected by a rustic wooden bridge, which spans the rift in front of the doors. In the central one-roomed cottage of this group, on the right bank, Robert Stephenson lived for a time with his family. The pit at which he worked stood in the rear of the cottages. The coal has long since been worked out, and the pit closed in; and only the marks of it are now visible,—a sort of blasted grass covering, but scarcely concealing, the scoriæ and coal-dust accumulated about the mouth of the old pit. Looking across the fields, one can still discern the marks of the former waggon-way, leading in the direction of Walbottle. It was joined on its course by another waggon-road leading from the direction of Black Callerton. Indeed, there is scarcely a field in the neighbourhood that does not exhibit traces of the workings of former pits.

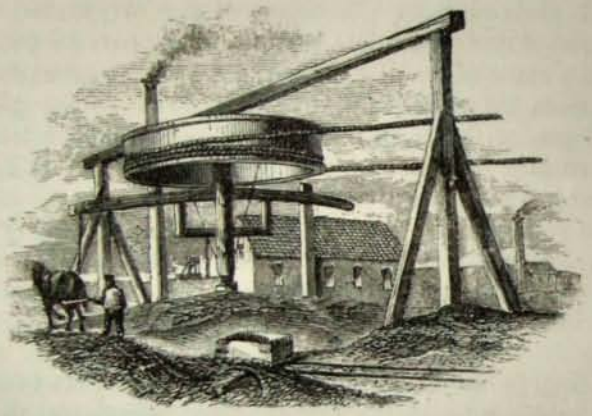
As every child in a poor man's house is a burden until his little hands can be turned to profitable account and made to earn money towards supplying the indispensable wants of the family, George Stephenson was put to work as soon as an opportunity of employment presented itself. A widow, named Grace Ainslie, then occupied the neighbouring farmhouse of Dewley. She kept a number of cows, and had the privilege of grazing them along the waggon-ways. She needed a boy to herd the cows, to keep them out of the way of the waggons, and prevent their straying or trespassing on the neighbours' "liberties;" the boy's duty was also to bar the gates at night after all the waggons had passed. George petitioned for this post, and, to his great joy, he was appointed, at the wage of twopence a-day.

It was light employment, and he had plenty of spare time on his hands, which he spent in birdnesting, making whistles out of reeds and scrannel straws, and erecting Lilliputian mills in the little water-streams that ran into the Dewley bog. But his favourite amusement at this early age was erecting clay engines in conjunction with

his chosen playmate, Bill Thirlwall. The place is still pointed out, "just aboon the cut-end," as the people of the hamlet describe it, where the future engineers made their first essays in modelling. The boys found the clay for their engines in the adjoining bog, and the hemlocks which grew about supplied them with imaginary steam-pipes. They even proceeded to make a miniature winding machine in connexion with their engine, and the apparatus was erected upon a bench in front of the Thirlwalls' cottage-door. Their corves were made out of hollowed corks; their ropes were supplied by twine; and a few bits of wood gleaned from the refuse of the carpenters' shops completed their materials. With this apparatus the boys made a show of sending the corves down the pit and drawing them up again, much to the marvel of the pitmen. But some of the more mischievous among them seized the opportunity of smashing the fragile machinery early one morning when going to their work, greatly to the sorrow of the young engineers. We may mention, in passing, that George Stephenson's companion afterwards became a workman of repute, and creditably held the office of engineer at Shilbottle, near Alnwick, for a period of nearly thirty years.

As George Stephenson grew older and more able to work, he was set to lead the horses when ploughing, though scarce big enough to stride across the furrows; and he used afterwards to say that he rode to his work in the mornings at an hour when most other children of his age were fast asleep in their beds. He was also employed to hoe turnips, and do similar farm work, for which he was paid the advanced wage of fourpence a-day. But his highest ambition was to be taken on at the colliery where his father worked; and he shortly joined his elder brother James there as a "corf-bitter," or "picker," where he was employed in clearing the coal of stones, bats, and dross. His wages were now advanced to sixpence a-day, and afterwards to eightpence when he was set to drive the gin-horse.

Shortly after he went to Black Callerton Colliery to drive the gin there; and as that colliery lies about two miles across the fields from Dewley Burn, the boy walked that distance early in the morning to his work, returning home late in the evening. Some of the old people of Black Callerton still remember him as a "grit bare-legged laddie," and they describe him as being then "very quick-witted, and full of fun and tricks." As they said, "there was nothing under the sun but he tried to imitate." He was usually foremost in the sports and pastimes of youth.



Colliery Gin.

Among his first strongly developed tastes was the love of birds and animals, which he inherited from his father. Blackbirds were his especial favourites. The hedges between Dewley and Black Callerton were capital bird-nesting places; and there was not a nest there that he did not know of. When the young birds were old enough, he would bring them home with him, feed them, and teach them to fly about the cottage unconfined by cages. One of his blackbirds became so tame that, after flying about the doors all day, and in and out of the cottage, it would take up its roost upon the bed-head at night. And most singular of all, the bird would disappear in the spring and

summer months, when it was supposed to go into the woods to pair and rear its young, after which it would reappear at the cottage and resume its social habits during the winter. This went on for several years. George had also a stock of tame rabbits, for which he built a little house behind the cottage, and for many years he continued to pride himself upon the superiority of his breed.

After he had driven the gin for some time at Dewley and Black Callerton, he was taken on as an assistant to his father in firing the engine at Dewley. This was a step of promotion which he had anxiously desired; his only fear being lest he should be found too young for the work. Indeed, he afterwards used to relate how he was wont to hide himself from sight when the owner of the colliery went round, lest he should be thought too little a boy thus to earn his small wages. Since he had modelled his clay engines in the bog, his young ambition was to be an engineman; and to be an assistant fireman was the first step towards this position. Great, therefore, was his exultation when, at about fourteen years of age, he was appointed assistant fireman, at the wage of a shilling a-day.

But the coal at Dewley Burn being at length worked out, and the pit about to be "laid in," the family prepared for another change. This time their removal was to Jolly's Close, a few miles to the south, close behind the village of Newburn, where another coal mine belonging to the Duke of Northumberland, called "the Duke's Winnin," had recently been opened out.

Jolly's Close then consisted of a small row of cottages situated upon a flat space of ground enclosed by lofty banks on either side, at the bottom of the narrow rift called Walbottle Dean. Jolly's Close, however, no longer exists, and only a few of the oldest people in the neighbourhood are aware that such a place ever was. A mountain of earth, shale, and débris, the accumulation of fifty years, lies tumbled over its site,—the rubbish, or "deeds," having been shot over from the hillside, once a green hill, but

now a scarified, blasted rock, along which furnaces blaze and engines labour night and day. The stream in the hollow, which used to run in front of old Robert Stephenson's cottage door, is made to pay tribute in the form of water power at every wheel in the Dean; and only a narrow strip now remains of what was once a green meadow.

One of the old persons in the neighbourhood, who knew the family well, describes the dwelling in which they lived as a poor cottage of only one room, in which the father, mother, four sons, and two daughters lived and slept. It was crowded with three low-poled beds. This one apartment served for parlour, kitchen, sleeping-room, and all. The cottage went with the work, and the use of it formed part of the workman's wage,—the Duke being both the employer and the landlord.

The children of the Stephenson family were now growing up apace, and were most of them of an age to be able to earn money at various kinds of colliery work. James and George, the two eldest sons, worked as assistant firemen; and the younger boys worked as wheelers or pickers on the bank-tops. The two girls helped their mother with the household work.

So far as weekly earnings went, the family were at this time pretty comfortable. Their united earnings amounted to from 35*s.* to 40*s.* a week; and they were enabled to command a fair share of the necessaries of life. But it will be remembered that in those days, from 1797 to 1802, it was much more difficult for the working classes to live than it is now; for money did not go nearly so far. The price of bread was excessive. Wheat, which for three years preceding 1795 had averaged only 54*s.*, now advanced to 76*s.* a quarter; and it continued to rise until, in December, 1800, it had advanced to 130*s.*, and barley and oats in proportion. There was a great dearth of provisions; corn riots were of frequent occurrence; and the taxes on all articles of consumption were very heavy. The war with Napoleon was then raging; derangements of trade were frequent, causing

occasional suspensions of employment in all departments of industry, from the pressure of which working people are always the first to suffer.

During this severe period George Stephenson continued to live with his parents at Jolly's Close. Other workings of the coal were opened out in the neighbourhood; and to one of these he was removed as fireman on his own account. This was called the "Mid Mill Winnin," where he had for his mate a young man named Bill Coe; and to these two was intrusted the working of the little engine put up at Mid Mill. They worked together there for about two years, by twelve-hour shifts, George firing the engine at the wage of a shilling a-day.

He was now fifteen years old. His ambition was as yet limited to attaining the standing of a full workman, at a man's wages; and with that view he endeavoured to attain such a knowledge of his engine as would eventually lead to his employment as an engineman, with its accompanying advantage of higher pay. He was a steady, sober, hard-working young man, and nothing more, according to the estimate of his fellow workmen.

One of his favourite pastimes in by-hours was trying feats of strength with his companions. Although in frame he was not particularly robust, yet he was big and bony, and considered very strong for his age. His principal competitor was Robert Hawthorn, with whom he had frequent trials of muscular strength and dexterity, such as lifting heavy weights, throwing the hammer, and putting the stone. At throwing the hammer George had no compeer; but there was a knack in putting the stone which he could never acquire, and here Hawthorn beat him. At lifting heavy weights off the ground from between his feet, —by means of a bar of iron passed through them, the bar placed against his knees as a fulcrum, and then straightening the spine and lifting them sheer up,—Stephenson was very successful. On one occasion, they relate, he lifted as much as sixty stones weight in this way—a striking indication of his strength of bone and vigour of muscle.

When the pit at Mid Mill was closed, George and his companion Coe were sent to work another pumping engine erected near Throckley Bridge, where they continued for some months. It was while working at this place that his wages were raised to 12*s.* a week,—an event of no small importance in his estimation. On coming out of the foreman's office that Saturday evening on which he received the advance, he announced the fact to his fellow workmen, adding triumphantly, "I am now a made man for life!"

The pit opened at Newburn, at which old Robert Stephenson worked, proving a failure, it was closed; and a new pit was sunk at Water-row, on a strip of land lying between the Wylam waggon-way and the river Tyne, about half a mile west of Newburn Church. A pumping engine was erected there by Robert Hawthorn, now the Duke's engineer at Walbottle; and old Stephenson went to work it as fireman, his son George acting as the engineman or plugman. At this time he was about seventeen years old,—a very youthful age for occupying so responsible a post. He had thus already got ahead of his father in his station as a workman; for the plugman holds a higher grade than the fireman, requiring more practical knowledge and skill, and usually receiving higher wages.

The duty of the plugman was to watch the engine, and to see that it kept well in work, and that the pumps were efficient in drawing the water. When the water-level in the pit was lowered, and the suction became incomplete through the exposure of the suction holes, then his business was to proceed to the bottom of the shaft and plug the tube so that the pump should draw: hence the designation of "plugman." If a stoppage in the engine took place through any defect in it which he was incapable of remedying, then it was his duty to call in the aid of the chief engineer of the colliery to set the engine to rights.

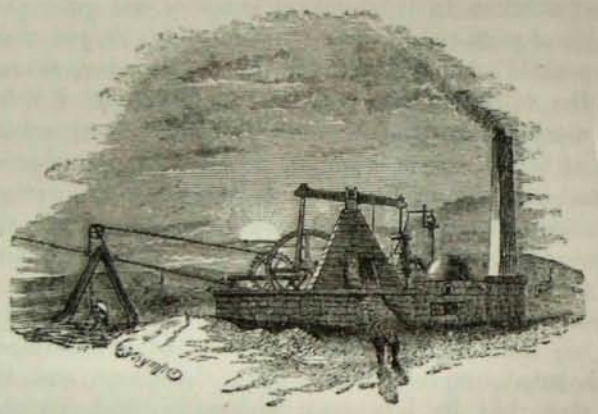
But from the time when George Stephenson was appointed fireman, and more particularly afterwards as engineman, he applied himself so assiduously and so successfully to the

study of the engine and its gearing,—taking the machine to pieces in his leisure hours for the purpose of cleaning and mastering its various parts,—that he soon acquired a thorough practical knowledge of its construction and mode of working, and thus he very rarely needed to call to his aid the engineer of the colliery. His engine became a sort of pet with him, and he was never wearied of watching and inspecting it with devoted admiration.

There is indeed a peculiar fascination about an engine to the intelligent workman who watches and feeds it. It is almost sublime in its untiring industry and quiet power: capable of performing the most gigantic work, yet so docile that a child's hand may guide it. No wonder, therefore, that the workman who is the daily companion of this life-like machine, and is constantly watching it with anxious care, at length comes to regard it with a degree of personal interest and regard, speaking of it often in terms of glowing admiration. This daily contemplation of the steam-engine, and the sight of its steady action, is an education of itself to the ingenious and thoughtful workman. It is certainly a striking and remarkable fact, that nearly all that has been done for the improvement of this machine has been accomplished, not by philosophers and scientific men, but by labourers, mechanics, and enginemen. It would appear as if this were one of the departments of practical science in which the higher powers of the human mind must bend to mechanical instinct. The steam-engine was but a mere toy until it was taken in hand by workmen. Savery was originally a working miner, Newcomen a blacksmith, and his partner Cawley a glazier. In the hands of Watt, the instrument maker, who devoted almost a life to the subject, the condensing engine acquired gigantic strength; and George Stephenson, the colliery engineman, was certainly not the least of those who have assisted to bring the high-pressure engine to its present power.

While studying to master the details of his engine, to know its weaknesses, and to quicken its powers, George

Stephenson gradually acquired the character of a clever and improving workman. Whatever he was set to do, that he endeavoured to do well and thoroughly; never neglecting small matters, but aiming at being a complete workman at all points; thus gradually perfecting his own mechanical capacity, and securing at the same time the respect of his fellow workmen and the increased confidence and esteem of his employers.



A Whimsey.

CHAPTER II.

NEWBURN AND CALLERTON — ENGINEMAN AND BRAKESMAN.

GEORGE STEPHENSON was eighteen years old before he learnt to read. He was now almost a full-grown workman, earning his twelve shillings a week, and having the charge of an engine, which occupied his time to the extent of twelve hours every day. He had thus very few leisure moments that he could call his own. But the busiest man will find them if he watch for them; and if he be careful in turning these moments to useful account, he will prove them to be the very "gold-dust of time," as Young has so beautifully described them.

To his poor parents George Stephenson owed a sound constitution and vigorous health. They had also set before him an example of sobriety, economy, and patient industry —habits which are in themselves equivalent to principles. For habits are the most inflexible of all things; and principles are, in fact, but the names which we assign to them. If his parents, out of their small earnings and scanty knowledge, were unable to give their son any literary culture, at all events they had trained him well, and furnished him with an excellent substratum of character.

We have seen how Stephenson's play hours were occasionally occupied—in a friendly rivalry with his fellows in feats of strength. Much also of his spare time, when he was not actually employed in working the engine, was devoted to cleaning it and taking it to pieces, for the purpose of mastering its details. At this time he was also paying some attention to the art of brakeing, which he had expressed to Coe his desire to learn, in order that he might improve his position and be advanced to higher wages.

Not many of his fellow-workmen had learnt to read; but those who could do so were placed under frequent contri-

bution by George and the other labourers at the pit. It was one of their greatest treats to induce some one to read to them by the engine-fire, out of any book or stray newspaper which might find its way into the village of Newburn. Buonaparte was then overrunning Italy, and astounding Europe by his brilliant succession of victories; and there was no more eager auditor of these exploits, when read from the newspaper accounts, than the young engine-man at the Water-row Pit.

Newburn Church and Village.

There were also numerous stray bits of information and intelligence contained in these papers, which excited Stephenson's interest. One of these related to the Egyptian art of hatching birds' eggs by *means of artificial* heat. Curious about everything relating to birds, he determined to test the art by experiment. It was spring time, and he forthwith went a birdnesting in the adjoining woods and hedges, where there were few birds' nests of which he did not know. He brought a collection of eggs of all kinds into the engine-house, set them in flour in a warm place, covering the whole

over with wool, and then waited the issue of his experiment. But though the heat was kept as steady as possible, and the eggs were carefully turned every twelve hours, they never hatched. The eggs chipped, and some of them exhibited well-grown chicks; but none of the birds came forth alive, and thus the experiment failed. This incident, however, shows that the inquiring mind of the youth was now fairly at work.

Another of his favourite occupations continued to be the modelling of clay engines. He not only tried to model engines which he had himself seen, but he also attempted to form models in clay of engines which were described to him as being in existence; and doubtless his modelling at this time, imperfect though his knowledge was, exhibited considerable improvement upon his first attempts in the art when a herd-boy in the bog at Dewley Burn. He was told, however, that all the wonderful engines of Watt and Boulton, about which he was so anxious to know, were to be found described in books, and that he must satisfy his curiosity by searching the publications of the day for a more complete description of them. But, alas! Stephenson could not read; he had not yet learnt even his letters.

Thus he shortly found, when gazing wistfully in the direction of knowledge, that to advance further as a skilled workman, he must master this wonderful art of reading—the key to so many other arts. He would thus be enabled to gain an access to books, the depositories of the experience and wisdom of all times. Although now a grown man and doing the work of a man, he was not ashamed to confess his ignorance, and go to school, big as he was, to learn his letters. Perhaps, too, he foresaw that, in laying out a little of his spare earnings for this purpose, he was investing money judiciously, and that, every hour he spent at school, he was really working for better wages. At all events, he determined to make a beginning—a small beginning, it is true, but still a right one, and a pledge and assurance that he was in earnest in the work of self-culture. He desired to find a road into knowledge; and no man can sincerely desire this but he will eventually succeed. He

possessed that will and purpose which are the invariable forerunners of success.

His first schoolmaster was Robin Cowens, a poor teacher in the village of Walbottle. He kept a night-school, which was attended by a few of the colliers and labourers' sons in the neighbourhood. George took lessons in spelling and reading three nights in the week. Tommy Musgrove, the lad who "sled out" the engine at the Water-row Pit, usually went with him to the evening lesson. This teaching of Robin Cowens cost threepence a week; and though it was not very good, yet George, being hungry for knowledge, and eager to acquire it, soon learnt to read. He also practised "pot-hooks," and at the age of nineteen he was proud to be able to write his own name.

A Scotch dominie, named Andrew Robertson, set up a night-school in the village of Newburn, in the winter of 1799. It was more convenient for George Stephenson to attend this school, as it was nearer to his work, and not more than a few minutes' walk from Jolly's Close. Besides, Andrew had the reputation of being a skilled arithmetician; and this was a branch of knowledge that Stephenson was now desirous of acquiring. He accordingly began taking lessons from him, paying fourpence a week. Robert Gray, the junior fireman at the Water-row Pit, began arithmetic at the same time; and he has since told the writer that George learnt "figuring" so much faster than he did, that he could not make out how it was—"he took to figures so wonderful." Although the two started together from the same point, at the end of the winter George had mastered "reduction," while Robert Gray was still grappling with the difficulties of simple division. But George's secret was his perseverance. He worked out the sums in his bye-hours, improving every minute of his spare time by the engine-fire, there solving the arithmetical problems set for him upon his slate by the master. In the evenings he took to Andrew Robertson the sums which he had thus "worked," and new ones were "set" for him to study out the following day. Thus his progress was rapid, and, with a willing heart and mind, he soon became well advanced in arithmetic. Indeed, Andrew Robertson became somewhat proud of his pupil; and shortly afterwards, when the Water-row Pit was closed, and George removed to Black Callerton to work there, the poor schoolmaster, not having a very extensive connexion in Newburn, went with his pupils, and set up his night-school at Black Callerton, where they continued to be instructed by him as before.

George still found time to attend to his favourite animals while working at the Water-row Pit. He kept up his breed of rabbits, and even drove a small trade in them, selling portions of his stock from time to time. Like his father, he used to tempt the robin-redbreasts to hop and fly about him at the engine-fire, by the bait of bread-crumbs saved from his dinner. But his favourite animal was his dog—so sagacious that he performed the office of a servant, in almost daily carrying his dinner to him at the pit. The tin containing the meal was suspended from the dog's neck, and, thus laden, he proudly walked the road from Jolly's Close to Water-row Pit, quite through the village of Newburn. He turned neither to left nor right, nor minded for the time the barking of curs at his heels. But his course was not unattended with perils. One day the big strange dog of a passing butcher espied the engineman's messenger, ran after him, and fell upon him with the tin can about his neck. There was a terrible tussle and worrying between the dogs, which lasted for a brief while, and, shortly after, the dog's master, anxious for his dinner, saw his faithful servant approaching, bleeding but triumphant. The tin can was still round his neck, but the dinner had escaped in the struggle. Though George went without his dinner that day, yet when the circumstances of the combat were related to him by the villagers who had seen it, he was prouder of his dog than ever.

It was while working at the Water-row Pit that Stephenson first learnt the art of brakeing an engine. This being one of the higher departments of colliery labour, and amongst the best paid, George was very anxious to learn it. A small winding engine having been put up for the purpose of drawing the coals from the pit, Bill Coe, his friend and fellow-workman, was appointed the brakesman.

He frequently allowed George to try his hand at the brake, and instructed him how to proceed. But in this course, Coe was opposed by several of the other workmen—one of whom, a brakesman named William Locke, went so far as to stop the working of the pit because Stephenson had been called in to the brake. But one day as Mr. Charles Nixon, the manager of the pit, was observed approaching, Coe adopted an expedient which had the effect of putting a stop to the opposition. He forthwith called upon George Stephenson to "come into the brake-house, and take hold of the machine." No sooner had he done this, than Locke, as usual, sat down, and the working of the pit was stopped. Locke, when requested by the manager to give an explanation, said that "young Stephenson couldn't brake, and, what was more, never would learn to brake: he was so clumsy that he was like to rive his arms off." Mr. Nixon, however, ordered Locke to go on with the work, which he did; and Stephenson, after some further practice, acquired the art of brakeing.

After working at the Water-row Pit and at other engines in the neighbourhood of Newburn, for about three years, George, with his companion Coe, went to work at Black Callerton in the year 1801. Though only twenty years of age, his employers thought so well of him that they then appointed him to the responsible office of brakesman at the Dolly Pit. For convenience' sake, he took lodgings at a small farmer's in the village, finding his own victuals, and paying so much a week for lodging and attendance. In the locality this was called "picklin in his awn poke neuck." It not unfrequently happens that the young workman about the colleries, when selecting a lodging, contrives to pitch his tent where the daughter of the house ultimately becomes his wife. This is often the real attraction that draws the youth from home, though a very different one may be pretended.

George Stephenson's duties as brakesman may be briefly described. The work was somewhat monotonous, and consisted in superintending the working of the engine and machinery by means of which the coals were drawn out of the pit. Brakesmen are almost invariably selected from

those who have had considerable experience as engine-firemen, and borne a good character for steadiness, punctuality, watchfulness, and "mother wit." In George Stephenson's day, the coals were drawn out of the pit in corves, or large baskets made of hazel rods. The corves were placed two together in a cage, between which and the pit ropes there was usually from fifteen to twenty feet of chain. The approach of the corves towards the pit mouth was signalled by a bell, brought into action by a piece of mechanism worked from the shaft of the engine. When the bell sounded, the brakesman checked the speed, by taking hold of the hand-gear connected with the steam-valves, which were so arranged that by their means he could regulate the speed of the engine, and stop or set it in motion when required. Connected with the fly-wheel was a powerful wooden brake, acting by pressure against its rim, something like the brake of a railway carriage against its wheels; and the brakesman was enabled, by applying his foot to a foot-step near him, on catching sight of the chain attached to the ascending corve cage, at once, and with great precision, to stop its revolutions, and arrest the ascent of the corves at the pit mouth, when they were forthwith landed on the "settle board." On the full corves being replaced by empty ones, it was then the duty of the brakesman to reverse the engine, and send the corves down the pit to be filled again.

The monotony of George Stephenson's occupation as a brakesman was somewhat varied by the change which he made, in his turn, from the day to the night shift. This duty, during the latter stage, chiefly consisted in sending the men and materials into the mine, and in drawing the other men and materials out. Most of the workmen enter the pit during the night shift, and leave it in the latter part of the day, whilst coal-drawing is proceeding. The requirements of the work at night are such, that the brakesman has a good deal of spare time on his hands, which he is at liberty to employ in his own way. From an early period, George was accustomed to employ those vacant night hours in working the sums set for him by Andrew

Robertson upon his slate, in practising writing in his copy-book, and also in mending the shoes of his fellow-workmen. His wages while working at the Dolly Pit amounted to from 1*l.* 15*s.* to 2*l.* in the fortnight; but he gradually added to them as he became more expert at shoe-mending, and afterwards at shoe-making. Probably he was stimulated to take in hand this extra work by the attachment which he had by this time formed for a fair maiden named Fanny Henderson, who officiated as servant in the small farmer's house in which he lodged. George found her a high-principled young woman of excellent character, and courted her with the intention of making her his wife and setting up in a house of his own. The personal attractions of Fanny Henderson, though these were considerable, were the least of her charms. Her temper was of the sweetest; and those who knew her speak of the charming modesty of her demeanour, her kindness of disposition, and withal her sound good sense.

Amongst his various mendings of old shoes at Callerton, George was on one occasion favoured with the shoes of his sweetheart to sole. One can imagine the pleasure with which he would linger over such a piece of work, and the pride with which he would execute it. A friend of his, still living, relates that, after he had finished the shoes, he carried them about with him in his pocket on the Sunday afternoon, and that from time to time he would whip them out and hold them up to sight,—the tiny little shoes that they were,—exhibiting them with exultation to his friend, and exclaiming, "what a capital job he had made of them!" Other lovers have carried about with them a lock of their fair one's hair, a glove, or a handkerchief; but none could have been prouder of their cherished love-token than was George Stephenson of his Fanny's shoes, which he had just soled, and of which he had made such a "capital job."

Out of his earnings from shoe-mending at Callerton, George contrived to save his first guinea. The first guinea saved by a working man is no trivial thing. If, as in Stephenson's case, it has been the result of prudent self-

denial, of extra labour at bye-hours, and of sound resolutions to save and economise for worthy purposes, the first guinea saved is an earnest of better things. It is a nest-egg—a token of increase—the beginning, it may be, of prosperity and wealth. When Stephenson had saved this guinea he was somewhat proud of the achievement, and expressed the opinion to a friend, who many years after reminded him of it, that he was "now a rich man."

At Callerton, Stephenson—habitually sober and steady—was a standing example of character to the other workmen. He never missed a day's wages by being off work in consequence of a drinking-bout, as many others did. William Coe says of him, that, though he knew Stephenson intimately, he never saw him "the worse for drink" in his life. On pay Saturday afternoons, when the workmen at the pit kept their fortnightly holiday, some spending their afternoon and evening in the public-house, and others in the adjoining fields, cock-fighting and dog-fighting, Stephenson, instead of either drinking or playing, used to take his engine to pieces for the purpose of obtaining "insight" and practical acquaintance with its details; and he invariably cleaned all the parts and put the machine in thorough working order before leaving her. Thus his engine was always clean and in excellent condition, and his knowledge of its powers and its mechanism became almost complete.

In the winter evenings Stephenson proceeded with his lessons in arithmetic under Andrew Robertson. But Robertson had soon taught his pupil all that he himself knew, which probably did not amount to much. He even admitted that he could carry Stephenson no further in arithmetic, the pupil having outstripped the master. He went on, however, with his writing lessons; and by the year following, when he signed his name in the parish registry of Newburn, on the occasion of his marriage to Fanny Henderson, he was able to write a good, legible round hand.

George continued very fond of measuring his strength and agility, as at Newburn, with his fellow-workmen, and he maintained his *prestige* at lifting heavy weights and

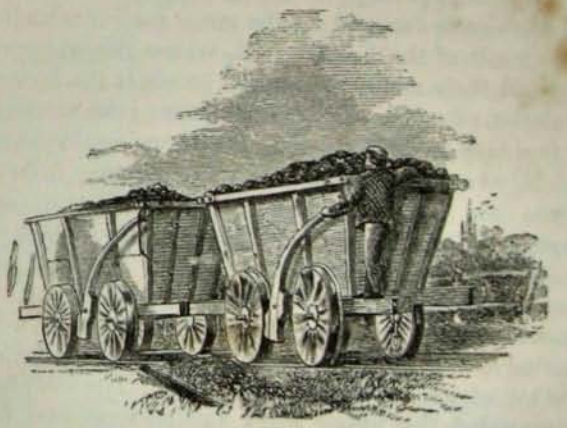
throwing the hammer. He also occasionally indulged in a little sporting by stealth; and in after life he was accustomed to tell a story of going out with some of the pitmen to shoot crows in a neighbouring wood, early one summer's morning, while it was yet grey, when, proceeding across the fields, he thought he saw a hare sitting on her form. Taking sure aim, he "let drive." The hare did not stir. Running up to the game to bag it, lo! it was only a big grey stone he had been firing at! George's "dead shot" was long a standing joke against him amongst the pitmen.

Not long after he began to work at Black Callerton as brakesman, he had a quarrel with a pitman named Ned Nelson, a roistering bully, who was the terror of the village. Nelson was a great fighter; and it was therefore considered dangerous to quarrel with him. Stephenson was so unfortunate as not to be able to please this pitman by the way in which he drew him out of the pit; and Nelson swore at him grossly because of the alleged clumsiness of his brakeing. George defended himself, and appealed to the testimony of the other workmen. But Nelson had not been accustomed to George's style of self-assertion; and, after a great deal of abuse, he threatened to kick the brakesman, who defied him to do so. Nelson ended by challenging Stephenson to a pitched battle; and the latter accepted the challenge, when a day was fixed on which the fight was to come off.

Great was the excitement at Black Callerton when it was known that George Stephenson had accepted Nelson's challenge. Everybody said that he would be killed. The villagers—the young men, and especially the boys of the place, with whom George was an especial favourite—all wished that he might beat Nelson, but they scarcely dared to say so. They came about him while he was at work in the engine-house to inquire if it was really true that he was "goin to feight Nelson?" "Ay; never fear for me; I'll feight him." And "feight" him he did. For some days previous to the appointed day of battle, Nelson went entirely off work for the purpose of keeping himself fresh and strong, whereas Stephenson went on doing his daily work, as usual, and appeared not in the least disconcerted by the

prospect of the affair. So, on the evening appointed, after George had done his day's labour, he went into the Dolly Pit Field, where his already exulting rival was ready to meet him. George stripped, and "went in" like a practised pugilist—though it was his first and last fight. After a few rounds, George's wiry muscles and practised strength enabled him severely to punish his adversary, and to secure for himself an easy victory.

This circumstance is related in illustration of Stephenson's personal pluck and courage; and it was thoroughly characteristic of the man. He was no pugilist, and the very reverse of quarrelsome. But he would not be put down by the bully of the colliery, and he fought him. There his pugilism ended; they afterwards shook hands, and continued good friends. In after life, Stephenson's mettle was often as hardly tried, though in a different way; and he did not fail to exhibit the same resolute courage, in contending with the bullies of the railway world, as he had thus early shown in his encounter with Ned Nelson, the fighting pitman of Black Callerton.



Coal Waggons.

CHAPTER III.

WILLINGTON AND KILLINGWORTH — MARRIAGE — MAKES IMPROVEMENTS IN PUMPING-ENGINES.

BY dint of thrift, sobriety, and industry, George Stephenson managed to save as much money at Callerton as enabled him, on leaving it for Willington Ballast Quay, to take a house and furnish it in a very humble style, for the reception of his young bride, Fanny Henderson.

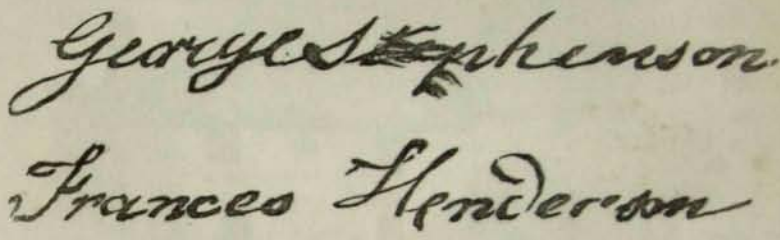
Willington Quay, whither Stephenson now went to act as brakesman at the Ballast Hill, lies on the north bank of the Tyne, about six miles below Newcastle. It consists of a line of houses straggling along the river side; and high behind it towers up the huge mound of ballast emptied out of the ships which resort to the quay for their cargoes of coal for the London market. The ballast is thrown out of the ship's hold into waggons laid alongside. When filled, a train of these is dragged up the steep incline which leads to the summit of the Ballast Hill, where the waggons are run out and their contents emptied to swell the monstrous accumulation of earth, chalk, and Thames mud already laid there, probably to form a puzzle for future antiquaries and geologists, when the origin of these immense hills along the Tyne has been forgotten. On the summit of the Willington Ballast Hill was a fixed engine, which drew the trains of laden waggons up the incline; and of this engine George Stephenson now acted as brakesman.

The cottage in which he took up his abode is a small two-storied dwelling, standing a little back from the quay, with a bit of garden ground in front. The Stephenson family occupied the upper room in the west end of the cottage. Close behind rises the Ballast Hill.

When the cottage dwelling had been made snug, and

prepared for the young wife's reception, the marriage took place. It was celebrated in Newburn Church, on the 28th of November, 1802.

George Stephenson's signature, as it stands in the books, is that of a person who seems to have just learnt to write. Yet it is the signature of a man, written slowly and deliberately, in strong round hand. With all his care, however, he had not been able to avoid a blotch; the word "Stephenson" has been brushed over before the ink was dry.



After the ceremony, George and his newly-wedded wife proceeded to the house of old Robert Stephenson and his wife Mabel at Jolly's Close. The old man was now becoming infirm, though he still worked as an engine-fireman, and contrived with difficulty "to keep his head above water." When the visit had been paid, the bridal party prepared to set out for their new home at Willington Quay. They went in a homely old-fashioned style, though one quite usual in those days, before macadamised roads had been adopted, or travelling by railway so much as dreamt of. Two stout farm horses were borrowed from Mr. Burn, of the Red House Farm, Wolsingham, where Anne Henderson, the bride's sister, lived as servant. The two horses were each provided with a saddle and a pillion, and George having mounted one, his wife seated herself on the pillion behind him, holding on by her arms round his waist. Robert Gray and Anne Henderson in like manner mounted the other horse; and in this wise the wedding party rode

across the country, passing through the old streets of Newcastle, and then by Wallsend to Willington Quay—a long ride of about fifteen miles.

House at Willington Quay.

George Stephenson's daily life at Willington was that of a regular steady workman. By the manner, however, in which he continued to improve his spare hours in the evening, he was silently and surely paving the way for being something more than a mere workman. He diligently set himself to study the principles of mechanics, and to master the laws by which his engine worked. For a workman, he was even at that time more than ordinarily speculative—often taking up strange theories, and trying to sift out the truth that was in them. While sitting by the side of his young wife in his cottage dwelling, in the winter evenings, he was usually occupied in making mechanical experiments, or in modelling experimental machines. Amongst his various speculations while at Willington, he occupied himself a

good deal in endeavouring to discover Perpetual Motion. Although he failed, as so many others had done before him, the very efforts he made tended to whet his inventive faculties, and to call forth his dormant powers. He actually went so far as to construct the model of a machine by which he thought he would secure Perpetual Motion. It consisted of a wooden wheel, the periphery of which was furnished with glass tubes filled with quicksilver; as the wheel rotated, the quicksilver poured itself down into the lower tubes, and thus a sort of self-acting motion was kept up in the apparatus, which, however, did not prove to be perpetual. Where he had first obtained the idea of this machine—whether from conversation, or reading, or his own thoughts, is not now remembered; but possibly he may have heard of an apparatus of a similar kind which is described in the "History of Inventions." As he had then no access to books, and indeed could barely read with ease, it is possible that he may have been told of the invention, and then set about testing its value according to his own methods.

Much of his spare time continued to be occupied by labour more immediately profitable, regarded in a pecuniary point of view. In the evenings, after his day's labour at the ballast-crane, he would occasionally employ himself for a few hours in casting ballast out of the collier ships, by which means he was enabled to earn a few shillings extra weekly. He also followed his old occupation of shoe-mending; and from mending he proceeded to making shoes, as well as shoe-lasts, in which he was admitted to be very expert. William Coe, who continued to live at Willington in 1851, informed the writer that he bought a pair of shoes from George Stephenson for 7*s.* 6*d.*, and he remembered that they were a capital fit, and wore well. But an accident occurred in Stephenson's household about this time, which had the effect of directing his industry into a new and still more profitable channel. The cottage chimney took fire one day in his absence, when the alarmed neighbours, rushing in, threw buckets-full of water upon

the flames; and some, in their zeal, mounted even the ridge of the house and poured volumes of water down the chimney. The fire was soon put out, but the house was thoroughly soaked. When George came home he found the water running out of the door, everything in disorder, and his new furniture covered with soot. The eight-day clock, which hung against the wall—one of the most highly-prized articles in the house—was grievously injured by the steam with which the room had been filled. Its wheels were so clogged by the dust and soot, that it was brought to a complete stand-still. George was always ready to turn his hand to anything, and his ingenuity, never at fault, immediately set to work for the repair of the unfortunate clock. He was advised to send it to the clock-maker, but that would have cost money; and he declared that he would repair it himself—at least he would try. The clock was accordingly taken to pieces and cleaned; the tools which he had been accumulating by him for the purpose of constructing the Perpetual Motion machine, enabled him to do this; and he succeeded so well that, shortly after, the neighbours sent him their clocks to clean, and he soon became one of the most famous clock-doctors in the neighbourhood.

It was while living at Willington Quay that George Stephenson's only son Robert was born, on the 16th of October, 1803. The child was from the first, as may well be imagined, a great favourite with his father, whose evening hours were made happier by his presence. George Stephenson's strong "philoprogenitiveness," as phrenologists call it, had in his boyhood expended itself on birds, and dogs, and rabbits, and even on the poor old gin-horses which he had driven at the Callerton Pit; and now he found in his child a more genial object on which to expend the warmth of his affection.

The christening of the boy took place in the school-house at Wallsend, the old parish church being at the time in so dilapidated a condition from the "creeping" of the ground underneath, consequent upon the excavation of the coal,

that it was considered dangerous to enter it. On this occasion, Robert Gray and Anne Henderson, who had officiated as bridesman and bridesmaid at the wedding, came over again to Willington, and stood as godfather and godmother to little Robert, as the child was named, after his grandfather.

After working for about three years as a brakesman at the Willington machine, George Stephenson was induced to leave his situation there for a similar one at the West Moor Colliery, Killingworth.

This village lies about seven miles north of Newcastle, and is one of the best known collieries in that neighbourhood. The workings of the coal are of vast extent, and give employment to a large number of workpeople. The colliery stands high, and commands an extensive view of the adjacent country; it overlooks the valley of the Tyne on the south, and the pinnacles of the Newcastle spires may be discerned in the distance, when not obscured by the clouds of smoke which rise up from that hive of manufacturing industry.

To this place George Stephenson first came as a brakesman in the year 1804. He had scarcely settled down in his new home, ere he sustained a heavy loss in the death of his wife, for whom he cherished the sincerest affection. Their married life had been happy, sweetened as it was by daily successful toil. The husband was sober and hard-working, and his young wife made his hearth so bright and his home so snug, that no attraction could draw him from her side in the evening hours. But this domestic happiness was all to pass away; and the twinkling feet, for which the lover had made those tiny shoes at Callerton, were now to be hidden for evermore from his eyes. It was a terrible blow; and he long lamented his bereavement, cherishing tenderly his dear wife's memory.

Shortly after this event, while his grief was still fresh, he received an invitation from some gentlemen concerned in large spinning works near Montrose in Scotland, to proceed thither and superintend the working of one of

Boulton and Watt's engines. He accepted the offer, and made arrangements to leave Killingworth for a time.

Having left his boy in charge of a worthy neighbour, he set out upon his long journey to Scotland on foot, with his kit upon his back. It was while working at Montrose that he first gave proofs of that remarkable readiness in contrivance for which he was afterwards so distinguished. It appears that the water required for the purposes of his engine, as well as for the use of the works, was pumped from a considerable depth, being supplied from the adjacent extensive sand strata. The pumps frequently got choked by the sand drawn in at the bottom of the well through the snore holes, or apertures through which the water to be raised is admitted. The barrels soon became worn, and the bucket and clack leathers destroyed, so that it became necessary to devise a remedy; and with this object the engineman proceeded to adopt the following simple but original expedient. He had a wooden box or boot made, twelve feet high, which he placed in the sump or well, and into this he inserted the lower end of the pump. The result was, that the water flowed clear from the outer part of the well over into the boot, and was drawn up without any admixture of sand; and the difficulty was thus conquered.

During his short stay, being paid good wages, Stephenson contrived to save a sum of 28*l.*, which he took back with him to Killingworth, after an absence of about a year. Longing to get back to his own kindred—his heart yearning for his son whom he had left behind, our engineman took leave of his Montrose employers, and trudged back to Killingworth on foot as he had gone. He related to his friend Coe, on his return, that when on the borders of Northumberland, late one evening, footsore and wearied with his long day's journey, he knocked at a small farmer's cottage door, and requested shelter for the night. It was refused, and then he entreated that, being sore tired and unable to proceed any further, they would permit him to lie down in the outhouse, for that a little clean straw would

serve him. The farmer's wife appeared at the door, looked at the traveller, then retiring with her husband, the two confabulated a little apart, and finally they invited Stephenson into the cottage. Always full of conversation and anecdote, he soon made himself at home in the farmer's family, and spent with them a few pleasant hours. He was hospitably entertained for the night, and when he left the cottage in the morning, he pressed them to make some charge for his lodging, but they would not hear of such a thing. They asked him to remember them kindly, and if he ever came that way, to be sure and call again. Many years after, when Stephenson had become a thriving man, he did not forget the humble pair who had thus succoured and entertained him on his way; he sought their cottage again, when age had silvered their hair; and when he left the aged couple, on that occasion, they may have been reminded of the old saying that we may sometimes "entertain angels unawares."

Reaching home, Stephenson found that his father had met with a serious accident at the Blucher Pit, which had reduced him to great distress and poverty. While engaged in the inside of an engine, making some repairs, a fellow-workman accidentally let in the steam upon him. The blast struck him full in the face—he was terribly scorched, and his eyesight was irretrievably lost. The helpless and infirm man had struggled for a time with poverty; his sons who were at home, poor as himself, were little able to help him, while George was at a distance in Scotland. On his return, however, with his savings in his pocket, his first step was to pay off his father's debts amounting to about 15*l.*; soon afterwards he removed the aged pair from Jolly's Close to a comfortable cottage adjoining the tramroad near the West Moor at Killingworth, where the old man lived for many years, supported entirely by his son. He was quite blind, but cheerful to the last. One of his greatest pleasures, towards the close of his life, was to receive a visit from his grandson Robert, who would ride straight into the cottage mounted on his "cuddy," and call upon

his grandfather to admire the points of the animal. The old man would then dilate upon the ears, fetlocks, and quarters of the donkey, and generally conclude by pronouncing him to be a "real blood."

Stephenson was again taken on as a brakesman at the West Moor Pit. He does not seem to have been very hopeful as to his prospects in life about the time (1807–8). Indeed the condition of the working class generally was then very discouraging. England was engaged in a great war, which pressed heavily upon the industry, and severely tried the resources, of the country. Heavy taxes were imposed upon all the articles of consumption that would bear them. There was a constant demand for men to fill the army, navy, and militia. Never before had England witnessed such drumming and fifing for recruits. In 1805, the gross forces of the United Kingdom amounted to nearly 700,000 men, and early in 1808 Lord Castlereagh carried a measure for the establishment of a local militia of 200,000 men. These measures produced great and general distress amongst the labouring classes. There were riots in Manchester, Newcastle, and elsewhere, through scarcity of work and lowness of wages. The working people were also liable to be pressed for the navy, or drawn for the militia; and though men could not fail to be discontented under such circumstances, they scarcely dared, in those perilous times, even to mutter their discontent to their neighbours.

George Stephenson was one of those drawn for the militia. He must therefore either quit his work and go a-soldiering, or find a substitute. He adopted the latter course, and paid a considerable sum of money to a militia-man to serve in his stead. Thus nearly the whole of his hard-won earnings were swept away at a stroke. He was almost in despair, and contemplated the idea of leaving the country, and emigrating to the United States. A voyage thither was then a more formidable thing for a working man to accomplish than a voyage to Australia is now. But he seriously entertained the project, and had all but made up his mind. His sister Ann with her husband emigrated about that time,

but George could not raise the requisite money, and they departed without him. After all, it went sore against his heart to leave his home and his kindred—the scenes of his youth and the friends of his boyhood; but he struggled long with the idea, brooding over it in sorrow. Speaking afterwards to a friend of his thoughts at the time, he said—"You know the road from my house at the West Moor to Killingworth. I remember, when I went along that road I wept bitterly, for I knew not where my lot would be cast." But Providence had better and greater things in store for George Stephenson than the lot of a settler in the wilds of America. It was well that his poverty prevented him from prosecuting further the idea of emigration, and rooted him to the place where he afterwards worked out his great career so manfully and victoriously.

In 1808, Stephenson, with two other brakesmen, named Robert Wedderburn and George Dodds, took a small contract under the colliery lessees, for brakeing the engines at the West Moor Pit. The brakesmen found the oil and tallow; they divided the work amongst them, and were paid so much per score for their labour. There being two engines working night and day, two of the three men were always at work; the average earnings of each amounting to from 18*s.* to 20*s.* a week. But Stephenson resorted to his usual mode of ekeing out his earnings. His son Robert would soon be of an age to be sent to school; and the father, being but too conscious, from his own experience, of the disadvantages arising from the want of instruction, determined that his boy should at least receive the elements of a good education. Stinted as he was for means at the time, maintaining his parents, and struggling with difficulties, this early resolution to afford his son proper culture must be regarded as a noble feature in his character, and strikingly illustrative of his thoughtfulness and conscientiousness. Many years after, speaking of the resolution which he thus early formed, he said, "In the earlier period of my career, when Robert was a little boy, I saw how deficient I was in education, and I made up my mind that he should

not labour under the same defect, but that I would put him to a good school, and give him a liberal training. I was, however, a poor man; and how do you think I managed? I betook myself to mending my neighbours' clocks and watches at nights, after my daily labour was done, and thus I procured the means of educating my son."

Besides mending clocks and watches at this time, he also continued to make and mend shoes, and to manufacture shoe-lasts for the shoemakers of the neighbourhood. He even cut out the pitmen's clothes for their wives to make up; and it is said that to this day there are clothes worn at Killingworth which have been made after "Geordy Steevie's cut."

Soon after he became a brakesman at the West Moor, he observed that the ropes with which the coal was drawn out of the pit by the winding-engine were badly arranged, as he thought, and he suggested an improvement. The ropes "glued," and wore each other to tatters by the perpetual friction. There was thus great wear and tear, and a serious increase in the expenses of the pit. George found that the ropes which, at other pits in the neighbourhood, lasted about three months, at the West Moor Pit became worn out in about a month. As there was at that time an interruption of the trade with Russia in consequence of the war, and ropes were exceedingly dear (about 1*s.* 5*d.* the pound), it was obvious to him that any improvement by which a saving in the wear of ropes could be effected, would be of considerable advantage to the owners. His suggestions were approved by the head engineer of the pit, and he was encouraged to carry them into effect. He accordingly did so, and by shifting the pulley-wheels so that they worked immediately over the centre of the pit, and by an entire rearrangement of the gearing of the machine, he shortly succeeded in greatly lessening the wear and tear of the ropes, much to the advantage of the owners as well as of the workmen, who were thus enabled to labour more continuously and profitably.

He also, about the same time, attempted to effect an

improvement in the winding-engine which he worked, by placing a valve between the air-pump and condenser. This expedient, although it led to no practical results, showed that his mind was actively at work in mechanical adaptations. It continued to be his regular habit, on Saturdays, to take the engine to pieces, for the purpose, at the same time, of familiarising himself with its action, and of placing it in a state of thorough working order. And by thus diligently mastering the details of the engine, he was enabled, as opportunity occurred, to turn to practical account the knowledge thus patiently acquired.

Such an opportunity was not long in presenting itself. In the year 1810, a pit was sunk by the "Grand Allies" (the lessees of the mines) at the village of Killingworth, now known as the Killingworth High Pit. An atmospheric or

Killingworth High Pit.

Newcomen engine, originally made by Smeaton, was fixed there for the purpose of pumping out the water from the shaft; but somehow or other the engine failed to clear the pit. As one of the workmen has since described the circumstance—"She couldn't keep her jack-head in water: all the enginemen in the neighbourhood were tried, as well as Crowther of the Ouseburn, but they were clean bet."

The engine went on fruitlessly pumping for nearly

twelve months, and began to be looked on as a total failure. Stephenson had gone to look at it when in course of erection, and then observed to the over-man that he thought it was defective; he also gave it as his opinion that, if there were much water in the mine, the engine would never keep it under. Of course, as he was only a brakesman, his opinion was considered to be worth very little on such a point, and no more was thought about it. He continued, however, to make frequent visits to the engine, to see "how she was getting on." From the bank-head where he worked his brake he could see the chimney smoking at the High Pit; and as the workmen were passing to and from their work, he would call out and inquire "if they had gotten to the bottom yet?" And the reply was always to the same effect,—the pumping made no progress, and the workmen were still "drowned out."

One Saturday afternoon he went over to the High Pit to examine the engine more carefully than he had yet done. He had been turning the subject over in his mind; and after a long examination, he seemed to satisfy himself as to the cause of the failure. Kit Heppel, who was a sinker at the pit, said to him: "Weel, George, what do you mak' o' her? Do you think you could do anything to improve her?" "Man," said George in reply, "I could alter her and make her draw: in a week's time from this I could send you to the bottom."

Forthwith Heppel reported this conversation to Ralph Dodds, the head viewer; and Dodds, being now quite in despair, and hopeless of succeeding with the engine, determined to give George's skill a trial. George had already acquired the character of a very clever and ingenious workman; and at the worst he could only fail, as the rest had done. In the evening Mr. Dodds went towards Stephenson's cottage in search of him. He met him on the road, dressed in his Sunday's suit, about to proceed to "the preaching" in the Methodist Chapel, which he at that time attended. "Well, George," said Mr. Dodds, accosting him, "they tell me you think you can put the engine at the

High Pit to rights." "Yes, sir," said George, "I think I could." "If that's the case, I'll give you a fair trial, and you must set to work immediately. We are clean drowned out, and cannot get a step further. The engineers hereabouts are all bet; and if you really succeed in accomplishing what they cannot do, you may depend upon it I will make you a man for life."

It is said that George, the same evening, borrowed the "howdie horse"* and rode over to Duke's Hall, near Walbottle, where his old friend Hawthorn, the engineer to the Duke of Northumberland, then resided, and consulted him as to the improvements which he proposed to make in the pumping-engine. And next morning, Sunday though it was (for the work must be commenced forthwith), Stephenson entered upon his labours. The only condition that he made, before setting to work, was that he should select his own workmen. There was, as he knew, a good deal of jealousy amongst the "regular" men that a colliery brakesman should pretend to know more about their engine than they themselves did, and attempt to remedy defects which the most skilled men of their craft, including the engineer of the colliery, had failed to do. But George made the condition a *sine quâ non*. "The workmen," said he, "must either be all Whigs or all Tories." There was no help for it, so Dodds ordered the old hands to stand aside. The men grumbled, but gave way; and then George and his party went in.

The engine was taken entirely to pieces. The injection cap, being considered too small, was enlarged to nearly double its former size, the opening being increased to about twice the area. The cylinder having been found too long, was packed at the bottom with pieces of timber; these and other alterations were necessarily performed in a rough way, but, as the result proved, on true principles. The repairs occupied about four days, and by the following Wednesday the engine was carefully put together again

* One of the pit horses generally employed in cases of emergency in bringing the midwife to the rescue.

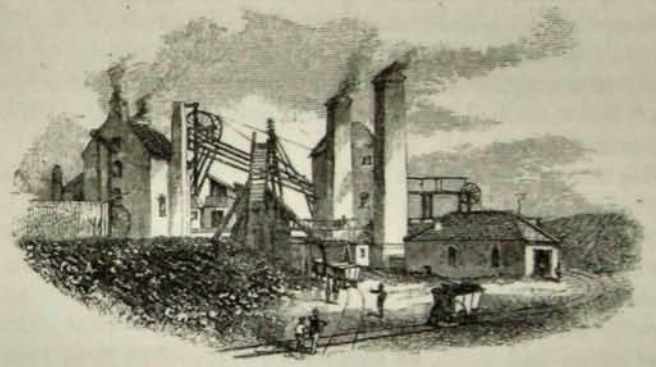
and set to work. Stephenson also, finding that the boiler would bear a greater pressure than five pounds to the inch, determined to work it at a pressure of ten pounds, though this was contrary to the directions of both Newcomen and Smeaton. The engine was kept pumping all Thursday, and by the Friday afternoon the pit was cleared of water, and the workmen were "sent to the bottom," as Stephenson had promised. The alterations thus effected in the pumping apparatus proved completely successful, and Stephenson's skill as a pump-curer became the marvel of the neighbourhood.

Mr. Dodds was particularly gratified with the manner in which the job had been done, and he made Stephenson a present of ten pounds, which, though very inadequate when compared with the value of the work performed, was accepted by him with gratitude. He was proud of the gift as the first marked recognition of his skill as a workman; and he used afterwards to say that it was the biggest sum of money he had up to that time earned in one lump. Ralph Dodds, however, did more than this. He appointed Stephenson engineman at the High Pit, at good wages, during the time the pit was sinking,—the job lasting for about a year; and he also kept him in mind for further advancement.

Stephenson's skill as an engine-doctor soon became noised abroad, and he was called upon to prescribe remedies for all the old, wheezy, and ineffective pumping machines in the neighbourhood. In this capacity he soon left the "regular" men far behind, though they in their turn were very much disposed to treat the Killingworth brakesman as no better than a quack. Nevertheless, his practice was really founded upon a close study of the principles of mechanics, and on an intimate practical acquaintance with the details of the pumping-engine.

Another of his smaller achievements in the same line is still told by the people of the district. While passing to and from his work at the High Pit, he observed that the workmen in the quarry at the corner of the road leading to

Long Benton, were considerably interrupted by the accumulation of water. A windmill was put up for the purpose of driving a pumping apparatus, but it failed to draw the water. Stephenson was asked what they were to do in order to clear the quarry. He said "he would set up for them an engine no bigger than a kail-pot, that would clear them out in a week." And he did so. A little engine was speedily erected by him, and by its means the quarry was pumped dry in the course of a few days. Thus his local celebrity very soon became considerable.



West Moor Pit, Killingworth.

CHAPTER IV.

KILLINGWORTH — SELF-CULTURE — IS APPOINTED ENGINE-WRIGHT OF THE COLLIERY.

WHILE thus daily engaged in the curing and working of pumping-engines, George Stephenson continued diligently to employ his evenings in self-improvement. When not occupied in cleaning clocks and watches, he was busy contriving models of steam-engines and pumping-engines, or attempting to master the mysteries of perpetual motion (which he had not yet given up), or endeavouring to embody in a tangible shape the mechanical inventions which he found described in the odd volumes on mechanics which came in his way.

He afterwards used to lament the time that he had lost in his perpetual-motion experiments, and said that if he enjoyed the opportunity which most young men now have, of learning from books what previous experimenters had accomplished, he would have been spared much labour and mortification. Not being acquainted with what other mechanics had done, he groped his way, often very much in the dark, in pursuit of some idea originated by his own independent thinking and observation; and, when he had brought it into some definite shape, lo! he found that his supposed invention had long been known and recorded in scientific books. Often he thought he had hit upon discoveries, which he subsequently found were but old and exploded fallacies. Yet the very effort to overcome the difficulties which lay in his way, was of itself an education of the best sort. By wrestling with them, he strengthened his judgment and sharpened his skill, stimulating and cultivating his inventiveness and mechanical ingenuity. Being in earnest on the subject of his several inquiries, he was

compelled to consider it in all its relations; and this would not suffer him to be superficial. Thus he gradually acquired practical ability through his steadfast efforts even after the impracticable.

Many of his evenings were spent in the society of John Wigham, whose father occupied the Glebe farm at Benton, close at hand. John was a good penman and a good arithmetician, and Stephenson frequented his society chiefly for the purpose of improving himself in these points. Under Andrew Robertson, he had never thoroughly mastered the Rule of Three, and it was only when Wigham took him in hand that he made any decided progress towards the higher branches of arithmetic. He generally took his slate with him to the Wighams' cottage, when he had his sums set, that he might work them out while tending the engine on the following day. When too busy with other work to be able to call upon Wigham in person, he sent the slate by a fellow-workman to have the former sums corrected and new ones set. So much patient perseverance could not but eventually succeed; and by dint of practice and study, Stephenson was enabled successively to master the various rules of arithmetic.

John Wigham was of great use to his pupil in many ways. He was a good talker, fond of argument, an extensive reader as country reading went in those days, and a very suggestive thinker. Though his store of information might be comparatively small when measured with that of more highly-cultivated minds, much of it was entirely new to Stephenson, who regarded him as a very clever and extraordinary person. Young as John Wigham was, he could give much useful assistance to Stephenson at that time, and his neighbourly services were worth untold gold to the eager pupil. Wigham taught him to draw plans and sections; though in this branch Stephenson proved so apt that he soon surpassed his master. Wigham was also a little versed in Chemistry and Natural Philosophy, and a volume of Ferguson's Lectures on Mechanics which he possessed was a great treasure to both the students. One

who remembers their evening occupations says he used to wonder what they meant by weighing the air and water in their odd way. They were trying the specific gravities of objects; and the devices which they employed, the mechanical shifts to which they were put, were often of the rudest kind. In these evening entertainments, the mechanical contrivances were supplied by Stephenson, whilst Wigham found the scientific rationale. The opportunity thus afforded to the former of cultivating his mind by contact with one wiser than himself proved of great value, and in after-life Stephenson gratefully remembered the assistance which, when a humble workman, he had derived from John Wigham the farmer's son.

His leisure moments thus carefully improved, it will be inferred that Stephenson was necessarily a sober man. Though his notions were never extreme on this point, he was systematically temperate. It appears that on the invitation of his master, Ralph Dodds,—and an invitation from a master to a workman is not easy to resist,—he had, on one or two occasions, been induced to join him in a forenoon glass of ale in the public-house of the village. But one day, about noon, when Mr. Dodds had got him as far as the public-house door, on his invitation to "come and take a glass o' yel," Stephenson made a dead stop, and said, firmly, "No, sir, you must excuse me; I have made a resolution to drink no more at this time of day." And he went back. He desired to retain the character of a steady workman; and the instances of men about him who had made shipwreck of their character through intemperance, were then, as now, unhappily but too frequent. Perhaps, too, he was sober with an eye to thrift. He still steadily kept in mind the resolution which he had formed to give his son a good education, and Robert was now of an age to be sent to a better school than that which the neighbouring village of Long Benton provided. There he had been some time under the charge of Rutter, the parish clerk, who kept a road-side school, where the instruction was of a very limited kind—scarcely extending beyond the child's

primer and "pot-hooks." About the year 1814, Robert was accordingly sent to Bruce's academy at Newcastle, where he commenced a course of sound elementary instruction; and many still remember seeing him in his homely grey suit, riding on his donkey to and from school, morning and evening.

By dint of extra labour during his bye-hours, with this object, George Stephenson had managed to save a sum of 100*l.*, which he accumulated in *guineas*, each of which he afterwards sold to Jews who went about buying up gold coins (then dearer than silver), at twenty-six shillings apiece; and he lent out the proceeds at interest. He was now, therefore, a comparatively thriving man. The first guinea which he had saved with so much difficulty at Black Callerton had proved the nest-egg of future guineas; and the habits of economy and sobriety which he had so early cultivated, now enabled him to secure a firmer foothold in the world, and to command the increased esteem and respect of his fellow-workmen and employers.

At this time, and for many years after, Stephenson dwelt in a cottage standing by the side of the road leading from the West Moor Pit to Killingworth. The railway from the West Moor Pit crosses this road close by the easternmost end of the cottage. The dwelling originally consisted of but one apartment on the ground-floor, with a garret overhead, to which access was obtained by means of a step-ladder. But with his own hands Stephenson built an oven, and in the course of time he added rooms to the cottage, until it grew into a comfortable four-roomed dwelling, in which he continued to live as long as he resided at Killingworth.

He continued as fond of birds and animals as ever, and seemed to have the power of attaching them to him in a remarkable degree. He had a blackbird at Killingworth so fond of him, that it would fly about the cottage, and on holding out his finger, the bird would come and perch upon it directly. A cage was built for "blackie" in the partition between the passage and the room, a square of glass forming

its outer wall: and on the master entering, the bird would cock his head aside, and follow him with his eye into the inner apartment.

Stephenson's Cottage at the West Moor, Killingworth.

Often neighbours called to have their clocks and watches set to rights, sometimes when there was but little need. One day, after looking at the works of a watch left by a pitman's wife, he handed it to his son; "Put her in the oven, Robert," said he, "for a quarter of an hour or so." It seemed an odd way of repairing a watch; nevertheless, the watch went into the oven, and at the end of the appointed time it was taken out again going all right. The wheels had merely got clogged by the oil congealed by the cold; which at once explains the rationale of the remedy adopted.

There was a little garden attached to the cottage, in which, while a workman, Stephenson took a pride in growing gigantic leeks, and astounding cabbages. There was

great competition amongst the villagers in the growth of vegetables, all of whom he excelled, excepting one of his neighbours, whose cabbages sometimes outshone his.

In the protection of his garden-crops from the ravages of the birds, he invented a strange sort of "fley-craw," which moved its arms with the wind; and he fastened his garden door by means of a piece of ingenious mechanism, so that no one but himself could enter it. Indeed, his odd and eccentric contrivances excited much marvel amongst the Killingworth villagers. Thus, he won the women's admiration by connecting their cradles with the smoke-jack, and making them self-acting! Then he astonished the pitmen by attaching an alarum to the clock of the watchman whose duty it was to call them betimes in the morning. The cottage of Stephenson was a sort of curiosity-shop of models, engines, self-acting planes, and perpetual-motion machines,—which last contrivance, however, baffled him as effectually as it had done hundreds of preceding inventors. He also contrived a wonderful lamp which burned under water, with which he was afterwards wont to amuse the Brandling family at Gosforth,—going into the fish-pond at night, lamp in hand, attracting and catching the fish, which rushed wildly towards the subaqueous flame.

Dr. Bruce tells of a competition which Stephenson had with the joiner at Killingworth, as to which of them could make the best shoe-last; and when the former had done his work, either for the humour of the thing, or to secure fair play from the appointed judge, he took it to the Morrisons in Newcastle, and got them to put their stamp upon it. So that it is possible the Killingworth brakesman, afterwards the inventor of the safety-lamp and the originator of the railway system, and John Morrison, the last-maker, afterwards the translator of the Scriptures into the Chinese language, may have confronted each other in solemn contemplation over the successful last, which won the verdict coveted by its maker.

Sometimes he would endeavour to impart to his fellow-

workmen the results of his scientific reading. Everything that he learnt from books was so new and so wonderful to him, that he regarded the facts he drew from them in the light of discoveries, as if they had been made but yesterday. Once he tried to explain to some of the pitmen how the earth was round, and kept turning round. But his auditors flatly declared the thing to be impossible, as it was clear that "at the bottom side they must fall off!" "Ah!" said George, "you don't quite understand it yet."

In elastic muscular vigour, George Stephenson was now in his prime, and he still continued to be zealous in measuring his strength and agility with his fellow workmen. The competitive element in his nature was strong; and his success was remarkable in these feats of rivalry. Few, if any, could lift such weights, throw the hammer and putt the stone so far, or cover so great a space at a standing or running leap. One day between the engine hour and the rope-rolling hour, Kit Heppel challenged him to leap from one high wall to another, with a deep gap between them. To Heppel's surprise and dismay, George took the standing leap, and cleared the eleven feet at a bound. Had his eye been less accurate, or his limbs less agile and sure, the feat must have cost him his life.

But so full of redundant muscular vigour was he, that leaping, putting, or throwing the hammer were not enough for him. He was also ambitious of riding on horseback, and as he had not yet been promoted to the honour of keeping a riding-horse of his own (which, however, he was shortly afterwards), he sometimes contrived to ride for "the howdie," when the services of that official were required in the village. He would volunteer his services on such occasions, when the fleetest of the gin-horses was usually put in requisition. Sometimes, also, he borrowed the animal for a pleasure ride. On one of these latter occasions, he brought the horse back reeking; on which Tommy Mitcheson, the bank-horsekeeper, a rough-spoken fellow, exclaimed to him;—"Set such fellows as you on

horseback, and you'll soon ride to the De'il." But Tommy Mitcheson lived to tell the joke, and to confess that, after all, there had been a better issue to George's horsemanship than that which he predicted.

Old Cree, the engine-wright at Killingworth, having been killed by an accident, George Stephenson was, in 1812, appointed engine-wright of the colliery at the salary of 100*l.* a year. He was also allowed the use of a gallo ay to ride upon in his visits of inspection to the collieries leased by the "Grand Allies" in that neighbourhood. The "Grand Allies" were a company of gentlemen, consisting of Sir Thomas Liddell (afterwards Lord Ravensworth), the Earl of Strathmore, and Mr. Stuart Wortley (afterwards Lord Wharncliffe), the lessees of the Killingworth collieries. Having been informed of the merits of Stephenson, of his indefatigable industry, and the skill which he had displayed in the repairs of the pumping-engines, they readily acceded to Mr. Dodds' recommendation that he should be appointed the colliery engineer; and, as we shall see, they continued to honour him by distinguished marks of their approval.

He was now in a measure relieved from the daily routine of manual labour, and advanced to the grade of a higher-class workman. He was no less a worker, but only in a different way. It might be inferred that he had now the command of greater leisure; but his leisure hours were more than ever given to work, either necessary or self-imposed.

When the High Pit had been sunk, and the coal was ready for working, Stephenson erected his first winding-engine to draw the coals out of the pit, and also a pumping-engine for Long Benton colliery, both of which proved quite successful. Amongst other works of this time, he projected and laid down a self-acting incline along the declivity which fell towards the coal-loading place near Willington, where he had formerly officiated as brakesman; and he so arranged it, that the full waggons descending drew the empty waggons up the incline. This was one of the first self-acting inclines laid down in that district.

Afterwards, in describing his occupation at this period of his life before a Committee of the House of Commons,* he said, "After making some improvements in the steam-engines above ground, I was then requested by the manager of the colliery to go underground along with him, to see if any improvements could be made in the mines, by employing machinery as a substitute for manual labour and horse-power in bringing the coals out of the deeper workings of the mine. On my first going down the Killingworth Pit, there was a steam-engine underground for the purpose of drawing water from a pit that was sunk at some distance from the first shaft. The Killingworth coal-field is considerably dislocated. After the colliery was opened, at a very short distance from the shaft, one of those dislocations was met with. The coal was thrown down about forty yards. Considerable time was spent in sinking another pit to this depth. And on my going down to examine the work, I proposed making the engine (which had been erected some time previously) to draw the coals up an inclined plane which descended immediately from the place where it was fixed. A considerable change was accordingly made in the mode of working the colliery, not only in applying the machinery, but in employing putters instead of horses in bringing the coals from the hewers; and by those changes the number of horses in the pit was reduced from about 100 to 15 or 16. During the time I was engaged in making these important alterations, I went round the workings in the pit with the viewer, almost every time that he went into the mine,—not only at Killingworth, but at Mountmoor, Derwentcrook, Southmoor, all of which collieries belonged to Lord Ravensworth and his partners; and the whole of the machinery in all these collieries was put under my charge."

Mr. Stephenson had now many more opportunities for improving himself in mechanics than he had hitherto possessed. His familiar acquaintance with the steam-engine

* Evidence given before the Select Committee on Accidents in Mines, 1835.

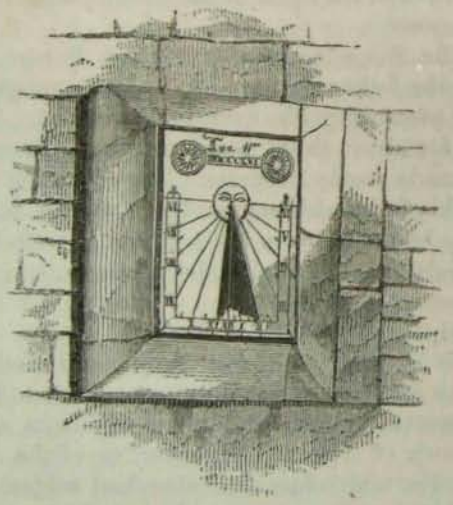
proved of great value to him. The practical study which he had given to it when a workman, and the patient manner in which he had groped his way through all the details of the machine, gave him the power of a master in dealing with it as applied to colliery purposes. His shrewd insight, together with his intimate practical acquaintance with its mechanism, enabled him to apprehend, as if by intuition, its most abtruse and difficult combinations.

Sir Thomas Liddell was frequently about the works, and he encouraged Stephenson greatly in his efforts after improvement. The subject of the locomotive engine was already closely occupying his attention; although as yet it was regarded very much in the light of a curious and costly toy, of comparatively small practical use. But Stephenson from the first detected the value of the machine, and formed an adequate conception of the gigantic might which as yet slumbered within it; and he was not slow in bending the whole faculties of his mind to the development of its extraordinary powers.

Meanwhile, the education of his son Robert proceeded apace, and the father contrived to make his progress instrumental in promoting his own improvement. The youth continued for about three years to attend Bruce's school, where he made steady progress. The education was expensive; but his father did not grudge it, for he held that the best legacy he could leave his son was a well-disciplined, carefully-cultivated mind. Robert was entered a member of the Newcastle Literary and Philosophical Institution, the subscription to which was 3*l.* 3*s.* a year. He spent much of his leisure time there, reading and studying; and on Saturday afternoons, when he went home to his father's at Killingworth, he usually carried with him a volume of the Repertory of Arts and Sciences, or of the Edinburgh Encyclopædia, which furnished abundant subjects for interesting and instructive converse during the evening hours. Then John Wigham would come over from the Glebe farm to join the party, and enter into the lively scientific discussions which occurred on the subjects of their mutual read-

ing. But many of the most valuable works belonging to the Newcastle Library were not permitted to be removed from the room; these Robert was instructed to read and study, and bring away with him descriptions and sketches for his father's information. His father also practised him in the reading of plans and drawings without at all referring to the written descriptions. He used to observe to his son, "A good drawing or plan should always explain itself;" and, placing a drawing of an engine or machine before the youth, he would say, "There, now, describe that to me—the arrangement and the action." Thus he taught him to read a drawing as easily as he would read a page of a book. This practice soon gave to both the greatest facility in apprehending the details of even the most difficult and complicated mechanical drawing.

On one occasion they determined to construct a sun-dial for the front of the cottage at West Moor. Robert brought



Sun-Dial at Killingworth.

home Ferguson's "Astronomy," and, under his father's directions, he carefully drew out on paper a dial suited to

the latitude of Killingworth; then a suitable stone was procured, and, after much hewing and polishing, the stone dial was at length completed, and fixed immediately over the cottage door, greatly to the wonderment of the villagers. It stands there yet; and we trust it will be long before it is removed. The date carved upon it is "August 11th, MDCCCXVI"—a year or two before Robert left school. George Stephenson was very proud of that sun-dial, for it had cost him much thought and labour; and, in its way, it was a success.

The son, like his father, was very fond of reducing his scientific reading to practice. On one occasion, after reading Franklin's description of the lightning experiment, he expended all his hoarded Saturday's pennies in purchasing about half a mile of copper wire at a brazier's shop in Newcastle. After privily preparing his kite, he sent it up at the cottage door, insulating the wire by means of a few feet of silk cord. His father's pony was standing near, waiting for the master to mount. Bringing the end of the wire just over the pony's crupper, so smart an electric shock was given it, that the brute was almost knocked down. At this juncture the father issued from the door with riding-whip in hand, and was witness to the scientific trick just played off upon his galloway. "Ah! you mischievous scoondrel!" cried he to the boy, who ran off. He inwardly chuckled with pride, nevertheless, at his son's successful experiment.

The connexion of Robert with the Philosophical and Literary Society of Newcastle brought him into communication with the Rev. William Turner, one of the secretaries of the institution. That gentleman was always ready to assist the inquirer after knowledge, and took an early interest in the studious youth from Killingworth, with whose father he also soon became acquainted. Mr. Turner cheerfully and even zealously helped them in their joint inquiries, and excited while he endeavoured to satisfy their eager thirst for scientific information. Many years afterwards, towards the close of his life, Mr. Stephenson ex-

pressed most warmly the gratitude and esteem he felt towards his revered instructor. "Mr. Turner," he said, "was always ready to assist me with books, with instruments, and with counsel, gratuitously and cheerfully. He gave me the most valuable assistance and instruction, and to my dying day I can never forget the obligations which I owe to my venerable friend."

Mr. Turner's conduct towards George Stephenson was all the more worthy of admiration, because at that time the object of his friendly instruction and counsel occupied but the position of a comparatively obscure workman, of no means or influence, who had become known to him only through his anxious desire for information on scientific subjects. He could little have dreamt that the object of his almost fatherly attention would achieve a reputation so distinguished as that to which he afterwards reached, and that he would revolutionise by his inventions and improvements the internal communications of the civilised world. The circumstance is encouraging to those who, like Mr. Turner, are still daily devoting themselves with equal disinterestedness to the education of the working-classes in our schools and mechanics' institutes. Though the opportunity of lending a helping hand to such men as George Stephenson may but rarely occur, yet the labours of such teachers are never without excellent results.

CHAPTER V.

GEORGE STEPHENSON'S FIRST LOCOMOTIVES.

TOWARDS the end of last century, numerous projects were set on foot for the purpose of facilitating the conveyance of coal from the pits to the loading staiths. Various mechanical methods were suggested with this object. Mr. Edgeworth even proposed to impel the waggons by means of sails, like ships before the wind. But the most favourite plan was the employment of the power of steam. Savery, Watt, Robison, and others in England, and Oliver Evans in America, threw out suggestions with this object. Cugnot, a French engineer, in 1763, constructed a remarkable machine which is still to be seen in the Conservatoire des Arts et Métiers at Paris. It has the look of a long brewer's cart, with a circular boiler hung on at one end. Yet, rude though it looks, it appears that, when set in motion by its projector, its force was such that it knocked down a wall which stood in its way; and, its power being considered too great for ordinary use, it was eventually put aside as a dangerous machine.

The first English model of a steam-carriage was made in 1784, by William Murdock, the friend and assistant of Watt. It was on the high-pressure principle, and ran on three wheels. The boiler was heated by a spirit-lamp; and the whole machine was of very diminutive dimensions, standing little more than a foot high. Yet, on one occasion, the little engine went so fast, that it outran the speed of its inventor. It seems that one night, after returning from his duties in the mine at Redruth, in Cornwall, Murdock determined to try the working of his model locomotive. For this purpose he had recourse to the walk leading to the church, about a mile from the town. The walk was

rather narrow, and was bounded on either side by high hedges. It was a dark night, and Murdock set out alone to try his experiment. Having lit his lamp, the water shortly began to boil, and off started the engine with the inventor after it. He soon heard distant shouts of despair. It was too dark to perceive objects; but he shortly found, on following up the machine, that the cries for assistance proceeded from the worthy pastor of the parish, who, going towards the town on business, was met on this lonely road by the hissing and fiery little monster, which he subsequently declared he had taken to be the Evil One *in propriâ personâ*. No further steps, however, were taken by Murdock to embody his idea of a locomotive carriage in a more practical form.

Richard Trevithick, a captain in a Cornish tin-mine, and a pupil of William Murdock,—influenced, no doubt, by the successful action of the model engine which the latter had constructed—determined to build a steam-carriage adapted for use on common roads. He took out a patent to secure the right of his invention in the year 1802. Andrew Vivian, his cousin, joined with him in the patent, —Vivian finding the money, and Trevithick the brains. The steam-carriage built on this patent presented the appearance of an ordinary stage-coach on four wheels. The engine had one horizontal cylinder, which, together with the boiler and the furnace-box, was placed in the rear of the hind axle. The motion of the piston was transmitted to a separate crank-axle, from which, through the medium of spur-gear, the axle of the driving-wheel (which was mounted with a fly-wheel) derived its motion. The steam-cocks and the force pump, as also the bellows used for the purpose of quickening combustion in the furnace, were worked off the same crank-axle. This was the first successful high-pressure engine constructed on the principle of moving a piston by the elasticity of steam against the pressure only of the atmosphere.

The steam-carriage excited considerable interest in the remote district near to the Land's End where it had been

constructed. Being so far removed from the great movements and enterprise of the commercial world, Trevithick and Vivian determined upon exhibiting the machine in the metropolis. They accordingly set out with it to Plymouth, whence it was to be conveyed by sea to London. Coleridge relates, that whilst the vehicle was proceeding along the road towards the port, at the top of its speed, and had just carried away a portion of the rails of a gentleman's garden, Andrew Vivian descried ahead of them a closed toll-gate, and called out to Trevithick, who was behind to slacken speed. He immediately shut off the steam; but the momentum was so great, that the carriage proceeded some distance, coming dead up, however, just on the right side of the gate, which was opened like lightning by the toll-keeper. "What have us got to pay here?" asked Vivian. The poor toll-man, trembling in every limb, his teeth chattering in his head, essayed a reply—"Na-na-na-na;"—"What have us got to pay, I say?"—"No-noth-nothing to pay! My de-dear Mr. Devil, do drive on as fast as you can! nothing to pay!" The carriage safely reached the metropolis, and was there publicly exhibited in an enclosed piece of ground near Euston Square, where the London and North-Western Station now stands; and it dragged behind it a wheel-carriage full of passengers. On the second day of the performance, crowds flocked to see the machine; but Trevithick, in one of his odd freaks, shut up the place, and shortly after removed the engine.

In the year following the exhibition of the steam-carriage, a gentleman was laying heavy wagers as to the weight which could be hauled by a single horse on the Wandsworth and Croydon iron tramway; and the number and weight of waggons drawn by the horse were something surprising. Trevithick very probably put the two things together—the steam-horse and the iron-way—and proceeded to construct his second or railway locomotive. It was completed in 1804, and tried on the Merthyr Tydvil Railway in South Wales. On the occasion of its first trial, the engine succeeded in dragging after it several waggons containing ten

tons of bar-iron, at the rate of about five miles an hour. The boiler of this engine was cylindrical, flat at the ends, and constructed of cast-iron. The furnace and flue were inside the boiler, within which the single cylinder, of eight inches in diameter, and four feet six inches stroke, was immersed upright. As in the first engine, the motion of the wheels was produced by spur-gear, to which was also added a fly-wheel on one side. The waste steam was thrown into the chimney through a tube inserted into it at right angles; but it will be obvious that this arrangement was not calculated to produce any result in the way of a steam-blast in the chimney; and, that Trevithick was not aware of the action of the blast in contributing to increase the draught, is clear from the fact that he employed bellows for this special purpose; and at a much later date (in 1815) he took out a patent which included a method of urging the fire by means of fanners.

Although the locomotive tried upon the Merthyr Tydvil Railway succeeded in drawing a considerable weight, and travelled at a fair speed, it nevertheless proved, like the first steam-carriage, a practical failure. It was never employed to do regular work, but was abandoned after a few experiments. It was then dismounted, and the engine was subsequently fixed and used to pump one of the largest pumps on the mine, for which work it was found well adapted.

Trevithick having abandoned the locomotive for more promising schemes, no further progress was made with it for some years. An imaginary difficulty seems to have tended, amongst other obstacles, to prevent its adoption and improvement. This was the supposition that, if any heavy weight were placed behind the engine, the "grip" or "bite" of the smooth wheels of the locomotive upon the equally smooth iron rail must necessarily be so slight that the wheels would slip round upon the rail, and, consequently, that the machine would not make any progress.

Following up the presumed necessity for a more effectual adhesion between the wheels and the rails than that presented by their mere smooth contact, Mr. Blenkinsop, of Leeds, in 1811, took out a patent for a racked or tooth-rail laid along one side of the road, into which the toothed-wheel of his locomotive worked as pinions work into a rack. The boiler of his engine was supported by a carriage with four wheels without teeth, and rested immediately upon the axles. The wheels were entirely independent of the working parts of the engine, and therefore merely supported its weight on the rails, the progress being effected by means of the cogged-wheel working into the cogged-rail. Mr. Blenkinsop's engines began running on the railway extending from the Middleton collieries to the town of Leeds, a distance of about three miles and a half, on the 12th of August, 1812. They continued for many years to be one of the principal curiosities of the neighbourhood, and were visited by strangers from all parts. In the year 1816, the Grand Duke Nicholas (afterwards Emperor) of Russia observed the working of Blenkinsop's locomotive with curious interest and expressions of no slight admiration. An engine dragged behind it as many as thirty coal-waggons at a speed of about three miles and a quarter per hour.

The Messrs. Chapman, of Newcastle, in 1812, endeavoured to overcome the same fictitious difficulty of the want of adhesion between the wheel and the rail, by patenting a locomotive to work along the road by means of a chain stretched from one end of it to the other. This chain was passed once round a grooved barrel-wheel under the centre of the engine: so that, when the wheel turned, the locomotive, as it were, dragged itself along the railway. An engine, constructed after this plan, was tried on the Heaton Railway, near Newcastle; but it was so clumsy in its action, there was so great a loss of power by friction, and it was found to be so expensive and difficult to keep in repair, that it was very soon abandoned. Another remarkable expedient was adopted by Mr. Brunton, of the Butterly Works, Derbyshire, who, in 1813, patented his Mechanical Traveller to go *upon legs*, working alternately like those of

a horse! But the engine never got beyond the experimental state, for, in one of its trials, it unhappily blew up and killed several of the bystanders. These, and other similar contrivances with the same object, projected about the same time, show that invention was actively at work, and that many minds were now anxiously labouring to solve the important problem of locomotive traction upon railways.

Mr. Blackett of Wylam, the owner of the colliery near which George Stephenson was born, was one of the most persevering in his efforts to introduce the locomotive as a working power instead of horses. He had an engine after Trevithick's patent made for him in 1811, but the road was too weak to carry it, and the engine was sold. In the following year he had a second engine made, to run upon a rack-rail like Blenkinsop's; but this too proved a complete failure. He persevered in building a third engine in his own workshops, and this, though clumsy and irregular in its movements—sometimes taking as much as six hours to haul the coal waggons the few miles down to the shipping place—was regarded as on the whole tolerably successful. The road was in a bad state, and it often ran off the rails. As a workman observed one day, when asked how they got on—"We don't get on—we only *gets off*." On such occasions, the horses had to be sent out to drag on the waggons. The engine itself, constructed by incompetent workmen, often broke down; its plugs, pumps, or cranks got wrong; and then the horses were sent out to drag it back to the shop. Indeed, it became so cranky, that the horses were very frequently sent out following the engine, to be in readiness to draw it along when it gave up; and at length the workmen declared it to be "a perfect plague."

A story is still current at Wylam, of a stranger who was proceeding one dark evening down the High Street Road, as the "Puffing Billy" (so called after William Hedley, Mr. Blackett's viewer, a highly ingenious person) was seen advancing, puffing and snorting its painful and laborious way up from Newburn. The stranger had never heard

of the new engine, and was almost frightened out of his senses at its approach. An uncouth monster it must have looked, coming flaming on in the dark, working its piston up and down like a huge arm, snorting out loud blasts of steam from either nostril, and throwing out smoke and fire as it panted along. No wonder that the stranger rushed terrified through the hedge, fled across the fields, and called out to the first person he met, that he had just encountered a "terrible deevil on the High Street Road."

While Mr. Blackett was thus experimenting and building locomotives at Wylam, George Stephenson was anxiously brooding over the same subject at Killingworth. He was no sooner appointed engine-wright of the collieries than his attention was directed to the more economical haulage of the coal from the pits to the river side. We have seen that one of the first important improvements which he made, after being placed in charge of the colliery machinery, was to apply the surplus power of a pumping steam-engine, fixed underground, for the purpose of drawing the coals out of the deeper workings of the Killingworth mines,—by which he succeeded in effecting a large reduction in the expenditure on manual and horse labour.

The coals, when brought above ground, had next to be laboriously dragged by means of horses to the shipping staiths on the Tyne, several miles distant. The adoption of a tramroad, it is true, had tended to facilitate their transit: nevertheless the haulage was both tedious and expensive. With the view of economising labour, inclined planes were laid down by Mr. Stephenson, where the nature of the ground would admit of this expedient being adopted. Thus, a train of full waggons let down the incline by means of a rope running over wheels laid along the tramroad, the other end of which was attached to a train of empty waggons placed at the bottom of the parallel road on the same incline, dragged them up by the simple power of gravity—an exceedingly economical mode of working the traffic. But this applied only to a comparatively small portion of the entire length of road. An economical method

of working the coal trains, instead of by means of horses—the keep of which was at the time very costly in consequence of the high price of corn,—was still a great desideratum; and the best practical minds in the collieries were actively engaged in the attempt to solve the problem. Although Mr. Stephenson from an early period entertained and gave utterance to his sanguine speculations as to the "travelling engine," this was his first practical object in studying it, and endeavouring to make it an effective power; and he now proceeded to devote the entire energy of his strong intellect to the subject.

First, he endeavoured to make himself thoroughly acquainted with what had already been done. Mr. Blackett's engines were working daily at Wylam, past the cottage where he had been born; and thither he frequently went to inspect Trevithick's patent engine, and observe the improvements which were from time to time made by Mr. Blackett, both in the locomotive and in the plateway along which it worked. He carefully inspected the "Puffing Billy," with its single cylinder and fly-wheel, its pumps, plugs, and spur-gear. After mastering its arrangements and observing the working of the machine, he did not hesitate to express his conviction that he could make a much better engine than Trevithick's—one that would draw steadier, and work more cheaply and effectively.

In the mean time he had also the advantage of seeing one of Blenkinsop's Leeds engines, which was placed on the tramway leading from the collieries of Kenton and Coxlodge, on the 2nd of September, 1813. This locomotive drew sixteen chaldron waggons containing an aggregate weight of seventy tons, at the rate of about three miles an hour. George Stephenson and several of the Killingworth men were amongst the crowd of spectators that day; and after examining the engine and observing its performances, he observed to his companions, that "he thought he could make a better engine than that, to go upon legs." Probably he had heard of the invention of Brunton, whose patent had by this time been published, and proved the subject of

much curious speculation in the colliery districts. Certain it is, that, shortly after the inspection of the Coxlodge engine, he contemplated the construction of a new locomotive, which was to surpass all which had preceded it. He observed that those engines which had been constructed up to this time, however ingenious in their arrangements, had proved practical failures. Mr. Blackett's were both clumsy and expensive. Chapman's had been removed from the Heaton tramway in 1812, and was regarded as a total failure. And the Blenkinsop engine at Coxlodge was found very unsteady and costly in its working; besides, it pulled the rails to pieces, the entire strain being upon the rack-rail on one side of the road. The boiler, however, having shortly blown up, there was an end of the engine; and the colliery owners did not feel encouraged to try any further experiment.

An efficient and economical working locomotive engine, therefore, still remained to be invented; and to accomplish this object Mr. Stephenson now applied himself. Profiting by what his predecessors had done, warned by their failures, and encouraged by their partial successes, he commenced his labours. There was still wanting the man who should accomplish for the locomotive what James Watt had done for the steam-engine, and combine in a complete form the separate plans of others, embodying with them such original inventions and adaptations of his own as to entitle him to the merit of inventing the working locomotive, in the same manner as James Watt is regarded as the inventor of the working condensing engine. This was the great work upon which George Stephenson now entered, probably without any adequate idea of the immense consequences of his labours to society and civilization.

He proceeded to bring the subject of constructing a "Travelling Engine," as he then denominated the locomotive, under the notice of the lessees of the Killingworth colliery, in the year 1813. Lord Ravensworth, the principal partner, had already formed a very favourable opinion of the colliery engine-wright from the important improve-

ments which he had effected in the colliery engines, both above and below ground; and, after considering the matter, and hearing Stephenson's statements, he authorized him to proceed with the construction of a locomotive,—though his lordship was, by some, called a fool for advancing money for such a purpose.

Mr. Stephenson had many obstacles to encounter before he could get fairly to work with the erection of his locomotive. His chief difficulty was in finding workmen sufficiently skilled in mechanics, and in the use of tools, to follow his instructions and embody his designs in a practical shape. The tools then in use about the collieries were rude and clumsy; and there were no such facilities as now exist for turning out machinery of an entirely new character. Mr. Stephenson was thus under the necessity of working with such men and tools as were at his command; and he had in a great measure to train and instruct his workmen himself. The engine was built in the workshops at the West Moor, the leading mechanic being John Thirlwall, the colliery blacksmith, an excellent workman in his way, though quite new to the work now entrusted to him.

In this first locomotive constructed at Killingworth, Mr. Stephenson to some extent followed the plan of Blenkinsop's engine. The boiler was cylindrical, eight feet in length and thirty-four inches in diameter, with an internal flue tube twenty inches wide passing through the boiler. The engine had two vertical cylinders of eight inches diameter and two feet stroke let into the boiler, working the propelling gear with cross heads and connecting rods. The power of the two cylinders was continued by means of spurwheels, which communicated the motive power to the wheels supporting the engine on the rail, instead of, as in Blenkinsop's engine, to cogwheels which acted on the cogged rail independent of the four supporting wheels. This adoption of spur-gear was the chief peculiarity of the *new engine*; it worked upon what is termed the second motion. The chimney was of wrought iron, around which was a chamber extending back to the feed-pumps, for the

purpose of heating the water previous to its injection into the boiler. The engine had no springs whatever, and was mounted on a wooden frame supported on four wheels. In order, however, to neutralise as much as possible the jolts and shocks which such an engine would necessarily encounter from the obstacles and inequalities of the then very imperfect plateway, the water-barrel which served for a tender was fixed to the end of a lever and weighted, the other end of the lever being connected with the frame of the locomotive carriage. By this means the weight of the two was more equally distributed, though the contrivance did not by any means compensate for the total absence of springs.

The wheels of the new locomotive were all smooth, and it was one of the first engines that had been so constructed. But before making the smooth wheels for his locomotive, Mr. Stephenson had the adhesion between the wheels of a loaded carriage and the rails tested and proved by experiment. He made a number of workmen mount upon the wheels of a waggon moderately loaded, and throw their entire weight upon the spokes on one side, when he found that the waggon could thus be easily propelled forward without the wheels slipping. He then determined to fix smooth wheels upon his locomotive, in the firm belief that the weight of the engine would of itself give sufficient adhesion for the purposes of traction.

The engine was, after much labour and anxiety, and frequent alterations of parts, at length brought to completion, having been about ten months in hand. It was placed upon the Killingworth Railway on the 25th of July, 1814; and its powers were tried on the same day. On an ascending gradient of 1 in 450, the engine succeeded in drawing after it eight loaded carriages of thirty tons' weight at about four miles an hour; and for some time after it continued regularly at work. It was indeed the most successful working engine that had yet been constructed.

As the principal test of the success of the locomotive was its economy as compared with horse power, careful calcula-

tions were made with the view of ascertaining this important point. The result was, that it was found the working of the engine was at first barely economical; and at the end of the year the steam power and the horse power were ascertained to be as nearly as possible upon a par in point of cost. The fate of the locomotive in a great measure depended on this very engine. Its speed was not beyond that of a horse's walk, and the heating surface presented to the fire being comparatively small, sufficient steam could not be raised to enable it to accomplish more on an average than about three miles an hour. The result was anything but decisive; and the locomotive might have been condemned as useless, had not Mr. Stephenson at this juncture applied the steam-blast, and at once more than doubled the power of the engine.

The eduction steam was originally allowed to escape into the open atmosphere with a hissing blast, which was the terror of horses and cattle, and was generally complained of as a nuisance. A neighbouring squire even threatened an action against the colliery lessees if it were not put an end to. But Mr. Stephenson's attention had already been drawn to the circumstance of the much greater velocity with which the steam issued from the exit pipe, compared with that at which the smoke escaped from the chimney of the engine. He then thought that, by conveying the eduction steam into the chimney by means of a small pipe after it had performed its office in the cylinders, and allowing it to escape in a vertical direction, its velocity would be imparted to the smoke from the fire, or to the ascending current of air in the chimney.

The experiment was no sooner made than he found that the combustion of the fuel in the furnace was greatly stimulated by the blast; consequently the capability of the boiler to generate steam was much increased, and the effective power of the engine was augmented in precisely the same proportion, without in any way adding to its weight.

This simple but beautiful expedient, though it has *hitherto*

received but slight notice as an original idea on the part of its author, was really fraught with the most important consequences to railway communication; and it is not too much to say that the success of the locomotive depended upon its adoption. Without the steam-blast, the advantages of the "multitubular boiler" could never have been fairly tested; and it was these two improvements, working together, which afterwards secured the triumph of the locomotive on the opening of the Liverpool and Manchester Railway. Without the steam-blast, by which the intensity of combustion was kept up to the highest point, and the evolution of steam thus rapidly effected, high rates of speed could not have been maintained, and locomotives might still have been dragging themselves unwieldily along at little more than five or six miles an hour.

The steam-blast had scarcely been adopted, with so decided a success, when Mr. Stephenson, observing the numerous defects in his engine, and profiting by the experience which he had already acquired, determined to construct a second engine, in which to embody his improvements in their best form. Careful and cautious observation of the working of his locomotive had convinced him that the complication arising out of the action of the two cylinders being combined by spurwheels would prevent its coming into practical use. He according directed his attention to an entire change in the construction and mechanical arrangements of the machine; and in the following year, conjointly with Mr. Dodds, who provided the necessary funds, he took out a patent, dated the 28th of February, 1815, for an engine which combined in a remarkable degree the essential requisites of an economical locomotive; that is to say, few parts, simplicity in their action, and directness in the mode by which the power was communicated to the wheels supporting the engine.

This locomotive, like the first, had two vertical cylinders, which communicated *directly* with each pair of the four wheels that supported the engine, by means of a cross head and a pair of connecting rods. But, in attempting to

establish a direct communication between the cylinders and the wheels that rolled upon the rails, considerable difficulties presented themselves. The ordinary joints could not be employed to unite the parts of the engine, which was a rigid mass, with the wheels rolling upon the irregular surface of the rails; for it was evident that the two rails of the line of way—more especially in those early days of imperfect construction of the permanent road—could not always be maintained at the same level,—that the wheel at one end of the axle might be depressed into one part of the line which had subsided, whilst the other wheel would be comparatively elevated; and, in such a position of the axle and wheels, it was obvious that a rigid communication between the cross head and the wheels was impracticable. Hence it became necessary to form a joint at the top of the piston-rod where it united with the cross head, so as to permit the cross head to preserve complete parallelism with the axle of the wheels with which it was in communication.

In order to obtain that degree of flexibility combined with direct action, which was essential for ensuring power and avoiding needless friction and jars from irregularities in the road, Mr. Stephenson made use of the "ball and socket" joint for effecting a union between the ends of the cross heads where they united with the connecting rods, and between the ends of the connecting rods where they were united with the crank-pins attached to each driving wheel. By this arrangement the parallelism between the cross head and the axle was at all times maintained and preserved, without producing any serious jar or friction on any part of the machine. Another important point was, to combine each pair of wheels by means of some simple mechanism, instead of by the cogwheels which had formerly been used. And, with this object, Mr. Stephenson began by making in each axle cranks at right angles to each other, with rods communicating horizontally between them.

A locomotive was accordingly constructed upon this plan in the year 1815, and it was found to answer extremely

well. But at that period the mechanical skill of the country was not equal to the task of forging cranked axles of the soundness and strength necessary to stand the jars incident to locomotive work. Mr. Stephenson was accordingly compelled to fall back upon a substitute, which, although less simple and efficient, was within the mechanical capabilities of the workmen of that day, in respect of construction as well as repair. He adopted a chain which rolled over indented wheels placed on the centre of each axle, and so arranged that the two pairs of wheels were effectually coupled and made to keep pace with each other. The chain, however, after a few years' use, became stretched; and then the engines were liable to irregularity in their working, especially in changing from working back to working forward again. Eventually the chain was laid aside, and the front and hind wheels were united by rods on the outside, instead of by rods and crank axles inside, as specified in the original patent. This expedient completely answered the purpose required, without involving any expensive or difficult workmanship.

Thus, in the year 1815, Mr. Stephenson, by dint of patient and persevering labour,—by careful observation of the works of others, and never neglecting to avail himself of their suggestions,—had succeeded in manufacturing an engine which included the following important improvements on all previous attempts in the same direction:—viz., simple and direct communication between the cylinder and the wheels rolling upon the rails; joint adhesion of all the wheels, attained by the use of horizontal connecting rods; and finally, a beautiful method of exciting the combustion of the fuel by employing the waste steam, which had formerly been allowed uselessly to escape into the air. Although many improvements in detail were afterwards introduced in the locomotive by Mr. Stephenson himself, as well as by his equally distinguished son, it is perhaps not too much to say that this engine, as a mechanical contrivance, contained the germ of all that has since been effected. It may in fact be regarded as the type of the present locomotive engine.

CHAPTER VI.

INVENTION OF THE "GEORDY" SAFETY-LAMP.

EXPLOSIONS of fire-damp were unusually frequent in the coal mines of Northumberland and Durham about the time when George Stephenson was engaged in the construction of his first locomotives. These explosions were frequently attended with fearful loss of life and dreadful suffering to the colliery workers. Killingworth Colliery was not free from such deplorable calamities; and during the time that Stephenson was employed as a brakesman at the West Moor, several "blasts" took place in the pit, by which many workmen were scorched and killed, and the owners of the colliery sustained heavy losses. One of the most serious of these accidents occurred in 1806, not long after he had been appointed brakesman, by which ten persons were killed. Stephenson was working at the mouth of the pit at the time, and the circumstances connected with the accident seem to have made a deep impression on his mind, as appeared from the graphic account which he gave to a committee of the House of Commons, which sat on the subject of Accidents in Coal Mines, some thirty years after the event.

Another explosion of a similar kind occurred in the same pit in 1809, by which twelve persons lost their lives. George Stephenson was working at the pit when the accident occurred, but the blast did not reach the shaft as in the former case; the unfortunate persons in the pit having been suffocated by the after-damp. But more calamitous explosions than these occurred in the neighbouring collieries; one of the worst being that which took place in May, 1812, in the Felling Pit, near Gateshead, a mine belonging to Mr. Brandling, by which no fewer than ninety men and boys were suffocated or burnt to death. And a similar accident occurred in the same pit in the year following, by which twenty-two men and boys perished.

It was natural that George Stephenson, when appointed to the responsible office of colliery engine wright, should devote his attention to the cause of these deplorable accidents, and to the means by which they might if possible be prevented. His daily occupation led him to think much and deeply on the subject. As the engineer of a colliery so extensive as that of Killingworth, where there were nearly 160 miles of gallery excavation, and in which he personally superintended the formation of inclined planes for the conveyance of the coal to the pit entrance, he was necessarily very often underground, and brought face to face with the dangers of fire-damp. From fissures in the roofs of the galleries, carburetted hydrogen gas was constantly flowing; in some of the more dangerous places it might be heard escaping from the crevices of the coal with a hissing noise. Ventilation, firing, and all conceivable modes of drawing out the foul air had been adopted, and the more dangerous parts of the galleries were built up. Still the danger could not be wholly prevented. The miners must necessarily guide their steps through the extensive underground pathways with lighted lamps or candles, the naked flame of which, coming in contact with the inflammable air, daily exposed them and their fellow-workers in the pit to the risk of death in one of its most dreadful forms.

One day, in the year 1814, a workman hurried into Mr. Stephenson's cottage with the startling information that the deepest main of the colliery was on fire! He immediately hastened to the pit-mouth, about a hundred yards off, whither the women and children of the colliery were fast running, with wildness and terror depicted in every face. In an energetic voice Stephenson ordered the engineman to lower him down the shaft in the corve. There was danger, it might be death, before him,—but he must go. As those about the pit-mouth saw him descend rapidly out of sight, and heard from the gloomy depths of the shaft the mingled cries of despair and agony rising from the workpeople

below, they gazed on the heroic man with breathless amazement.

He was soon at the bottom, and in the midst of his workmen, who were paralysed at the danger which threatened the lives of all in the pit. Leaping from the corve on its touching the ground, he called out "Stand back! Are there six men among you who have courage enough to follow me? If so, come, and we will put the fire out." The Killingworth men always had the most perfect confidence in George Stephenson, and instantly they volunteered to follow him. Silence succeeded to the frantic tumult of the previous minute, and the men set to work. In every mine, bricks, mortar, and tools enough are at hand, and by Stephenson's direction materials were forthwith carried to the required spot, where, in a very short time, the wall was raised at the entrance to the main, he himself taking the most active part in the work. The atmospheric air was by this means excluded, the fire was extinguished, the people were saved from death, and the mine was preserved.

This anecdote of Mr. Stephenson was related to the writer, near the pit-mouth, by one of the men, Kit Heppel, who had been an eye-witness to it, and helped to build up the brick wall by which the fire was stayed, though several workmen were suffocated in the pit. Heppel relates that, when down the pit some days after, seeking out the dead bodies, the cause of the accident was the subject of some conversation between himself and Stephenson, and Heppel then asked him, "Can nothing be done to prevent such awful occurrences?" Stephenson replied that he thought something might be done. "Then," said Heppel, "the sooner you start the better; for the price of coal-mining now is *pitmen's lives*."

The chief object to be attained was, to devise a lamp that would burn and give forth sufficient light to guide the miner in his underground labours, without communicating flame to the inflammable gas which accumulated in certain parts of the pit. Something had already been attempted towards the invention of a colliery lamp by Dr. Clanny, of Sunderland, who, in 1813, contrived an apparatus to which he gave air from the mine through water, by means of bellows. This lamp went out of itself in inflammable gas. It was found, however, too unwieldy to be used by the miners for the purposes of their work. A committee of gentlemen was formed at Sunderland to investigate the causes of the explosions, and to devise, if possible, some means of preventing them. At the invitation of that Committee, Sir Humphry Davy, then in the full zenith of his reputation, was requested to turn his attention to the subject. He accordingly visited the collieries near Newcastle on the 24th of August, 1815; and at the close of that year, on the 9th of November, 1815, he read his celebrated paper "On the Fire-Damp of Coal Mines, and on Methods of lighting the Mine so as to prevent its Explosion," before the Royal Society of London.

But a humbler though not less diligent and original thinker had been at work before him, and had already practically solved the problem of the Safety-Lamp. Stephenson was of course well aware of the anxiety which prevailed in the colliery districts as to the invention of a lamp which should give light enough for the miners' work without exploding the fire-damp. The painful incidents above described only served to quicken his eagerness to master the difficulty. Let the reader bear in mind the comparative obscurity of Stephenson's position, for he was as yet but one step removed from the grade of a manual labourer,—the meagreness of his scientific knowledge, all of which he had himself gathered bit by bit during his leisure moments, which were but few,—his almost entire lack of teachers excepting his own keen and observant eye and his shrewd and penetrating judgment: let these things be remembered, and the invention of the Geordy Safety-Lamp will be regarded as an achievement of the highest merit.

For several years he had been engaged, in his own rude way, in making experiments with the fire-damp in the Killingworth mine. The pitmen used to expostulate with him

on these occasions, believing that the experiments were fraught with danger. One of the sinkers called M'Crie, observing him holding up lighted candles to the windward of the "blower" or fissure from which the inflammable gas escaped, entreated him to desist; but Stephenson's answer was, that "he was busy with a plan by which he could make his experiments useful for preserving men's lives." On these occasions the miners usually got out of the way before he lit the gas.

In 1815, although he was very much occupied with the business of the collieries and with the improvements in his new locomotive engine, he was also busily engaged in making experiments on inflammable gas in the Killingworth pit. As he himself afterwards related to the Committee of the House of Commons which sat on the subject of Accidents in Mines in 1835, the nature and object of those experiments, we cannot do better than cite his own words:—

"I will give the Committee," said he, "my idea mechanically, because I knew nothing of chemistry at the time. Seeing the gas lighted up, and observing the velocity with which the flame passed along the roof, my attention was drawn to the contriving of a lamp, seeing it required a given time to pass over a given distance. My idea of making a lamp was entirely on mechanical principles; and I think I shall be found quite correct in my views, from mechanical reasoning. I knew well that the heated air from the fire drove round a smoke-jack, and that caused me to know that I could have a power from it. I also knew very well that a steam-engine chimney was built for the purpose of causing a strong current of air through the fire. Having these facts before me, and knowing the properties of heated air, I amused myself with lighting one of the blowers in the neighbourhood of where I had to erect machinery. I had it on fire; the volume of flame was coming out the size of my two hands, but was not so large but that I could approach close to it. Holding my candle to the windward of the flame, I observed that it

changed its colour. I then got two candles, and again placed them to the windward of the flame: it changed colour still more, and became duller. I got a number of candles, and placing them all to the windward, the blower ceased to burn. This then gave me the idea, that if I could construct my lamp so as, with a chimney at the top, to cause a current, it would never fire at the top of the chimney; and by seeing the velocity with which the ignited fire-damp passed along the roof, I considered that, if I could produce a current through tubes in a lamp equal to the current that I saw passing along the roof, I should make a lamp that could be taken into an explosive mixture without exploding externally."

Such was Mr. Stephenson's theory, when he proceeded to embody his idea of a miner's safety-lamp in a practical form. In the month of August, 1815, he requested his friend Mr. Nicholas Wood, the head viewer of the colliery, to prepare a drawing of a lamp, according to the description which he gave him. After several evenings' careful deliberations, the drawing was prepared, and it was shown to several of the head men about the works. "My first lamp," said Mr. Stephenson, describing it to the Committee above referred to, "had a chimney at the top of the lamp, and a tube at the bottom, to admit the atmospheric air, or fire-damp and air, to feed the burner or combustion of the lamp. I was not aware of the precise quantity required to feed the combustion; but to know what quantity was necessary, I had a slide at the bottom of the first tube in my lamp, to admit such a quantity of air as might eventually be found necessary to keep up the combustion." Stephenson then, accompanied by his friend Wood, the head viewer, went to Newcastle and ordered a lamp to be made according to the prepared plan, by Messrs. Hogg, tinmen, at the head of the Side—a well-known street in Newcastle. At the same time, they ordered a glass to be made for the lamp, at the Northumberland Glass House, in the same town. This lamp was received from the makers on the 21st of October, and

was taken to Killingworth for the purpose of immediate experiment.

George Stephenson arrived home about dusk, and found Moodie, the under viewer, all anxiety, waiting for him at the cottage. The lamp was immediately filled with oil, trimmed, and lighted; and all was now ready for its trial in the pit. But Mr. Wood had not yet arrived, and it was thought necessary that he should be present. He was known to be at Benton, about a mile distant. "Robert," said George, turning to his son, "you must go over for Wood, and tell him to come directly." It was a dark night; but the boy had learnt implicitly to obey his father, and he set out forthwith. On his way he had to pass through Benton churchyard, and, as he cautiously approached the wicket-gate and opened it, he thought he saw a white figure standing amongst the tombs! He started back, his heart fluttering, and, making the circuit of the wall of the burying-ground, he came round on the other side; and then he saw that the supposed white figure had been caused by a lanthorn flashing its light upon the grave-digger, who was busy plying his vocation at that late hour. Mr. Wood was soon found, and, mounting his horse, he rode over to Killingworth at once. When Robert reached the cottage, he found his father had just left (it was then near eleven o'clock), and gone down the shaft for the purpose of trying the lamp in one of the most dangerous parts of the mine!

Arrived at the bottom of the shaft with the lamp, the party directed their steps towards one of the foulest galleries in the pit, where the explosive gas was issuing through a blower in the roof of the mine with a loud hissing noise. By erecting some deal boarding around that part of the gallery into which the gas was escaping, the air was thus made more foul for the purpose of the experiment. After waiting for about an hour, Moodie, whose practical experience of fire-damp in pits was greater than that of either Stephenson or Wood, was requested to go into the place which had been made foul; and, having done so, he

then returned, and told them that the smell of the air was such, that if a lighted candle were now introduced, an explosion must inevitably take place. He cautioned Stephenson as to the danger both to themselves and to the pit, if the gas took fire. But Stephenson declared his confidence in the safety of his lamp, and, having lit the wick, he boldly proceeded with it towards the explosive air. The others, more timid and doubtful, hung back when they came within hearing of the blower; and apprehensive of the danger, they retired into a safe place, out of sight of the lamp, which gradually disappeared with its bearer in the recesses of the mine. It was a critical moment; and the danger was such as would have tried the stoutest heart. Stephenson advancing alone, with his yet untried lamp, in the depths of those underground workings,—calmly venturing his own life in the determination to discover a mode by which the lives of many might be saved and death disarmed in these fatal caverns,—presented an example of intrepid nerve and manly courage, more noble even than that which, in the excitement of battle and the collective impetuosity of a charge, carries a man up to the cannon's mouth.

Advancing to the place of danger, and entering within the fouled air, his lighted lamp in hand, Stephenson held it firmly out, in the full current of the blower, and within a few inches of its mouth! Thus exposed, the flame of the lamp at first increased, and then flickered and went out; but there was no explosion of the gas. Returning to his companions, who were still at a distance, he told them what had occurred. Having now acquired somewhat more confidence, they advanced with him to a point from which they could observe him repeat his experiment—but still at a safe distance. They saw that when the lighted lamp was held within the explosive mixture, there was a great flame: the lamp was almost full of fire; and then it smothered out. Again returning to his companions, he relighted the lamp, and repeated the experiment. This he did several times, with the same result. At length Wood and Moodie

ventured to advance close to the fouled part of the pit; and, in making some of the later trials, Mr. Wood himself held up the lighted lamp to the blower. Such was the result of the first experiments with the *first practical Miner's Safety-Lamp;* and such the daring resolution of its inventor in testing its valuable qualities.

Before leaving the pit, Stephenson expressed his opinion that, by an alteration of the lamp, which he then contemplated, he could make it burn better. This was by a change in the slide through which the air was admitted into the lower part of the lamp, under the flame. After making some experiments on the air collected at the blower, by means of bladders which were mounted with tubes of various diameters, he satisfied himself that, when the tube was reduced to a certain diameter, the explosion would not pass through; and he fashioned his slide accordingly, reducing the diameter of the tube until he conceived it was quite safe. In the course of about a fortnight the experiments were repeated in the pit, in a place purposely made foul as before. On this occasion a larger number of persons ventured to witness the experiments, which again proved perfectly successful. The lamp was not yet, however, so efficient as he desired. It required, he observed, to be kept very steady when burning in the inflammable gas, otherwise it was very liable to go out, in consequence, as he imagined, of the contact of the burnt air (as he then called it), or azotic gas, that lodged round the exterior of the flame. If the lamp was moved backwards and forwards, the azote came in contact with the flame and extinguished it. "It struck me," said he, "that if I put more tubes in, I should discharge the poisonous matter that hung round the flame, by admitting the air to its exterior part." Although he had then no access to scientific works, nor intercourse with scientific men, nor anything that could assist him in his inquiries on the subject, besides his own indefatigable spirit of inquiry, he contrived a rude apparatus, by means of which he proceeded to test the explosive properties of the gas and the velocity of current (for this

was the direction of his inquiries) required to permit the explosion to pass through tubes of different diameters. His own description of these experiments, in the course of which he had several "blows up," is interesting:—

"I made several experiments (and Mr. Wood was with me at the time) as to the velocity required in tubes of different diameters, to prevent explosion from fire-damp. We made the mixtures in all proportions of light carburetted hydrogen with atmospheric air in the receiver; and we found by the experiments that when a current of the most explosive mixture that we could make was forced up a tube four-tenths of an inch in diameter, the necessary current was nine inches in a second to prevent its coming down that tube. These experiments were repeated several times. We had two or three blows up in making the experiments, by the flame getting down into the receiver, though we had a piece of very fine wire-gauze put at the bottom of the pipe, between the receiver and the pipe through which we were forcing the current. In one of these experiments I was watching the flame in the tube, my son was taking the vibrations of the pendulum of the clock, and Mr. Wood was attending to give me the column of water as I called for it, to keep the current up to a certain point. As I saw the flame descending in the tube I called for more water, and he unfortunately turned the cock the wrong way; the current ceased, the flame went down the tube, and all our implements were blown to pieces, which at the time we were not very well able to replace."

The explosion of this glass receiver, which had been borrowed from the stores of the Philosophical Society at Newcastle, for the purpose of making the experiments, caused the greatest possible dismay amongst the party; and they dreaded to inform Mr. Turner, the Secretary, of the calamity which had occurred. Fortunately none of the experimenters were injured by the explosion.

Mr. Stephenson followed up those experiments by others of a similar kind, with the view of ascertaining whether

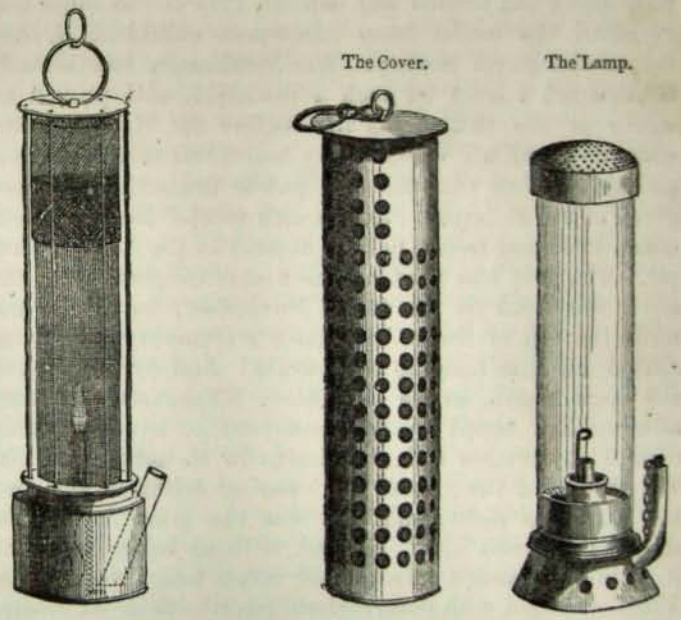
ordinary flame would pass through tubes of a small diameter; and with this object he filed off the barrels of several small keys. Placing these together, he held them perpendicularly over a strong flame, and ascertained that it did not pass upward. This served as further proof to his mind, of the soundness of the principle he was pursuing.

In order to correct the defect of his first lamp, Mr. Stephenson accordingly resolved to alter it so as to admit the air to the flame by several tubes of reduced diameter, instead of by one tube. He inferred that a sufficient quantity of air would thus be introduced into the lamp for the purposes of combustion, whilst the smallness of the apertures would still prevent the explosion passing downwards, —and at the same time the "burnt air" (the cause, in his opinion, of the lamp going out) would be more effectually dislodged. He accordingly took the lamp to the shop of Mr. Matthews, a tinman in Newcastle, and had it altered so that the air was admitted by three small tubes inserted in the bottom of the lamp, the openings of which were placed on the outside of the burner, instead of having (as in the original lamp) one tube opening directly under the flame.

This second or altered lamp was tried in the Killingworth pit on the 4th of November, and was found to burn better than the first lamp, and to be perfectly safe. But as it did not yet come up entirely to the inventor's expectations, he proceeded to contrive a third lamp, in which he proposed to surround the oil vessel with a number of capillary tubes. Then it struck him, that if he cut off the middle of the tubes, or made holes in metal plates, placed at a distance from each other equal to the length of the tubes, the air would get in better, and the effect in preventing the communication of explosion would be the same.

He was encouraged to persevere in the completion of his safety-lamp, by the occurrence of several fatal accidents about this time in the Killingworth pit. On the 9th of November, a boy was killed by a blast in the *A* pit, at the very place where Stephenson had made the experiments with his first lamp; and, when told of the accident,

he observed that if the boy had been provided with his lamp, his life would have been saved. Accordingly, on the 20th of November, he went over to Newcastle to order his third lamp from Mr. Watson, a plumber in that town. Mr. Watson referred him to his clerk, Henry Smith; whom Stephenson invited to join him at a neighbouring public-house, where they might quietly talk over the matter together, and the plan of the new lamp could be finally settled. They adjourned to the "Newcastle Arms," near the present High Level Bridge, where they had some ale, and a design of the lamp was drawn in pencil upon a half-sheet of foolscap, with a rough specification subjoined. The sketch now before us still bears the marks of the ale;



Davy's Safety-Lamp. Stephenson's Safety-Lamp.

it is a very rude design, but quite sufficient to work from. It was immediately placed in the hands of the workmen, finished in the course of a few days, and experimentally

tested in the Killingworth pit like the previous lamps, on the 30th of November, by which time neither Stephenson nor Wood had heard of Sir Humphry Davy's experiments, nor of the lamp which that gentleman proposed to construct.

A long and heated controversy afterwards took place as to the respective merits of George Stephenson and Sir Humphry Davy, as the inventor of the safety-lamp. A committee was formed on both sides, and the facts were stated in various ways. It is perfectly clear, however, that Mr. Stephenson had ascertained *the fact* that flame will not pass through tubes of a certain diameter—the principle on which the safety-lamp is constructed—before Sir Humphry Davy had formed any definite idea on the subject, or invented the model lamp afterwards exhibited by him before the Royal Society. Mr. Stephenson had actually constructed a lamp on such a principle, and proved its safety at the risk of his life, before Sir Humphry had communicated his views to any individual on the subject; and by the time that the first public intimation had been given of his discovery, Stephenson's second lamp had been constructed and tested in like manner in the Killingworth pit. The *first* was tried on the 21st of October, 1815, the *second* was tried on the 4th of November; but it was not until the 9th of November that Sir Humphry Davy presented his first lamp to the public. And by the 30th of the same month, as we have seen, Stephenson had constructed and tested his *third* safety-lamp, improved after careful observation and experiment in an actual coal-pit. His theory of the "burnt air" was no doubt wrong; but his lamp was right; and that was the great fact which mainly concerned him. He had, without being aware of it, followed Bacon's rule, as laid down long before by Da Vinci—"Begin with observations, go on with experiments, and, supported by both, try to find a law and causes." There seems to be no room for doubt that George Stephenson was the first to discover *the fact* that flame will not pass through tubes of a certain diameter; but to Sir Humphry

Davy belongs the merit of pointing out the true law on which the safety-lamp is constructed.

The subject of this important invention excited so much interest in the northern mining districts, and Mr. Stephenson s numerous friends considered his lamp so completely successful,—having stood the test of repeated experiments,—that they urged him to bring his invention before the Philosophical and Literary Society of Newcastle, of some of whose apparatus he had availed himself in the course of his experiments on fire-damp. After much persuasion, he consented to do so; and a meeting was appointed for the purpose of receiving his explanations, on the evening of the 5th of December, 1815. Mr. Stephenson was at that time so diffident in manner and unpractised in speech, that he took with him his friend Mr. Nicholas Wood, to act as his interpreter and expositor on the occasion. From eighty to a hundred of the most intelligent members of the Society were present at the meeting, when Mr. Wood stood forward to expound the principles on which the lamp had been formed, and to describe the details of its construction. Several questions were put, to which Mr. Wood proceeded to give replies to the best of his knowledge. But Stephenson, who up to that time had stood behind Wood, screened from notice, observing that the explanations given were not quite correct, could no longer control his reserve; and standing forward, he proceeded in his strong Northumberland dialect, to describe the lamp, down to its minutest details. He then produced several bladders full of carburetted hydrogen, which he had collected from the blowers in the Killingworth mine, and proved the safety of his lamp by numerous experiments with the gas, repeated in various ways; his earnest and impressive manner exciting in the minds of his auditors the liveliest interest both in the inventor and his invention.

Shortly after, Sir H. Davy's model lamp was received, and exhibited to the coal-miners at Newcastle, on which occasion the observation was made by several gentlemen, "Why, it is the same as Stephenson's!"

Notwithstanding Mr. Stephenson's claim to be regarded as the first inventor of the Tube Safety Lamp, his merits do not seem to have been recognised at the time beyond the limits of his own district. Sir Humphry Davy carried off all the *éclat* which attached to the discovery. What chance had the unknown workman of Killingworth with so distinguished a competitor? The one was as yet but a colliery engine-wright, scarce raised above the manual-labour class, without chemical knowledge or literary culture, pursuing his experiments in obscurity, with a view only to usefulness: the other was the scientific prodigy of his day, the pet of the Royal Society, the favourite of princes, the most brilliant of lecturers, and the most popular of philosophers.

No small indignation was expressed by the friends of Sir Humphry Davy at this "presumption" on Stephenson's part. The scientific class united to ignore him entirely in the matter. In 1831, Dr. Paris, in his 'Life of Sir Humphry Davy,' thus spoke of Stephenson, in connexion with his claims as an inventor of the safety-lamp:—"It will hereafter be scarcely believed that an invention so eminently scientific, and which could never have been derived but from the sterling treasury of science, should have been claimed on behalf of an engine-wright of Killingworth, of the name of Stephenson—a person not even possessing a knowledge of the elements of chemistry."

But Mr. Stephenson was really far above claiming for himself an invention which did not belong to him. He had already accomplished a far greater thing than even the making of a safety-lamp—he had constructed the first successful locomotive, which was to be seen daily at work upon the Killingworth railway. By the important improvements he had made in the engine, he might almost be said to have *invented* it; but no one—not even the philosophers—detected as yet the significance of that wonderful machine. It excited no scientific interest, called forth no leading articles in the newspapers or the reviews, and

formed the subject of no eloquent lectures at the Royal Society; for railways were, as yet, comparatively unknown, and the might which slumbered in the locomotive was scarcely, as yet, even dreamt of. What railways were to become, rested in a great measure with that "engine-wright of Killingworth, of the name of Stephenson," though he was scarcely known as yet beyond the limits of his own district.

As to the value of the invention of the safety-lamp, there could be no doubt; and the colliery owners of Durham and Northumberland, to testify their sense of its importance, determined to present a testimonial to its inventor. A meeting of coal-owners was called to consider the subject; but, previous to its taking place, Mr. Robert William Brandling, of Gosforth, a warm friend of Stephenson, although he could not attend the meeting, anxious that justice should be done in the matter, addressed a letter to the committee, dated the 22nd August, 1816, in which he expressed the wish that a strict examination should take place previous to the adoption of any measure which might carry a decided opinion to the public, as to the person to whom the invaluable discovery of the safety-lamp was actually due. "The conviction," said he, "upon my mind is, that Mr. George Stephenson, of Killingworth colliery, is the person who first discovered and applied the principle upon which safety-lamps may be constructed: for, whether the hydrogen gas is admitted through capillary tubes, or through the apertures of wire gauze, which may be considered as merely the orifices of capillary tubes, does not, as I conceive, in the least affect the principle."

On the 31st of August following, a meeting of the coal-owners was held at Newcastle, for the purpose of presenting Sir Humphry Davy with a reward for "the invention of *his* Safety-Lamp." To this no objection could be taken; for though the principle on which the first safety-lamps of Stephenson and Davy were constructed was the same; and although Stephenson's lamp was, unquestionably, the first successful lamp that was constructed on such principle, and

proved to be efficient,—yet Sir H. Davy did invent a safety-lamp, no doubt quite independent of all that Stephenson had done; and having directed his careful attention to the subject, and elucidated the true theory of explosion of carburetted hydrogen, he was entitled to all praise and reward for his labours. But when the meeting of coal-owners proposed to raise a subscription for the purpose of presenting Sir H. Davy with a reward for "his invention of *the* safety-lamp," the case was entirely altered; and Mr. Stephenson's friends then proceeded to assert his claims to be regarded as its first inventor.

Many meetings took place on the subject, and much discussion ensued, the result of which was, that a sum of 2000*l.* was presented to Sir Humphry Davy as "the inventor of the safety-lamp;" but, at the same time, a purse of 100 guineas was voted to George Stephenson, in consideration of what he had done in the same direction. This result was, however, very unsatisfactory to Stephenson, as well as to his friends; and Mr. Brandling, of Gosforth, suggested to him that, the subject being now fairly before the public, he should publish a statement of the facts on which his claim was founded.

This was not at all in George Stephenson's line. He had never appeared in print before; and it seemed to him to be a more formidable thing to write a letter for publication in "the papers," than even to invent a safety-lamp or design a locomotive. However, he called to his aid his son Robert, set him down before a sheet of foolscap, and when all was ready, told him to "put down there just what I tell you." The writing of this letter occupied more evenings than one; and when it was at length finished, after many corrections, and fairly copied out, the father and son set out—the latter dressed in his Sunday's round jacket—to lay the joint production before Mr. Brandling, at Gosforth House. Glancing over the letter, Mr. Brandling said, "George, this will not do." "It is all true, sir," was the reply. "That may be; but it is badly written." Robert blushed, for he thought it was the penmanship that was called in question, and he had written his very best. Mr. Brandling requested his visitors to sit down while he put the letter in a more polished form, which he did, and it was shortly after published in the local papers.

In that and subsequent communications, Mr. Stephenson treated as an ungenerous insult the insinuation made against him, that he was pretending to run a race of science with Sir Humphry Davy. "With means," said he, "too limited to allow me to indulge myself by purchasing many of those beautiful instruments that facilitate the labours of the experimental philosopher,—with not always one day's respite in the week from a laborious employment,—it is impossible that Mr. Hodgson (his controversial opponent) could have imagined I had the folly and presumption to enter the lists with a gentleman of talents and fortune, whose time has long been and still is devoted to the pursuit, who has an opportunity of having his ideas brought immediately to the test of experiment, and who for that purpose (an advantage beyond all others) can command the assistance of such an artist as Mr. Newman. Whether or not Mr. Brandling be justified in the opinion he has expressed, it appears to me may easily be decided; and if it can be proved that I took advantage in the formation of the Safety-Lamp, of any suggestions, except the printed opinions of scientific men, I deserve to lose the confidence of my honourable employers and the good opinion of my fellow-men, which I feel an honest pride in declaring, even in my humble situation of life, is of more value in my estimation than any reward that generous but indiscriminating affluence can bestow."

As a vehement controversy continued to be carried on in the Newcastle papers as to the relative merits of the respective claimants, Mr. Stephenson, in the year 1817, consented to publish the detailed plans, with descriptions, of the several safety-lamps which he had contrived for use in the Killingworth colliery. The whole forms a pamphlet of only sixteen pages of letterpress.

His friends, being fully satisfied of his claims to priority as the inventor of the safety-lamp used in the Killingworth

and other collieries, proceeded to hold a public meeting for the purpose of presenting him with a reward "for the valuable service he had thus rendered to mankind." Charles J. Brandling, Esq., occupied the chair; and a series of resolutions were passed, of which the first and most important was as follows:—"That it is the opinion of this meeting that Mr. George Stephenson, having *discovered the fact* that explosion of hydrogen gas will not pass through tubes and apertures of small dimensions, and having been *the first to apply that principle in the construction of a safety lamp*, is entitled to a public reward."

A subscription was immediately commenced with this object, and a committee was formed, consisting of the Earl of Strathmore, C. J. Brandling, and others. The subscription list was headed by Lord Ravensworth, one of the partners in the Killingworth colliery, who showed his appreciation of the merits of Stephenson by giving 100 guineas. C. J. Brandling and partners gave a like sum, and Matthew Bell and partners, and John Brandling and partners, gave fifty guineas each.

When the resolutions appeared in the newspapers, the scientific friends of Sir Humphry Davy in London met, and passed a series of counter-resolutions, which they published, declaring their opinion that Mr. Stephenson was *not* the author of the discovery of the fact that explosion of hydrogen will not pass through tubes and apertures of small dimensions, and that he was *not* the first to apply that principle to the construction of a safety-lamp. To these counter-resolutions were attached the well-known names of Sir Joseph Banks, P.R.S., William Thomas Brande, Charles Hatchett, W. H. Wollaston, and Thomas Young.

Mr. Stephenson's friends then, to make assurance doubly sure, and with a view to set the question at rest, determined to take evidence in detail as to the date of discovery by George Stephenson of the fact in question, and its practical application by him in the formation and actual trial of his safety-lamp. The witnesses examined were, George Stephenson himself, Mr. Nicholas Wood, and John Moodie, who

had been present at the first trial of the lamp; the several tinmen who made the lamps; the secretary and other members of the Literary and Philosophical Society of Newcastle, who were present at the exhibition of the third lamp; and some of the workmen at Killingworth colliery, who had been witnesses of Mr. Stephenson's experiments on fire-damp, made with the lamps at various periods, considerably before Sir Humphry Davy's investigations were heard of. This evidence was quite conclusive to the gentlemen who investigated the subject, and they published it in 1817, together with their report, in which they solemnly declared that, "after a careful inquiry into the merits of the case, conducted, as they trust, in a spirit of fairness and moderation, they can perceive no satisfactory reason for changing their opinion."

Tankard presented to Stephenson for his discovery of the Safety-Lamp.

The Stephenson subscription, when collected, amounted to 1000*l*. Part of the money was devoted to the purchase of a silver tankard, which was presented to the Inventor, together with the balance of the subscription,

at a public dinner given in the Assembly Rooms at Newcastle. The tankard bore the following inscription:—"This piece of plate, purchased with a part of the sum of 1000*l.*, a subscription raised for the remuneration of Mr. GEORGE STEPHENSON for having discovered the fact that inflamed fire-damp will not pass through tubes and apertures of small dimensions, and having been *the first* to apply that principle in the construction of a safety-lamp calculated for the preservation of human life in situations formerly of the greatest danger, was presented to him at a general meeting of the subscribers, Charles John Brandling, Esq., in the Chair. January 12th, 1818."

Mr. Brandling, on presenting the testimonial, observed:—"A great deal of controversy, and, he was sorry to say, of animosity, had prevailed upon the subject of the 'safety-lamp;' but this, he trusted, after the example of moderation that had been set by Mr. Stephenson's friends, would subside, and all personalities would cease to be remembered. As to the claim of that individual, to testify their gratitude to whom they were that day assembled, he thought every doubt must have been removed from the minds of unprejudiced persons by a perusal of the evidence recently laid before the public. He begged Mr. Stephenson's acceptance of this token of their esteem, wishing him health long to enjoy it, and to enable him to employ those talents with which Providence had blessed him for the benefit of his fellow-creatures."

On returning thanks for the honour done him, Mr. Stephenson said: "I shall ever reflect with pride and gratitude that my labours have been honoured with the approbation of such a distinguished meeting; and you may rest assured that my time, and any talent I may possess, shall hereafter be employed in such a manner as not to give you, gentlemen, any cause to regret the countenance and support which you have so generously afforded me." That Stephenson amply fulfilled this promise and pledge to his friends, his future career abundantly proved.

Now that all angry feelings between the contending

parties have softened down, it is not perhaps very difficult to get at the truth of this controversy. From what we have stated, we think it must be admitted that the fact that carburetted hydrogen will not explode down narrow tubes, was discovered by Stephenson, and that this fact or principle was applied by him in the invention of three successive lamps constructed under his directions. Sir Humphry Davy discovered the same fact about the same time, but most probably at a subsequent date, and afterwards constructed a safety-lamp which was preferred to that of Stephenson, on account of its greater cheapness and lightness. Sir H. Davy himself acknowledges that the merit of his lamp rested entirely on the discovery of the principle referred to, which had previously been ascertained and verified by the repeated experiments of Mr. Stephenson.

However great the merits of Mr. Stephenson in connection with the invention of the tube safety-lamp, they cannot be regarded as detracting from the distinguished reputation of Sir Humphry Davy. His inquiries into the explosive properties of carburetted hydrogen gas were quite original; and his discovery of the fact that explosion will not pass through tubes of a certain diameter was made independently of all that Stephenson had done in verification of the same fact. It even appears that Mr. Smithson Tennant and Dr. Wollaston had observed the same fact several years before, though neither Stephenson nor Davy knew it while they were prosecuting their experiments. Sir Humphry Davy's subsequent modification of the tube lamp, by which, while diminishing the diameter, he in the same ratio shortened the tubes without danger, and in the form of wire-gauze enveloped the safety-lamp by a multiplicity of tubes, was a beautiful application of the true theory which he had formed upon the subject.

The increased number of accidents which have occurred from explosions in coal mines since the general introduction of the Davy lamp have led to considerable doubts as to its safety, and to inquiries as to the means by which it may be

further improved; for experience has shown that, under certain circumstances, the Davy lamp is *not* safe. Mr. Stephenson was of opinion that the modification of his own and Sir Humphry Davy's lamp, combining the glass cylinder with the wire-gauze, was the most secure lamp; at the same time it must be admitted that the Davy and the Geordy lamps alike failed to stand the severe tests to which they were submitted by Dr. Pereira, when examined before the Committee on Accidents in Mines. Indeed, Dr. Pereira did not hesitate to say, that when exposed to a current of explosive gas the Davy lamp is "decidedly unsafe," and that the experiments by which its safety had been "demonstrated" in the lecture-room, had proved entirely "fallacious."

It is worthy of remark, that under circumstances in which the wire-gauze of the Davy lamp becomes red-hot from the high explosiveness of the gas, the Geordy lamp is extinguished; and we cannot but think that this fact testifies to the decidedly superior safety of the Geordy. An accident occurred in the Oaks Colliery Pit at Barnsley, on the 20th of August, 1857, which strikingly exemplified the respective qualities of the lamps. A sudden outburst of gas took place from the floor of the mine, along a distance of fifty yards. Fortunately the men working in the pit at the time were all supplied with safety-lamps—the hewers with Stephenson's, and the hurriers with Davy's. Upon this occasion, the whole of the Stephenson lamps, over a space of five hundred yards, were extinguished almost instantaneously; whereas the Davy lamps were filled with fire, and became red-hot—so much so, that several of the men using them had their hands burnt by the gauze. Had a strong current of air been blowing through the gallery at the time, an explosion would most probably have taken place,—an accident which, it will be observed, could not, under such circumstances, occur from the use of the Geordy, which is immediately extinguished as soon as the air becomes explosive.

To this day, the Geordy lamp continues in regular use in

the Killingworth Collieries; and the Killingworth pitmen have expressed to the writer their decided preference for it compared with the Davy. It is certainly a strong testimony in its favour, that no accident is known to have arisen from its use, since it was generally introduced into the Killingworth pits.

CHAPTER VII.

FURTHER IMPROVEMENTS IN THE LOCOMOTIVE — THE HETTON RAILWAY.

MR. STEPHENSON'S experiments on fire-damp, and his labours in connexion with the invention of the safety lamp, occupied but a small portion of his time, which was mainly devoted to the engineering business of the colliery. He was also giving daily attention to the improvement of his locomotive, which every day's observation and experience satisfied him was still far from being perfect.

At that time railways were almost exclusively confined to the colliery districts, and attracted the notice of few persons except those immediately connected with the coal trade. Nor were the colliery proprietors generally favourable to locomotive traction. There were great doubts as to its economy. Mr. Blackett's engines at Wylam were still supposed to be working at a loss; those tried at Coxlodge and Heaton, proving failures, had been abandoned; and the colliery owners, seeing the various locomotive speculations prove abortive, ceased to encourage further experiments.

George Stephenson alone remained in the field after all the other improvers and inventors of the locomotive had abandoned it in despair. He continued to entertain confident expectations of its eventual success. He even went so far as to say that it would yet supersede every other tractive power. Many looked upon him as an enthusiast, which no doubt he was, and upon sufficient grounds. As for his travelling engine, it was by most persons regarded as a curious toy; and many, shaking their heads, predicted for it "a terrible blow-up some day." Nevertheless, it was daily performing its work with regularity, dragging the

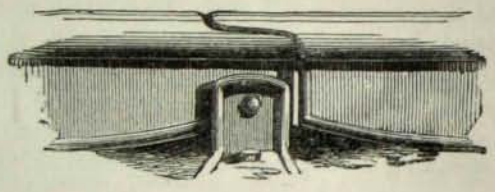
coal waggons between the colliery and the staiths, and saving the labour of many men and horses. There was not, however, so marked a saving in the expense of working when compared with the cost of horse traction, as to induce the northern colliery masters to adopt it as a substitute for horses. How it could be improved and rendered more efficient as well as economical, was never out of Mr. Stephenson's mind. He was quite conscious of the imperfections both of the road and of the engine; and he gave himself no rest until he had brought the efficiency of both up to a higher point. He worked his way step by step, slowly but surely: every step was in advance of the one preceding, and thus inch by inch was gained and made good as a basis for further improvements.

At an early period of his labours, or about the time when he had completed his second locomotive, he began to direct his particular attention to the state of the road; as he perceived that the extended use of the locomotive must necessarily depend in a great measure upon the perfection, solidity, continuity, and smoothness of the way along which the engine travelled. Even at that early period, he was in the habit of regarding the road and the locomotive as one machine, speaking of the rail and the wheel as "man and wife."

All railways were at that time laid in a careless and loose manner, and great inequalities of level were allowed to occur without much attention being paid to repairs; the result was that great loss of power was caused, and also great wear and tear of machinery, by the frequent jolts and blows of the wheels against the rails. His first object therefore was, to remove the inequalities produced by the imperfect junction between rail and rail. At that time (1816) the rails were made of cast iron, each rail being about three feet long; and sufficient care was not taken to maintain the points of junction on the same level. The chairs, or cast-iron pedestals into which the rails were inserted, were flat at the bottom; so that, whenever any disturbance took place in the stone blocks or sleepers

supporting them, the flat base of the chair upon which the rails rested, being tilted by unequal subsidence, the end of one rail became depressed, whilst that of the other was elevated. Hence constant jolts and shocks, the reaction of which very often caused the fracture of the rails, and occasionally threw the engine off the road.

To remedy this imperfection, Mr. Stephenson devised a new chair, with an entirely new mode of fixing the rails therein. Instead of adopting the *butt joint* which had hitherto been used in all cast-iron rails, he adopted the *half-lap joint*, by which means the rails extended a certain distance over each other at the ends, somewhat like a scarf joint. These ends, instead of resting upon the flat chair, were made to rest upon the apex of a curve forming the bottom of the chair. The supports were extended from three feet to three feet nine inches or four feet apart. These rails



Half-lap Joint.

were accordingly substituted for the old cast-iron plates on the Killingworth Colliery Railway, and they were found to be a very great improvement upon the previous system, adding both to the efficiency of the horse power (still used on the railway) and to the smooth action of the locomotive engine, but more particularly increasing the efficiency of the latter.

This improved form of the rail and chair was embodied in a patent taken out in the joint names of Mr. Losh, of Newcastle, iron-founder, and of Mr. Stephenson, bearing date the 30th of September, 1816. Mr. Losh being a wealthy, enterprising iron-manufacturer, and having con-

fidence in George Stephenson and his improvements, found the money for the purpose of taking out the patent, which, in those days, was a very costly as well as troublesome affair.

The specification of the same patent also described various important improvements on all locomotives previously constructed. The wheels of the engine were improved, being altered from cast to malleable iron, in whole or in part, by which they were made lighter as well as more durable and safe. Thus the road was rendered smoother, and the wheels of the locomotive were made stronger. But the most ingenious and original contrivance embodied in this patent was the substitute for springs which was devised by Mr. Stephenson. He contrived an arrangement by which the steam generated in the boiler was made to perform this important office! The means by which this was effected were so strikingly characteristic of true mechanical genius, that we would particularly call the reader's attention to this ingenious device, which was the more remarkable, as it was contrived long before the possibility of steam locomotion had become an object of parliamentary inquiry or even of public interest.

It has already been observed that up to, and indeed for some time after the period of which we speak, there was no such class of skilled mechanics, nor were there any such machinery and tools in use, as are now at the disposal of inventors and manufacturers. The same difficulty had been experienced by Watt many years before, in the course of his improvements in the steam-engine; and on the occasion of the construction of his first condensing engine at Soho, Mr. Smeaton, although satisfied of its great superiority to Newcomen's, expressed strong doubts as to the practicability of getting the different parts executed with the requisite precision; and he consequently argued that, in its improved form, this powerful machine would never be generally introduced. Such was the low state of the mechanical arts in those days. Although skilled workmen were in course of gradual training in a few of the larger

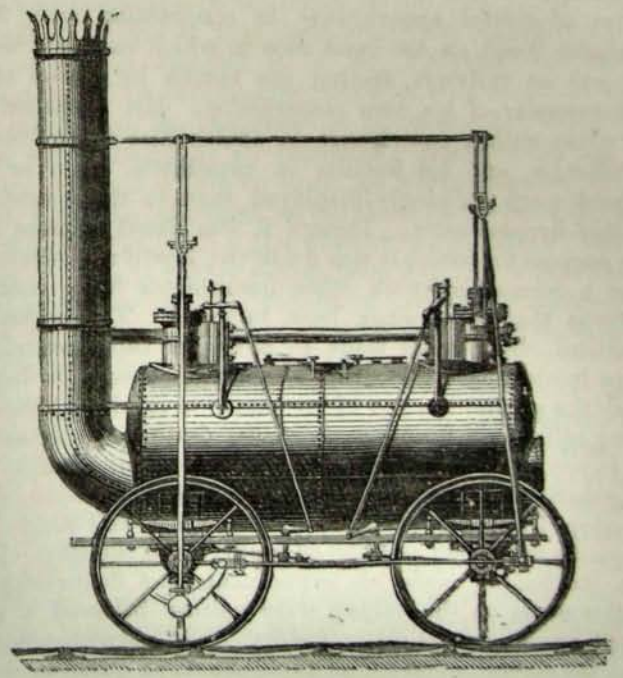
manufacturing towns, they did not, at the date of Stephenson's patent, exist in any considerable numbers, nor was there then any class of mechanics capable of constructing springs of sufficient strength and elasticity to support a locomotive engine ten tons in weight.

The rails then used being extremely light, the road soon became worn down by the traffic, and, from the inequalities of the way, the whole weight of the engine, instead of being uniformly distributed over the four wheels, was occasionally thrown almost diagonally upon two. Hence frequent jerks of the locomotive, and increased stress upon the slender road, which occasioned numerous breakages of the rails and chairs, and consequent interruptions to the safe working of the railway.

In order to avoid the dangers arising from this cause, Mr. Stephenson contrived his Steam Springs. He so arranged the boiler of his new patent locomotive that it was supported upon the frame of the engine by four cylinders, which opened into the interior of the boiler. These cylinders were occupied by pistons with rods, which passed downwards and pressed upon the upper side of the axles. The cylinders opening into the interior of the boiler, allowed the pressure of steam to be applied to the upper side of the piston; and that pressure being nearly equivalent to one-fourth of the weight of the engine, each axle, whatever might be its position, had at all times nearly the same amount of weight to bear, and consequently the entire weight was pretty equally distributed amongst the four wheels of the locomotive. Thus the four floating pistons were ingeniously made to serve the purpose of springs in equalising the weight, and in softening the jerks of the machine; the weight of which, it must also be observed, had been increased, on a road originally calculated to bear a considerably lighter description of carriage. This mode of supporting the engine remained in use until the progress of spring-making had so far advanced that steel springs could be manufactured of sufficient strength to be used in locomotives.

The result of the actual working of the new locomotive on the improved road amply justified the promises held forth in the specification. The traffic was conducted with greater regularity and economy, and the superiority of the locomotive engine, as compared with horse traction, became more apparent. And it is a fact worthy of notice, that the identical engines constructed by Mr. Stephenson in 1816 are to this day to be seen in regular useful work upon the Killingworth railway, conveying heavy coal trains at the speed of between five or six miles an hour, probably as economically as any of the more perfect locomotives now in use.

Mr. Stephenson's endeavours having been attended with such marked success in the adaptation of locomotive power



Old Engine in use on Killingworth Railway.

to railways, his attention was called, by many of his friends, about the year 1818, to the application of steam to travelling on common roads. It was from this point, indeed, that the locomotive had been started, Trevithick's first engine having been constructed with this special object. Stephenson's friends having observed how far behind he had left the original projector of the locomotive in its application to railroads, perhaps naturally inferred that he would be equally successful in applying it to the purpose for which Trevithick and Vivian originally intended it.

But the accuracy with which he estimated the resistance to which loads were exposed on railways, arising from friction and gravity, led him at a very early stage to reject the idea of ever successfully applying steam power to common road travelling. In October, 1818, he made a series of careful experiments, in conjunction with Mr. Nicholas Wood, on the resistance to which carriages were exposed on railways, testing the results by means of a dynamometer of his own construction. His readiness at all times with a contrivance to enable him to overcome a difficulty, and his fertility in expedients, were in no respect more strikingly displayed than in the invention of this dynamometer. Though it was found efficient for the purpose for which it was contrived, it will not of course bear a comparison with other instruments for a similar purpose that have since been invented. The series of practical observations made by means of this instrument were interesting, as the first systematic attempt to determine the precise amount of resistance to carriages moving along railways. It was thus for the first time ascertained by experiment that the friction was a constant quantity at all velocities. Although this theory had long before been developed by Vince and Coulomb, and was well known to scientific men as an established truth, yet at the time when Mr. Stephenson made his experiments, the deductions of philosophers on the subject were neither believed in nor acted upon by practical engineers. And notwithstanding that the carefully conducted experiments in question went

directly to corroborate the philosophical theories on the subject, it was a considerable time (so great were the prejudices then existing) before the conclusions which they established received the sanction of practical men.

It was maintained by many that the results of these experiments led to the greatest possible mechanical absurdities. For example, it was insisted that, if friction was constant at all velocities upon a level railway, when once a power was applied to a carriage, which exceeded the friction of that carriage by the smallest possible amount, such excess of power, however small, would be able to convey the carriage along a level railway at all conceivable velocities. When this position was taken by those who opposed the conclusions to which Mr. Stephenson had arrived, he felt the greatest hesitation in maintaining his own views; for it appeared to him at first sight really the absurdity which his opponents asserted it to be. Frequent and careful repetition of his experiments, however, left no doubt upon his mind as to the soundness of his conclusion—that friction was uniform at all velocities. Notwithstanding the ridicule that was thrown upon his views by many persons with whom he associated at the time, he continued to hold to this conclusion as a fact positively established; and he soon afterwards boldly maintained, that that which was an apparent absurdity was indeed an inevitable consequence, and that every increase of speed involved a necessary expenditure of power almost in a direct ratio.

The other resistances to which carriages are exposed, were at the same time investigated by Mr. Stephenson. He perceived that these resistances were mainly three; the first being upon the axles of the carriages, the second (which may be called the rolling resistance) being between the circumference of the wheel and the surface of the rail, and the third being the resistance of gravity. The amount of friction and gravity was accurately ascertained; but the rolling resistance was a matter of greater difficulty, being subject to much variation. He however satisfied himself that it was so great when the surface presented to the

wheel was of a rough character, that the idea of working steam carriages upon common roads was dismissed by him as entirely out of the question.

Taking it as 10 lbs. to a ton weight on a level railway, it became obvious to him that so small a rise as 1 in 100 would diminish the useful effort of a locomotive by upwards of 50 per cent. This was demonstrated by repeated experiments, and the important fact, thus rooted deeply in his mind, was never lost sight of in the course of his future railway career. It was owing in a great measure to these painstaking experiments that he thus early became convinced of the vital importance, in an economical point of view, of reducing the country through which a railway was intended to pass as nearly as possible to a level. Where, as in the first coal railways of Northumberland and Durham, the load was nearly all one way,—that is, from the colliery to the shipping-place,—it was an advantage to have an inclination in that direction. The strain on the powers of the locomotive was thus diminished, and it was an easy matter for it to haul the empty waggons back to the colliery up even a pretty steep incline. But when the loads were both ways, it appeared obvious to him that the railroad must be constructed as nearly as possible on a level. The strong and sagacious mind of Stephenson early recognised this broad principle; and he had so carefully worked out the important facts as to the resistance offered by adverse gradients, that he never afterwards swerved from it, invariably insisting upon the importance of flat railroads. It is true, great and important additions were made to the powers of the locomotive; but no sooner were these effected, than lines of steeper and still steeper gradients were devised, until, as he used to declare, engineers were constantly neutralising the increased powers of the engine, and in precisely the same degree diminishing the comparative advantages of railways over common roads.

These views, thus early entertained, originated, in Mr. Stephenson's mind, the peculiar character of railroad works

as distinguished from all other roads; for, in railroads, he early contended that large sums would be wisely expended in perforating barriers of hills with long tunnels, and in raising the lower levels with the excess cut down from the adjacent high ground. In proportion as these views forced themselves upon his mind and were corroborated by his daily experience, he became more and more convinced of the hopelessness of applying steam locomotion to common roads; for every argument in favour of a level railway was, in his view, an argument against the rough and hilly course of a common road. Nor did he cease to urge upon the numerous patrons of road steam-carriages, that if, by any amount of ingenuity, an engine could be made, which could by possibility travel on a turnpike road at a speed equal to that obtainable by horse power, and at a less cost, such an engine, if applied to the more perfect surface of a railway, would have its efficiency enormously enhanced.

For instance, he calculated that, if an engine had been constructed, and had been found to travel uniformly between London and Birmingham at an average speed of 10 miles an hour, conveying say 20 or 30 passengers, at a cost of 1*s.* per mile, it was clear that the same engine, if applied to a railway, instead of conveying 20 or 30 persons, would easily convey 200 or 300; and, instead of travelling at a speed of 10 or 12 miles an hour, a speed of at least 30 or 40 miles an hour might be attained.

All this seems trite and commonplace enough, now that the thing has been done; but it was not so in those days, before it had been attempted or even thought of, excepting by one man, whom his contemporaries spoke of as a dreamer and enthusiast on the subject of railways. Then, the so-called "practical" men were bent upon a really impracticable thing—the economical application of steam power to turnpike roads; while the "enthusiast" was pursuing the only safe road to practical success. At this day it is difficult to understand how the sagacious and strong common-sense views of Stephenson on this subject failed to force themselves sooner upon the minds of those who were por-

sisting in their vain though ingenious attempts to apply locomotive power to ordinary roads. For a long time they continued to hold with obstinate perseverance to the belief that for steam purposes a soft road was better than a hard one—a road easily crushed better than one incapable of being crushed; and they held to this after it had been demonstrated in all parts of the mining districts, that iron tramways were better than paved roads. But the fallacy that iron was incapable of adhesion upon iron continued to prevail, and the projectors of steam-travelling on common roads only shared in the common belief. They still considered that roughness of surface was essential to produce "bite," especially in surmounting acclivities; the truth being, that they confounded roughness of surface with tenacity of surface and contact of parts; not perceiving that a yielding surface which would adapt itself to the tread of the wheel, could never become an unyielding surface to form a fulcrum for its progression.

It is somewhat remarkable that, although George Stephenson's locomotive engines were in daily use for many years on the Killingworth railway, they excited comparatively little interest. Yet by them he had already solved the great problem of the employment of steam power for the purposes of railway traction. In his hands the locomotive was no longer an experiment, for he had ascertained and proved by the experience of years, that it worked more steadily, drew heavier loads, and was, on the whole, a more economical power to employ on railways, than horses. Nevertheless eight years passed before another locomotive railway was constructed and opened for the purposes of coal traffic.

It is difficult to account for this early indifference on the part of the public to the merits of the greatest mechanical invention of the age. Steam carriages were exciting great interest, and numerous and repeated experiments were made with them. The improvements effected by M'Adam in the mode of constructing turnpike-roads were the subject of frequent discussions in the legislature, on the grants of

public money being proposed, which were from time to time made to him. Yet here at Killingworth, without the aid of a farthing of government money, a system of road locomotion had been in existence since 1814, which was destined, before many years, to revolutionise the internal communications of England and of the world, but of which the English public and the English government as yet knew nothing.

Mr. Stephenson had no means of bringing his important invention prominently under the notice of the public. He himself knew well its importance, and he already anticipated its eventual general adoption; but being an unlettered man, he could not give utterance to the thoughts which brooded within him on the subject. Killingworth Colliery lay far from London, the centre of scientific life in England. It was visited by no savans nor literary men, who might have succeeded in introducing to notice the wonderful machine of Stephenson. Even the local chroniclers seem to have taken no notice of the Killingworth railway. The "Puffing Billy" was doing its daily quota of hard work, and had long ceased to be a curiosity in the neighbourhood. Blenkinsop's clumsier and less successful engine—which has long since been disused, while Stephenson's Killingworth engines continue working to this day—excited far more interest; partly, perhaps, because it was close to the large town of Leeds, and used to be visited by strangers as one of the few objects of interest in that place. Blenkinsop was also an educated man, and was in communication with some of the most distinguished personages of his day upon the subject of his locomotive, which thus obtained considerable notoriety. The first locomotive constructed after the Killingworth model and tried upon any other railway, was made to the order of the Duke of Portland in 1817, for use upon his tramroad, about ten miles long, extending from Kilmarnoch to Troon, in Ayrshire. The engine was employed for the purpose of hauling the coals from the Duke's collieries along the line to Troon harbour. Its use was however discontinued in consequence of the frequent breakages of the cast-iron rails,

by which the working of the line was interrupted, and accordingly horses were again employed as before. There seemed, indeed, to be so small a prospect of introducing the locomotive into general use, that Mr. Stephenson,—perhaps feeling the capabilities within him,—again recurred to his old idea of emigrating to the United States. Before becoming a sleeping partner in a small foundry at Forth Banks, in Newcastle, managed by Mr. John Burrell, he had thrown out the suggestion that it would be a good speculation for them to emigrate to North America, and introduce steamboats upon the great inland lakes. The first steamers were then plying upon the Tyne before his eyes; and he saw in them the germ of a great revolution in navigation. It occurred to him that North America presented the finest field on which to try their wonderful powers. He was an engineer, and Mr. Burrell was an ironfounder; and between them, he thought they could strike out a path to success in the mighty West. Fortunately, this remained a mere speculation so far as Mr. Stephenson was concerned; and it was left to others to do what he had dreamt of achieving. After all his patient waiting, his skill, industry, and perseverance were at length about to bear fruit.

In 1819, the owners of the Hetton Colliery, in the county of Durham, determined to have their waggon-way altered to a locomotive railroad. The result of the working of the Killingworth Railway had been so satisfactory, that they resolved to adopt the same system. One reason why an experiment so long continued and so successful as that at Killingworth should have been so slow in producing results, perhaps was, that to lay down a railway and furnish it with locomotives, or fixed engines where necessary, required a very large capital, beyond the means of ordinary coal-owners; whilst the small amount of interest felt in railways by the general public, and the supposed impracticability of working them to a profit, as yet prevented the ordinary capitalists from venturing their money in the promotion of such undertakings. The Hetton Coal Company was, however, possessed of adequate means; and the local reputation of the

Killingworth engine-wright pointed him out as the man best calculated to lay out their line and superintend their works. They accordingly invited him to act as the engineer of the proposed railway. Being in the service of the Killingworth Company, Mr. Stephenson felt it necessary to obtain their permission to enter upon this new work. This was at once granted. The best feeling existed between him and his employers; and they regarded it as a compliment that their colliery engineer should be selected for a work so important as the laying down of the Hetton Railway, which was to be the longest locomotive line that had, up to that time, been constructed in the neighbourhood. Mr. Stephenson accepted the appointment, his brother Robert acting as resident engineer, and personally superintending the execution of the works.

The Hetton Railway extended from the Hetton Colliery, situated about two miles south of Houghton-le-Spring, in the county of Durham, to the shipping-place on the banks of the Wear, near Sunderland. Its length was about eight miles; and in its course it crossed Warden Law, one of the highest hills in the district. The character of the country forbade the construction of a flat line, or one of comparatively easy gradients, except by the expenditure of a much larger capital than was placed at Mr. Stephenson's command. Heavy works could not be executed: it was, therefore, necessary to form the line with but little deviation from the natural conformation of the district which it traversed, and also to adapt the mechanical methods employed for the working of the railway to the character of the gradients, which in some places were necessarily heavy.

Although Mr. Stephenson had, with every step made towards its increased utility, become more and more identified with the success of the locomotive engine, he did not allow his enthusiasm to carry him away into costly mistakes. He carefully drew the line between the cases in which the locomotive could be usefully employed, and those in which stationary engines were calculated to be more economical. This led him, as in the instance of the

Hetton Railway, to execute lines through and over rough countries, where gradients within the powers of the locomotive engine of that day could not be secured, employing in their stead stationary engines where locomotives were not practicable. In the present case, this course was adopted by him most successfully. On the original Hetton line, there were five self-acting inclines,—the full waggons drawing the empty ones up,—and two inclines worked by fixed reciprocating engines of sixty-horse power each. The locomotive travelling engine, or "the iron horse," as the people of the neighbourhood then styled it, did the rest. On the day of the opening of the Hetton Railway, the 18th of November, 1822, crowds of spectators assembled from all parts to witness the first operations of this ingenious and powerful machinery, which was entirely successful. On that day five of Stephenson's locomotives were at work upon the railway, under the direction of his brother Robert; and the first shipment of coal was then made by the Hetton Company, at their new staiths on the Wear. The speed at which the locomotives travelled was about four miles an hour, and each engine dragged after it a train of seventeen waggons, weighing about sixty-four tons.

While thus advancing step by step,—attending to the business of the Killingworth Colliery, and also assisting in the formation of railways beyond the boundaries of his own immediate district,—he was carefully watching over the education of his son. We have already seen that he was put to school at Newcastle, after which, on leaving it, he was put apprentice to Mr. Nicholas Wood, the head viewer at Killingworth, to learn the business of the colliery; and he served in this capacity for about three years, thus becoming familiar with all the departments of underground works. The occupation was not unattended with peril, as the following incident will show. Though the Geordy lamp was now in general use in the Killingworth pits, and the workmen were bound, under a penalty of half-a-crown, not to use a naked candle, yet it was difficult to

enforce the rule, and even the masters themselves occasionally broke it. One day, Mr. Nicholas Wood, the head viewer, accompanied by Robert Stephenson and Moodie, the under viewer, was proceeding along one of the galleries, Wood with a naked candle in his hand, and Robert following him with a lamp. They came to a place where a fall of stones from the roof had taken place, and Nicholas Wood, who was first, proceeded to clamber over the stones, holding high the naked candle. He had reached nearly the summit of the heap, when the fire-damp, which had accumulated in the hollow of the roof, exploded, and instantly the whole party were blown down, and the lights extinguished. They were a mile from the shaft, and quite in the dark. There was a rush of the workpeople from all quarters towards the shaft, for it was feared that the fire might extend to more dangerous parts of the pit, where, if the gas had exploded, every soul in the mine must inevitably have perished. Robert Stephenson and Moodie, on the first impulse, ran back at full speed along the dark gallery leading to the shaft, coming into collision, on their way, with the hind quarters of a horse stunned by the explosion. When they had gone half-way, Moodie halted, and bethought him of Nicholas Wood. "Stop, laddie!" said he to Robert, "stop; we maun gang back, and seek the maister." So they retraced their steps. Happily no further explosion had taken place. They found the master lying on the heap of stones, stunned and bruised, with his hands severely burnt. They led him back out of the pit; and he afterwards took care never to venture into the dangerous parts of the mine without the protection of a Geordy lamp.

The time that Robert spent at Killingworth as under viewer was of advantage both to his father and himself. The evenings were generally devoted to reading and study, the two from this time working together as friends and co-labourers. One who used to drop in at the cottage of an evening, well remembers the animated and eager discussions which on some occasions took place, more

especially with reference to the then comparatively unknown powers of the locomotive engine, daily at work on the waggon way. The son was even more enthusiastic than the father on this subject. Robert would suggest alterations and improvements in this, that, and the other detail of the machine. His father, on the contrary, would offer every possible objection, defending the existing arrangements,—proud, nevertheless, of his son's suggestions, and often warmed and excited by his brilliant anticipations of the ultimate triumph of the locomotive.

These discussions probably had considerable influence in inducing Mr. Stephenson to take the next important step in the education of his son. Although Robert, who was only nineteen years of age, was doing well, and was certain at the expiration of his apprenticeship to rise to a higher position, his father was not satisfied with the amount of instruction which he had as yet given him. Remembering the disadvantages under which he had laboured in consequence of his ignorance of practical chemistry during his investigations connected with the safety-lamp, more especially with reference to the properties of gas, as well as in the course of his experiments in connexion with the improvement of the locomotive engine, he desired to furnish his son with as complete a scientific culture as his means would afford. He was also of opinion that a proper training in technical science was almost indispensable to success in the higher walks of the engineer's profession; and, aware that he himself could not now devote the requisite time and attention to its study, he determined to give to his son that kind and degree of education which he so much desired for himself. He would thus, he knew, secure a hearty and generous co-worker in the elaboration of the great ideas now looming grandly before him, and with their united practical and scientific knowledge he probably felt that they would be equal to any enterprise.

He accordingly took Robert from his labours as under viewer in the West Moor Pit, and, in the year 1820, sent him to the Edinburgh University, there being then no

college in England accessible to persons of moderate means, for purposes of scientific culture. He was furnished with some good introductions to men of science in Edinburgh, the reputation of his father in connexion with the safety-lamp and the locomotive being of some service to him in this respect. Though he studied at Edinburgh College for only one session of six months, he entered upon the work with such zest and interest—his mind was so ripe for the pursuit and reception of knowledge—that it is not too much to say, that in that short period he learnt more than most students do during a three years' course. He attended the chemical lectures of Dr. Hope, the lectures on natural philosophy by Sir John Leslie, and the natural history classes of Jameson; and his evenings were sedulously devoted to the study of practical chemistry under Dr. John Murray, himself one of the numerous speculators respecting the safety-lamp. This six months' study cost his father 80*l.*, a considerable sum with him in those days; but he was amply repaid when his son returned to Killingworth in the summer of 1821, bringing with him the prize for mathematics, which he had gained at the university.

As an illustration of Robert Stephenson's industry and application while attending college, we may adduce the following anecdote:—An engineering friend (Mr. T. Harrison) was engaged with him one evening in the discussion of a scientific subject in his own library, when Mr. Stephenson rose from his seat and took down a volume from his book-shelves. Mr. Harrison observed that the book was in MS., neatly written out. "What have we here?" he asked. The answer was,—"When I went to college, I knew the difficulty my father had in collecting the funds to send me there. Before going I studied short-hand; while at Edinburgh, I took down verbatim every lecture; and in the evenings, before I went to bed, I transcribed those lectures word for word. You see the result in that range of books."

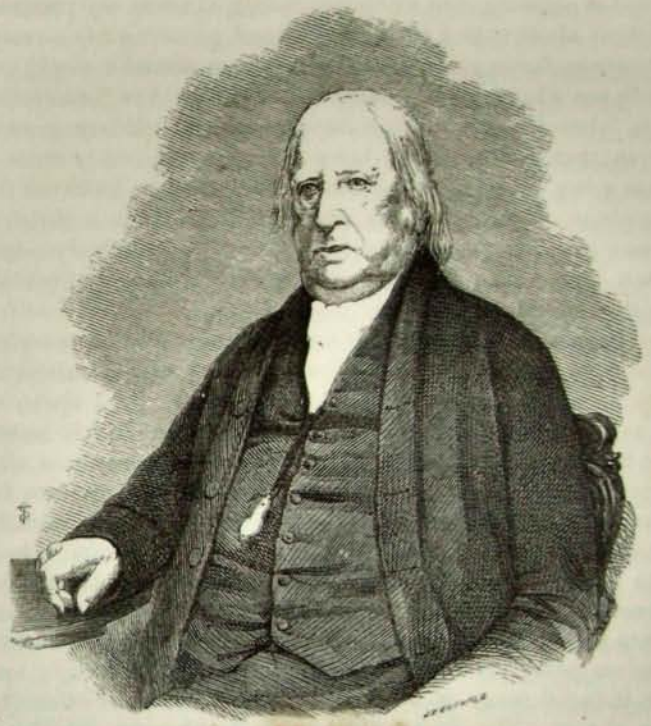
CHAPTER VIII.

ENGINEER OF THE STOCKTON AND DARLINGTON RAILWAY.

THE district lying west of Darlington, in the county of Durham, is one of the richest mineral fields of the North. Vast stores of excellent coal underlie the Bishop Auckland Valley; and from an early period it was felt to be an exceedingly desirable object to open up new communications to enable the article to be sent to market. But as yet it remained almost a closed field, the cost of transport of the coal in carts, or on horses' or donkeys' backs, greatly limiting the sale. Long ago, in the days of canal formations, Brindley was consulted about a canal; afterwards, in 1812, a tramroad was surveyed by Rennie; and eventually, in 1817, a railway was projected from Witton Colliery, a few miles above Darlington, to Stockton-on-Tees.

Of this railway Edward Pease was the projector. A thoughtful and sagacious man, ready in resources, possessed of indomitable energy and perseverance, he was eminently qualified to undertake what appeared to many the desperate enterprise of obtaining an Act of Parliament to construct a railway through a rather unpromising district. One who knew him in 1818 said, "he was a man who could see a hundred years ahead." When the writer last saw him, in the autumn of 1854, Mr. Pease was in his eighty-eighth year; yet he still possessed the hopefulness and mental vigour of a man in his prime. Hale and hearty, full of interesting reminiscences of the past, he yet entered with interest into the life of the present, and displayed a warm sympathy for all current projects calculated to render the lives of men happier. Still sound in health, his eye had not lost its brilliancy, nor his cheek its colour; and there was an elasticity in his step which younger men

might have envied.* His vigorous judgment and genuine native shrewdness, together with that courageous strength and tenacity of purpose, which made him, when once convinced, stand by the railway project upon which he had set his heart, when all the world called him schemer and fool, had not yet departed from him; and he could now



The late Mr. Edward Pease. (From a Photograph.)

afford to crack a lively joke at the prejudiced blindness of those who had so long made him the subject of their ridicule. Pointing to a fine prospect from his drawing-

* Mr. Pease died at Darlington on the 31st of July, 1858, aged 92. The photograph from which the above cut is taken, was kindly supplied by Mr. Pease himself in the course of the preceding month.

room window, extending to the wooded knolls on the further side of the valley, the numerous full-grown trees within sight, gay in all the gorgeous livery of autumn, Mr. Pease observed:—"What changes happen in a single lifetime! Look at those fine old trees; every one of them has been planted by my own hand. When I was a boy I was fond of planting, and my father indulged me in my pastime; I went about with a spade in my hand, planting trees everywhere as far as you can see: they grew whilst I slept; and now see what a goodly array they make! Aye," continued he, "but RAILWAYS are a far more extraordinary growth even than these. They have grown up not only since I was a boy, but since I became a man. When I started the Stockton and Darlington Railway, some five-and-thirty years since, I was already fifty years old. Nobody could then have dreamt what railways would have grown to, within one man's lifetime."

In getting up a company for the purpose of surveying and forming a railway, Mr. Pease had great difficulties to contend with. The people of the neighbourhood spoke of it as a ridiculous undertaking, and predicted that it would be the ruin of all who had to do with it. Even those who were most interested in the opening out of new markets for the vend of their coals, were indifferent, if not actually hostile. The Stockton merchants and shipowners, whom the formation of a railway was calculated to benefit so greatly, gave the project no support; and not twenty shares were subscribed for in the whole town. Mr. Pease nevertheless persevered with the formation of a company; and he induced many of his friends and relations to subscribe for shares. The Richardsons and Backhouses, members, like himself, of the Society of Friends, influenced by his persuasion, united themselves with him; and so many of the same denomination (having great confidence in these influential Darlington names) followed their example and subscribed for shares, that the railway subsequently obtained the designation, which it still enjoys, of "The Quakers' Line."

The engineer first employed to make a survey of the tramroad, was a Mr. Overton, who had had considerable experience in the formation of similar roads in Wales. The necessary preliminary steps were taken in the year 1818 to apply for an Act to authorise the construction of a tramroad from Witton to Stockton. The measure was, however, strongly opposed by the Duke of Cleveland, because the proposed line passed near to one of his fox covers; and, having considerable parliamentary influence, he succeeded in throwing out the bill by a majority of only thirteen,—above one hundred members voting in support of the measure. A nobleman said, when he heard of the division, "Well, if the Quakers in these times, when nobody knows anything about railways, can raise up such a phalanx as they have done on this occasion, I should recommend the county gentlemen to be very wary how they oppose them."

A new survey was then made, avoiding the Duke's fox cover; and in 1819 a renewed application was made to Parliament for an act. But George III. dying in January, 1820, while Parliament was still sitting, there was a dissolution, and the bill was necessarily suspended. The promoters, however, did not lose sight of their project. They had now spent a considerable sum of money in surveys and legal and parliamentary expenses, and were determined to proceed, though they were still unable to enlist the active support of the inhabitants of the district proposed to be served by the railway.

The energy of Edward Pease, backed by the support of his Quaker friends, enabled him to hold the company together, to raise the requisite preliminary funds from time to time for the purpose of prosecuting the undertaking, and eventually to overcome the opposition raised against the measure in Parliament. The bill at length passed; and the royal assent was given to the first Stockton and Darlington Railway Act on the 19th of April, 1821.

The preamble of this Act recites, that "the making and maintaining of a Railway or Tramroad, for the passage of waggons and other carriages" from Stockton to Witton

Park Colliery (by Darlington), "will be of great public utility, by facilitating the conveyance of coal, iron, lime, corn, and other commodities" between the places mentioned. The projectors of the line did not originally contemplate the employment of locomotives; for in the Act they provide for the making and maintaining of the tramroads for the passage upon them "of waggons and other carriages" "*with men and horses* or otherwise," and a further clause made provision as to the damages which might be done in the course of traffic by the "waggoners." The public were to be free "to use, with horses, cattle, and carriages," the roads formed by the company, on payment of the authorised rates, "between the hours of seven in the morning and six in the evening," during the winter months; "between six in the morning and eight in the evening," in two of the spring and autumn months each; and "between five in the morning and ten in the evening," in the high summer months of May, June, July, and August. From this it will be obvious that the projectors of this line had themselves at first no very large conceptions as to the scope of their project.

Some time elapsed before any active steps were taken to proceed with the construction of the railway. Doubts had been raised whether the line was the best that could be adopted for the district; and the subscribers generally were not so sanguine about their undertaking as to induce them to press on the formation of the line.

One day, about the end of the year 1821, two strangers knocked at the door of Mr. Pease's house in Darlington; and the message was brought to him that some persons from Killingworth wanted to speak with him. They were invited in, on which one of the visitors introduced himself as Nicholas Wood, viewer at Killingworth, and then, turning to his companion, he introduced him to Mr. Pease as George Stephenson, of the same place. Mr. Stephenson came forward and handed to Mr. Pease a letter from Mr. Lambert, the manager at Killingworth, in which it was stated that the bearer was the engine-wright at the pits, that he had had experience in the laying out of railways and had given

satisfaction to his employers, and that he would therefore recommend him to the notice of Mr. Pease if he stood in need of the services of such a person.

Mr. Pease entered into conversation with his visitors, and soon ascertained the object of their errand. Stephenson had heard of the passing of the Stockton and Darlington Act, and desiring to increase his railway experience, and also to employ in some larger field the practical knowledge he had already gained, he determined to visit Mr. Pease, the known projector of the undertaking, with the view of being employed to carry it out. He had brought with him his friend Nicholas Wood, for the purpose at the same time of relieving his diffidence, and supporting his application.

Mr. Pease liked the appearance of his visitor. "There was," as he afterwards remarked, in speaking of Stephenson, "such an honest, sensible look about him, and he seemed so modest and unpretending. He spoke in the strong Northumbrian dialect of his district, and described himself as 'only the engine-wright at Killingworth; that's what he was.'"

Mr. Pease very soon saw that his visitor was the man for his purpose. The whole plans of the railway being still in an undetermined state, Mr. Pease was glad to have the opportunity of gathering from Mr. Stephenson the results of his experience. The latter strongly recommended a *railway* in preference to a tramroad, in which Mr. Pease was disposed to concur with him. The conversation next turned on the tractive power which the company intended to employ, and Mr. Pease said that they had based their whole calculations on the employment of *horse* power. "I was so satisfied," said he afterwards, "that a horse upon an iron road would draw ten tons for one ton on a common road, that I felt sure that before long the railway would become the King's Highway."

But Mr. Pease was scarcely prepared for the bold assertion made by his visitor, that the locomotive engine with which *he had been working* the Killingworth Railway for

many years past was worth fifty horses, and that engines made after a similar plan would yet entirely supersede all horse power upon railroads. Mr. Stephenson was daily becoming more positive as to the superiority of his locomotive; and on this, as on all subsequent occasions, he strongly urged Mr. Pease to adopt it. "Come over to Killingworth," said he, "and see what my Blutcher can do; seeing is believing, sir." And Mr. Pease promised that on some early day he would go over to Killingworth with his friend Thomas Richardson, and take a look at this wonderful machine that was to supersede horses.

On Mr. Pease referring to the difficulties and the opposition which the projectors of the railway had had to encounter, and the obstacles which still lay in their way, Stephenson said to him, "I think, sir, I have some knowledge of craniology, and from what I see of your head, I feel sure that if you will fairly *buckle* to this railway, you are the man successfully to carry it through." "I think so, too," rejoined Mr. Pease; "and I may observe to thee, that if thou succeed in making this a good railway, thou may consider thy fortune as good as made." He added that all they would require at present was an estimate of the cost of re-surveying the line, with the direction of which the company were not quite satisfied; and as they had already paid away several hundred pounds, and found themselves very little advanced, Mr. Pease asked that this new survey should be done at as little expense as possible. This Stephenson readily assented to; and after Mr. Pease had pledged himself to bring his application for the appointment of engineer before the Directors on an early day, and to support it with his influence, the two visitors prepared to take their leave, informing Mr. Pease that they intended to return as they had come, "by nip;" that is, they would obtain a sort of smuggled lift on the stage coach, by tipping Jehu,—for in those days the stage coachmen were wont to regard all casual roadside passengers as their special perquisite. And thus the two contrived to make a cheap journey of it between Darlington and Killingworth

Mr. Pease having made further inquiries respecting the character and qualifications of George Stephenson, and having received from John Grimshaw—also a Friend, the inventor of endless spinning—a very strong recommendation of him as the right man for the intended work, he brought the subject of his application before the directors of the Stockton and Darlington Company. They resolved to adopt his recommendation that a railway be formed instead of a tramroad; and they further requested Mr. Pease to write to Mr. Stephenson, which he accordingly did, requesting him to report as to the practicability, or otherwise, of the line as laid out by Mr. Overton, and to state his suggestions as to any deviations or improvements in its course, together with estimates of comparative expenses. "In short," said Mr. Pease, "we wish thee to proceed in all thy levels, estimates, and calculations, with that care and economy which would influence thee if the whole of the work were thy own."

Mr. Stephenson replied (August 2nd, 1821) that the re-survey of the line would occupy at least four weeks, and that his charge would include all necessary assistance for the accomplishment of the survey, estimates of the expense of cuts and batteries (since called cuttings and embankments) *on the different projected lines, together with all remarks*, reports, &c., on the same; also the comparative cost of malleable and cast-iron rails, laying the same, winning and preparing the blocks of stone, and all other materials wanted to complete the line. "I could not do this," said he, "for less than 140*l*., allowing me to be moderately paid. Such a survey would of course have to be made before the work could be begun, as it is impossible to form any idea of contracting for the cuts and batteries by the former one; and I assure you I shall, in completing the undertaking, act with that economy which would influence me if the whole of the work was my own."

About the end of September Mr. Stephenson went over the line of the proposed railway, for the purpose of suggesting such improvements and deviations as he might consider desirable. He went over every foot of the ground himself,

accompanied by an assistant and a chainman,—his son Robert, who had recently returned from college, entering the figures while his father took the sights. After being engaged in the work at intervals for about six weeks, Mr. Stephenson reported the result of his survey to the Board of Directors, and showed that by certain deviations, a line shorter by about three miles might be constructed at a considerable saving in expense, while at the same time more favourable gradients—an important consideration—would be secured.

The directors of the company, being satisfied that the improvements suggested in the line, and the saving which would thus be effected in mileage and in money, fully warranted them in incurring the trouble, delay, and expense of making a further application to Parliament for an amended Act, took the requisite steps with this object. And in the mean time they directed Mr. Stephenson to prepare the specifications for the rails and chairs, and make arrangements to enter into contracts for the supply of the stone and wooden blocks on which the rails and chairs were to be laid. It was determined in the first place to proceed with the works at those parts of the line where no deviation was proposed; and the first rail of the Stockton and Darlington Railway was laid with considerable ceremony, by Thomas Meynell, Esq., of Yarm, at a point near St. John's Well, Stockton, on the 23rd of May, 1822.

It is worthy of note that Mr. Stephenson, in making his first estimate of the cost of forming the railway according to the instructions of the directors, set down, as part of the cost, 6200*l.* for stationary engines, not mentioning locomotives at all. The directors as yet confined their views to the employment only of horses for the haulage of the coals, and of fixed engines and ropes where horse-power was not applicable. The whole question of steam locomotive power was, in the estimation of the public, as well as of practical and scientific men, as yet in doubt. The confident anticipations of Mr. Stephenson, as to the eventual success of locomotive engines, were regarded as mere speculations;

and when he gave utterance to his views, as he frequently took the opportunity of doing, it had the effect of shaking the confidence of some of his friends in the solidity of his judgment and his practical qualities as an engineer.

When Mr. Pease discussed the question with Stephenson, his remark was, "Come over and see my engines at Killingworth, and satisfy yourself as to the efficiency of the locomotive. I will show you the colliery books, that you may ascertain for yourself the actual cost of working. And I must tell you that the economy of the locomotive engine is no longer a matter of theory, but a matter of fact." So confident was the tone in which Stephenson spoke of the success of his engines, and so important were the consequences involved in ariving at a correct conclusion on the subject, that Mr. Pease at length resolved upon paying a visit to Killingworth; and accordingly he proceeded thither, in company with his friend Mr. Thomas Richardson,* a considerable subscriber to the Stockton and Darlington project, in the summer of 1822.

When Mr. Pease arrived at Killingworth village, he inquired for George Stephenson, and was told that he must go over to the West Moor, and seek for a cottage by the roadside, with a dial over the door—that was where George Stephenson lived. They soon found the house with the dial; and on knocking, the door was opened by Mrs. Stephenson — his second wife (Elizabeth Hindmarsh), the daughter of a farmer at Black Callerton, whom he had married in 1819. Her husband, she said, was not in the house at present, but she would send for him to the colliery. And in a short time Stephenson appeared before them in his working dress, just out of the pit.

He very soon had his locomotive brought up to the crossing close by the end of the cottage,—made the gentlemen mount it, and showed them its paces. Harnessing it to a train of loaded waggons, he ran it along the railroad, and so thoroughly satisfied his visitors of its powers and capa-

* Mr. Richardson was the founder of the celebrated discount house of Richardson, Overend, and Gurney, in Lombard Street.

bilities, that from that day Edward Pease was a declared supporter of the locomotive engine. In preparing, in 1823, the Amended Stockton and Darlington Act, at Mr. Stephenson's urgent request, Mr. Pease had a clause inserted, taking power to work the railway by means of locomotive engines, and to employ them for the haulage of passengers as well as of merchandise; * and Mr. Pease gave a further and still stronger proof of his conviction as to the practical value of the locomotive, by entering into a partnership with Mr. Stephenson, in the following year, for the establishment of a locomotive foundry and manufactory in the town of Newcastle—the northern centre of the English railroad system.

The second Stockton and Darlington Act was obtained in the session of 1823, not, however, without opposition, the Duke of Cleveland and the road trustees still appearing as the determined opponents of the bill. Nevertheless, the measure passed into law, Mr. Stephenson was appointed the company's engineer at a salary of 300*l.* per annum, and the works were now proceeded with as vigorously as possible.

He at once proceeded with the working survey of the improved line of the Stockton and Darlington Railway, laying out every foot of the ground himself, accompanied by his assistants. Railway surveying was as yet in its infancy, and was very slow and deliberate work. Afterwards it became a separate branch of railway business, and was left to a special staff of surveyors. Indeed on no subsequent line did Mr. Stephenson take the sights through the spirit level with his own hands and eyes as he did on this railway. He would start very early in the morning, and survey until dusk. Mr. John Dixon, who assisted in the survey, mentions that he remembers on one occasion, after a long day's work near Aycliffe, when the light had completely failed them, the party separated—some to walk to Darlington, four miles off, Mr. Stephenson himself to the Simpasture farmhouse, where he had arranged to stay for the night; and his last stringent injunction was, that they

* The first clause in any railway act, empowering the employment of locomotive engines for the working of passenger traffic.

must all be on the ground to resume levelling as soon as there was light enough for the purpose. "You must not," he said, "set off from Darlington by daybreak, for then we shall lose an hour; but you must be *here*, ready to begin work as soon as it is daylight."

Mr. Stephenson performed the survey in top-boots and breeches—a usual dress at the time. He was not at any time particular as to his living; and during the survey, he took his chance of getting a drink of milk and a bit of bread at some cottager's house along the line, or occasionally joined in a homely dinner at some neighbouring farmhouse. The country people were accustomed to give him a hearty welcome when he appeared at their door; for he was always full of cheery and homely talk, and, when there were children about the house, he had plenty of surplus humour for them as well as for their seniors.

After the day's work was over, Mr. Stephenson would drop in at Mr. Pease's, to talk over with him the progress of the survey, and discuss various matters connected with the railway. Mr. Pease's daughters were usually present; and on one occasion, finding the young ladies learning the art of embroidery, he volunteered to instruct them. "I know all about it," said he; "and you will wonder how I learnt it. I will tell you. When I was a brakesman at Killingworth, I learnt the art of embroidery while working the pitman's button-holes by the engine fire at nights." He was never ashamed, but on the contrary rather proud, of reminding his friends of these humble pursuits of his early life. Mr. Pease's family were greatly pleased with his conversation, which was always amusing and instructive; full of all sorts of experience, gathered sometimes in the oddest and most out-of-the-way places. Even at that early period, before he mixed in the society of educated persons, there was a dash of speculativeness in his remarks, which gave a high degree of originality to his conversation; and sometimes he would, in a casual remark, throw a flash of light upon a subject, which called up a whole train of pregnant suggestions.

One of the most important subjects of discussion at these meetings with Mr. Pease, was the establishment of a manufactory at Newcastle for the building of locomotive engines. Up to this time all the locomotives constructed after Mr. Stephenson's designs, had been made by ordinary mechanics working amongst the collieries in the North of England. But he had long felt that the accuracy and style of their workmanship admitted of great improvement, and that upon this the more perfect action of the locomotive engine, and its general adoption as the tractive power on railways, in a great measure depended. One great object that he had in view in establishing the proposed factory was, to concentrate a number of good workmen for the purpose of carrying out the improvements in detail which he was constantly making in his engine. He felt hampered by the want of efficient helpers in the shape of skilled mechanics, who could work out in a practical form the ideas of which his busy mind was always so prolific. Doubtless, too, he believed that the locomotive manufactory would prove a remunerative investment, and that, on the general adoption of the railway system, which he now anticipated, he would derive solid advantages from the fact of his manufactory being the only establishment of the kind for the special construction of railway locomotives.

He still believed in the eventual success of railways, though it might be slow. Much, he believed, would depend upon the issue of this great experiment at Darlington; and as Mr. Pease was a man on whose sound judgment he could rely, he determined upon consulting him about his proposed locomotive factory. Mr. Pease approved of his design, and strongly recommended him to carry it into effect. But there was the question of means; and he did not think he had capital enough for the purpose. He told Mr. Pease that he could advance a thousand pounds—the amount of the testimonial presented by the coal-owners for his safety-lamp invention, which he had still left untouched; but he did not think this sufficient for the purpose, and he thought that he should require at least another thousand pounds.

Mr. Pease had been very much struck by the successful performances of the Killingworth engine; and being an accurate judge of character, he was not slow to perceive that he could not go far wrong in linking a portion of his fortune with the energy and industry of George Stephenson. He consulted his friend Thomas Richardson in the matter; and the two consented to advance 500*l.* each for the purpose of establishing the engine factory at Newcastle. A piece of land was accordingly purchased in Forth Street, in August, 1823, on which a small building was erected—the nucleus of the gigantic establishment which was afterwards formed around it; and active operations commenced early in 1824.

While the Stockton and Darlington Railway works were in progress, Mr. Stephenson held many interesting discussions with Mr. Pease, on points connected with its construction and working, the determination of which in a great measure affected the formation and working of all future railways. The most important points were these: 1. The comparative merits of cast and wrought-iron rails. 2. The gauge of the railway. 3. The employment of horse or engine power in working it when ready for traffic.

The kind of rails to be laid down to form the permanent road, was a matter of considerable importance. A wooden tramroad had been contemplated when the first act was applied for; but Stephenson having advised that an iron road should be laid down, he was instructed to draw up a specification of the rails. He went before the directors to discuss with them the kind of rails which was to be specified. He was himself interested in the patent for cast-iron rails, which he had taken out in conjunction with Mr. Losh in 1816; and, of course, it was to his interest that his articles should be adopted. But when requested to give his opinion on the subject, he frankly said to the directors, "Well, gentlemen, to tell you the truth, although it would put 500*l.* in my pocket to specify my own patent rails, I cannot do so after the experience I have had. If you take my advice, you will not lay down a single cast-iron rail." "Why?" asked the directors. "Because they will not stand the

weight; there is no wear in them, and you will be at no end of expense for repairs and re-lays." "What kind of road, then," he was asked, "would you recommend?" "Malleable rails, certainly," said he; "and I can recommend them with the more confidence from the fact that at Killingworth we have had some Swedish bars laid down—nailed to wooden sleepers—for a period of fourteen years, the waggons passing over them daily; and there they are, in use yet, whereas the cast rails are constantly giving way."

The price of malleable rails was, however, so high—being then worth about 12*l.* per ton—as compared with cast-iron rails at about 5*l.* 10*s.*, and the saving of expense was so important a consideration with the subscribers to the railway, that Mr. Stephenson was directed to provide, in the specification drawn by him, that only one-half of the quantity of the rails required—or 800 tons—should be of malleable iron, the remainder being of cast-iron. The malleable rails were required by the specification to be "made from scraps or good English bars re-manufactured." They were also of the kind called "fish-bellied," after Birkenshaw's patent, and weighed only *28 lbs. to the yard*, being 2¼ inches broad at the top, with the upper flange ¾ inch thick. They were only 2 inches in depth at the points at which they rested on the rails, and 3¼ inches in the middle or bellied part.

When forming the road, the proper Gauge had also to be determined. What width was this to be? The gauge of the first tramroad laid down had virtually settled the point. The gauge of wheels of the common vehicles of the country—of the carts and waggons employed on common roads, which were first used on the tramroads—was 4 feet 8½ inches. And so the first tramroads were laid down of this gauge. The tools and machinery for constructing coal-waggons and locomotives were formed with this gauge in view. The Wylam waggon-way, afterwards the Wylam plate-way, the Killingworth railroad, and the Hetton railroad, were all laid down on this gauge. Some of the earth-

waggons used to form the Stockton and Darlington road were brought from the Hetton railway; and others which were specially constructed were formed of the same dimensions, these being intended afterwards to be employed in the working of the traffic.

As the time for the opening of the line approached, the question of the Tractive Power to be employed was warmly discussed. At the Brusselton incline, fixed engines must necessarily be made use of; and the designs for these were completed by Robert Stephenson in 1824, previous to his departure for South America. With respect to the mode of working the railway generally, it was decided that horses were to be largely employed, and arrangements were made for their purchase. The influence of Mr. Pease also secured that a fair trial should be given to the experiment of working the traffic by locomotive power; and three engines were ordered from the firm of Stephenson and Co., Newcastle, which were put in hand forthwith, in anticipation of the opening of the railway. These were constructed after Mr. Stephenson's most matured designs, and embodied all the improvements in the locomotive which he had contrived up to that time. No. 1 engine, the "Locomotion," which was first delivered upon the line, weighed about eight tons. It had one large flue or tube through the boiler, through which the heated air passed direct from the furnace at one end, lined with fire-bricks, to the chimney at the other. The combustion in the furnace was quickened by the adoption of the steam-blast into the chimney. The heat raised was sometimes so great, and was so imperfectly abstracted by the surrounding water, that the chimney became almost red-hot. Such engines, when put to the top of their speed, were found capable of running at the rate of from twelve to sixteen miles an hour; but they were better adapted for the heavy work of hauling coal trains at low speeds—for which, indeed, they were specially constructed—than for running at the higher speeds afterwards adopted. Nor was it contemplated by the directors as possible, at the time when they were ordered, that locomo-

tives could be made available for the purposes of passenger travelling. Besides, the Stockton and Darlington Railway did not run through a district in which passengers were supposed to be likely to constitute any considerable portion of the traffic.

We may easily imagine the anxiety felt by Mr. Stephenson during the progress of the works towards completion, and his mingled hopes and doubts (though his doubts were but few) as to the issue of this great experiment. When the formation of the line near Stockton was well advanced, Mr. Stephenson one day, accompanied by his son Robert and John Dixon, made a journey of inspection of the works. His son, as we have said, was about to set out for South America, having received an appointment to superintend some mining operations in Columbia, respecting which there was then a large amount of speculation on foot. His health also had recently suffered through the closeness of his application to work and study; and his father, hoping that he might derive benefit from the change of climate, encouraged him to undertake the charge which was offered him. *On the day in question* the party reached Stockton, and proceeded to dine at one of the inns there. After dinner, Mr. Stephenson ventured on the very unusual measure of ordering in a bottle of wine, to drink success to the railway. John Dixon remembers and relates with pride the utterance of the master on the occasion. "Now, lads," said he to the two young men, "I will tell you that I think you will live to see the day, though I may not live so long, when railways will come to supersede almost all other methods of conveyance in this country—when mail coaches will go by railway, and railroads will become the Great Highway for the king and all his subjects. The time is coming when it will be cheaper for a working man to travel on a railway than to walk on foot. I know there are great and almost insurmountable difficulties that will have to be encountered; but what I have said will come to pass as sure as we live. I only wish I may live to see the day, though that I can scarcely hope for, as I know how

slow all human progress is, and with what difficulty I have been able to get the locomotive adopted, notwithstanding my more than ten years' successful experiment at Killingworth." The result, however, outstripped even the most sanguine anticipations of Stephenson; and his son Robert, shortly after his return from America in 1827, saw his father's locomotive generally adopted as the tractive power on railways.

The Stockton and Darlington line was opened for traffic on the 27th of September, 1825. An immense concourse of people assembled from all parts to witness the ceremony of opening this first public railway. The powerful opposition which the project had encountered, the threats which were still uttered against the railway by the road trustees and others, who declared that they would yet prevent its being worked, and perhaps the general unbelief as to its success which still prevailed, tended greatly to excite the curiosity of the public as to the result. Some went to rejoice at the opening, some to see the "bubble burst;" and there were many prophets of evil who would not miss the blowing up of the boasted Travelling Engine. The opening was, however, auspicious. The proceedings commenced at Brusselton Incline, about nine miles above Darlington, when the fixed engine drew a train of loaded waggons up the incline from the west, and lowered them on the east side. At the foot of the incline, a locomotive was in readiness to receive them, Mr. Stephenson himself driving the engine. The train consisted of six waggons loaded with coals and flour; after these was the passenger coach, filled with the directors and their friends, and then twenty-one waggons fitted up with temporary seats for passengers; and lastly came six waggon-loads of coals, making in all a train of thirty-eight vehicles. The local chronicler of the day went almost out of breath in describing the extraordinary event:—"The signal being given," he says, "the engine started off with this immense train of carriages; and such was its velocity, that in some parts the speed was frequently 12 miles an hour; and at that time the number of passengers was counted to be 450,

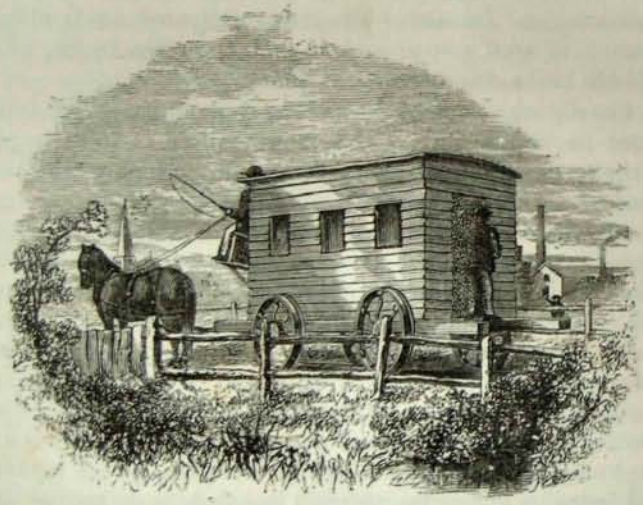
which, together with the coals, merchandise, and carriages, would amount to near 90 tons. The engine, with its load, arrived at Darlington, a distance of 8¾ miles, in 65 minutes. The six waggons loaded with coals, intended for Darlington, were then left behind; and, obtaining a fresh supply of water and arranging the procession to accommodate a band of music, and numerous passengers from Darlington, the engine set off again, and arrived at Stockton in 3 hours and 7 minutes, including stoppages, the distance being nearly 12 miles." By the time the train reached Stockton, there were about 600 persons in the train or hanging on to the waggons, which must have gone at a safe and steady pace of from 4 to 6 miles an hour from Darlington. "The arrival at Stockton," it is added, "excited a deep interest and admiration."

The working of the line then commenced, and the results were such as to surprise even the most sanguine of its projectors. The traffic upon which they had formed their estimates of profit, proved to be small in comparison with the traffic which flowed in upon them that had never been taken into account. Thus, what the company had principally relied upon for their profit was the carriage of coals for land sale at the stations along the line, whereas the haulage of coals to the seaports for exportation to the London market was not contemplated as possible. When the bill was before Parliament, Mr. Lambton (afterwards Earl of Durham) succeeded in getting a clause inserted, limiting the charge for the haulage of all coal to Stockton-on-Tees for the purpose of shipment, to one halfpenny per ton per mile; whereas a rate of fourpence per ton was allowed to be taken for all coals led upon the railway for land sale. Mr. Lambton's object in enforcing the low rate of one halfpenny was to protect his own trade in coal exported from Sunderland and the northern ports. He believed, in common with everybody else, that the halfpenny rate would effectually secure him against any competition on the part of the Stockton and Darlington Company; for it was not considered possible for coals to be led at that

low price, and the proprietors of the railway themselves considered that to carry coals at such a rate would be utterly ruinous. The projectors never contemplated sending more than 10,000 tons a year to Stockton, and those only for shipment as ballast; they looked for their profits almost exclusively to the land sale. The result, however, was as surprising to them as it must have been to Mr. Lambton. The halfpenny rate which was forced upon them, instead of being ruinous, proved the vital element in the success of the railway. In the course of a few years, the annual shipment of coal, led by the Stockton and Darlington Railway to Stockton and Middlesborough, exceeded five hundred thousand tons; and it has since far exceeded this amount. Instead of being, as anticipated, a subordinate branch of traffic, it proved, in fact, the main traffic, while the land sale was merely subsidiary.

The anticipations of the company as to passenger traffic were in like manner more than realised. At first, passengers were not thought of; and it was only while the works were in progress that the starting of a passenger coach was seriously contemplated. The number of persons travelling between the two towns was very small: and it was not known whether these would risk their persons upon the iron road. It was determined, however, to make the trial of a railway coach; and Mr. Stephenson was authorised by the Directors to have one built to his order at Newcastle, at the cost of the company. This was done accordingly; and the first railway passenger carriage was built after our engineer's plans. It was, however, a very modest, and indeed a somewhat uncouth machine, more resembling a caravan such as is still to be seen at country fairs, containing the "Giant and the Dwarf" and other wonders of the world, than a passenger coach of any extant form. A row of seats ran along each side of the interior, and a long deal table was fixed in the centre; the access being by means of a door at the end, in the manner of an omnibus. This coach arrived from Newcastle the day before the opening, and formed part of the railway procession above

described. Mr. Stephenson was consulted as to the name of the coach, and he at once suggested the "Experiment;" and by this name it was called. The Company's arms were afterwards painted on her panels, with the motto of "Periculum privatum utilitas publica." Such was the sole passenger-carrying stock of the Stockton and Darlington Company in the year 1825. But the "Experiment" proved the forerunner of a mighty traffic: and long time did not elapse before it was displaced, not only by improved coaches (still drawn by horses), but afterwards by long trains of passenger carriages drawn by locomotive engines.



The "Experiment" Railway Coach.

No sooner did the coal and merchandise trains begin to run regularly upon the line, than new business relations sprang up between Stockton and Darlington, and there were many more persons who found occasion to travel between the two towns,—merchandise and mineral traffic invariably stimulating, if not calling into existence, an entirely new traffic in passengers. Before the construction of the line, the attempt had been made to run a coach between Stockton, Darlington, and Barnard Castle three times a week; but it was starved off the road for want of support. Now, however, that there were numbers of people desiring to travel, the stage coach by the common road was revived and prospered, and many other persons connected with the new traffic got a "lift" by the railway waggons, which were even more popular than the stage coach.

The "Experiment" was fairly started as a passenger coach on the 10th of October, 1825, a fortnight after the opening of the line. It was drawn by one horse, and performed a journey daily each way between the two towns, accomplishing the distance of twelve miles in about two hours. The fare charged was a shilling, without distinction of class; and each passenger was allowed fourteen pounds of luggage free. The "Experiment" was not, however, worked by the company, but was let to Messrs. Pickersgill and Harland, carriers on the railway, under an arrangement with them as to the payment of tolls for the use of the line, rent of booking cabins, &c.

The speculation answered so well, that several coaching companies were shortly got up by innkeepers at Darlington and Stockton, for the purpose of running other coaches upon the railroad, and an active competition for passenger traffic now sprang up. The "Experiment" being found too heavy for one horse to draw between Stockton and Darlington, besides being found an uncomfortable machine, was banished to the coal district, and ran for a time between Darlington and Shildon. Its place on the line between Stockton and Darlington was supplied by other and better vehicles,—though they were no other than old stage-coach bodies, which were purchased by the company, each mounted upon an underframe with flange wheels, and let out to the coaching companies, who horsed and managed them under an arrangement as to tolls, in like manner as the "Experiment" had been worked. Now began the distinction of inside and outside passenger, equivalent to first

and second class, paying different fares. The competition with each other upon the railway, and with the ordinary stage coaches upon the road, soon brought up the speed, which was increased to ten miles an hour—the mail coach rate of travelling in those days, and considered very fast. The coaches filled almost daily. "In fact," says a writer of the time, "the passengers do not seem to be at all particular, for, in cases of urgency, they are seen crowding the coach on the top, sides, or any part where they can get a footing; and they are frequently so numerous, that when they descend from the coach and begin to separate, it looks like the dismissal of a small congregation!"

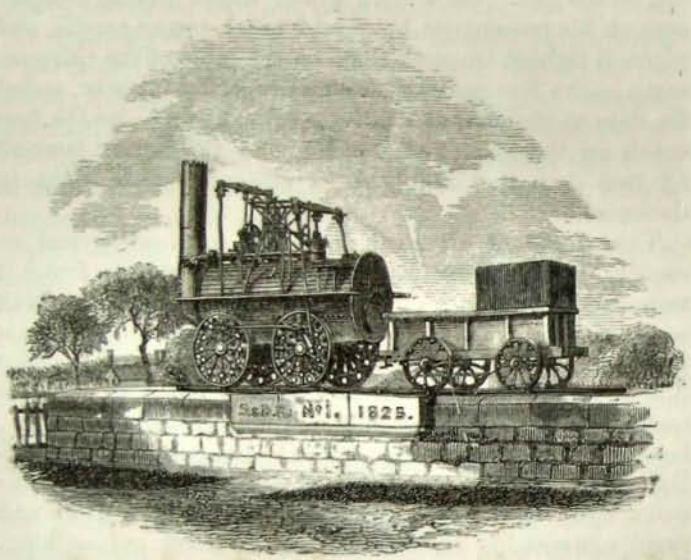
Mr. Clephan, a native of the district, thus piquantly describes some of the more prominent features of the competition between the rival coach companies;—"There were two separate coach companies in Stockton: and amusing collisions sometimes occurred between the drivers—who found on the rail a novel element for contention. Coaches cannot pass each other on the rail as on the road; and at the more westward publichouse in Stockton (the Bay Horse, kept by Joe Buckton), the coach was always on the line betimes, reducing its eastward rival to the necessity of waiting patiently (or impatiently) in the rear. Difficulties, too, occurred along the road. The line was single, with four sidings in the mile, and when two coaches met, or two trains, or coach and train, the question arose which of the drivers must go back? This was not always settled in silence. As to trains it came to be a sort of understanding that light waggons should give way to loaded; and as to trains and coaches, that the passengers should have preference over coals; while coaches, when they met must quarrel it out. At length, midway between sidings, a post was erected; and a rule was laid down that he who had passed the pillar must go on, and the 'coming man' go back. At the Goose Pool and Early Nook, it was common for these coaches to stop; and there, as Jonathan would say, passengers and coachmen 'liquored.' One coach, introduced by an innkeeper was a compound of two mourning-coaches,—

an approximation to the real railway coach, which still adheres, with multiplying exceptions, to the stage-coach type. One Dixon, who drove the 'Experiment' between Darlington and Shildon, is the inventor of carriage-lighting on the rail. On a dark winter night, having compassion on his passengers, he would buy a penny candle, and place it lighted amongst them on the table of the 'Experiment'—the first railway coach (which, by the way, ended its days at Shildon, as a railway cabin) being also the first coach on the rail (first, second, and third-class jammed all into one) that indulged its customers with light in darkness."

The traffic of all sorts increased so steadily and so rapidly that the Directors of the company shortly found it necessary to take into their own hands the entire working—of minerals, merchandise, and passengers. It had been provided by the first Stockton and Darlington Act that the line should be free to all parties who chose to use it at certain prescribed rates, and that any person might put horses and waggons on the railway, and carry for himself. But this arrangement led to increasing confusion and difficulty, and could not continue in the face of a large and rapidly increasing traffic. The goods trains got so long, that the carriers found it necessary to call in the aid of the locomotive engine to help them on their way. Then mixed trains began to be seen, of passengers and merchandise,—the final result being the assumption of the entire charge of the traffic by the railway company. In course of time new passenger carriages were specially built for the better accommodation of the public, until at length regular passenger trains were run, drawn by the locomotive engine,—though this was not until after the Liverpool and Manchester Company had established passenger trains as a distinct branch of their traffic.

The three Stephenson locomotives were from the first regularly employed to work the coal trains; and their proved efficiency for this purpose led to the gradual increase of the locomotive power. The speed of the engines

—slow though it was in those days—was regarded as something marvellous; a race actually came off between No. I. engine, the "Locomotion," and one of the stage



The No. 1. Engine at Darlington.

coaches travelling from Darlington to Stockton by the ordinary road; and it was regarded as a great triumph of mechanical skill that the locomotive reached Stockton first, beating the stage coach by about a hundred yards! The same engine continued in good working order in the year 1846, when it headed the railway procession on the opening of the Middlesborough and Redcar Railway, travelling at the rate of about fourteen miles an hour. This engine, the first that travelled upon the first public railway, has recently been placed upon a pedestal in front of the railway station at Darlington.

For some years, however, the principal haulage of the line was performed by horses. The inclination of the gradients being towards the sea, this was perhaps the cheapest mode of traction, so long as the traffic was not very large. The horse drew the train along the level road, until, on reaching a descending gradient, down which the train ran by its own weight, the horse was unharnessed, and, when loose, he wheeled round to the other end of the waggons, to which a "dandy-cart" was attached, its bottom being only a few inches from the rail. Bringing his step into unison with the speed of the train, the horse leapt nimbly into his place in this waggon, which was usually fitted with a well-filled hay-rack. Mr. Clephan relates the story of a sagacious grey horse, which was fertile in expedients when emergencies arose:—"On one occasion, perceiving that a train, which had run amain, must rush into his dandy-cart, he took a leap for life over the side and escaped. In a similar peril, a leap over the side being impracticable, he sprung on to the coal waggon in front, and stood like an equestrian statue on a pedestal. But the time came, at last, when there was no escape; and the poor old grey was destroyed."

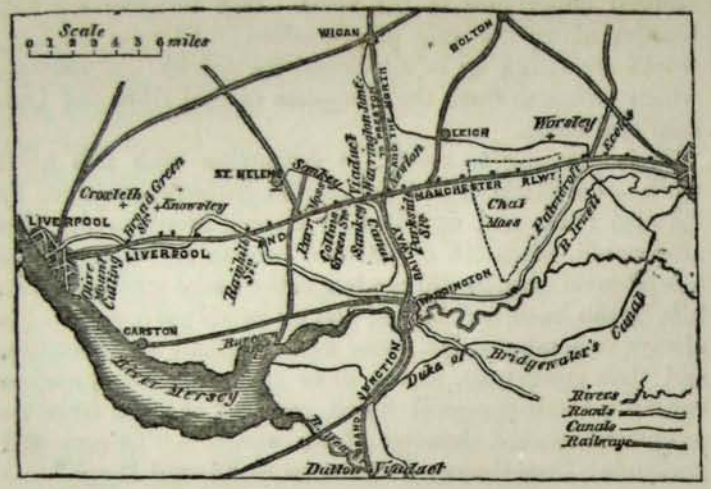
The details of the working were gradually perfected by experience, the projectors of the line being at first scarcely conscious of the importance and significance of the work which they had taken in hand, and little thinking that they were laying the foundation of a system which was yet to revolutionise the internal communications of the world, and confer the greatest blessings on mankind. It is important to note that the commercial results of the enterprise were considered satisfactory from the opening of the railway. Besides conferring a great public benefit upon the inhabitants of the district and throwing open entirely new markets for the almost boundless stores of coal found in the Bishop Auckland district, the profits derived from the traffic created by the railway enabled increasing dividends to be paid to those who had risked their capital in the undertaking, and thus held forth an encouragement to the projectors of railways generally, which was not without an important effect in stimulating the projection

of similar enterprises in other districts. These results, as displayed in the annual dividends, must have been eminently encouraging to the astute commercial men of Liverpool and Manchester, who were then engaged in the prosecution of their railway. Indeed, the commercial success of the Stockton and Darlington Company may be justly characterised as the turning-point of the railway system. With that practical illustration daily in sight of the public, it was no longer possible for Parliament to have prevented its eventual extension.

Before leaving the subject of the Stockton and Darlington Railway, we cannot avoid alluding to one of its most remarkable and direct results—the creation of the town of Middlesborough-on-Tees. When the railway was opened in 1825, the site of this future metropolis of Cleveland was occupied by one solitary farm-house and its outbuildings. All round was pasture land or mud banks; scarcely another house was within sight. But when the coal export trade, fostered by the halfpenny maximum rate imposed by the legislature, seemed likely to attain a gigantic growth, and it was found that the accommodation furnished at Stockton was insufficient, Mr. Edward Pease, in 1829, joined by a few of his Quaker friends, bought about 500 or 600 acres of land, five miles lower down the river—the site of the modern Middlesborough—for the purpose of there forming a new seaport for the shipment of coals brought to the Tees by the railway. The line was accordingly shortly extended thither; docks were excavated; a town sprang up; churches, chapels, and schools were built, with a custom-house, mechanics' institute, banks, shipbuilding yards, and iron factories; and in a few years the port of Middlesborough became one of the most important on the north-east coast of England. In ten years a busy population of about 6000 persons (since swelled into 15,000) occupied the site of the original farmhouse. More recently, the discovery of vast stores of ironstone in the Cleveland Hills, close adjoining Middlesborough, has tended still more rapidly to augment the population and increase the commercial importance of the place. Iron furnaces are now blazing along the vale of Cleveland; and new smelting works are rising up in all directions, fed by the railway, which brings to them their supplies of fuel from the Durham coal-fields.

It is pleasing to relate, in connexion with this great work—the Stockton and Darlington Railway, projected by Edward Pease and executed by George Stephenson,—that afterwards, when Mr. Stephenson became a prosperous and a celebrated man, he did not forget the friend who had taken him by the hand, and helped him on in his early days. He always remembered Mr. Pease with gratitude and affection, and that gentleman, to the close of his life, was proud to exhibit a handsome gold watch, received as a gift from his celebrated *protégé*, bearing these words:—"Esteem and gratitude: from George Stephenson to Edward Pease."

Middlesborough-on-Tees.



Map of the Liverpool and Manchester Railway.

CHAPTER IX.

SURVEY OF THE LIVERPOOL AND MANCHESTER RAILWAY.

THE rapid growth of trade and manufactures in South Lancashire, involving the necessity for largely increased means of transit, gave rise, about the year 1821, to the project of a tramroad between Liverpool and Manchester. The increase in the business between these towns during a few years had been something marvellous. In nine years, the quantity of raw cotton sent from the one town to the other had increased by fifty millions of pounds weight; and all other raw materials had increased in proportion. Around Manchester, hamlets had expanded into towns, and towns had assumed the dimensions of cities, the inhabitants of which were for the most part dependent for their means of subsistence upon the regularity of the supply of cotton from Liverpool. Up to this time the Duke of Bridgewater's Canal and the Irwell and Mersey Navigation had principally

supplied the means of transport; but the enormously increasing demands of the trade outstripped their tardy efforts. Possessing a monopoly of the traffic, and having no rivals to fear, the canal managers were most dictatorial in the treatment of their customers. Perhaps, however, the canal companies did all that could be done under the circumstances, and had already fully taxed the resources of the navigation. The immense mass of goods to be conveyed had simply outgrown all their appliances of wharves, boats, and horses. Cotton lay at Liverpool for weeks together, waiting to be removed: and it occupied a longer time to transport the cargoes from Liverpool to Manchester than it had done to bring them across the Atlantic from the United States to England. Carts and waggons were tried, but these proved altogether insufficient. Sometimes manufacturing operations had to be suspended altogether: and during a frost, when the canals were frozen up, the communication was entirely stopped. The consequences were often disastrous, alike to operatives, merchants, and manufacturers. The same difficulty was experienced in the conveyance of manufactured goods from Manchester to Liverpool for export. Mr. Huskisson, in the House of Commons, referring to these ruinous delays, truly observed that "cotton was detained a fortnight at Liverpool, while the Manchester manufacturers were obliged to suspend their labours, and goods manufactured at Manchester for foreign markets could not be transmitted in time, in consequence of the tardy conveyance."

The Liverpool merchants and the Manchester manufacturers were therefore prepared to welcome any new mode of transit which would relieve them of the losses arising from these constant interruptions to their commercial operations. The scheme of a tramroad was, however, so new to them, that it is not surprising they should have hesitated before committing themselves fully to it. Mr. Sandars, an influential Liverpool merchant, was amongst the first to broach the subject. He himself had suffered in his business, in common with many other merchants, from

the insufficiency of the existing modes of communication, and was ready to give due consideration to any plan presenting elements of practical efficiency, which proposed a remedy for the generally admitted grievance.

Mr. William James, of West Bromwich, a gentleman who, from an early period had taken an active interest in the formation of tramroads, came down to Liverpool to see Mr. Sandars on the subject of the scheme. Mr. James had himself laid down many of such roads in Warwick and Gloucester, being an iron and coal miner in the former county. He offered to make a preliminary survey of the proposed road, and his offer was accepted by Mr. Sandars and Mr. Moss, who guaranteed to pay him a sum of 300*l.* for making the survey. It was conducted with difficulty, the inhabitants of the locality offering great resistance to the surveying party. In some places they encountered even personal violence, for it was feared that the projected road would seriously damage the farms and gardens near which it passed. Near Newton-in-the-Willows, the farmers stationed men at the field gates with pitchforks, and sometimes with guns, to drive the surveyors back. At St. Helen's, one of the chainmen was laid hold of by a mob of colliers, and threatened to be hurled down a coalpit. A number of men, women, and children collected and ran after the surveyors wherever they made their appearance, bawling nicknames and throwing stones at them. As one of the chainmen was climbing over a gate one day, a labourer made at him with a pitchfork, and ran it through his clothes into his back; other watchers running up, the chainman, who was more stunned than hurt, took to his heels and fled. But the theodolite most excited the fury of the natives, who concentrated on the man who carried it their fiercest execrations and most offensive nicknames.

A powerful fellow, a noted bruiser, was hired by the surveyors to carry the instrument, with a view to its protection against all assailants; but one day an equally powerful fellow, a St. Helen's collier, who was the cock of the walk in his neighbourhood, made up to the theodolite

carrier to wrest it from him by sheer force. A battle took place, the collier was soundly pummelled, the natives poured in volleys of stones upon the surveyors and their instruments, and the theodolite was smashed to pieces.

In the mean time public meetings had been got up by Mr. Sandars in several of the principal towns of the district, on the subject of the proposed tramway. One was held in the Exchange at Liverpool, and another in the George Hotel, Warrington, at which Mr. Sandars, Mr. Moss, and Mr. James appeared as the advocates of the measure, which, however, did not as yet meet with any degree of general support. But the subject was thus brought prominently under notice, and only wanted time to enable it to work its way in public estimation.

Mr. James, having heard of Stephenson's engines, which were reported to him as being more efficient than any locomotives that had yet been constructed, determined to go down to Killingworth to inspect them in person. He was not so fortunate as to meet Mr. Stephenson on that occasion; but he examined the locomotive at work, and was very much struck by its power and efficiency. He saw at a glance the magnificent uses to which it might be applied. "Here," said he, "is an engine that will, before long, effect a complete revolution in society." Returning to Moreton-in-the-Marsh, he wrote to Mr. Losh (Stephenson's partner in the patent) expressing his admiration of the Killingworth engine. "It is," said he, "the greatest wonder of the age, and the forerunner, as I firmly believe, of the most important changes in the internal communications of the kingdom." Mr. Losh invited him again to visit Killingworth, for the purpose of having an interview with Mr. Stephenson on the subject of the locomotive. Accordingly, in September of the same year, accompanied by his two sons, he met Mr. Losh at Newcastle; they proceeded together to Killingworth, where Mr. Stephenson met them; and taking them to where the locomotive was working, he invited them to mount. The uncouth and extraordinary appearance of the machine, as it came snort-

ing along, was somewhat alarming to the youths, who expressed their fears lest it should burst; and they were with some difficulty induced to mount.

The locomotive went through its usual performances, dragging a heavy load of coal waggons at about six miles an hour with apparent ease, at which Mr. James expressed his extreme satisfaction, and declared to Mr. Losh his opinion that Stephenson "was the greatest practical genius of the age," and that, "if he developed the full powers of that engine (the locomotive), his fame in the world would rank equal to that of Watt." Mr. James informed Stephenson and Losh of his survey of the proposed tramroad between Liverpool and Manchester, and did not hesitate to state that he would thenceforward advocate the adoption of a locomotive railroad instead of the tramroad which had originally been proposed.

As Mr. James's influence amongst persons in authority was considerable, and he was identified with several important railway projects, Stephenson and Losh were naturally desirous of enlisting his good services on behalf of their patent locomotive, for as yet it had proved comparatively unproductive. They believed that Mr. James might be able so to advocate it in influential quarters as to ensure its more extensive adoption, and with this object they proposed to give him an interest in their patent, in exchange for his services. Accordingly they assigned to Mr. James one fourth of the profits derived from the use of their patent locomotive on any lines which might be constructed south of a line drawn across England from Liverpool to Hull. The arrangement, however, led to no beneficial results. Mr. James endeavoured to introduce the engine on the Moreton-on-Marsh railway; but Mr. Rastrick, the engineer, opposed it, and the attempt failed. He next urged Mr. Stephenson to send a locomotive for trial on the Merstham tramroad; but anxious though he was respecting its extended employment, the inventor was too cautious to risk an experiment which might only bring discredit upon the engine; and the Merstham road being

only laid with cast-iron plates, which would not bear its weight, the invitation was eventually declined.

In the course of the following year (1822), Mr. James proceeded with the survey of the Liverpool railway, but he does not seem to have succeeded in preparing the plans and estimates in readiness for the ensuing parliamentary session. Next year, the directors again pressed Mr. James for the plans, but the result was the same; the plans were not forthcoming, and the session of 1824 was also lost. It was then that the promoters of the railway determined to call to their aid another engineer.

Mr. Sandars continued to hold to his project of a railway; and he gradually succeeded in enlisting on his side an increasing number of influential merchants and manufacturers both at Liverpool and Manchester. In 1824 he published a pamphlet, in which he strongly urged the great losses and interruptions to the trade of the district by the delays in the transport of goods; and in the same year a Public Declaration was drawn up, and signed by upwards of 150 of the principal merchants of Liverpool, setting forth that they considered "the present establishments for the transport of goods quite inadequate, and that a new line of conveyance has become absolutely necessary to conduct the increasing trade of the country with speed, certainty, and economy."

A public meeting was held at Liverpool to consider the best plan to be adopted, and a railway was determined on. A committee was appointed to take the necessary measures; but, as if reluctant to enter upon their arduous struggle with "vested interests," they first waited on Mr. Bradshaw, the Duke of Bridgewater's canal agent, in the hope of persuading him to increase the means of conveyance, as well as to reduce the charges; but they were met by an unqualified refusal. They suggested the expediency of a railway, and invited Mr. Bradshaw to become a proprietor of the shares in it. But his reply was—"All or none!" The canal proprietors were confident in their imagined security, ridiculing the proposed railway as a chimera. It

had been spoken about years before, and nothing had come of it then: it would be the same now.

In order to form an opinion as to the practicability of a railroad, a deputation of gentlemen interested in the project proceeded to Killingworth, to inspect the engines which had been so long in use there. They first went to Darlington, where they found the works of the Stockton line in full progress, though still unfinished. Proceeding next to Killingworth with Mr. Stephenson, they there witnessed the performances of his locomotive engines. The result of their visit was, on the whole, so satisfactory, that on their report being delivered to the committee at Liverpool, it was finally determined to form a company of proprietors for the construction of a double line of railway between Liverpool and Manchester.

The first prospectus of the scheme was dated the 29th of October, 1824, and had attached to it the names of the leading merchants of Liverpool and Manchester. It was a carefully prepared document, very unlike the inflated balloons which were sent up by railway speculators in succeeding years. It set forth as its main object the establishment of a safe and cheap mode of transit for merchandise, by which the conveyance of goods between the two towns would be effected in four or five hours (instead of thirty-six hours, as by the canal), whilst the charges would be reduced one-third. On looking at the prospectus now, it is curious to note that, while the advantages anticipated from the carriage of merchandise were strongly insisted upon, the conveyance of passengers—which proved to be the chief source of profit—was only very cautiously referred to. "As a cheap and expeditious means of conveyance for travellers," says the prospectus in conclusion, "the railway holds out the fair prospect of a public accommodation, the magnitude and importance of which cannot be immediately ascertained." The estimated expense of forming the line was set down at 400,000*l.*,—a sum which was eventually found to be quite inadequate. A subscription list was opened, and speedily filled up.

While the project was still under discussion in its earlier stages, its promoters, desirous of removing the doubts which existed as to the employment of steam-carriages on the proposed railway, sent a second deputation to Killingworth for the purpose of again observing the action of Mr. Stephenson's engines. The deputation was on this occasion accompanied by Mr. Sylvester, an ingenious mechanic and engineer, who afterwards presented an able report on the subject to the committee. Mr. Sylvester showed that the high-pressure engines employed by Mr. Stephenson were both safe and economical in their working. With respect to the speed of the engines, he says:—"Although it would be practicable to go at any speed, limited by the means of creating steam, the size of the wheels, and the number of strokes in the engine, it would not be safe to go at a greater rate than nine or ten miles an hour." This was considered a very high rate of speed in those days; and speculators were considered reckless who ventured to express themselves in favour of any more accelerated pace.

Satisfactory though the calculations and statements of Mr. Sylvester were, the cautious projectors of the railway were not yet quite satisfied; and a third journey was made to Killingworth, in January, 1825, by several gentlemen of the committee, accompanied by practical engineers, for the purpose of being personal eye-witnesses of what steam-carriages were able to perform upon a railway. There they saw a train, consisting of a locomotive and loaded waggons, weighing in all fifty-four tons, travelling at the average rate of about seven miles an hour, the greatest speed being about nine and a half miles an hour. But when the engine was run by itself, with only one waggon attached containing twenty gentlemen, five of whom were engineers, the speed attained was from ten or twelve miles an hour. In the following month, Mr. (afterwards Sir William) Cubitt, then an ingenious millwright at Ipswich, made a separate inspection of the Killingworth engines, and arrived at similarly favourable conclusions. In the report which he afterwards forwarded to the Railway

Committee as to the powers of the locomotive, he stated that, in his opinion, "ten miles an hour is far short of what might be obtained with an engine constructed for the purpose on a well-laid level tram railway;" and he further expressed an opinion, which he offered to support by evidence, as to the greater ease, safety, speed, convenience, and economy, of conveying passengers by means of such an engine on the proposed railroad between Liverpool and Manchester, than by any other means of land conveyance. Strangely enough, this report seems to have been completely lost sight of; and Mr. Cubitt's evidence was never asked on the subject, probably because it was felt at the time that his experience had not then been such as to give weight to any opinion he might entertain about the powers of locomotive engines, or the capabilities of railways.

When the promoters of the measure had finally determined to proceed to Parliament for the requisite powers to form the railway, they invited Mr. Stephenson to undertake the survey. The frequent interviews which the deputations from Liverpool had held with him on the subject, as well as on the best mode of *working the line when made*, had already convinced them that he was, of all others, the man best calculated to help them at this juncture. The successful working of his Killingworth locomotives; the energy which he had displayed in carrying on the works of the Stockton and Darlington Railway, now approaching completion; his readiness to face difficulties, and his practical ability in overcoming them; the enthusiasm which he displayed on the subject of railways and railway locomotion,—had indeed directed their attention to him from the first as the most fitting man for the office of engineer of their great undertaking; and his appointment was unanimously confirmed.

The survey was proceeded with, in the face of great opposition on the part of the proprietors of the lands through which the railway was intended to pass. The prejudices of the farming and labouring classes were strongly excited

against the persons employed upon the ground, and it was with the greatest difficulty that the levels could be taken. This opposition was especially manifested when the attempt was made to survey the line through the properties of Lords Derby and Sefton, and also where it crossed the Duke of Bridgewater's canal. At Knowsley, Mr. Stephenson was driven off the ground by the keepers, and threatened with rough handling if found there again. Lord Derby's farmers also turned out their men to watch the surveying party, and prevent them entering upon any lands where they had the power of driving them off. Afterwards, Mr. Stephenson suddenly and unexpectedly went upon the ground with a body of surveyors and their assistants who out-numbered Lord Derby's keepers and farmers, hastily collected to resist them; and this time they were only threatened with the legal consequences of their trespass. The same sort of resistance was offered by Lord Sefton's keepers and farmers, with whom the following ruse was adopted. A minute was concocted, purporting to be a resolution of the Old Quay Canal Company to oppose the projected railroad by every possible means, and calling upon landowners and others to afford every facility for making such a survey of the intended line as should enable the opponents to detect errors in the scheme of the promoters, and thereby to ensure its defeat. A copy of this minute, without any signature, was exhibited by the surveyors who went upon the ground, and the farmers, believing them to have the sanction of the landlords, permitted them to proceed with the hasty completion of their survey.

The principal opposition, however, was experienced from Mr. Bradshaw, the manager of the Duke of Bridgewater's canal property, who offered a vigorous and protracted resistance to the railway in all its stages. The Duke's farmers obstinately refused permission to enter upon their fields, although Mr. Stephenson offered to pay for any damage that might be done. Mr. Bradshaw positively refused his sanction in any case; and being a strict preserver of game, with a large staff of keepers in his pay, he declared that he

would order them to shoot or apprehend any persons attempting a survey over his property. But one moonlight night, a survey was obtained by the following ruse. Some men, under the orders of the surveying party, were set to fire off guns in a particular quarter; on which all the gamekeepers on the watch made off in that direction, and they were drawn away to such a distance in pursuit of the supposed poachers, as to enable a rapid survey to be made during their absence.

Mr. Stephenson, afterwards describing the difficulties which he had encountered in the course of the survey, said: —"I was threatened to be ducked in the pond if I proceeded, and, of course, we had a great deal of the survey to take by stealth, at the time when the people were at dinner. We could not get it done by night: indeed, we were watched day and night, and guns were discharged over the grounds belonging to Captain Bradshaw to prevent us. I can state further, that I was myself twice turned off Mr. Bradshaw's grounds by his men; and they said if I did not go instantly, they would take me up and carry me off to Worsley."

When the canal companies found that the Liverpool merchants were determined to proceed with their scheme,—that they had completed their survey, and were ready to apply to Parliament for an Act to enable them to form the railway, —they at last reluctantly, and with a bad grace, made overtures of conciliation. They promised to employ steam-vessels both on the Mersey and on the canals. One of the companies offered to reduce its length by three miles, at a considerable expenditure. At the same time they made a show of lowering their rates. But it was all too late; for the project of the railway had now gone so far that the promoters (who might have been conciliated by such overtures at an earlier period) felt they were fully committed to the scheme, and that now they could not well draw back. Besides, the remedies offered by the canal companies could only have had the effect of staving off the difficulty for a brief season,—the absolute necessity of forming a new line

of communication between Liverpool and Manchester becoming more urgent from year to year. Arrangements were therefore made for proceeding with the bill in the parliamentary session of 1825. On this becoming known, the canal companies prepared to resist the measure tooth and nail. The public were appealed to on the subject; pamphlets were written and newspapers were hired to revile the railway. It was declared that its formation would prevent cows grazing and hens laying. The poisoned air from the locomotives would kill birds as they flew over them, and render the preservation of pheasants and foxes no longer possible. Householders adjoining the projected line were told that their houses would be burnt up by the fire thrown from the engine-chimneys; while the air around would be polluted by clouds of smoke. There would no longer be any use for horses; and if railways extended, the species would become extinguished, and oats and hay be rendered unsaleable commodities. Travelling by road would be made highly dangerous, and country inns would be ruined. Boilers would burst and blow passengers to atoms. But there was always this consolation to wind up with—that the weight of the locomotive would completely prevent its moving, and that railways, even if made, could *never* be worked by steam-power!

Nevertheless, the canal companies of Leeds, Liverpool, and Birmingham, called upon every navigation company in the kingdom to oppose railways wherever they were projected, but more especially the projected Liverpool and Manchester line, the battle with which they evidently regarded as their Armageddon. A Birmingham newspaper invited opposition to the measure, and a public subscription was entered into for the purpose of making it effectual. The newspapers generally spoke of the project as a mere speculation; some wishing it success, although greatly doubting; others ridiculing it as a delusion, similar to the many other absurd projects of that madly-speculative period. It was a time when balloon companies proposed to work passenger traffic through the air at forty miles an hour, and

when road companies projected carriages to run on turnpikes at twelve miles an hour, with relays of bottled gas instead of horses. There were companies for the working of American gold and silver mines,—companies for cutting ship canals through Panama and Nicaragua,—milk companies, burying companies, fish companies, and steam companies of all sorts; and many, less speculatively disposed than their neighbours, were ready to set down the projected railways of 1825 as mere bubbles of a similarly delusive character.

Among the most remarkable newspaper articles of the day calling attention to the application of the locomotive engine to the purposes of rapid steam-travelling on railroads, was a series which appeared in 1824, in the *Scotsman* newspaper, then edited by Mr. Charles Maclaren. In those publications the wonderful powers of the locomotive were logically demonstrated, and the writer, arguing from the experiments on friction made more than half a century before by Vince and Coulomb, which scientific men seemed to have altogether lost sight of, clearly showed that, by the use of steam-power on railroads, the more rapid, as well as cheaper transit of persons and merchandise might be confidently anticipated.

Not many years passed before the anticipations of the writer, sanguine and speculative though they were regarded at the time, were amply realised. Even Mr. Nicholas Wood, in 1825, speaking of the powers of the locomotive, and referring doubtless to the speculations of the *Scotsman* as well as of his equally sanguine friend Stephenson, observed:—"It is far from my wish to promulgate to the world that the ridiculous expectations, or rather professions, of the enthusiastic speculator will be realised, and that we shall see engines travelling at the rate of twelve, sixteen, eighteen, or twenty miles an hour. Nothing could do more harm towards their general adoption and improvement than the promulgation of such nonsense."

Indeed, when Mr. Stephenson, at the consultations of counsel previous to the Liverpool and Manchester bill going into Committee of the House of Commons, confidently stated his expectation of being able to impel his locomotive at the rate of twenty miles an hour, Mr. William Brougham, who was retained by the promoters to conduct their case, frankly told him, that if he did not moderate his views, and bring his engine within a *reasonable* speed, he would "inevitably damn the whole thing, and be himself regarded as a maniac fit for Bedlam."

The idea of travelling at a rate of speed double that of the fastest mail coach appeared at that time so preposterous that Mr. Stephenson was unable to find any engineer who would risk his reputation in supporting his "absurd views." Speaking of his isolation at this time, he subsequently observed, at a public meeting of railway men in Manchester: "He remembered the time when he had very few supporters in bringing out the railway system—when he sought England over for an engineer to support him in his evidence before Parliament, and could find only one man, James Walker, but was afraid to call that gentleman, because he knew nothing about railways. He had then no one to tell his tale to but Mr. Sandars of Liverpool, who did listen to him, and kept his spirits up; and his schemes had at length been carried out only by dint of sheer perseverance."

George Stephenson's idea was indeed at that time regarded as but the dream of a chimerical projector. It stood before the public friendless, struggling hard to gain a footing, but scarcely daring to lift itself into notice for fear of ridicule. The civil engineers generally rejected the notion of a Locomotive Railway; and when no leading man of the day could be found to stand forward in support of the Killingworth mechanic, its chances of success must have been pronounced small. But, like all great truths, the time was surely to come when it was to prevail.

When such was the hostility of the civil engineers, no wonder the reviewers were puzzled. The *Quarterly*, in an able article in support of the projected Liverpool and Manchester Railway,—while admitting its *absolute necessity*,

and insisting that there was no choice left but a railroad, on which the journey between Liverpool and Manchester, whether performed by horses or engines, would always be accomplished "within the day,"—nevertheless scouted the idea of travelling at a greater speed than eight or nine miles an hour. Adverting to a project for forming a railway to Woolwich, by which passengers were to be drawn by locomotive engines, moving with twice the velocity of ordinary coaches, the reviewer observed:—"What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling *twice as fast* as stage coaches! We should as soon expect the people of Woolwich to suffer themselves to be fired off upon one of Congreve's ricochet rockets, as trust themselves to the mercy of such a machine going at such a rate. We will back old Father Thames against the Woolwich Railway for any sum. We trust that Parliament will, in all railways it may sanction, limit the speed to *eight or nine miles an hour*, which we entirely agree with Mr. Sylvester is as great as can be ventured on with safety."

The article was, however, in other respects so favourable to the proposed railway, that allegations were even made by the opponents of the bill, when in committee, that the writer had been bought by the Liverpool and Manchester party; which was, of course, a mere licence of counsel. As for the objections urged by the reviewer against the high speed attainable on railways,—then a mere matter of speculation,—they were also entertained by nearly all the practical and scientific men of the kingdom, and by the public generally.

CHAPTER X.

PARLIAMENTARY CONTEST ON THE LIVERPOOL AND MANCHESTER BILL.

THE Liverpool and Manchester Bill went into Committee of the House of Commons on the 21st of March, 1825. There was an extraordinary array of legal talent on the occasion, but especially on the side of the opponents to the measure. Their wealth and influence enabled them to retain the ablest counsel at the bar; Mr. (since Baron) Alderson, Mr. Stephenson, Mr. (afterwards Baron) Parke, Mr. Rose, Mr. Macdonnell, Mr. Harrison, Mr. Erle, and Mr. Cullen, made common cause with each other in their opposition to the bill; the case for which was conducted by Mr. Adam, Mr. Serjeant Spankie, Mr. William Brougham, and Mr. Joy.

Evidence was taken at great length as to the difficulties and delays in forwarding raw goods of all kinds from Liverpool to Manchester, as also in the conveyance of manufactured articles from Manchester to Liverpool. The evidence adduced in support of the bill on these grounds was overwhelming. The utter inadequacy of the existing modes of conveyance to carry on satisfactorily the large and rapidly-growing trade between the two towns was fully proved. But then came the gist of the promoters' case—the evidence to prove the practicability of a railroad to be worked by locomotive power. Mr. Adam, in his opening speech, referred to the cases of the Hetton and the Killingworth railroads, where heavy goods were safely and economically transported by means of locomotive engines. "None of the tremendous consequences," he observed, "have ensued from the use of steam in land carriage that have been stated. The horses have not started, nor the

cows ceased to give their milk, nor have ladies miscarried at the sight of these things going forward at the rate of four miles and a half an hour." Notwithstanding the petition of two ladies alleging the great danger to be apprehended from the bursting of the boilers of such engines, he urged the safety of the high-pressure engine when the boilers were constructed of wrought-iron; and as to the rate at which they could travel, he expressed his full conviction that such engines "could supply force to drive a carriage at the rate of five or six miles an hour."

The taking of the evidence as to the impediments thrown in the way of trade and commerce by the existing system extended over a month, and it was the 21st of April before the Committee went into the engineering evidence, which was the vital part of the question. Mr. Rastrick, then a manufacturer of steam-engines at Stourbridge, near Birmingham, was examined as to the safety of high-pressure engines. He had made a travelling engine of this sort for Mr. Trevithick about twelve years before (in 1813), which was exhibited in London, when a circular railroad was laid down, and the engine was run against a horse for a wager. He had also seen the locomotive engine of Mr. Stephenson at work on the Killingworth and Hetton railroads. He had examined them together with Mr. Cubitt, Mr. James Walker, Mr. Sylvester, and others, and was *satisfied* of their applicability to the purposes of railway traction. He described to the Committee *the proper* form of the boiler, and the arrangement of the valves, so as to secure complete safety in the working of the locomotive. He was of opinion that such an engine might be constructed as would take forty tons weight at the rate of six miles an hour, with perfect ease and safety.

On the 25th of April, Mr. George Stephenson was called into the witness-box. It was his first appearance before a Committee of the House of Commons, and he well knew what he had to expect. He was aware that the whole force of the opposition was to be directed against him; and if they could break down his evidence, the canal monopoly might yet be upheld for a time. Many years afterwards, when looking back at his position on this trying occasion, he said:—"When I went to Liverpool to plan a line from thence to Manchester, I pledged myself to the directors to attain a speed of ten miles an hour. I said I had no doubt the locomotive might be made to go much faster, but that we had better be moderate at the beginning. The directors said I was quite right; for that if, when they went to Parliament, I talked of going at a greater rate than ten miles an hour, I should put a cross upon the concern. It was not an easy task for me to keep the engine down to ten miles an hour, but it must be done, and I did my best. I had to place myself in that most unpleasant of all positions—the witness-box of a Parliamentary Committee. I was not long in it, before I began to wish for a hole to creep out at! I could not find words to satisfy either the Committee or myself. I was subjected to the cross-examination of eight or ten barristers, purposely, as far as possible, to bewilder me. Some member of the Committee asked if I was a foreigner, and another hinted that I was mad. But I put up with every rebuff, and went on with my plans, determined not to be put down."

Mr. Stephenson stood before the Committee to prove what the public opinion of that day held to be impossible. The self-taught mechanic had to demonstrate the practicability of accomplishing that which the most distinguished engineers of the time regarded as impracticable. Clear though the subject was to himself, and familiar as he was with the powers of the locomotive, it was no easy task for him to bring home his convictions, or even to convey his meaning, to the less informed minds of his hearers. In his strong Northumbrian dialect, he struggled for utterance, in the face of the sneers, interruptions, and ridicule of the opponents of the measure, and even of the Committee, some of whom shook their heads and whispered doubts as to his sanity, when he energetically avowed that he could make the locomotive go at the rate of twelve miles an hour! It was so grossly in the teeth of all the experience

of honourable members, that the man must certainly be labouring under a delusion!

And yet his large experience of railways and locomotives, as described by himself to the Committee, entitled this "untaught, inarticulate genius," as he has so well been styled, to speak with confidence on such a subject. Beginning with his experience as a brakesman at Killingworth in 1803, he went on to state that he was appointed to take the entire charge of the steam-engines in 1813, and had superintended the railroads connected with the numerous collieries of the Grand Allies from that time downwards. He had laid down or superintended the railways at Borrerton, Mount Moor, Spring Darlington, Bedington, Hetton, and Darlington, besides improving those at Killingworth, South Moor, and Derwent Brook. He had constructed fifty-five steam-engines, of which sixteen were locomotives. Some of these had been sent to France. The only accident that had occurred to any of these engines was on the occasion of the tubes in one of them wearing out, by which a man and boy were slightly scalded. The engines constructed by him for the working of the Killingworth Railroad, eleven years before, had continued steadily at work ever since, and fulfilled his most sanguine expectations. He was prepared to prove the safety of working high-pressure locomotives on a railroad, and the superiority of this mode of transporting goods over all others. As to speed, he said he had recommended eight miles an hour with twenty tons, and four miles an hour with forty tons; but he was quite confident that much more might be done. Indeed, he had no doubt they might go at the rate of twelve miles.

As to the charge that locomotives on a railroad would so terrify the horses in the neighbourhood, that to travel on horseback or to plough the adjoining fields would be rendered highly dangerous, the witness said that horses learnt to take no notice of them, though there *were* horses that would shy at a wheelbarrow. A mail coach was likely to be more shied at by horses than a locomotive. In the

neighbourhood of Killingworth, the cattle in the fields went on grazing while the engines passed them, and the farmers made no complaints.

Mr. Alderson, who had carefully studied the subject, and was well skilled in practical science, subjected the witness to a protracted and severe cross-examination as to the speed and power of the locomotive, the strokes of the engine, the slipping of the wheels upon the rails, and various other points of detail. Mr. Stephenson insisted that no slipping took place, as attempted to be extorted from him by the counsel. He said; "It is impossible for slipping to take place so long as the adhesive weight of the wheel upon the rail is greater than the weight to be dragged after it." There was a good deal of interruption to the witness's answers by Mr. Alderson, to which Mr. Joy more than once objected. As to accidents, Mr. Stephenson knew of none that had occurred with his engines. There had been one, he was told, at the Middleton Colliery, near Leeds, with a Blenkinsop engine. The driver had been in liquor, and had put a considerable load on the safety-valve, so that upon going forward the engine blew up and the man was killed. But he added, if proper precautions had been used with that boiler, the accident could not have happened. The following cross-examination occurred in reference to the question of speed:—

"Of course," he was asked, "when a body is moving upon a road, the greater the velocity the greater the momentum that is generated?" "Certainly."—"What would be the momentum of forty tons moving at the rate of twelve miles an hour?" "It would be very great."—"Have you seen a railroad that would stand that?" "Yes."—"Where?" "Any railroad that would bear going four miles an hour: I mean to say, that if it would bear the weight at four miles an hour, it would bear it at twelve."—"Taking it at four miles an hour, do you mean to say that it would not require a stronger railway to carry the same weight twelve miles an hour?" "I will give an answer to that. I dare say every person has been

over ice when skating, or seen persons go over, and they know that it would bear them better at a greater velocity than it would if they went slower; when they go quick, the weight in a measure ceases."—"Is not that upon the hypothesis that the railroad is perfect?" "It is; and *I mean to make it perfect.*"

Mr. Alderson had so pressed the point of "twelve miles an hour," and the promoters were so alarmed lest it should appear in evidence that they contemplated any such extravagant rate of speed, that immediately on Mr. Alderson sitting down, Mr. Joy proceeded to re-examine Mr. Stephenson, with the view of removing from the minds of the Committee an impression so unfavourable, and, as they supposed, so damaging to their case. "With regard," asked Mr. Joy, "to all those hypothetical questions of my learned friend, they have been all put on the supposition of going twelve miles an hour: now that is not the rate at which, I believe, any of the engines of which you have spoken have travelled?" "No," replied Mr. Stephenson, "except as an experiment for a short distance."—"But what they have gone has been three, five, or six miles an hour?" "Yes."—"So that those hypothetical cases of twelve miles an hour do not fall within your general experience?" "They do not."

The Committee also seem to have entertained some alarm as to the high rate of speed which had been spoken of, and proceeded to examine the witness further on the subject. They supposed the case of the engine being upset when going at nine miles an hour, and asked what, in such a case, would become of the cargo astern. To which the witness replied that it would not be upset. One of the members of the Committee pressed the witness a little further. He put the following case:—"Suppose, now, one of these engines to be going along a railroad at the rate of nine or ten miles an hour, and that a cow were to stray upon the line and get in the way of the engine; would not that, think you, be a very awkward circumstance?" "Yes," replied the witness, with a twinkle in

his eye, "very awkward indeed—*for the cow!*" The honourable member did not proceed further with his cross-examination; to use a railway phrase, he was "shunted."

On the following day (the 26th April), Mr. Stephenson was subjected to a most severe examination. On that part of the scheme with which he was most practically conversant, his evidence was clear and conclusive. Now, he had to give evidence on the plans made by his surveyors, and the estimates which had been founded on such plans. So long as he was confined to locomotive engines and iron railroads, with the minutest details of which he was more familiar than any man living, he felt at home, and in his element. But when the designs of bridges and the cost of constructing them had to be gone into, his evidence was much less satisfactory.

Mr. Alderson cross-examined him at great length on the plans of the bridges, the tunnels, the crossings of the roads and streets, and the details of the survey, which, it soon clearly appeared, were in some respects seriously at fault. The proposed formation of the line of railway over Chat Moss was also the subject of much cross-examination,—the witness stating that it was quite practicable, although it would require time to become consolidated.

For three entire days was Mr. Stephenson subjected to cross-examination by Mr. Alderson, Mr. Cullen, and the other leading counsel for the opposition. He held his ground bravely, and defended the plans and estimates with consummate ability and skill; but it was clear they were imperfect, and the result was on the whole damaging to the bill. Mr. (afterwards Sir William) Cubitt was called by the promoters,—Mr. Adam stating that he proposed by this witness to correct some of the levels as given by Mr. Stephenson. It seems a singular course to have been taken by the promoters of the measure; for Mr. Cubitt's evidence went to upset the statements made by Mr. Stephenson as to the survey. This adverse evidence was, of course, made the most of by the opponents of the bill.

Mr. Serjeant Spankie then summed up for the bill, on

the 2nd of May, in a speech of great length; and the case of the opponents was next gone into, Mr. Harrison opening with a long and eloquent speech on behalf of his clients, Mrs. Atherton and others. He indulged in the severest vituperation against the witnesses for the bill, and especially dwelt upon the manner in which Mr. Cubitt, for the promoters, had proved that Mr. Stephenson's levels were wrong. "They got a person," said he, "whose character and skill I do not dispute, though I do not exactly know that I should have gone to the inventor of the treadmill as the fittest man to take the levels of Knowsley Moss, and Chat Moss, which shook almost as much as a treadmill, as you recollect, for he (Mr. Cubitt) said Chat Moss trembled so much under his feet that he could not take his observations accurately. . . . . In fact, Mr. Cubitt did not go to the Chat Moss, because he knew that it was an immense mass of pulp, and nothing else. It actually rises in height, from the rain swelling it like a sponge, and sinks again in dry weather: and if a boring instrument is put into it, it sinks immediately by its own weight. The making of an embankment out of this pulpy, wet moss, is no very easy task. Who but Mr. Stephenson would have thought of entering into Chat Moss, carrying it out almost like wet dung? It is ignorance almost inconceivable. It is perfect madness, in a person called upon to speak on a scientific subject, to propose such a plan. . . . . Every part of the scheme shows that this man has applied himself to a subject of which he has no knowledge, and to which he has no science to apply." Then adverting to the proposal to work the intended line by means of locomotives, the learned gentleman proceeded; "When we set out with the original prospectus, we were to gallop, I know not at what rate;—I believe it was at the rate of twelve miles an hour. My learned friend, Mr. Adam, contemplated—possibly alluding to Ireland—that some of the Irish members would arrive in the waggons to a division. My learned friend says that they would go at the rate of twelve miles an hour with the aid of the devil in the form of a locomotive, sitting as

postilion on the fore horse, and an honourable member sitting behind him to stir up the fire, and keep it at full speed. But the speed at which these locomotive engines are to go has slackened: Mr. Adam does not go faster now than five miles an hour. The learned serjeant (Spankie) says he should like to have seven, but he would be content to go six. I will show he cannot go six; and probably, for any practical purposes, I may be able to show that I can keep up with him *by the canal*. . . . . Locomotive engines are liable to be operated upon by the weather. You are told they are affected by rain, and an attempt has been made to cover them; but the wind will affect them; and any gale of wind which would affect the traffic on the Mersey would render it *impossible* to set off a locomotive engine, either by poking of the fire, or keeping up the pressure of the steam till the boiler is ready to burst." How amusing it now is to read these extraordinary views as to the formation of a railway over Chat Moss, and the impossibility of starting a locomotive engine in the face of a gale of wind! The men who then laughed at Stephenson's "mad projects," had but to live a few years longer to find that the laugh was all on the other side.

Evidence was called to show that the house property passed by the proposed railway would be greatly deteriorated—in some places almost destroyed; that the locomotive engines would be terrible nuisances, in consequence of the fire and smoke vomited forth by them; and that the value of land in the neighbourhood of Manchester alone would be deteriorated by no less than 20,000*l*.! But the opposition mainly relied upon the evidence of the leading engineers—not, like Mr. Stephenson, self-taught men, but regular professionals. Mr. Francis Giles, C.E., was their great card. He had been twenty-two years an engineer, and could speak with some authority. His testimony was mainly directed to the utter impossibility of forming a railway over Chat Moss. "*No engineer in his senses*," said he, "would go through Chat Moss if he wanted to make a railroad from Liverpool to Manchester." Mr. Giles thus described this bottomless

pit: "The surface of the Moss is a sort of long, coarse, sedgy grass, tough enough to enable you to walk upon it, about half-leg deep; underneath that, on putting an iron into the soil (a boring-rod), it will, with its own weight, sink down. In the centre, where this railroad is to cross, it is all pulp from the top to the depth of 34 feet; at 34 feet there is a vein of 4 or 6 inches of clay; below that there are 2 or 3 feet of quicksand; and the bottom of that is hard clay, which keeps all the water in. The boring rod will get down to the first vein of clay by its own weight; a slight pressure of the hand will carry it to the next vein of clay; a very little pressure indeed will get it to the additional depth of 2 or 3 feet, beyond which you must use more pressure to get it down to the foundation. If this sort of material were to be carried, it would greatly increase the expense; and it would be necessary to lay it aside, for the purpose of draining and drying, before any man in his senses would convey it along the railroad for the purpose I have been speaking of. . . . . In my judgment *a railroad certainly cannot be safely made over Chat Moss without going to the bottom of the Moss.* The soil ought all to be taken out, undoubtedly; in doing which, it will not be practicable to approach each end of the cutting, as you make it, with the carriages. No carriages would stand upon the Moss short of the bottom. My estimate for the whole cutting and embankment over Chat Moss is 270,000*l.* nearly, at those quantities and those prices which are decidedly correct. . . . It will be necessary to take this Moss completely out at the bottom, in order to make a solid road."

Mr. Alderson summed up in a speech which extended over two days. He declared Mr. Stephenson's plan to be "the most absurd scheme that ever entered into the head of man to conceive. My learned friends," said he, "almost endeavoured to stop my examination; they wished me to put in the plan, but I had rather have the exhibition of Mr. Stephenson in that box. I say he never had a plan—I believe he never had one—I do not believe he is capable of making one. His is a mind perpetually fluctuating between

opposite difficulties: he neither knows whether he is to make bridges over roads or rivers, of one size or of another; or to make embankments, or cuttings, or inclined planes, or in what way the thing is to be carried into effect. Whenever a difficulty is pressed, as in the case of a tunnel, he gets out of it at one end, and when you try to catch him at that, he gets out at the other." Mr. Alderson proceeded to declaim against the gross ignorance of this so-called engineer, who proposed to make "impossible ditches by the side of an impossible railway" through Chat Moss; and he contrasted with his evidence that given "by that most respectable gentleman we have called before you, I mean Mr. Giles, who has executed a vast number of works," &c. Then Mr. Giles's evidence as to the impossibility of making any railway over the Moss that would stand short of the bottom, was emphatically dwelt upon; and Mr. Alderson proceeded to say,—"Having now, sir, gone through Chat Moss, and having shown that Mr. Giles is right in his principle when he adopts a solid railway,—and I care not whether Mr. Giles is right or wrong in his estimate, for whether it be effected by means of piers raised up all the way for four miles through Chat Moss, whether they are to support it on beams of wood or by erecting masonry, or whether Mr. Giles shall put a solid bank of earth through it,—in all these schemes there is not one found like that of Mr. Stephenson's, namely, to cut impossible drains on the side of this road; and it is sufficient for me to suggest and to show, that this scheme of Mr. Stephenson's is impossible or impracticable, and that no other scheme, if they proceed upon this line, can be suggested which will not produce enormous expense. I think that has been irrefragably made out. Every one knows Chat Moss—every one knows that Mr. Giles speaks correctly when he says the iron sinks immediately on its being put upon the surface. I have heard of culverts, which have been put upon the Moss, which, after having been surveyed the day before, have the next morning disappeared; and that a house (a poet's house, who may be supposed in the habit of building

castles even in the air), story after story, as fast as one is added, the lower one sinks! There is nothing, it appears, except long sedgy grass, and a little soil, to prevent its sinking into the shades of eternal night. I have now done, sir, with Chat Moss, and there I leave this railroad." Mr. Alderson, of course, called upon the Committee to reject the bill; and he protested "against the despotism of the Exchange at Liverpool striding across the land of this country. I do protest," he concluded, "against a measure like this, supported as it is by such evidence, and founded upon such calculations."

The case of the other numerous petitioners against the bill still remained to be gone into. Witnesses were called to prove the residential injury which would be caused by the "intolerable nuisance" of the smoke and fire from the locomotives; and others to prove that the price of coals and iron would "infallibly" be greatly raised throughout the country. This was part of the case of the duke of Bridgewater's trustees, whose witnesses "proved" many very extraordinary things. The Leeds and Liverpool Canal Company were so fortunate as to pick up a witness from Hetton, who was ready to furnish some damaging evidence as to the use of Mr. Stephenson's locomotives on that railway. This was Mr. Thomas Wood, one of the Hetton company's clerks, whose evidence was to the effect that the locomotives, having been found ineffective, were about to be discontinued in favour of fixed engines. The locomotives, he said, were greatly affected by the weather, and the waggons had then to be drawn on by horses. The engines were also frequently getting off the road, and were liable to accident. The evidence of this witness, incompetent though he was to give an opinion on the subject, and exaggerated as his statements were afterwards proved to be, was made the most of by Mr. Harrison, when summing up the case of the canal companies. "At length," he said, "we have come to this,—having first set out at twelve miles an hour, the speed of these locomotives is reduced to six, and now comes down to two or two and a half. They must be

content to be pulled along by horses and donkeys; and all those fine promises of galloping along at the rate of twelve miles an hour are melted down to a total failure—the foundation on which their case stood is cut from under them completely; for the Act of Parliament, the Commitee will recollect, prohibits any person using any animal power, of any sort, kind, or description, except the projectors of the railway themselves; therefore, I say, that the whole foundation on which this project exists is gone." After further personal abuse of Mr. Stephenson, whose evidence he spoke of as "trash and confusion," he closed the case of the canal companies on the 30th of May. Afterwards Mr. Adam replied for the promoters, recapitulating the principal points of their case, and vindicating Mr. Stephenson and the evidence which he had given before the Committee. Even Mr. Adam himself, however, seemed to have fears of the railway formation across Chat Moss, after the positive evidence given by Mr. Giles. "Supposing that Mr. Stephenson is rash," said he, "and I do not deny it, I say his error is an error from want of caution, and not from want of knowledge; and he ought not to be reproached with his want of knowledge of railways, being a man of great practical experience,"—which Mr. Giles was not, as respected railways. "Will you now," he said to the Committee, in winding up his speech, "will you now—when this experiment is brought before you and discussed so fully for the first time, while we are in the infancy of the application of this most powerful agent for the purpose of forming a communication for goods throughout the country—will you reject it because my learned friend, by some ingenious objection, has endeavoured to throw discredit upon it? All I ask you is, not to crush it in its infancy. Let not this country have the disgrace of putting a stop to that which, if cherished, may ultimately prove of the greatest advantage to our trade and commerce, and which, if we do not adopt it, will be adopted by our rivals. . . . My learned friends appeal to the Committee on the ground of private rights, all of which will be recognised. I

appeal to you in the name of the two largest towns in England, the one as a commercial port, and the other as a commercial town; I appeal to you in the name of the country at large; and I implore you not to blast the hopes that this powerful agent—steam—may be called in aid for the purpose of land communication; only let it have a fair trial, and these little objections and private prejudices will, I am quite sure, be instantly dispelled."

The Committee then divided on the preamble, which was carried by a majority of only *one*,—thirty-seven voting for it, and thirty-six against it. The clauses were next considered; and on a division, the first clause, empowering the Company to make the railway, was lost by a majority of nineteen to thirteen. In like manner, the next clause, empowering the company to take land, was lost; on which Mr. Adam, on the part of the promoters, withdrew the bill.

Thus ended this memorable contest, which had extended over two months—carried on throughout with great pertinacity and skill, especially on the part of the opposition, who left no stone unturned to defeat the measure. The want of a third line of communication between Liverpool and Manchester had been clearly proved; but the engineering *evidence in support* of the proposed railway, having been thrown almost entirely upon Mr. Stephenson, who fought this, the most important part of the battle, single-handed, was not brought out so clearly as it would have been had he secured more efficient engineering assistance,—which he was not able to do, as all the engineers of eminence of that day were against the locomotive railway. The obstacles thrown in the way of the survey by the landowners and canal companies, by which the plans were rendered exceedingly imperfect, also in a great measure tended to defeat the bill.

The result of this first application to Parliament was so far discouraging. Mr. Stephenson had been so terribly abused by the leading counsel for the opposition in the course of the proceedings before the Committee, — stigmatised by

them as an ignoramus, a fool, and a maniac,—that even his friends seem for a time to have lost faith in him and in the locomotive system, whose efficiency he continued to uphold. Things never looked blacker for the success of the railway system than at the close of this great parliamentary struggle. And yet it was on the very eve of its triumph.

The Committee of Directors appointed to watch the measure in Parliament were so determined to press on the project of a railway, even though it should have to be worked merely by horse-power, that the bill had scarcely been defeated ere they met in London, to consider their next step. They called their parliamentary friends together to consult as to future proceedings. Among those who attended the meeting of gentlemen with this object, in the Royal Hotel, St. James's Street, on the 4th of June, were Mr. Huskisson, Mr. Spring Rice, and General Gascoyne. Mr. Huskisson urged the promoters to renew their application to Parliament. They had secured the first step by the passing of their preamble; the measure was of great public importance; and whatever temporary opposition it might meet with, he conceived that Parliament must ultimately give its sanction to the undertaking. Similar views were expressed by other speakers; and the deputation went back to Liverpool determined to renew their application to Parliament in the ensuing session.

It was not considered desirable to employ Mr. Stephenson in making the new survey. He had not as yet established his reputation as an engineer beyond the boundaries of his own county; and the promoters of the bill had doubtless felt the disadvantages of this in the course of their parliamentary struggle. They therefore resolved now to employ engineers of the highest established reputation, as well as the best surveyors that could be obtained. In accordance with these views, they engaged Messrs. George and John Rennie to be the engineers of the railway; and Mr. Charles Vignolles, on their behalf, was appointed to prepare the plans and sections. The line which was eventually adopted differed somewhat from that surveyed by Mr. Stephenson,

—entirely avoiding Lord Sefton's property, and passing through only a few detached fields of Lord Derby's at a considerable distance from the Knowsley domain. The principal game preserves of the district were carefully avoided. The promoters thus hoped to get rid of the opposition of the most influential of the resident landowners. The crossing of certain of the streets of Liverpool was also avoided, and the entrance contrived by means of a tunnel and an inclined plane. The new line stopped short of the river Irwell at the Manchester end, and thus in some measure removed the objections grounded on an illegal interruption to the canal or river traffic. With reference to the use of the locomotive engine, the promoters, remembering with what effect the objections to it had been urged by the opponents of the measure, intimated, in their second prospectus, that "as a guarantee of their good faith towards the public they will not require any clause empowering them to use it; or they will submit to such restrictions in the employment of it as Parliament may impose, for the satisfaction and ample protection both of proprietors on the line of road and of the public at large."

It was found that the capital required to form the line of railway, as laid out by the Messrs. Rennie, was considerably beyond the amount of Mr. Stephenson's estimate; and it became a question with the Committee in what way the new capital should be raised. A proposal was made to the Marquis of Stafford, who was principally interested in the Duke of Bridgewater's Canal, to become a shareholder in the railway. A similar proposal, it will be remembered, had at an earlier period been made to Mr. Bradshaw, the trustee for the property; but his answer was "all or none," and the negotiation was broken off. The Marquis of Stafford, however, now met the projectors of the railway in a more conciliatory spirit; and it was ultimately agreed that he should become a subscriber to the extent of 1000 shares.

The survey of the new line having been completed, the plans were deposited, the standing orders duly complied

with, and the bill went before Parliament. The same counsel appeared for the promoters: but the examination of witnesses was not nearly so protracted as on the previous occasion. Mr. Erle and Mr. Harrison led the case of the opposition. The bill went into Committee on the 6th of March; and on the 16th the preamble was declared proved by a majority of forty-three to eighteen. On the third reading in the House of Commons, an animated, and what now appears a very amusing, discussion took place. The Hon. Edward Stanley moved that the bill be read that day six months; and in the course of his speech he undertook to prove that the railway trains would take *ten hours* on the journey, and that they could only be worked by horses. Sir Isaac Coffin seconded the motion, and in doing so denounced the project as a most flagrant imposition. He would not consent to see widows' premises invaded; and "What, he would like to know, was to be done with all these who had advanced money in making and repairing turnpike-roads? What with those who may still wish to travel in their own or hired carriages, after the fashion of their forefathers? What was to become of coach-makers and harness-makers, coachmasters and coachmen, inn-keepers, horse-breeders, and horse-dealers? Was the House aware of the smoke and the noise, the hiss and the whirl, which locomotive engines, passing at the rate of ten or twelve miles an hour, would occasion? Neither the cattle ploughing in the fields or grazing in the meadows could behold them without dismay. Iron would be raised in price 100 per cent., or more probably, exhausted altogether! It would be the greatest nuisance, the most complete disturbance of quiet and comfort in all parts of the kingdom, that the ingenuity of man could invent!"

Mr. Huskisson and other speakers, though unable to reply to such arguments as these, strongly supported the bill; and it passed the third reading by a majority of eighty-eight to forty-one. The bill passed the House of Lords almost unanimously, the only opponents being the Earl of Derby and his relative the Earl of Wilton. The

cost of obtaining the Act amounted to the enormous sum of 27,000*l.*

At the first meeting of the directors of the Company at Liverpool, the selection of a principal engineer was taken into consideration. The magnitude of the proposed works, and the vast consequences involved in the experiment, were deeply impressed upon their minds; and they resolved to secure the services of a resident engineer of proved experience and ability. Their attention was naturally directed to Mr. Stephenson as the best man to carry out the undertaking; at the same time they desired to have the benefit of the Messrs. Rennie's professional assistance in superintending the works. Mr. George Rennie had an interview with the directors on the subject, and proposed to undertake the chief superintendence, making six visits in each year, and stipulating that he should have the appointment of the resident engineer. But the responsibility attaching to the direction, in the matter of the efficient carrying on of the works, would not admit of their being influenced by ordinary punctilios on the occasion: and they accordingly declined Mr. Rennie's proposal, and proceeded to appoint Mr. George Stephenson their principal engineer at a salary of 1000*l.* per annum.

CHAPTER XI.

CHAT MOSS — CONSTRUCTION OF THE RAILWAY.

MR. STEPHENSON was no sooner appointed chief engineer, than he removed his residence to Liverpool, and made arrangements to commence the works. He began with the "impossible"—to do that which the most distinguished engineers of the day had declared that "no man in his senses would undertake to do"—namely, to make the road over Chat Moss! It was indeed a most formidable undertaking; and the project of carrying a railway along, under, or over such a material as the Moss presented, would certainly never have occurred to an ordinary mind.

Chat Moss is an immense peat-bog of about twelve square miles in extent. Unlike the bogs or swamps of Cambridge and Lincolnshire, which consist principally of soft mud or silt, the *peat* bog is a mass of spongy vegetable pulp, the result of the growth and decay of ages. The spagni, or bog-mosses, cover the entire area; one year's growth rising over another,—the older growths not entirely decaying, but remaining partially preserved by the antiseptic properties peculiar to peat. Hence the remarkable fact that, although a semifluid mass, the surface of Chat Moss rises above the level of the surrounding country. Like a turtle's back, it declines from the summit in every direction, having from thirty to forty feet gradual slope to the solid land on all sides. From the remains of trees, chiefly alder and birch, which have been dug out of it, and which must have previously flourished upon the surface of soil now deeply submerged, it is probable that the sand and clay base on which the bog rests is saucer-shaped, and so retains the entire mass in position. In rainy weather, such is its capacity for water that it sensibly swells, and rises in those

parts where the moss is the deepest. This occurs through the capillary attraction of the fibres of the submerged moss, which is from twenty to thirty feet in depth, whilst the growing plants effectually check evaporation from the surface. This peculiar character of the Moss has presented an insuperable difficulty in the way of draining it by any system of wholesale drainage—such as by sinking shafts in its substance, and pumping up the water by steam power, as has been proposed by some engineers. Supposing a shaft of thirty feet deep to be sunk, it has been calculated that this would only be effectual for draining a circle of about one hundred yards, the water running down an incline of about 5 to 1 ; for it was found in the course of draining the bog, that a ditch three feet deep only served to drain a space of less than five yards on either side, and two ditches of this depth, ten feet apart, left a portion of the Moss between them scarcely affected by the drains.

When the survey of the line was made, only the edges of the Moss could be entered on, and that with difficulty. One gentleman, of considerable weight and rotundity, when endeavouring to obtain a stand for his theodolite or spirit-level, felt himself suddenly sinking, when he immediately threw himself down, and rolled over and over until he reached the firm ground in a sorry mess. Other attempts were subsequently made to enter upon the Moss for the same purpose, but they were abandoned for the same reason, the want of a sufficiently solid stand for the theodolite.

The three resident engineers selected by Mr. Stephenson to superintend the construction of the line, were Mr. Joseph Locke, Mr. Allcard, and Mr. John Dixon. The last was appointed to that portion which included the proposed road across the Moss, and the other two were by no means desirous of exchanging posts with him. On Mr. Dixon's arrival, about the month of July, 1826, Mr. Locke proceeded to show him over the length he was to take charge of, and to instal him in office. When they reached Chat Moss, Mr. Dixon found that the line had already been staked

out and the levels taken in detail by the aid of planks laid upon the bog. The cutting of the drains along each side of the proposed road had also been commenced; but the soft pulpy stuff had up to this time flowed into the drains and filled them up as fast as they were cut. Proceeding across the Moss, on the first day's inspection, the new resident, when about half-way over, slipped off the plank on which he walked, and sank to his knees in the bog. Struggling only sent him the deeper, and he might have disappeared altogether, but for the workmen, who hastened to his assistance upon planks, and rescued him from his perilous position. Much disheartened, he desired to return, and even for the moment thought of giving up the job; but Mr. Locke assured him that the worst part was now past; so the new resident plucked up heart again, and both floundered on until they reached the further edge of the Moss, wet and plastered with bog sludge. Mr. Dixon's brother residents endeavoured to comfort him by the assurance that he might in future avoid similar perils, by walking upon "pattens," or *boards fastened to the soles of his feet*, as they had done when taking the levels, and as the workmen did when engaged in making drains in the softest parts of the Moss. Still the resident engineer could not help being puzzled by the problem of how to construct a road for a heavy locomotive, with a train of passengers or goods, upon a bog which he had found to be incapable of supporting his single individual weight!

Mr. Stephenson's idea was, that such a road might be made to *float* upon the bog, simply by means of a sufficient extension of the bearing surface. As a ship, or a raft, capable of sustaining heavy loads floated in water, so in his opinion, might a light road be floated upon a bog, which was of considerably greater consistency than water. Long before the railway was thought of, Mr. Roscoe of Liverpool had adopted the remarkable expedient of fitting his plough horses with flat wooden soles or pattens, to enable them to walk upon the Moss land which he had brought into cultivation. These pattens were fitted on by

means of a screw apparatus, which met in front of the foot and was easily fastened. The mode by which these pattens served to sustain the horse is capable of easy explanation, and it will be observed that the *rationàle* alike explains the floating of a railway train. The foot of an ordinary farm horse presents a base of about five inches diameter, but if this base be enlarged to seven inches—the circles being to each other as the squares of the diameters—it will be found that, by this slight enlargement of the base, a circle of nearly double the area has been secured; and consequently the pressure of the foot upon every unit of ground upon which the horse stands has been reduced one half. In fact, this contrivance has an effect tantamount to setting the horse upon eight feet instead of four.

Apply the same reasoning to the ponderous locomotive, and it will be found, that even such a machine may be made to stand upon a bog, by means of a similar extension of the bearing surface. Suppose the engine to be twenty feet long and five feet wide, thus covering a surface of a hundred square feet, and, provided the bearing has been extended by means of cross sleepers supported upon a matting of *heath and branches* of trees, covered with a few inches of gravel, the pressure of an engine of twenty tons will be only equal to about three pounds per inch over the whole surface on which it stands. Such was George Stephenson's idea in contriving his floating road—something like an elongated raft across the Moss; and we shall see that he steadily kept it in view in carrying the work into execution.

The first thing done was to form a footpath of ling or heather along the proposed road, on which a man might walk across without risk of sinking. A single line of temporary railway was then laid down, formed of ordinary cross-bars about three feet long and an inch square, with holes punched through them at the end and nailed down to temporary sleepers. Along this way ran the waggons in which were conveyed the materials requisite to form the permanent road. The waggons carried about a ton each,

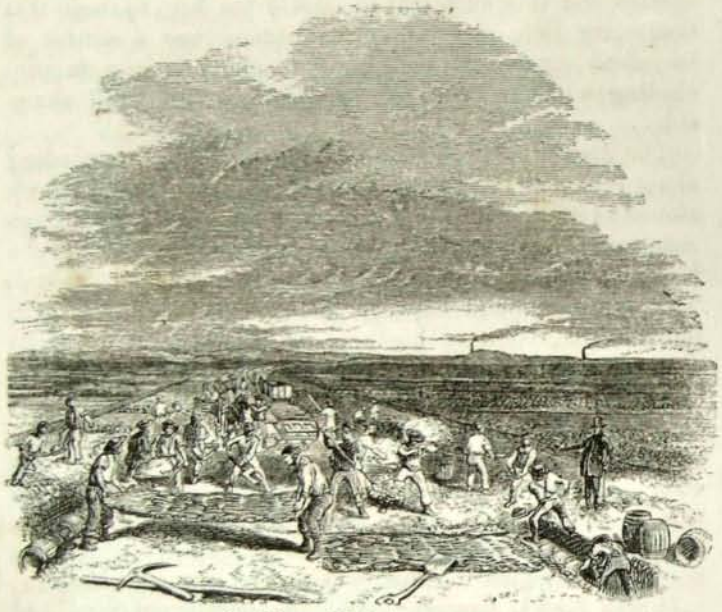
and they were propelled by boys running behind them along the narrow bar of iron. The boys became so expert that they would run the four miles across at the rate of seven or eight miles an hour without missing a step; if they had done so, they would have sunk in many places up to their middle. The slight extension of the bearing surface was thus sufficient to enable the bog to bear this temporary line, and this circumstance was a source of increased confidence and hope to the engineer in proceeding with the formation of the permanent road alongside.

The digging of drains had for some time been proceeding along each side of the intended railway; but they filled up almost as soon as dug, the sides flowing in, and the bottom rising up; and it was only in some of the drier parts of the bog that a depth of three or four feet could be reached. The surface-ground between the drains, containing the intertwined roots of heather and long grass, was left untouched, and upon this was spread branches of trees and hedge-cuttings; in the softest places rude gates or hurdles, some eight or nine feet long by four feet wide, interwoven with heather, were laid in double thicknesses, their ends overlapping each other; and upon this floating bed was spread a thin layer of gravel, on which the sleepers, chairs, and rails were laid in the usual manner. Such was the mode in which the road was formed upon the Moss.

It was found, however, after the permanent road had been thus laid, that there was a tendency to sinking at some parts where the bog was the softest. In ordinary cases, where a bank subsides, the sleepers are packed up with ballast or gravel; but in this case the ballast was dug away and removed in order to lighten the road, and the sleepers were packed instead with cakes of dry turf or bundles of heath. By these expedients the subsided parts again floated up to the level, and an approach was made towards a satisfactory road. But the most formidable difficulties were encountered at the centre and towards the edges of the Moss; and it required no small degree of in-

genuity and perseverance on the part of the engineer successfully to overcome them.

The Moss, as has been already observed, was highest in the centre, and there presented a sort of hunchback with a rising and falling gradient. At that point it was found necessary to cut deeper drains in order to consolidate the



Chat Moss. Works in progress.

Moss between them on which the road was to be formed. But, as at other parts of the Moss, the deeper the cutting the more rapid was the flow of fluid bog into the drain, the bottom rising up almost as fast as it was removed. To meet this emergency, a number of empty tar-barrels were brought from Liverpool; and as soon as a few yards of drain were dug, the barrels were laid down end to end, firmly fixed to each other by strong slabs laid over the joints and nailed; they were then covered over with clay, thus forming an underground sewer of wood instead of

bricks. This expedient was found to answer the purpose intended, and the road across the centre of the Moss was thus successfully prepared, and then laid with the permanent materials.

The greatest difficulty was, however, experienced in forming an embankment upon the edge of the bog at the Manchester end. Moss as dry as it could be cut, was brought up in small waggons, by men and boys, and emptied so as to form an embankment; but the bank had not been raised to three or four feet in height, ere the stuff broke through the heathery surface of the bog and sunk overhead. More moss was brought up and emptied in with no better result; and for many weeks the filling was continued without any visible embankment having been made. It was the duty of the resident engineer to proceed to Liverpool every fortnight to obtain the wages for the workmen employed under him; and on these occasions he was required to colour up, on a section drawn to a working scale, suspended against the wall of the directors' room, the amount of excavations, embankments, &c., executed from time to time. But on many of these occasions, Mr. Dixon had no progress whatever to show for the money expended upon the Chat Moss embankment. Sometimes, indeed, the visible work done was *less* than it had appeared a fortnight or month before!

The directors now became seriously alarmed, and feared that the evil prognostications of the eminent engineers were about to be fulfilled. The resident himself was greatly disheartened, and he was even called upon to supply the directors with an estimate of the cost of filling up the Moss with solid stuff from the bottom, as also the cost of piling the roadway, and in effect, constructing a four mile viaduct of timber across the Moss, from twenty to thirty feet high. But the expense appalled the Directors, and the question then arose, whether the work was to be proceeded with or *abandoned!*

Mr. Stephenson himself afterwards described the transaction at a public dinner given at Birmingham, on the 23rd

of December, 1837, on the occasion of a piece of plate being presented to his son, the engineer of the London and Birmingham Railway. He related the anecdote, he said, for the purpose of impressing upon the minds of those who heard him the necessity of perseverance.

"After working for weeks and weeks," said he, "in filling in materials to form the road, there did not yet appear to be the least sign of our being able to raise the solid embankment one single inch; in short we went on filling in without the slightest apparent effect. Even my assistants began to feel uneasy, and to doubt of the success of the scheme. The directors, too, spoke of it as a hopeless task; and at length they became seriously alarmed, so much so, indeed, that a board meeting was held on Chat Moss to decide whether I should proceed any further. They had previously taken the opinion of other engineers, who reported unfavourably. There was no help for it, however, but to go on. An immense outlay had been incurred; and great loss would have been occasioned had the scheme been then abandoned, and the line taken by another route. So the directors were *compelled* to allow me to go on with my plans, of the ultimate success of which I myself never for one moment doubted."

During the progress of this part of the works, the Worsley and Trafford men, who lived near the Moss, and plumed themselves upon their practical knowledge of bog-work, declared the completion of the road to be utterly impracticable. "If you knew as much about Chat Moss as we do," they said, "you would never have entered on so rash an undertaking; and depend upon it, all you have done and are doing will prove abortive. You must give up altogether the idea of a floating railway, and either fill the Moss up with hard material from the bottom, or else deviate the line so as to avoid it altogether." Such were the conclusions of science and experience.

In the midst of all these alarms and prophecies of failure, Mr. Stephenson never lost heart, but held to his purpose. His motto was "Persevere!" "You must go on filling in,"

he said; "there is no other help for it. The stuff emptied in is doing its work out of sight, and if you will but have patience, it will soon begin to show." And so the filling in went on; several hundreds of men and boys were employed to skin the Moss all round for many thousand yards, by means of sharp spades, called by the turf-cutters "tommy-spades;" and the dried cakes of turf were afterwards used to form the embankment, until at length as the stuff sank down and rested upon the bottom, it gradually rose above the surface, and slowly advanced onwards, declining in height and consequently in weight, until at length it joined the floating road already laid upon the Moss. In the course of forming the embankment, the pressure of the bog turf tipped out of the waggons caused a copious stream of bog-water to flow from the end of it, in colour resembling Barclay's double stout; and when completed, the bank looked like a long ridge of tightly pressed tobacco-leaf. The compression of the turf may be understood from the fact that 670,000 cubic yards of raw moss formed only 277,000 cubic yards of embankment at the completion of the work.

At the western, or Liverpool end, there was a like embankment; but, as the ground was there solid, little difficulty was experienced in forming it, beyond the loss of substance caused by the oozing out of the water held by the moss-earth.

At another part of the Liverpool and Manchester line, Parr Moss was crossed by an embankment about a mile and a half in extent. In the immediate neighbourhood was found a large excess of cutting, which it would have been necessary to "put out in spoil banks" (according to the technical phrase), but for the convenience of Parr Moss, into which the surplus clay, stone, and shale, were tipped, waggon after waggon, until a solid but concealed embankment, from fifteen to twenty-five feet high, was formed; although to the eye it appears to be laid upon the level of the adjoining surface, as at Chat Moss.

The road across Chat Moss was finished by the 1st of

January, 1830, when the first experimental train of passengers passed over it, drawn by the "Rocket;" and it turned out that, instead of being the most expensive part of the line, it proved about the cheapest. The total cost of forming the line over the Moss was 28,000*l.*, whereas Mr. Giles's estimate was 270,000*l.*! It also proved to be one of the best portions of the railway. Being a floating road, it was smooth and easy to run upon, just as Dr. Arnott's water-bed is soft and easy to lie upon — the pressure being equal at all points. There was, and still is, a sort of springiness in the road over the Moss, such as is felt when passing along a suspended bridge; and those who looked along the Moss as a train passed over it, said they could observe a waviness, such as precedes and follows a skater upon ice.

During the progress of these works the most ridiculous rumours were set afloat. The drivers of the stage-coaches who feared for their calling, brought the alarming intelligence into Manchester from time to time, that "Chat Moss was blown up!" "Hundreds of men and horses had sunk in the bog; and the works were completely abandoned!" The engineer himself was declared to have been swallowed up in the Serbonian bog; and "railways were at an end for ever!"

In the construction of the railway, Mr. Stephenson's capacity for organising and directing the labours of a large number of workmen of all kinds eminently displayed itself. A vast quantity of ballast-waggons had to be constructed for the purposes of the work, and implements and *materials* had to be collected, before the mass of labour to be employed could be efficiently set in motion at the various points of the line. There were not at that time, as there are now, large contractors possessed of railway plant, capable of executing earthworks on a large scale. The first railway engineer had not only to contrive the plant, but to organise the labour, and direct it in person. The very labourers themselves had to be trained to their work by him; and it was on the Liverpool and Manchester line that Mr. Stephenson organised the staff of that formidable band of railway navvies, whose handiworks will be the wonder and admiration of succeeding generations. Looking at their gigantic traces, the men of some future age may be found ready to declare, of the engineer and of his workmen, "that there were giants in those days."

Although the works of the Liverpool and Manchester Railway are of a much less formidable character than those of many lines that have since been constructed, they were then regarded as of the most stupendous description. Indeed, the like of them had not before been executed in England. Several of the heaviest and most expensive works were caused by the opposition of Lords Derby and Sefton, whose objections to the line passing near or through their properties forced it more to the south, and thereby involved much tunnelling and heavy stone cutting. It had been Mr. Stephenson's original intention to carry the railway from the north end of Liverpool, round the red-sandstone ridge, on which the upper part of the town is built, and also round the higher rise of the coal formation at Rainhill, by following the natural levels to the north of Knowsley. But the line being forced to the south, it was then rendered necessary to cut through the hills, and go over the high grounds instead of round them. The first consequence of this alteration in the plans was the necessity for constructing a tunnel under the town of Liverpool a mile and a half in length, from the docks at Wapping to the top of Edgehill; the second was the necessity for forming a long and deep cutting through the red-sandstone rock at Olive Mount; and the third and worst of all, was the necessity for ascending and descending the Whiston and Sutton hills by means of inclined planes of 1 in 96. The line was also, by the same forced deviation, prevented passing through the Lancashire coal-field, and the engineer was compelled to carry the works across the Sankey valley, at a point where the waters of the brook had dug out an excessively deep channel through the marl-beds of the district.

The principal difficulty was experienced in pushing on the works connected with the formation of the tunnel under Liverpool, 2200 yards in length. The blasting and hewing of the rock were vigorously carried on night and day; and the engineer's practical experience in the collieries here proved of great use to him. Many obstacles had to be encountered and overcome in the formation of the tunnel, the rock varying in hardness and texture at different parts. In some places the miners were deluged by water, which surged from the soft blue shale found at the lowest level of the tunnel. In other places, beds of wet sand were cut through; and there careful propping and pinning were necessary to prevent the roof from tumbling in, until the masonry to support it could be erected. On one occasion, while Mr. Stephenson was absent from Liverpool, a mass of loose moss-earth and sand fell from the roof, which had been insufficiently propped. The miners withdrew from the work; and on Mr. Stephenson's return, he found them in a refractory state, refusing to re-enter the tunnel. He induced them, however, by his example, to return to their labours; and when the roof had been secured, the work went on again as before. When there was danger, he was always ready to share it with the men; and gathering confidence from his fearlessness, they proceeded vigorously with the undertaking, boring and mining their way towards the light.

The Olive Mount cutting was the first extensive stone cutting executed on any railway, and to this day it is one of the most formidable. It is about two miles long, and in some parts more than a hundred feet deep. It is a narrow ravine or defile cut out of the solid rock; and not less than four hundred and eighty thousand cubic yards of stone were removed from it. Mr. Vignolles, afterwards describing it, said it looked as if it had been dug out by giants.

The crossing of so many roads and streams involved the necessity of constructing an unusual number of bridges. There were not fewer than sixty-three, under or over the

railway, on the thirty miles between Liverpool and Manchester. Up to this time, bridges had been applied generally to high roads, where inclined approaches were of comparatively small importance, and in determining the rise

Olive Mount Cutting.

of his arch the engineer selected any headway he thought proper. Every consideration was indeed made subsidiary to constructing the bridge itself, and the completion of one large structure of this sort was regarded as an epoch in engineering history. Yet here, in the course of a few years, no fewer than sixty-three bridges were constructed on one line of railway! Mr. Stephenson early found that the ordinary arch was inapplicable in certain cases, where the headway was limited, and yet the level of the railway must

be preserved. In such cases he employed simple cast-iron beams, by which he safely bridged gaps of moderate width, economizing headway, and introducing the use of a new material of the greatest possible value to the railway engineer. The bridges of masonry upon the line were of many kinds; several of them askew bridges, and others, such as those at Newton and over the Irwell at Manchester, of considerable dimensions. But the principal piece of masonry on the line was the Sankey viaduct.

Sankey Viaduct.

This fine work consists of nine arches of fifty feet span each. The piers are supported on two hundred piles driven deep into the soil; and they rise to a great height, —the coping of the parapet being seventy feet above the level of the valley which it spans, and in which flow the Sankey brook and canal.

By the end of 1828 the directors found they had expended 460,000*l.* on the works, and that they were still far from completion. They looked at the loss of interest

on this large investment, and began to grumble at the delay. They desired to see their capital becoming productive; and in the spring of 1829 they urged the engineer to push on the works with increased vigour. Mr. Cropper, one of the directors, who took an active interest in their progress, said to him one day, "Now, George, thou must get on with the railway, and have it finished without further delay: thou must really have it ready for opening by the first day of January next." "Consider the heavy character of the works, sir, and how much we have been delayed by the want of money, not to speak of the wetness of the weather: it is impossible." "Impossible!" rejoined Cropper; "I wish I could get Napoleon to thee—he would tell thee there is no such word as 'impossible' in the vocabulary." "Tush!" exclaimed Stephenson, with warmth; "don't speak to me about Napoleon! Give me men, money, and materials, and I will do what Napoleon couldn't do—drive a railroad from Liverpool to Manchester over Chat Moss!" And truly the formation of a high road over that bottomless bog was, apparently, a far more difficult task than the hewing even of Napoleon's far-famed road across the Simplon.

The directors had more than once been pressed by want of funds to meet the heavy expenditure. The country had scarcely yet recovered from the general panic and crash of 1825: and it was with difficulty that the calls could be raised from the shareholders. A loan of 100,000*l.* was obtained from the Exchequer Loan Commissioners in 1826; and in 1829 an Act was obtained enabling the company to raise further capital, to provide working plant for the railway. Two acts were also obtained during the progress of the works, enabling deviations and alterations to be made: one to improve the curves and shorten the line near Rainhill, and the other to carry the line across the Irwell into the town of Manchester. Thanks to the energy of the engineer, the industry of his labourers, and the improved supply of money by the directors, the railway made rapid progress in the course of the year 1829. Double

sets of labourers were employed on Chat Moss and at other points, in carrying on the works by night and day, the night shifts working by torch and fire light; and at length, the work advancing at all points, the directors saw their way to the satisfactory completion of the undertaking.

It may well be supposed that Mr. Stephenson's time was fully occupied in superintending the extensive and for the most part novel works connected with the railway, and that even his extraordinary powers of labour and endurance were taxed to the utmost during the four years that they were in progress. Although he had able helpers in the young engineers whom he had selected to take charge of the different "lengths" of the line, every detail in the plans was directed and arranged by himself. Every bridge, from the simplest to the most complicated, including the then novel structure of the "skew bridge," iron girders, siphons, fixed engines, the machinery for working the tunnel at the Liverpool end, had all to be thought out by his own head, and reduced to definite plans by his own hands. Besides all this, he had to design the working plant in anticipation of the opening of the railway. He planned the waggons, trucks, and carriages, and himself superintended their manufacture. The turntables, switches, crossings, and signals, — in short, the entire structure and machinery of the line, from the turning of the first sod to the running of the first train of carriages upon the railway,—went on under his immediate supervision.

He had no staff of experienced assistants,—not even a staff of draughtsmen in his office,—but only a few young pupils learning their business; and frequently he was without even their help. The time of his engineering inspectors was fully occupied in the actual superintendence of the works at different parts of the line; and he directed all their more important operations in person. It was in the midst of this vast accumulation of work and responsibility that the battle of the locomotive engine had to be fought,—a battle, not merely against material difficulties,

but against the still more trying obstructions of deeply-rooted mistrust and prejudice on the part of a considerable minority of the directors.

The usual routine of his life at this time—if routine it might be called—was, to rise early, by sunrise in summer and before it in winter, and thus "break the back of the day's work" by mid-day. Before breakfast he would visit the extensive workshops at Edgehill, where most of the "plant" for the line was manufactured. Then, returning home, after a hurried breakfast, he would ride along the works to inspect their progress, and push them on with greater energy where needful. On other days he would prepare for the much less congenial engagement of meeting the board, which was often a cause of great anxiety and pain to him; for it was difficult to satisfy men of all tempers, and some of these not of the most generous sort. On such occasions he might be seen with his right-hand thumb thrust through the topmost button-hole of his coat-breast, vehemently hitching his right shoulder, as was his habit when labouring under any considerable excitement. Occasionally he would take an early ride before breakfast, to inspect the progress of the Sankey viaduct. He had a favourite horse, brought by him from Newcastle, called "Bobby,"—so tractable that, with his rider on his back, he would walk up to a locomotive with the steam blowing off, and put his nose against it without shying. "Bobby," saddled and bridled, was brought to Mr. Stephenson's door betimes in the morning; and mounting him, he would ride the fifteen miles to Sankey, putting up at a little public house which then stood upon the banks of the canal. There he had his breakfast of "crowdie,' which he made with his own hands. It consisted of oatmeal stirred into a basin of hot water,—a sort of porridge,—which was supped with cold sweet milk. After this frugal breakfast, he would go upon the works, and remain there, riding from point to point for the greater part of the day. If he returned home before mid-day, it would be to examine the pay-sheets in the different depart-

ments, sent in by the assistant engineers, or by the foremen of the workshops; all this he did himself, with the greatest care, requiring a full explanation of every item.

After a late dinner, which occupied very short time and was always of a plain and frugal description, he would proceed to dispose of his correspondence, or prepare sketches of drawings, and give instructions as to their completion. He would occasionally refresh himself for this evening work by a short doze, which, however, he would never admit had exceeded the limits of "winking," to use his own term. Mr. Frederick Swanwick, one of his most rising pupils, officiated as his amanuensis; and he then remarked—what in after years he could better appreciate—the clear, terse, and vigorous style of his dictation; there was nothing superfluous in it; but it was close, direct, and to the point,—in short, thoroughly business-like. And if, in passing through the pen of the amanuensis, his meaning happened in any way to be distorted or modified, it did not fail to escape his detection, though he was always tolerant of any liberties taken with his own form of expression, so long as the words written down conveyed his real meaning. His strong natural acumen showed itself even in such matters as grammar and composition,—a department of knowledge in which, it might be supposed, he could scarcely have had either time or opportunity to acquire much information. But here, as in all other things, his shrewd common sense came to his help; and his simple, vigorous English might almost be cited as a model of composition.

His letters and reports written, and his sketches of drawings made and explained, the remainder of the evening was usually devoted to conversation with his wife and those of his pupils who lived under his roof, and constituted, as it were, part of the family. He delighted to test the knowledge of his young companions, and to question them upon the principles of mechanics. If they were not quite "up to the mark" on every point, there was no escaping detection by any evasive or specious explanations

on their part. These always met with the verdict of, "Ah! you know nought about it now; but think it over again, and tell me the answer when you understand it." If there was even partial success in the reply, it would at once be acknowledged, and a full explanation was given, to which the master would add illustrative examples for the purpose of impressing the principle more deeply upon the pupil's mind.

It was not so much his object and purpose to "cram" the minds of the young men committed to his charge with the *results* of knowledge, as to stimulate them to educate themselves—to induce them to develope their mental and moral powers by the exercise of their own free energies, and thus acquire that habit of self-thinking and self-reliance which is the spring of all true manly action. In a word, he sought to bring out and invigorate the *character* of his pupils. He felt that he himself had been made stronger and better through his encounters with difficulty; and he would not have the road of knowledge made too smooth and easy for them. "Learn for yourselves,—think for yourselves," he would say;—"make yourselves masters of principles,—persevere,—be industrious,—and there is then no fear of you." And not the least emphatic proof of the soundness of this system of education, as conducted by Mr. Stephenson, was afforded by the after history of these pupils themselves. There was not one of those trained under his eye who did not rise to eminent usefulness and distinction as an engineer. He sent them forth into the world braced with the spirit of manly self-help—inspired by his own noble example; and they repeated in their after career the lessons of earnest effort and persistent industry which his own daily life had taught them.

Mr. Stephenson's evenings at home were not, however, exclusively devoted either to business or to the graver exercises above referred to. He would often indulge in cheerful conversation and anecdote, falling back from time to time upon the struggles and difficulties of his early

life. The not unfrequent winding up of his story, addressed to the pupils about him, was—"Ah! ye young fellows don't know what wark is in these days!" Mr. Swanwick delights recalling to mind how seldom, if ever, an angry or captious word, or an angry look, marred the enjoyment of those evenings. The presence of Mrs. Stephenson conferred upon them an additional charm: amiable, kind-hearted, and intelligent, she shared quietly in the pleasure; and the atmosphere of comfort which always prevaded her home, contributed in no small degree to render it a centre of cheerful, hopeful intercourse, and of earnest, honest industry. She was a wife who well deserved, what she through life retained, the strong and unremitting affection of her husband.

When Mr. Stephenson retired for the night, it was not always that he permitted himself to sink into slumber. Like Brindley, he worked out many a difficult problem in bed; and for hours he would turn over in his mind and study how to overcome some obstacle, or to mature some project, on which his thoughts were bent. Some remark inadvertently dropped by him at the breakfast-table in the morning, served to show that he had been stealing some hours from the past night in reflection and study. Yet he would rise at his accustomed early hour, and there was no abatement of his usual energy in carrying on the business of the day.

Such is a brief sketch of Mr. Stephenson's private life and habits while carrying on the works of the Liverpool and Manchester Railway.

CHAPTER XII.

THE BATTLE OF THE LOCOMOTIVE—THE ROCKET.

THE works were far advanced towards completion before the directors had determined on the kind of tractive power to be employed in working the railway when opened for traffic. It was necessary that they should now come to a decision, and many board meetings were held for the purpose of discussing the subject. The old-fashioned and well-tried system of horse haulage was not without its advocates; but, looking at the large amount of traffic which there was to be conveyed, and at the probable delay in the transit from station to station if this method were adopted, the directors, after a visit made by them to the Northumberland and Durham railways in 1828, came to the conclusion that the employment of horse power was inadmissible.

The tunnel at Liverpool had been finished, a firm road had been formed over Chat Moss, and yet the directors had got no further than this decision against the employment of horse power. It was felt that some mechanical agency must be adopted; but whether fixed or locomotive power, was still a moot point. Fixed engines had many advocates, the locomotive very few: it stood as yet almost in a minority of one—George Stephenson. The prejudice against the employment of the latter power had even increased since the Liverpool and Manchester Bill underwent its first ordeal in the House of Commons. In proof of this, we may mention that the Newcastle and Carlisle Railway Act was conceded in 1829, on the express condition that it should *not* be worked by locomotives, but by horses only.

Grave doubts existed as to the practicability of working a large traffic by means of travelling engines. The most celebrated engineers offered no opinion on the subject.

They did not believe in the locomotive, and would not even give themselves the trouble to examine it. The ridicule with which George Stephenson had been assailed by the barristers before the Parliamentary Committee had pleased them greatly. They did not relish the idea of a man who had picked up his experience at Newcastle coal-pits appearing in the capacity of a leading engineer before Parliament, and attempting to establish a new system of internal communication in the country. Mr. Telford, the Government engineer, was consulted by his employers on the occasion of the Company applying to the Exchequer Loan Commissioners to forego their security of 30 per cent. of the calls, which the Directors wished to raise to enable them to proceed more expeditiously with the works. His report was, however, so unsatisfactory that the Commissioners would not release any part of the calls. All that Mr. Telford would say on the subject of the power to be employed was, that the use of horses had been done away with by introducing two sets of inclined planes, and he considered this an evil, inasmuch as the planes must be worked either by locomotive or fixed engines; "but," he said, "which of the two latter modes shall be adopted, I understand has not yet been finally determined; and both being recent projects, in which I have had no experience, I cannot take upon me to say whether either will fully answer in practice." It was absolutely necessary, however, that the directors of the Liverpool Railway should now come to a decision whether fixed or locomotive engines were to be employed. Mr. Stephenson urged, as usual, the superiority of the latter, in point of efficiency, convenience, and economy, over any other mode of traction. The directors, who were no engineers, could not disregard the adverse opinions of professional men, and they declined to endorse his recommendation. But Mr. Stephenson had so repeatedly and earnestly urged upon them the propriety of making a trial of the locomotive before coming to any decision against it, that they at length authorised him to proceed with the construction of one of his engines by way of experiment. In their report

to the proprietors at their annual meeting on the 27th March, 1828, they state that they had, after due consideration, authorised the engineer "to prepare a locomotive engine, which, from the nature of its construction and from the experiments already made, he is of opinion will be effective for the purposes of the company, without proving an annoyance to the public." In the same report the directors express their confidence in Mr. Stephenson, whose ability and unweared activity they are glad to take the opportunity of acknowledging. The locomotive thus ordered was placed upon the line in 1829, and was found of great service in drawing the waggons full of marl from the two great cuttings.

In the mean time the discussion proceeded as to the kind of power to be permanently employed for the working of the railway. The directors were inundated with schemes of all sorts for facilitating locomotion. The projectors of England, France, and America, seemed to be let loose upon them. There were plans for working the waggons along the line by water power. Some proposed hydrogen, and others carbonic acid gas. Atmospheric pressure had its eager advocates. And various kinds of fixed and locomotive steam power were suggested. Thomas Gray urged his plan of a greased road with cog rails; and Messrs. Vignolles and Ericsson recommended the adoption of a central friction rail, against which two horizontal rollers under the locomotive, pressing upon the sides of this rail, were to afford the means of ascending the inclined planes. The directors felt themselves quite unable to choose from amidst this multitude of projects. Their engineer expressed himself as decidedly as heretofore in favour of smooth rails and locomotive engines, which, he was confident, would be found the most economical and by far the most convenient moving power that could be employed. The Stockton and Darlington Railway being now at work, another deputation went down personally to inspect the fixed and locomotive engines on that line, as well as at Hetton and Killingworth. They returned to Liverpool with much information; but their

testimony as to the relative merits of the two kinds of engines was so contradictory, that the directors were as far from a decision as ever.

They then resolved to call to their aid two professional engineers of high standing, who should visit the Darlington and Newcastle railways, carefully examine both modes of working—the fixed and locomotive, and report to them fully on the subject. The gentlemen selected were Mr. Walker of Limehouse, and Mr. Rastrick of Stourbridge. After carefully examining the modes of working the northern railways, they made their report to the directors in the spring of 1829. These engineers concurred in the opinion that the cost of an establishment of fixed engines would be somewhat greater than that of locomotives to do the same work; but that the annual charge would be less if the former were adopted. They calculated that the cost of moving a ton of goods thirty miles by fixed engines would be 6·40*d.*, and by locomotives, 8·36*d.*,—assuming a profitable traffic to be obtained both ways. At the same time it was admitted that there appeared more ground for expecting improvements in the construction and working of locomotives than of stationary engines. "On the whole, however, and looking especially at the computed annual charge of working the road on the two systems on a large scale, Messrs. Walker and Rastrick were of opinion that fixed engines were preferable, and accordingly recommended their adoption to the directors." * And in order to carry the

* Mr. Booth's Account, pp. 70-1. While concurring with Mr. Rastrick in recommending "the stationary reciprocating system as the best," if it was the directors' *intention to make* the line complete at once, so as to accommodate the traffic expected by them, or a quantity approaching to it (*i. e. 3750 tons* of goods and passengers from Liverpool towards Manchester, and 3950 tons from Manchester towards Liverpool), Mr. Walker added,—"but if any circumstances should induce the directors to proceed by degrees, and to proportion the power of conveyance to the demand, then we recommend locomotive engines upon the line generally; and two fixed engines upon Rainhill and Sutton planes, to draw up the locomotive engines as well as the goods and carriages." And "if on any occasion the trade should get beyond the supply of locomotives, *the horse* might form a temporary substitute." As, however, it was the directors' determination, with a view to the success of their experiment, to open the line complete for working, they felt that it would be unadvisable to adopt this partial experiment; and it was still left for them to decide whether they would adopt or not the substantial recommendation of the reporting engineers in favour of the stationary engine system for the complete accommodation of the expected traffic.

system recommended by them into effect, they proposed to divide the railroad between Liverpool and Manchester into nineteen stages of about a mile and a half each, with twenty-one engines fixed at the different points to work the trains forward.

Here was the result of George Stephenson's labours! The two best practical engineers of the day concurred in reporting in favour of the employment of fixed engines! Not a single professional man of eminence could be found to coincide with him in his preference for locomotive over fixed engine power. He had scarcely a supporter; and the locomotive system seemed on the eve of being abandoned. Still he did not despair. With the profession against him, and public opinion against him,—for the most frightful stories were abroad respecting the dangers, the unsightliness, and the nuisance which the locomotive would create,—Mr. Stephenson held to his purpose. Even in this, apparently the darkest hour of the locomotive, he did not hesitate to declare that locomotive railroads would, before many years had passed, be "the great highways of the world."

At the meetings of the directors, and in his numerous reports, he combated in detail the reports of the consulting engineers,—urged that the simplicity of the locomotive engine power, and its application to any quantity of trade, would best answer the purpose of the railway,—pointed out that the Messrs. Walker and Rastrick had under-estimated the working expense of fixed engines, while they had over-stated that of locomotives; but, above all, he insisted that the adoption of fixed engines and ropes—an accident to any of which would involve the stoppage of the entire arrangements—would render the Liverpool and Manchester line altogether unfitted for the purposes of a public railway. The convenience of locomotives, which could be increased in power and number according to the requirements of the

traffic, appeared to him one of their chief advantages; they would form a series of short unconnected chains, any one of which could be removed and another at once substituted, in event of an accident, without interruption to the traffic; whereas, according to the admission of Mr. Walker himself, the fixed engine system would constitute a continuous chain, extending from Liverpool to Manchester, "the failure of one link of which would derange the whole." This, in Mr. Stephenson's view, constituted a capital objection to the adoption of the latter plan. Besides, he did not hesitate to express his decided conviction that, in reporting against the locomotive, the consulting engineers had not made themselves fully acquainted with its powers, and especially that they had not taken into account the value of the steam blast. They had obviously overlooked the most important property of this beautiful contrivance, by which it increases the production of steam exactly in proportion to the velocity of the engine. The quicker the strokes of the piston, the stronger the draught in the chimney, the more intense the combustion of fuel in the furnace, and the more rapid the production of steam, on which the power of the engine depends. Mr. Walker, in his report, assumed that the power of the engine was in an inverse ratio to its velocity; but Mr. Stephenson held, what has since been clearly established, that, instead of the steam becoming exhausted, and the working power of the locomotive lessened, in proportion to its speed, the result was the very reverse, and that the expenditure of steam was, by means of the important contrivance of the blast, made subservient, through the more intense combustion of fuel which it excited, to the increased production of power in the engine.*

The directors could not fail to have been influenced by these arguments. But the fixed-engine party was very strong at the board, and, led by Mr. James Cropper, they

* This principle was afterwards clearly illustrated by Mr. Robert Stephenson in the joint essay entitled 'Observations on the Comparative Merits of Locomotive and Fixed Engines,' published by himself and Mr. Locke (as compiled from the Reports of Mr. George Stephenson) in reply to the Report of *Mr. James Walker, C.E. The pamphlet was published in February, 1830.*

urged the propriety of forthwith adopting the report of Messrs. Walker and Rastrick. Mr. Sandars and Mr. William Rathbone, on the other hand, desired that a fair trial should be given to the locomotive; and they with reason objected to the expenditure of the large capital necessary to construct the proposed engine-houses, with their fixed engines, ropes, and machinery, until they had tested the powers of the locomotive as recommended by their own engineer. Mr. Stephenson continued to urge upon them that the locomotive was yet capable of great improvements, if proper inducements were held out to inventors and machinists to make them; and he pledged himself that, if time were given him, he would construct an engine that should satisfy their requirements, and prove itself capable of working heavy loads along the railway with speed, regularity, and safety.

The directors were more bewildered than ever. Yet they had confidence in their engineer, and had but recently borne public testimony to his practical efficiency. They *had seen him form a road* which other engineers of high reputation had repeatedly declared to be impracticable; and it might be the same with the locomotive.

At length, influenced by his persistent earnestness not less than by his arguments, the directors, at the suggestion of Mr. Harrison, determined to offer a prize of 500*l.* for the best locomotive engine, which on a certain day, should be produced on the railway, and perform certain specified conditions in the most satisfactory manner. The conditions were these:—

1. The engine must effectually consume its own smoke.
2. The engine, if of six tons weight, must be able to draw after it, day by day, twenty tons weight (including the tender and water-tank) at *ten miles* an hour, with a pressure of steam on the boiler not exceeding fifty pounds to the square inch.
3. The boiler must have two safety valves, neither of which must be fastened down, and one of them be completely out of the control of the engineman.

4. The engine and boiler must be supported on springs, and rest on six wheels, the height of the whole not exceeding fifteen feet to the top of the chimney.

5. The engine, with water, must not weigh more than six tons; but an engine of less weight would be preferred on its drawing a proportionate load behind it; if of only four and a half tons, then it might be put on only four wheels. The Company to be at liberty to test the boiler, &c., by a pressure of one hundred and fifty pounds to the square inch.

6. A mercurial gauge must be affixed to the machine, showing the steam pressure above forty-five pounds per square inch.

7. The engine must be delivered, complete and ready for trial, at the Liverpool end of the railway, not later than the 1st of October, 1829.

8. The price of the engine must not exceed 550*l*.

It will be observed that the requirements of the directors as to speed were not excessive. All that they asked for was, that a speed of ten miles an hour should be maintained. Perhaps they had in mind the severe animadversions of the Quarterly Reviewer on the absurdity of travelling at a greater velocity, and also the remarks published by Mr. Nicholas Wood, whom they selected to be one of the judges of the competition, in conjunction with Mr. Rastrick of Stourbridge and Mr. Kennedy of Manchester.

It was now generally felt that the fate of railways in a great measure depended upon the issue of this appeal to the mechanical genius of England. When the advertisement of the prize for the best locomotive was published, scientific men began more particularly to direct their attention to the new power which was thus struggling into existence. In the mean time public opinion on the subject of railway working remained suspended, and the progress of the undertaking was watched with the most intense interest.

We now return to the history of the locomotive factory

commenced by Mr. Stephenson and his associates at Newcastle in the year 1824. Its establishment at that early period was a most important step in the progress of the railway system, and mainly contributed to the eventual triumph of the locomotive. Mr. Stephenson engaged skilled mechanics in the workshops, by whose example others were trained and educated. Having their attention specially directed to the fabrication of locomotives, they acquired a skill and precision in the manufacture of the several parts, which gave to the Stephenson factory a prestige which was afterwards a source of no small profit to its founders. It was a school or college, in which the locomotive workmen of the kingdom were trained; and many of the most celebrated engineers of Europe, America, and India, acquired their best practical knowledge in its workshops.

Forth Street Works, Newcastle.

Several years, however, passed before the factory so much as paid expenses. For the first four or five years it

was carried on at a considerable loss; and Edward Pease wished to retire, but Mr. Stephenson could not provide the necessary money to buy him out. It must therefore be persevered in until the locomotive had established itself in public estimation as a practicable and economical motive power. And that time was now fast approaching.

It will be remembered that Robert Stephenson set out for the mines of Columbia in South America in the year 1824, during the time that the works of the Stockton and Darlington Railway were in progress. He remained there until the middle of 1827, when he received a letter from his father urging him to come home and take charge of the Newcastle works, as the time was coming when there would probably be a fair chance for the locomotive. Mr. Stephenson felt that he was now engaged in the greatest enterprise of his life; and he wanted some fast friend and helper to stand by him and aid him in developing his plans as to the locomotive railway system. He knew that he could rely upon the now matured judgment of his son: and he urged him to return home forthwith. Accordingly, Robert made immediate arrangements to leave Columbia for England, which he reached in December, 1827.

Mr. Robert Stephenson, on his arrival in England, proceeded to take charge of the locomotive manufactory at Newcastle, thenceforward devoting himself assiduously to the development of his father's ideas of the locomotive; and, by the great additions made by him to its working powers from time to time, as will afterwards be seen, he contributed in an eminent degree to the ultimate success of the railway system.

During the progress of the important discussion at Liverpool with reference to the kind of power to be employed in working the railway, the father and son were in constant communication, and Robert made frequent visits to Liverpool for the purpose of assisting his father in the preparation of his reports to the board on the subject. Mr. Swanwick remembers the vivid interest of the evening discussions which then took place between father and son as to

the best mode of increasing the powers and perfecting the mechanism of the locomotive. He wondered at their quick perception and rapid judgment on each other's suggestions, at the mechanical difficulties which they anticipated and at once provided for in the practical arrangement of the machine; and he speaks of these evenings as most interesting displays of two actively ingenious and able minds, stimulating each other to feats of mechanical invention, by which it was ordained that the locomotive engine should become what it now is. These discussions became more frequent, and still more interesting, after the public prize had been offered for the best locomotive by the directors of the railway, and the working plans of the engine which they proposed to construct had to be settled.

One of the most important considerations in the new engine was the arrangement of the boiler and the extension of its heating surface to enable steam enough to be raised rapidly and continuously, for the purpose of maintaining high rates of speed,—the effect of high-pressure engines being ascertained to depend mainly upon the quantity of steam which the boiler can generate, and upon its degree of elasticity when produced. The quantity of steam so generated, it will be obvious, must chiefly depend upon the quantity of fuel consumed in the furnace, and, by consequence, upon the high rate of temperature maintained there.

It will be remembered that in Mr. Stephenson's first Killingworth engines he invented and applied the ingenious method of stimulating combustion in the furnace, by throwing the waste steam into the chimney after performing its office in the cylinders, thus accelerating the ascent of the current of air, greatly increasing the draught, and consequently the temperature of the fire. This plan was adopted by him, as we have already seen, as early as 1815; and it was so successful that he himself attributed to it the greater economy of the locomotive as compared with horse power, and hence its continued use upon the Killingworth Railway.

Though the adoption of the steam blast greatly quickened

combustion and contributed to the rapid production of high-pressure steam, the limited amount of heating surface presented to the fire was still felt to be an obstacle to the complete success of the locomotive engine. Mr. Stephenson endeavoured to overcome this by lengthening the boilers and increasing the surface presented by the flue tubes. He also further endeavoured to meet the difficulty by doubling the flue, the last engine which he constructed for the Stockton and Darlington Railway, previous to the building of the "Rocket," being constructed with a double tube, which thus presented a considerably greater surface to the fire. The "Lancashire Witch," built by him for the Bolton and Leigh Railway, and employed in the completion of the Liverpool and Manchester Railway embankments, was also constructed with a double tube, each of which contained a fire and passed longitudinally through the boiler. But this arrangement necessarily led to a considerable increase in the weight of these engines, which amounted to about twelve tons each; and as six tons was the limit allowed for engines admitted to the Liverpool competition, it was clear that the time was come when the Killingworth engine must undergo a further important modification.

For many years previous to this period, ingenious mechanics had been engaged in attempting to solve the problem of the best and most economical boiler for the production of high-pressure steam. As early as 1803, Mr. Woolf patented a tubular boiler, which was extensively employed at the Cornish mines, and was found greatly to facilitate the production of steam, by the extension of the heating surface. The ingenious Trevithick, in his patent of 1815, seems also to have entertained the idea of employing a boiler constructed of "small perpendicular tubes," with the object of increasing the heating surface. These tubes were to be closed at the bottom, opening into the common reservoir, from whence they were to receive their water, and into which the steam of all the tubes was to be united. It does not, however, appear that any locomotive

was ever constructed according to this patent. Mr. Goldsworthy Gurney, the persevering inventor of steam-carriages for travelling on common roads, also applied the tubular principle extensively in his boiler, the steam being generated within the tubes. Messrs. Summers and Ogle invented a boiler for their turnpike-road steam-carriage, consisting of a series of tubes placed vertically over the furnace, through which the heated air passed before reaching the chimney. The application of the same principle to the railway locomotive, it has been stated by a French author, was first effected by M. Seguin, the engineer of the Lyons and St. Etienne Railway. He claimed to have patented a boiler, in 1828, in which he placed a series of horizontal tubes immersed in the water, through which the hot air passed in streamlets, thus greatly increasing the heating surface, and consequently the evaporative power.

Two locomotives had been constructed at Mr. Stephenson's works in Newcastle for the St. Etienne Railway, which were sent to France in 1829. In the boilers of these engines tubes were placed containing water, by which the heating surface was materially increased; but the expedient was not successful, for the tubes, becoming furred with deposit, shortly burned out. It was then that M. Seguin, pursuing the same idea, is said to have adopted his plan of employing horizontal tubes through which the heated air passed. Mr. Henry Booth, the secretary of the Liverpool and Manchester Railway, without any knowledge of M. Seguin's proceedings, next devised his plan of a tubular boiler, which he brought under the notice of Mr. Stephenson, who at once adopted it, and settled the mode in which the firebox and tubes were to be mutually arranged and connected. This plan was adopted in the construction of the celebrated "Rocket" engine, the building of which was immediately proceeded with at the works of Messrs. Robert Stephenson and Co., Newcastle-on-Tyne.

The fitting of the copper tubes in the boiler of the "Rocket" so as to prevent leakage, was a work of some

difficulty. They were manufactured by a Newcastle coppersmith, and soldered to brass screws, which were screwed into the boiler ends, standing out in great knobs. When the tubes were thus fitted, and the boiler was filled with water, hydraulic pressure was applied; but the water squirted out at every joint, and the factory floor was soon flooded. Robert went home in despair; and in the first moment of grief, he wrote to his father that the whole thing was a failure. By return of post came a letter from his father, telling him that despair was not to be thought of—that he must "try again;" and he suggested a mode of overcoming the difficulty, which his son had already anticipated and proceeded to adopt. It was, to bore clean holes in the boiler ends, fit in the smooth copper tubes as tightly as possible, solder up, and then raise the steam. This plan succeeded perfectly, the expansion of the copper tubes completely filling up all interstices, and producing a perfectly watertight boiler, capable of withstanding extreme internal pressure.

The mode of employing the steam-blast for the purpose of increasing the draught in the chimney was also the subject of numerous experiments. When the engine was first tried, it was thought that the blast in the chimney was not sufficiently strong for the purpose of keeping up the intensity of the fire in the furnace, so as to produce high-pressure steam with the required velocity. The expedient was therefore adopted of hammering the copper tubes at the point at which they entered the chimney, whereby the blast was considerably sharpened; and on a further trial it was found that the draught was increased to such an extent as to enable abundance of steam to be raised. The rationale of the blast may be simply explained by referring to the effect of contracting the pipe of a water-hose, by which the force of the jet of water is proportionately increased. Widen the nozzle of the pipe, and the jet is in like manner diminished. So it is with the steam-blast in the chimney of the locomotive.

Doubts were, however, expressed whether the greater

draught secured by the contraction of the blast-pipe was not counterbalanced in some degree by the negative pressure upon the piston. A series of experiments was made with pipes of different diameters; and their efficiency was tested by the amount of vacuum that was produced in the smoke-box. The degree of rarefaction was determined by a glass tube fixed to the bottom of the smoke-box, and descending into a bucket of water, the tube being open at both ends. As the rarefaction took place, the water would of course rise in the tube; and the height to which it rose above the surface of the water in the bucket was made the measure of the amount of rarefaction. These experiments proved that a considerable increase of draught was obtained by the contraction of the orifice; accordingly, the two blast-pipes opening from the cylinders into either side of the "Rocket" chimney, and turned up within it,* were contracted slightly below the area of the steam-ports; and before the engine left the factory, the water rose in the glass tube three inches above the water in the bucket.

The other arrangements of the "Rocket" were briefly these:—The boiler was cylindrical with flat ends, six feet in length, and three feet four inches in diameter. The upper half of the boiler was used as a reservoir for the steam, the lower half being filled with water. Through the lower part, twenty-five copper tubes of three inches diameter extended, which were open to the fire-box at one end, and to the chimney at the other. The fire-box, or furnace, two feet wide and three feet high, was attached immediately behind the boiler, and was also surrounded with water. The cylinders of the engine were placed on each side of the boiler, in an oblique position, one end being nearly level with the top of the boiler at its after

* The alteration afterwards made in the blast of the "Rocket," after the competition at Rainhill, by which the two separate exit pipes were thrown into one, as in the original Killingworth engines, was adopted rather with the view of lessening the space occupied by them in the chimney than because of any increased effect thereby secured, though it is probable that the jet of steam is rather more efficient when thrown upwards in the exact centre of the chimney than when slightly on one side.

end, and the other pointing towards the centre of the foremost or driving pair of wheels, with which the connexion was directly made from the piston-rod to a pin on the outside of the wheel. The engine, together with its load of water, weighed only four tons and a quarter; and it was supported on four wheels, not coupled. The tender was four-wheeled, and similar in shape to a waggon,—the foremost part holding the fuel, and the hind part a water-cask.

When the "Rocket" was completed, it was placed upon the Killingworth railway for the purpose of experiment. The new boiler arrangement was found perfectly successful. The steam was raised rapidly and continuously, and in a quantity which then appeared marvellous. The same evening a letter was dispatched to George Stephenson at Liverpool, informing him, to his great joy, that the "Rocket" was "all right," and would be in complete working trim by the day of trial. The engine was shortly after sent by waggon to Carlisle, and thence shipped for Liverpool.

The time so much longed for by Mr. Stephenson had now arrived, when the merits of the passenger locomotive were about to be put to the test. He had fought the battle for it until now almost single-handed. Engrossed by his daily labours and anxieties, and harassed by difficulties and discouragements which would have crushed the spirit of a less resolute man, he had held firmly to his purpose through good and through evil report. The hostility which he experienced from some of the directors opposed to the adoption of the locomotive, was the circumstance that caused him the greatest grief of all; for where he had looked for encouragement, he found only carping and opposition. But his pluck never failed him; and now the "Rocket" was upon the ground,—to prove, to use his own words, "whether he was a man of his word or not."

Great interest was felt at Liverpool, as well as throughout the country, in the approaching competition. Engineers, scientific men, and mechanics, arrived from all quarters to

witness the novel display of mechanical ingenuity on which such great results depended. The public generally were no indifferent spectators either. The populations of Liverpool, Manchester, and the adjacent towns felt that the successful issue of the experiment would confer upon them individual benefits and local advantages almost incalculable, whilst populations at a distance waited for the result with almost equal interest.

On the day appointed for the great competition of locomotives at Rainhill, the following engines were entered for the prize:—

1. Messrs. Braithwaite and Ericsson's "Novelty."
2. Mr. Timothy Hackworth's "Sanspareil."
3. Messrs. R. Stephenson and Co.'s "Rocket."
4. Mr. Burstall's "Perseverance."

Another engine was entered by Mr. Brandreth of Liverpool—the "Cycloped," weighing three tons, worked by a horse in a frame; but it could not be admitted to the competition. The above were the only four exhibited, out of a considerable number of engines constructed in different parts of the country in anticipation of this contest, but which could not be satisfactorily completed by the day of trial.

The ground on which the engines were to be tried was a level piece of railroad, about two miles in length. Each was required to make twenty trips, or equal to a journey of seventy miles, in the course of the day; and the average rate of travelling was to be not under ten miles an hour. It was determined that, to avoid confusion, each engine should be tried separately, and on different days.

The day fixed for the competition was the 1st of October, but to allow sufficient time to get the locomotives into good working order, the directors extended it to the 6th. On the morning of the 6th, the ground at Rainhill presented a lively appearance, and there was as much excitement as if the St. Leger were about to be run. Many thousand spectators looked on, amongst whom were some of the first en-

gineers of the day. A stand was provided for the ladies; and the "beauty and fashion" of the neighbourhood were present, whilst the side of the road was lined with carriages of all descriptions.

It was quite characteristic of Mr. Stephenson, that, although his engine did not stand first on the list for trial, it was the first that was ready; and it was accordingly ordered out by the judges for an experimental trip. The distance which it ran on that day was about twelve miles, performed in about fifty-three minutes.

The "Novelty" was next called out. It was a light engine, very compact in appearance, carrying the water and fuel upon the same wheels as the engine. The weight of the whole was only three tons and one hundredweight. A peculiarity of this engine was that the air was driven or *forced* through the fire by means of bellows. The day being now far advanced, and some dispute having arisen as to the method of assigning the proper load for the "Novelty," no particular experiment was made, further than that the engine traversed the line by way of exhibition, occasionally moving at the rate of twenty-four miles an hour.

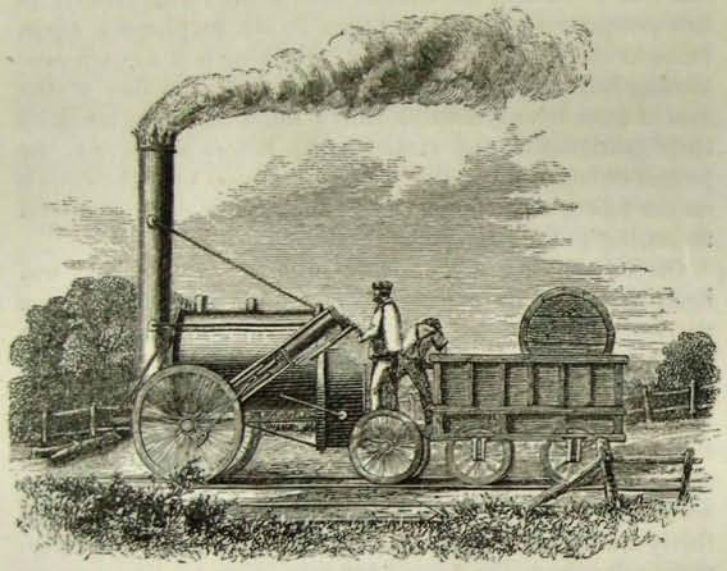
The "Sanspareil," constructed by Mr. Timothy Hackworth, was next exhibited; but no particular experiment was made with it on this day. This engine differed but little in its construction from the locomotive last supplied by Mr. Stephenson to the Stockton and Darlington Railway, of which Mr. Hackworth was the locomotive foreman. It had the double tube containing the fire, passing along the inside of the boiler, and returning back to the same end at which it entered. It had also the steam blast in the chimney; but as the contraction of the orifice by which the steam was thrown into the chimney for the purpose of intensifying the draught, was a favourite idea of Mr. Hackworth, he had sharpened the blast of his engine in a remarkable degree. This was the only novel feature in the Sanspareil.

The contest was postponed until the following day; but before the judges arrived on the ground, the bellows for

creating the blast in the "Novelty" gave way, and it was found incapable of going through its performance. A defect was also detected in the boiler of the "Sanspareil;" and Mr. Hackworth was allowed some further time to get it repaired. The large number of spectators who had assembled to witness the contest were greatly disappointed at this postponement; but, to lessen it, Mr. Stephenson again brought out the "Rocket," and, attaching to it a coach containing thirty persons, he ran them along the line at the rate of from twenty-four to thirty miles an hour, much to their gratification and amazement. Before separating, the judges ordered the engine to be in readiness by eight o'clock on the following morning, to go through its definitive trial according to the prescribed conditions.

On the morning of the 8th of October, the "Rocket" was again ready for the contest. The engine was taken to the extremity of the stage, the fire-box was filled with coke, the fire lighted, and the steam raised until it lifted the safety-valve loaded to a pressure of fifty pounds to the square inch. This proceeding occupied fifty-seven minutes. The engine then started on its journey, dragging after it about thirteen tons weight in waggons, and made the first ten trips backwards and forwards along the two miles of road, running the thirty-five miles, including stoppages, in an hour and forty-eight minutes. The second ten trips were in like manner performed in two hours and three minutes. The maximum velocity attained during the trial trip was twenty-nine miles an hour, or about three times the speed that one of the judges of the competition had declared to be the limit of possibility. The average speed at which the whole of the journeys were performed was fifteen miles an hour, or five miles beyond the rate specified in the conditions published by the Company. The entire performance excited the greatest astonishment amongst the assembled spectators; the directors felt confident that their enterprise was now on the eve of success; and George Stephenson rejoiced to think that in spite of all false prophets and fickle counsellors, his locomotive system was now safe. When the "Rocket,"

having performed all the conditions of the contest, arrived at the "grand stand" at the close of its day's successful run, Mr. Cropper—one of the directors favourable to the fixed-engine system—lifted up his hands, and exclaimed, "Now has George Stephenson at last delivered himself!"



The "Rocket."

Neither the "Novelty" nor the "Sanspareil" was ready for trial until the 10th, on the morning of which day an advertisement appeared, stating that the former engine was to be tried on that day, when it would perform more work than any engine upon the ground. The weight of the carriages attached to it was only about seven tons. The engine passed the first post in good style; but in returning, the pipe from the forcing-pump burst and put an end to the trial. The pipe was afterwards repaired, and the engine made several trips by itself, in which it was said to have gone at the rate of from twenty-four to twenty-eight miles an hour.

The "Sanspareil" was not ready until the 13th; and when its boiler and tender were filled with water, it was found to weigh four hundredweight beyond the weight specified in the published conditions as the limit of four-wheeled engines; nevertheless the judges allowed it to run on the same footing as the other engines, to enable them to ascertain whether its merits entitled it to favourable consideration. It travelled at the average speed of about fourteen miles an hour, with its load attached; but at the eighth trip the cold-water pump got wrong, and the engine could proceed no further.

It was determined to award the premium to the successful engine on the following day, the 14th, on which occasion there was an unusual assemblage of spectators. The owners of the "Novelty" pleaded for another trial; and it was conceded. But again it broke down. Then Mr. Hackworth requested the opportunity for making another trial of his "Sanspareil." But the judges had now had enough of failures; and they declined, on the ground that not only was the engine above the stipulated weight, but that it was constructed on a plan which they could not recommend for adoption by the directors of the Company. One of the principal practical objections to this locomotive was the enormous quantity of coke consumed or wasted by it—about 692 lbs. per hour when travelling—caused by the sharpness of the steam blast in the chimney, which blew a large proportion of the burning coke into the air.

The "Perseverance" of Mr. Burstall was found unable to move at more than five or six miles an hour; and it was withdrawn at an early period from the contest. The "Rocket" was thus the only engine that had performed, and more than performed, all the stipulated conditions; and it was declared to be fully entitled to the prize of 500*l*., which was awarded to the Messrs. Stephenson and Booth accordingly. And further to show that the engine had been working quite within its powers, Mr. Stephenson ordered it to be brought upon the ground and detached from all incumbrances, when, in making two trips, it was found

to travel at the astonishing rate of thirty-five miles an hour.

The "Rocket" had thus eclipsed the performances of all locomotive engines that had yet been constructed, and outstripped even the sanguine anticipations of its constructors. Above all, it effectually answered the report of Messrs. Walker and Rastrick, and established the superiority of the locomotive for the working of the Liverpool and Manchester Railway, and indeed all future railways. The success of the experiment, as judged by the public, may be inferred from the fact that the shares of the Company immediately rose ten per cent., and nothing further was heard of the proposed twenty-one fixed engines, engine-houses, ropes, &c. All this cumbersome apparatus had at once been effectually disposed of.

Very different now was the tone of those directors who had distinguished themselves by the persistency of their opposition to Mr. Stephenson's plans. Coolness gave way to eulogy, and hostility to unbounded offers of friendship; after the manner of many men who run to the help of the strongest. Deeply though he had felt aggrieved by the conduct pursued towards him during this eventful struggle, by some from whom forbearance was to have been expected, Mr. Stephenson never entertained towards them in after life any angry feelings; on the contrary, he forgave all. But though the directors afterwards passed unanimous resolutions eulogising "the great skill and unwearied energy" of their engineer, he himself, when speaking confidentially to those with whom he was most intimate, could not help distinguishing between his "foul-weather and fair-weather friends."

CHAPTER XIII.

OPENING OF THE LIVERPOOL AND MANCHESTER RAILWAY, AND EXTENSION OF RAILWAYS FROM LANCASHIRE TO THE METROPOLIS.

THE directors of the Railway now began to see daylight, and they derived encouragement from the skilful manner in which their engineer had overcome the principal difficulties of the undertaking. He had formed a solid road over Chat Moss, and thus achieved one "impossibility;" he had next constructed a locomotive that could run at a speed of thirty miles an hour, and thus overcome a second and even a still more formidable difficulty.

As promised by the engineer, a single line of way was completed over Chat Moss by the 1st of January, 1830; and on that day, the "Rocket" with a carriage full of directors, engineers, and their friends, passed along the greater part of the road between Liverpool and Manchester. The remaining works were now pushed on; in the mean time the coal traffic was commenced at different parts of the line; and Mr. Stephenson continued to direct his close attention to the improvement of the details of the locomotive, every successive trial of which proved more satisfactory. In this department, he had the benefit of the able and unremitting assistance of his son, who, in the workshops at Newcastle, directly superintended the construction of the new engines required for the public working of the railway. Mr. Stephenson did not by any means rest satisfied with the success, decided though it was, which he had achieved in the construction of the "Rocket." He regarded it but in the light of a successful experiment; and every succeeding engine which he placed upon the railway exhibited some *improvement upon its predecessors. The arrangement of*

the parts, and the weight and proportions of the engines, were altered, as the experience of each successive day, or week, or month, suggested; and it was soon found that the performances of the "Rocket" on the day of trial had been greatly within the powers of the locomotive.

The first entire trip between Liverpool and Manchester was performed on the 14th of June, 1830, on the occasion of a board meeting being held at the latter town. The train was on this occasion drawn by the "Arrow," one of the new locomotives, in which the most recent improvements had been adopted. Mr. Stephenson himself drove the engine, and Captain Scoresby, the circumpolar navigator, stood beside him on the foot-plate, and minuted the speed of the train. A great concourse of people assembled at both termini, as well as along the line, to witness the novel spectacle of a train of carriages dragged by an engine at a speed of seventeen miles an hour. On their arrival in Manchester within two hours, the directors were astonished as well as delighted; and they immediately proceeded to the house of Mr. Gilbert Winter, one of their number, and passed a resolution to this effect: "That the directors cannot allow this opportunity to pass without expressing their strong sense of the great skill and unwearied energy displayed by their engineer, Mr. George Stephenson, which has thus far brought this great national work to a successful termination, and which promises to be followed by results so beneficial to the country at large, and to the proprietors of this concern." On the return journey to Liverpool in the evening, the "Arrow" crossed Chat Moss at a speed of nearly twenty-seven miles an hour, reaching its destination in about an hour and a half.

At length the line was completed, and ready for the public ceremony of the opening, which took place on the 15th of September, 1830. This important event attracted a vast number of spectators from all parts of the country. Strong palings were erected for miles along the deep cuttings near Liverpool, to keep off the pressure of the multitude, and prevent them falling over in their eagerness to witness the

passing trains. Constables and soldiers were there in numbers to assist in keeping the line clear. The completion of the railway was justly regarded as an important national event, and the ceremony of the opening was celebrated accordingly. The Duke of Wellington, then Prime Minister, Sir Robert Peel, Secretary of State, Mr. Huskisson, one of the members for Liverpool, and an earnest supporter of the project from its commencement, were amongst the number of distinguished public personages present.

Eight locomotive engines constructed at the Stephenson works had been delivered and placed upon the line, the whole of which had been tried and tested, weeks before, with perfect success. The various trains of carriages accommodated in all about six hundred persons. The "Northumbrian" engine, driven by Mr. George Stephenson himself, headed the procession; then followed the "Phœnix," driven by Robert Stephenson; the "North Star," by Robert Stephenson, senior (brother of George); the "Rocket," by Joseph Locke; the "Dart," by Thomas L. Gooch; the "Comet," by William Allcard; the "Arrow," by Frederick Swanwick; and the "Meteor," by Anthony Harding. The procession was cheered in its progress by thousands of spectators—through the deep ravine of Olive Mount; up the Sutton incline; over the great Sankey viaduct, beneath which a multitude of persons had assembled,—carriages filling the narrow lanes, and barges crowding the river; the people below gazing with wonder and admiration at the trains which sped along the line, far above their heads, at the rate of some twenty-four miles an hour.

At Parkside, about seventeen miles from Liverpool, the engines stopped to take in water. Here a deplorable accident occurred to one of the most distinguished of the illustrious visitors present, which threw a deep shadow over the subsequent proceedings of the day. The "Northumbrian" engine, with the carriage containing the Duke of Wellington, was drawn up on one line, in order that the whole of the trains might pass in review before him and his party on the other. Mr. Huskisson had, unhappily,

alighted from the carriage, and was standing on the opposite road, along which the "Rocket" engine was observed rapidly coming up. At this moment the Duke of Wellington, between whom and Mr. Huskisson some coolness had existed, made a sign of recognition, and held out his hand. A hurried but friendly grasp was given; and before it was loosened there was a general cry from the bystanders of "Get in, get in!" Flurried and confused, Mr. Huskisson endeavoured to get round the open door of the carriage, which projected over the opposite rail; but in so doing he was struck down by the "Rocket," and falling with his leg doubled across the rail, the limb was instantly crushed. His first words, on being raised, were, "I have met my death," which unhappily proved too true, for he expired that same evening in the neighbouring parsonage of Eccles. It was cited at the time as a remarkable fact, that the "Northumbrian" engine conveyed the wounded body of the unfortunate gentleman a distance of about fifteen miles in twenty-five minutes, or at the rate of thirty-six miles an hour. This incredible speed burst upon the world with the effect of a new and unlooked-for phenomenon.

The lamentable accident threw a gloom over the rest of the day's proceedings. The Duke of Wellington and Sir Robert Peel expressed a wish that the procession should return to Liverpool. It was, however, represented to them that a vast concourse of people had assembled at Manchester to witness the arrival of the trains; that report would exaggerate the mischief, if they did not complete the journey; and that a false panic on that day might seriously affect future railway travelling and the value of the Company's property. The party consented accordingly to proceed to Manchester, but on the understanding that they should return as soon as possible, and refrain from further festivity.

It is scarcely necessary that we should here speak of the commercial results of the Liverpool and Manchester Railway. Suffice it to say that its success was complete and decisive. The anticipations of its projectors were, however,

in many respects at fault. They had based their calculations almost entirely on the heavy merchandise traffic—such as coal, cotton, and timber—relying little upon passengers; whereas the receipts derived from the conveyance of passengers far exceeded those derived from merchandise of all kinds, which, for a time, continued a subordinate branch of the traffic. In the evidence given before the committee of the House of Commons, the promoters stated their expectation of obtaining about one-half of the whole number of passengers that the coaches then running could take, which was from 400 to 500 a day. But the railway was scarcely opened before it carried on an average about 1200 passengers a day; and five years after the opening, it carried nearly half a million of persons yearly.

It was anticipated that the speed at which the locomotive could run upon the line would be about nine or ten miles an hour; but the wisest of the lawyers and the most experienced of the civil engineers did not believe this to be practicable, and they laughed outright at the idea of an engine running twenty miles in the hour. But very soon after the railway was opened for traffic, passengers were regularly carried the entire thirty miles between Liverpool and Manchester in little more than an hour. Two Edinburgh engineers, who went to report on the railway, expressed their wonder at the travelling being smoother and easier than any they had hitherto experienced even on the smoothest turnpikes of Mr. M'Adam. At the highest speed, of twenty-five miles an hour, they said, "we could observe the passengers, among whom were a good many ladies, talking to gentlemen with the utmost *sang froid*." Such things were considered wonderful then. It was regarded as quite extraordinary that men should be enabled, by this remarkable invention, to proceed to Manchester in the morning, do a day's business there, and return to Liverpool the same night. So successful, indeed, was the passenger traffic, that it engrossed the whole of the Company's small stock of engines.

Although the bulk of the heavy goods continued to go

by the canal, yet the opening of the railway immediately caused a large reduction in the price of coals and in the rates for the carriage of merchandise. The annual saving to the public in money, not to speak of the great saving of its equivalent—time,—was about 250,000*l.* a year. The net profit had been estimated by the projectors at 62,500*l.* a year, whereas the net profit actually realised during the first five years exceeded this amount by about 20,000*l.* The expense of executing the works had, however, been exceeded,—the estimate having been 800,000*l.*, and the actual expenditure about 1,200,000*l.*

For some time after the opening of the railway for traffic, Mr. Stephenson's ingenuity continued to be employed in devising methods for securing the safety and comfort of the travelling public. Few are aware of the thousand minute details which have to be arranged—the forethought and contrivance that have to be exercised—to enable the traveller by railway to accomplish his journey. After the difficulties of constructing a level road over bogs, across valleys, and through deep cuttings, have been overcome, the maintenance of the way has to be provided for with continuous care. Every rail with its fastenings must be complete to prevent risk of accident, and the road must be kept regularly ballasted up to the level to prevent the jolting of the vehicles passing over it at high speeds. Then the stations must be protected by signals observable from such a distance as to enable the train to be stopped in event of an obstacle, such as a stopping or shunting train being in the way. For some years, however, the signals employed on the Liverpool railway were entirely given by men with flags of different colours stationed along the line; there were no fixed signals, nor electric telegraphs; but the traffic was nevertheless worked quite as safely as under the more elaborate and complicated system of telegraphing which has since been established.

From an early period it became obvious that the iron road as originally laid down was quite insufficient for the heavy traffic which it had to carry. The line was in the first place

laid with fish-bellied rails of only thirty-five pounds to the yard, calculated only for horse traffic, or, at most, for engines like the "*Rocket*," of very light weight. But as the power and the weight of the locomotives were increased, it was found that such rails were quite insufficient for the safe conduct of the traffic. The engineer then recommended that the road should be relaid with heavier and stronger rails, which was done, though the alteration involved a considerable additional expense to the Company.

The details of the carrying stock had in like manner to be devised and settled. There was no past experience to serve for a guide in this new sort of traffic; everything had in a measure to be begun from the beginning. The coal-waggon, it is true, served in some degree as a model for the railway truck; but the railway passenger-carriage was an entirely novel structure. It had to be mounted upon strong framing, of a peculiar kind, supported on springs to prevent jolting. Then there was the necessity for contriving some method of preventing hard bumping of the carriage-ends when the train was pulled up; and hence the contrivance of buffer springs and spring frames. As a method of stopping the train, brakes on an improved plan were also contrived, with new modes of lubricating the carriage-axles, on which the wheels revolved at an unusually high velocity. In all these contrivances, Mr. Stephenson's inventiveness was kept constantly on the stretch; and though many improvements in detail have been effected since his time, the foundations were then laid by him of the present system of conducting railway traffic. As a curious illustration of the inventive ingenuity which he displayed in contriving the working of the Liverpool line, we may mention his invention of the Self-acting Brake. He early entertained the idea, that the momentum of the running train might itself be made available for the purpose of checking its speed. He proposed to fit each carriage with a brake which should be called into action immediately on the locomotive at the head of the train being pulled up. The impetus of the carriages carrying them forward, the buffer springs would

be driven home, and, at the same time, by a simple arrangement of the mechanism, the brakes would be called into simultaneous action; thus the wheels would be brought into a state of sledge, and the train speedily stopped. This plan was adopted by Mr. Stephenson before he left the Liverpool and Manchester Railway, though it was afterwards discontinued; and it is a remarkable fact, that this identical plan, with the addition of a centrifugal apparatus, has quite recently been revived by M. Guérin, a French engineer, and extensively employed on foreign railways as the best method of stopping railway trains in the most efficient manner and in the shortest time.

Finally, Mr. Stephenson had to attend to the improvement of the power and speed of the locomotive—always the grand object of his study,—with a view to economy as well as regularity in the working of the railway. In the "Planet" engine, delivered upon the line immediately subsequent to the public opening, all the improvements which had up to this time been contrived by him and his son, were introduced in combination—the blast pipe, the tubular boiler, horizontal cylinders inside the smoke-box, the cranked axle, and the fire-box firmly fixed to the boiler. The first load of goods conveyed from Liverpool to Manchester by the "Planet" was eighty tons weight, and the engine performed the journey against a strong head wind, in two hours and a half. On another occasion, the same engine brought up a cargo of voters from Manchester to Liverpool, during a contested election, within a space of sixty minutes. The "Samson," delivered in the following year, exhibited still further improvements, the most important of which was that of *coupling* the fore and hind wheels of the engine. By this means, the adhesion of the wheels on the rails was more effectually secured, and thus the full hauling power of the locomotive was made available. The "Samson," shortly after it was placed upon the line, dragged after it a train of waggons weighing one hundred and fifty tons at a speed of about twenty miles an hour; the consumption of coke being reduced to only about a third of a pound per ton per mile.

The engineer had also to seek out the proper men to maintain and watch the road, and more especially to work the locomotive engines. Steadiness, sobriety, common sense, and practical experience, were the qualities which he especially valued in those selected by him for this purpose. But where were the men of experience to be found? Very few railways were yet at work, and those were almost exclusively confined to the northern coal counties; hence a considerable proportion of the drivers and firemen employed on the Liverpool line were brought from the neighbourhood of Newcastle. Mr. Stephenson was, however, severely censured in the 'Edinburgh Review,' for the alleged preference shown by him in selecting workmen from his own county. It was there insisted that the local population had the first claim to be employed, and he was blamed for "introducing into the country a numerous body of workmen, in various capacities, strangers to the soil and to the surrounding population; thus wresting from the hands of those to whom they had naturally belonged, all the benefits which the enterprise and capital of the district had conferred." In the case of the drivers of stage-coaches, it was never regarded as a qualification for the performance of their duties, that they should be natives of the parishes through which the coaches ran, but mainly that they should know something of the business of coach-driving. Mr. Stephenson merely adopted the same course in selecting his drivers and firemen; and though Durham and Northumberland supplied a considerable proportion of them in the first instance, he could not always find skilled workmen enough for the important and responsible duties to be performed. It was a saying of his, that "he could engineer matter very well, and make it bend to his purpose, but his greatest difficulty was in engineering *men*."

Mr. Stephenson did not think it necessary to vindicate himself from the above charge, but Mr. Hardman Earle, one of the directors of the Company, did so in an effectual manner, showing that of the six hundred persons employed in the working of the Liverpool line, not more than sixty had

been recommended by their engineer, and of these a considerable number were personally unknown to him. Some of them indeed had been brought up under his own eye, and were men whose character and qualifications he could vouch for. But these were not nearly enough for his purpose; and he often wished that he could contrive heads and hands on which he might rely, as easily as he could construct railways and manufacture locomotives. As it was, Stephenson's enginemen were in request all over England; the Newcastle workshops continuing for many years to perform the part of a training school for engineers, and to supply locomotive superintendents and drivers, not only for England but for nearly every country in Europe; preference being given to them by the directors of railways, in consequence of their previous training and experience, as well as because of their generally excellent qualities as steady and industrious workmen.

It was at the same time made a ground of complaint against Mr. Stephenson, that he had obtained a monopoly of the engines supplied to the Liverpool line,—the simple fact being, that this Newcastle factory was the *only* source from which efficient engines could at that time be obtained. Although the Directors declined to allow their railway to be used as a practising ground for experimenters, in the midst of a large and increasing traffic, they were fully alive to the importance of inducing competition in the new branch of manufacture, and offered every inducement to mechanical engineers, with the view of enlarging the sources from which they could draw their supplies of engines. And so soon as they could rely upon the quality of the article supplied to them by other firms, they distributed their orders indiscriminately and impartially.

The success of the Liverpool and Manchester experiment naturally excited great interest. People flocked to Lancashire from all quarters to see the locomotive running upon a railway at three times the speed of a mail-coach, and to enjoy the excitement of actually travelling in the wake of a steam engine at that incredible velocity. The travellers

returned to their respective districts full of the wonders of the railway, considering it to be the greatest marvel of the age. Railways are familiar enough objects now, and our children who grow up in their midst may think little of them; but thirty years since it was an event in one's life to see a locomotive, and to travel for the first time upon a public railroad.

In remote country districts, however, the stories about the Liverpool railway were received with considerable incredulity, and the proposal to extend such roads in all directions throughout the country caused great alarm. In the districts through which stage-coaches ran, giving employment to large numbers of persons, it was apprehended that if railways were established, the turnpike roads would become deserted and grown over with grass, country inns and their buxom landladies would be ruined, the race of coach-drivers and hostlers would become extinct, and the breed of horses be entirely destroyed. Hence from time to time the spirits of country readers of the local papers were kept up by paragraphs recounting dreadful accidents on the Liverpool railway; thus, in September, 1830, an alarming paragraph went the rounds, headed a "Dreadful Accident,"* from which it appeared that in consequence of Mr. Stephenson having tried the utmost speed to which the locomotive engine could be propelled, it had burst its boiler, killed his brother "the contractor for the railroad," and "injured another person so severely that no hopes were entertained of his recovery." A month later, the same paragraph was revived and again went the rounds, adding that "several lives" had been destroyed. Nor were the dangers of Chat Moss yet forgotten, and the rumour was often revived of the Moss having sunk under a train, and swallowed up locomotive, passengers, and all! These "dreadful accidents," however, fortunately turned out to be mere inventions devised for pleasant reading in country quarters.

At the same time there was hope for the coaching in-

* Northampton Mercury, September 11th, 1830.

terest, in the fact that the government were employing their engineer, Mr. Telford, in so improving the public high roads as to render railways unnecessary. It was announced in the papers that a saving of thirty miles would be effected by the new road between London and Holyhead, and an equal saving between London and Edinburgh. And to show what the speed of horses could accomplish, we find it set forth as an extraordinary fact, that the "Patent Tallyho Coach" in the year 1830 (when the Birmingham line had been projected), performed the entire journey of 109 miles between London and Birmingham—breakfast included—in seven hours and fifty minutes! Great speed was also recorded on the Brighton road, the "Red Rover" doing the distance between London and Brighton in four hours and a half. These speeds were not, however, secured without accidents, for there was scarcely a newspaper of the period that did not contain one or more paragraphs headed "Another dreadful coach accident."

The practicability of railway locomotion being now proved, and its great social and commercial advantages ascertained, the extension of the system was merely a question of time, money, and labour. A fine opportunity presented itself for the wise and judicious action of the government in the matter,—the improvement of the internal communications of a country being really one of its most important functions. But the government of the day, though ready enough to spend money in improvements of the old turnpike roads, regarded the railroads with hostility, and met them with obstructions of all kinds. They seemed to think it their duty to protect the turnpike trusts, disregarding the paramount interest of the general public. This may possibly account for the singular circumstance that, at the very time they were manifesting indifference or aversion to the locomotive on the railroad, they were giving every encouragement to the locomotive on the turnpike road. In 1831, we find a Committee of the House of Commons appointed to inquire into and report upon—not the railway system—but the applicability of the steam

carriage to common roads; and, after investigation, the committee were so satisfied with the evidence taken, that they reported decidedly in favour of the road-locomotive system. Though they ignored the railway, they recognised the steam carriage. But even a report of the House of Commons—powerful though it be—cannot alter the laws of gravity and friction; and the road-locomotive remained, what it ever will be, an impracticable machine. Not that it is impossible to work a locomotive upon a common road; but to work it to any profit at all as compared with the locomotive upon a railway. Numerous trials of steam carriages were made at the time by Sir Charles Dance, Mr. Hancock, Mr. Gurney, Sir James Anderson, and other distinguished gentlemen of influence; but, notwithstanding the House of Commons' report in its favour, Mr. Stephenson's first verdict, pronounced upon it many years before, when he was only an engine-wright at Killingworth, was fully borne out by the result; and it became day by day clearer that the attempt to introduce the road-locomotive into general use on turnpike roads could only prove a delusion and a snare.

Although the legislature took no initiative step in the direction of railway extension, the public spirit and enterprise of the country did not fail it at this juncture. The English people, though they may be defective in their capacity for organization, are strong in individualism; and not improbably their admirable qualities in the latter respect detract from their efficiency in the former. Thus, in all times, their greatest national enterprises have not been planned by officialism and carried out upon any regular system, but have sprung, like their constitution, their laws, and their entire industrial arrangements, from the force of circumstances and the individual energies of the people. Hence railway extension, like so many other great English enterprises, was now left to be carried out by the genius of English engineers, backed by the energy of the English public.

The mode of action was characteristic and national. The

execution of the new lines was undertaken entirely by joint-stock associations of proprietors, after the manner of the Stockton and Darlington, and Liverpool and Manchester companies. These associations are conformable to our national habits, and fit well into our system of laws. They combine the power of vast resources with individual watchfulness and motives of self-interest; and by their means gigantic enterprises, which elsewhere would be impossible to any but kings and emperors with great national resources at command, were carried out by the co-operation of private persons. And the results of this combination of means and of enterprise have been truly marvellous. Within the life of the present generation, the private citizens of England engaged in railway enterprises have, in the face of Government obstructions, and without taking a penny out of the public purse, executed a system of railways involving works of the most gigantic kind, which, in their total mass, their cost, and their eminent public utility, far exceed the most famous national constructions of any age or country.

Mr. Stephenson was of course actively engaged in the construction of the numerous railways now projected by the joint-stock companies. During the formation of the Manchester and Liverpool line, he had been consulted respecting many projects of a similar kind. One of these was a short railway between Canterbury and Whitstable, about six miles in length. He was too much occupied with the works at Liverpool to give this scheme much of his personal attention. But he sent his assistant, Mr. John Dixon, to survey the line; and afterwards Mr. Locke to superintend the execution of the principal works. The act was obtained in 1826, and the line was opened for traffic in 1830. It was partly worked by fixed-engine power, and partly by Stephenson's locomotives, similar to the engines used upon the Stockton and Darlington Railway.

Another project respecting which he was consulted about the same time, was the Leicester and Swannington Railway, a short line, the object of which was to open up a communi-

cation between the town of Leicester and the coal-fields in the western part of the county. Mr. Ellis, afterwards chairman of the Midland Railway, and, like Edward Pease, a member of the Society of Friends, was the projector of the undertaking. He had some difficulty, however, in getting the requisite capital subscribed for, the Leicester townspeople who had money being for the most part interested in canals. Mr. Ellis went over to Liverpool to invite George Stephenson to come upon the ground and survey the line. He did so, and then the projector told him of the difficulty he had in finding subscribers to the concern. "Give me a sheet," said Stephenson, "and I will raise the money for you in Liverpool." The engineer was as good as his word, and in a short time the sheet was returned with the subscription complete. Mr. Stephenson was then asked to undertake the office of engineer for the line, but his answer was that he had thirty miles in hand, which were enough for any engineer to attend to properly. Was there any person he could recommend? "Well," said he, "I think my son Robert is competent to undertake the thing." Would Mr. Stephenson be answerable for him? "Oh, yes, certainly." And Robert Stephenson, at twenty-seven years of age, was installed engineer of the line accordingly.

But the desire for railway extension principally pervaded the manufacturing districts, especially after the successful opening of the Liverpool and Manchester line. The commercial classes of the larger towns soon became eager for a participation in the good which they had so recently derided. Railway projects were set on foot in great numbers, and Manchester became a centre from which main lines and branches were started in all directions. The interest, however, which attaches to these later schemes is of a much less absorbing kind than that which belongs to the earlier history of the English railway, and the steps by which George Stephenson secured its eventual establishment. We naturally sympathise more with the early struggles of a great principle, its trials and its difficulties, than with its after stages of success; and, however gratified

and astonished we may be at its permanent results, the secret charm of the interest is gone, and the excitement has ceased, when its ultimate triumph has become a matter of certainty.

The commercial results of the Liverpool and Manchester line were so satisfactory, and indeed so greatly exceeded the expectations of its projectors, that many of the abandoned projects of the speculative year 1825 were forthwith revived. An abundant crop of engineers sprang up, ready to execute railways of any extent. Now that the Liverpool and Manchester line had been made, and the practicability of working it by locomotive power had been proved, it was as easy for engineers to make railways and to work them, as it was for navigators to find America after Columbus had made the first voyage. George Stephenson had shown the way, and engineers forthwith crowded after him full of great projects. Mr. Francis Giles himself took the field as a locomotive railway engineer, attaching himself to the Newcastle and Carlisle and London and Southampton projects. Mr. Brunel appeared, in like manner, as the engineer of the line projected between London and Bristol; and Mr. Braithwaite, the builder of the "Novelty" engine, as the engineer of a line from London to Colchester.

The first lines, however, which were actually constructed subsequent to the opening of the Liverpool and Manchester Railway, were in connexion with it, and principally in the county of Lancaster. Thus a branch was formed from Bolton to Leigh, and another from Leigh to Kenyon, where it formed a junction with the main line between Liverpool and Manchester. Branches to Wigan on the north, and to Runcorn Gap and Warrington on the south of the same line, were also formed. A continuation of the latter, as far south as Birmingham, was shortly after projected under the name of the Grand Junction Railway. Of the principal lines projected in these districts, Mr. George Stephenson was appointed the engineer, in some cases in conjunction with his son.

The Grand Junction line was projected as early as the

year 1824, when the Liverpool and Manchester scheme was under discussion, and Mr. Stephenson then published a report on the subject. The plans were deposited, but the bill was thrown out on the opposition of the landowners and canal proprietors. When engaged in making the survey, Mr. Stephenson called upon some of the landowners in the neighbourhood of Nantwich to obtain their assent, and was somewhat disgusted to learn that the agents of the canal companies had been before him, and described the locomotive to the farmers as a most frightful machine, emitting a breath as poisonous as the fabled dragon of old; and telling them that if a bird flew over the district when one of these engines passed, it would inevitably drop down dead. The application for the bill was renewed in 1826, and again failed; and at length it was determined to wait the issue of the Liverpool and Manchester experiment. The act was eventually obtained in 1833, by which time the projectors of railways had learnt the art of "conciliating" the landlords,—and a very expensive process it proved. But it was the only mode of avoiding a still more expensive parliamentary opposition.

In like manner the Act was obtained authorizing the construction of the London and Birmingham Railway. This project caused an immense amount of alarm in the minds of the country gentlemen and farmers in the western and midland counties. They did not relish the idea of private individuals, principally resident in the manufacturing districts, invading their domains; and they everywhere rose up in arms against the "new-fangled roads." The farmers were thrown into a state of consternation at the idea of "fire-horses" running through their quiet fields and frightening their sheep and cattle while grazing. Colonel Sibthorpe openly declared his hatred of these "infernal railroads," and said that he "would rather meet a highwayman, or see a burglar on his premises, than an engineer!" Mr. Berkeley, the member for Cheltenham, at a public meeting in that town, re-echoed Colonel Sibthorpe's sentiments, and "wished that the concoctors of every such

scheme, with their solicitors and engineers, were at rest in Paradise!" The impression prevailed amongst the rural classes, that fox-covers and game-preserves would be seriously prejudiced by the formation of railroads; that agricultural communications would be destroyed, land thrown out of cultivation, landowners and farmers reduced to beggary, the poor-rates increased through the number of persons thrown out of employment by the railways,—and all this in order that Liverpool, Manchester, and Birmingham shopkeepers and manufacturers might establish a monstrous monopoly in railway traffic. However, there was generally this consolation to wind up with,—that the canals would beat the railroads; and, even if the latter were made, that the public would not use them, nor trust either their persons or goods to the risks of railway accident and explosions. They would thus prove only monuments of the folly of their projectors, whom they must eventually involve in ruin and disaster.

Nothwithstanding these alarms, the application for the line from London to Birmingham was proceeded with. Like the Grand Junction, it had been surveyed as early as 1825, but its further progress was stopped by the commercial crisis of that year. When the success of the Liverpool and Manchester project had been well nigh proved in 1830, it was again revived. There were two competing projects—one by Oxford, the other by Coventry. In those early days of railways, there was less of the combative spirit between rival projectors than unhappily prevailed at a subsequent period. The promoters were desirous of obtaining a good railroad to London, rather than of carrying on a costly warfare for the benefit of rival lawyers, surveyors, and engineers. So the two committees wisely determined to unite, and call to their aid the matured experience and judgment of Mr. George Stephenson, in adjudicating upon the merits of the respective lines. After a careful examination of the country, Mr. Stephenson reported in favour of the Coventry route; and the Lancashire gentlemen, having great confidence in his judgment, supported his decision; on which the line recommended by him was adopted.

At the meeting of gentlemen held at Birmingham to determine upon the appointment of the engineer for the railway, there was a strong party in favour of appointing as Mr. Stephenson's associate a gentleman with whom he had been brought into serious collision in the course of the Liverpool and Manchester undertaking. When the offer was made to him that he should be joint engineer with the other, he requested leave to retire and consider the proposal with his son. The two walked into St. Philip's churchyard, which adjoined the place of meeting, and debated the proposal. The father was in favour of accepting it: his struggle heretofore had been so hard, that he could not bear the idea of missing an opportunity of advancing himself. But the son, foreseeing the jealousies and heartburnings which the joint engineership would most probably create, recommended to his father the answer which Mr. Bradshaw gave, when shares were offered to the Duke of Bridgewater's Trustees in the Liverpool and Manchester line,—"All or none!" "Well, I believe you are right," said Mr. Stephenson; and returning to the Committee, he announced to them his decision. "Then 'all' be it!" replied the Chairman; and he was at once appointed the engineer of the London and Birmingham Railway in conjunction with his son, who took the principal charge of carrying out the works of that great undertaking.

From the first this project encountered the determined opposition of the landowners, canal proprietors, and the inhabitants generally of the districts proposed to be served by the railway. Public meetings were held in all the counties through which the line would pass between London and Birmingham, at which the project was denounced, and strong resolutions were passed against it. The county meetings of Northampton were held at Towcester; of Bedford at Leighton Buzzard; of Buckingham at Stony Stratford; of Hertford at Watford and Great Berkhampstead; and of Middlesex, in Exeter Hall, London. It was insisted at

those meetings that there was no necessity whatever for accelerating the existing communications, there being already abundant means of conveyance for travellers by the coaches daily travelling through the districts at ten miles an hour, whilst there was water-carriage for heavy goods to a much greater extent than had ever been required. Deputations from the promoters of the railway attended at some of these meetings for the purpose of giving explanations, but the landowners would not permit them to be heard. The Earls of Clarendon and Essex were the most powerful opponents of the measure, and the other landed proprietors followed in their wake. The attempt was made to conciliate these landlords by explanations, but all such efforts proved futile.

Sir Astley Cooper, the eminent surgeon, near whose estate at Hemel Hampstead the railway would pass, was one of the most active opponents of the measure, and a deputation of the promoters one day called upon him for the purpose of mitigating his opposition. They found a courtly old gentleman, of highly dignified manners and appearance. The deputation explained to him their project, and he politely heard them out: but Sir Astley was not to be conciliated. "The scheme is preposterous and absurd," said he, "from beginning to end. You are entering upon an enormous undertaking of which you know nothing. Then look at the recklessness of your proceedings! You are proposing to destroy property, cutting up our estates in all directions! Why, gentlemen, if this sort of thing be permitted to go on, you will in a very few years *destroy the noblesse!*" The deputation retired disgusted, one of them bitterly remarking after they had left—"Well, it is really provoking to find one who has been made a 'Sir' for cutting a wen out of George IV.'s neck, charging us with destroying the noblesse, because we propose to confer upon him and his neighbourhood the benefits of a railway!"

Such being the opposition of the owners of land, it was with the greatest difficulty that a survey of the line could be made: at some points the surveyors could only accomplish it at night by means of dark lanterns. In one place a

clergyman offered so strenuous an opposition that his grounds could only be surveyed during the time he was engaged in the pulpit; the surveyors concluding their task as he concluded his sermon. The survey, though imperfect, was eventually accomplished, Mr. Robert Stephenson having during its progress walked over the ground between London and Birmingham no fewer than twenty times. But no deviations that could be made with the view of obviating opposition had any effect; and when the bill came before Parliament in 1832, the owners of nearly seven-eighths of the land required for the railway were returned as dissentients. It was, however, a noticeable fact, that Lords Derby and Sefton, who had so vehemently opposed the Liverpool Railway in all its stages, were found amongst the assentients to the London and Birmingham line. These noble lords had already ascertained that railways were not the dangerous things they had supposed them to be, and they already regretted that they had forced the Liverpool line to avoid their estates. Indeed, not many years passed before they were found patronizing a second and rival line between Liverpool and Manchester, on the express condition that the new line should not avoid their property, but pass through it!

The result of the first application to Parliament was that the bill passed the Commons, after a protracted examination of witnesses; but it was rejected by the Lords, where those peers who were the avowed opponents of the measure were themselves found sitting upon it as judges to decide its fate. One of the opponents offered to withdraw his opposition on payment of the sum of 10,000*l.*, but the offer was rejected. The directors would not at that time bribe high enough; and the bill was lost, after an expenditure, up to this stage, in preliminary and parliamentary expenses, of 32,000*l.*! The measure was reintroduced in the following session, and, singularly enough, it passed both Houses almost without opposition. The mystery of the unopposed passing of the bill through the Lords was shortly after solved by the appearance of a circular issued by the directors of the

company, in which it was stated that they had opened "negotiations" with the most influential of their opponents; that "these measures had been successful to a greater extent than they had ventured to anticipate; and the most active and formidable had been conciliated." An instructive commentary on the mode by which these noble lords and influential landed proprietors had been "conciliated," was furnished by the simple fact that the estimate for land was nearly trebled, and that the owners were paid about 750,000*l.* for what had been originally estimated at 250,000*l.* The total expenses of carrying the bill through Parliament amounted to the frightful sum of 72,868*l.*

The landowners having thus been "conciliated," the promoters of the measure were at length permitted to proceed with the formation of their great highway, and allowed to benefit the country by establishing one of the grandest public works that has ever been achieved in England, the utility of which may almost be pronounced unparalleled. Eighty miles of the railway were shortly under construction; the works being let (within the estimates) to contractors, who were necessarily for the most part new to such work. The business of railway contractors was not then so well understood as it has since become. There were no leviathans among them, as there are now, able to contract for the formation of a line of railway hundreds of miles in length; they were for the most part men of small capital and slender experience. Their tools and machinery were imperfect; they did not understand the economy of time and piece labour; the workmen, as well as their masters, had still to learn their trade; and it may be mentioned as a remarkable fact, that of the eighteen firms of contractors who undertook the construction of the line between London and Birmingham, not fewer than eleven became bankrupt, on which the works had to be relet, or they were taken in hand and completed by the Company.

The difficulties encountered by the Messrs. Stephenson, in the execution of the London and Birmingham Railway, were hus very great; but the most formidable of them originated

in the character of the works themselves. Extensive tunnels had to be driven through unknown strata, and miles of underground excavation accomplished in order to form a level road from valley to valley under the intervening ridges. This kind of work was the newest of all to the contractors of that day. The experience of the Messrs. Stephenson in the collieries of the north, made them, of all living engineers, the best fitted to grapple with such difficulties; but even they, with all their practical knowledge, could scarcely have foreseen or anticipated such difficulties as were encountered in the execution of the Blisworth Cutting and the Kilsby Tunnel, of which we venture to subjoin the following brief description, as an illustration of the more formidable kinds of railway work.

The Blisworth Cutting is one of the most formidable grooves ever cut in the solid earth. It is a mile and a half long, in some places sixty-five feet deep, and it passes through earth, stiff clay, and hard rock. Not less than a million cubic yards of these materials were dug, quarried, and blasted out of it. One third of the cutting was stone, and beneath the stone lay a thick bed of clay, under which were found beds of loose shale so full of water that almost constant pumping was necessary at many points to enable the works to proceed. For a year and a half the contractor went on fruitlessly contending with these difficulties, and at length he was compelled to abandon the adventure. The engineer then took the works in hand for the Company, and they were vigorously proceeded with. Steam engines were set to work to pump out the water; two locomotives were put on, one at either end of the cutting, to drag away the excavated rock and clay; and eight hundred men and boys were employed along the work, in digging, wheeling, and blasting, besides a large number of horses. Some idea of the extent of the blasting operations may be formed from the fact that twenty-five barrels of gunpowder were exploded weekly; the total quantity used in forming this one cutting being about three thousand barrels. Considerable difficulty was experienced in supporting the bed

of rock cut through, which overlaid the clay and shale along either side of the cutting. It was found necessary to hold it up by strong retaining walls, to prevent the clay bed from bulging out, and these walls were further supported by a strong invert,—that is, an arch placed in an inverted position under the road,—thus binding together the walls on both sides. Behind the retaining walls, a drift or horizontal drain was run to enable the water to escape, and occasional openings were left in the walls themselves for the same purpose. The work was at length brought to a successful completion, but the extraordinary difficulties encountered in forming the cutting had the effect of greatly increasing the cost of this portion of the railway.

But the chief difficulty of the undertaking was the execution of the tunnel under the Kilsby ridge,—a tunnel, though not the largest, yet in many respects one of the most interesting works of the kind in this country. It was forced upon the Company by the opposition of the landowners of the county of Northampton, who had not yet discovered the advantages of railways. A tunnel two thousand four hundred yards long, passing one hundred and sixty feet below the surface, was thus rendered necessary The ridge under which it extends is of considerable extent, the famous battle of Naseby having been fought upon one of the spurs of the same ridge some seven miles to the eastward. Previous to the letting of the work to the contractors, the character of the underground soil was fairly tested by trial shafts, which indicated that it consisted of shale of the lower oolite, and it was let accordingly. But the works had scarcely been commenced when it was discovered that at an interval between the two trial-shafts which had been sunk about two hundred yards from the south end of the tunnel, there existed an extensive quicksand under a bed of clay forty feet thick, and which the borings had escaped in the most singular manner. At the bottom of one of these shafts the excavation and building of the tunnel was proceeding, when the roof at one part

suddenly gave way, a deluge of water burst in, and the party of workmen with the utmost difficulty escaped with their lives. They were only saved by means of a raft on which they were towed by one of the engineers swimming, with the rope in his mouth, to the lower end of the

Kilsby Tunnel.

shaft, out of which they were safely lifted to the daylight. The works were of course at that point immediately stopped. Pumping engines were erected for the purpose of draining off the water, but for a long time it prevailed, and sometimes even rose in the shaft. It was then thought expedient to run a drift along the heading from the south end of the tunnel, in order to drain off the water in that way. The drift had nearly reached the sand bed, when, one day that the engineer, his assistants, and the workmen were clustered about its open entrance, they heard a sudden roar as of distant thunder. It was hoped that the water had burst in—for all the workmen were out of the drift,—

and that the sand bed would now drain itself off in a natural way. Instead of which, very little water made its appearance; and on examining the inner end of the drift, it was found that the loud noise had been caused by the sudden discharge into it of an immense mass of sand, which had completely choked up the passage, and prevented the water from draining off. The engineer now found that there was nothing for it but numerous additional shafts and pumping engines placed over the line of the tunnel where it crossed the quicksand. But this involved a large additional expenditure, and it was necessary to obtain the sanction of the board of directors before it could be adopted. As for the contractor, he abandoned the work in despair, and died shortly after: it was said the anxiety killed him. The directors, in their perplexity, called to their aid certain engineers of the highest eminence at that day, who declared against the practicability of prosecuting the work, and advised its abandonment.

The Company's engineers, on the other hand, strongly urged its prosecution, and their plan was at length adopted by a majority of the directors. A line of pumping-engines, having an aggregate power of 160 horses, was erected at short intervals over the quicksand, and in the direction of the tunnel; shafts were simultaneously sunk down through the sand; and the pumping went on for eight continuous months, until the tunnel at that part was completed. It was found that the water, with which the bed of sand extending over many miles was charged, was to a certain extent held back by the particles of the sand itself, and that it could only percolate through at a certain average rate. It appeared in its flow to take a slanting direction to the suction of the pumps, the angle of inclination depending upon the coarseness or fineness of the sand, and regulating the time of the flow. Hence the distribution of the pumping power at short intervals along the line of the tunnel had a much greater effect than the concentration of that power at any one spot. In short, the water had found its master; and protected by the pumps, which cleared for the workmen a space for their operations, in the midst, as it were, of two almost perpendicular walls of water and sand on either side, they proceeded with the building of the tunnel at numerous points. Every exertion was used to wall in this dangerous part as quickly as possible; the excavators and bricklayers working night and day until the work was finished. Even while under the protection of the immense pumping power above described, it often happened that the bricks were scarcely covered with cement ready for the setting, ere they were washed quite clean by the streams of water which poured down overhead. The workmen were accordingly under the necessity of holding over their work large whisks of straw and other appliances to protect the bricks and cement at the moment of setting. The quantity of water pumped out of the sand bed during the eight months of incessant pumping, averaged two thousand gallons per minute, raised from an average depth of 120 feet. It is difficult to form an adequate idea of the bulk of the water thus raised, but it may be stated that if allowed to flow for three hours only, it would fill a lake one acre square to the depth of one foot, and if allowed to flow for one entire day it would fill the lake to over eight feet in depth, or sufficient to float vessels of a hundred tons burthen. The water pumped out of the tunnel during the entire period of the works, would nearly be equivalent to the contents of the Thames at high water, between London and Woolwich. It is a curious circumstance, that notwithstanding the quantity of water pumped out, the level of the surface in the tunnel was only lowered about two and a half to three inches per week, proving the vast extent of the quicksand, which probably extended along the entire ridge of land under which the railway passed.

The labourers who executed these formidable works were in many respects a remarkable class. The "railway navvies," as they were called, were men drawn by the attraction of good wages from all parts of the kingdom; and they were ready for any sort of hard work. Many of the labourers employed on the Liverpool line were Irish, others were

from the Northumberland and Durham railways, where they had been accustomed to similar work; and some of the best came from the fen districts of Lincoln and Cambridge where they had been trained to execute works of excavation and embankment. These old practitioners formed the nucleus of a skilled manipulation and aptitude, which rendered them of indispensable utility in the immense undertakings of the period. Their expertness in all sorts of earthwork, in embanking, boring, and well-sinking—their practical knowledge of the nature of soils and rocks, the tenacity of clays, and the porosity of certain stratifications—were very great; and, rough-looking as they were, many of them were as important in their own department as the contractor or the engineer.

During the railway-making period the navvy wandered about from one public work to another—apparently belonging to no country and having no home. He usually wore a white felt hat, the brim turned up all round—a headdress since become fashionable,—a velveteen or jean square-tailed coat, a scarlet plush waistcoat with little black spots, and a bright-coloured handkerchief round his herculean neck, when, as often happened, it was not left entirely bare. His corduroy breeches were retained in position by a leathern strap round the waist, and tied and buttoned at the knee, displaying beneath a solid calf and foot firmly encased in strong high-laced boots. Joining together in a "butty gang," some ten or twelve of these men would take a contract to cut out and remove so much "dirt"—so they denominated earth-cutting—fixing their price according to the character of the "stuff," and the distance to which it had to be wheeled and tipped. The contract taken, every man put himself to his mettle: if any was found skulking, or not putting forth his full working power, he was ejected from the gang. Their powers of endurance were extraordinary. In times of emergency they would work for twelve and even sixteen hours, with only short intervals for meals; and the quantity of flesh-meat which they consumed was something enormous; but it was to their bones and

muscles what coke is to the locomotive—the means of keeping up the steam.

When railway-making extended to France, the English contractors for the works took with them gangs of English navvies, with the usual plant, which included wheelbarrows. These the English navvy was accustomed to run out continuously, loaded with some three to four hundredweight of stuff, piled so high that he could barely see over the summit of the load the gang-board along which he wheeled his barrow; whereas the French navvy was contented with half the weight. Indeed, the French navvies on one occasion struck work because of the size of the barrows, and there was a dangerous émeute, which was only quelled by the aid of the military. The consequence was that the big barrows were abandoned to the English workmen, who earned nearly double the wages of the Frenchmen. The manner in which they stood to their work was matter of great surprise and wonderment to the French country people, who came crowding round them in their blouses, and, after gazing admiringly at their expert handling of the pick and mattock, and the immense loads of "dirt" which they wheeled out, would exclaim to each other, "*Mon Dieu, voila! voila ces Anglais, comme ils travaillent!*" [Goodness gracious! look at these Englishmen! see how they work!]

Such were the indefatigable labourers who executed the great undertakings of the railway era.

CHAPTER XIV.

ALTON GRANGE — GENERAL ADOPTION OF RAILWAYS, AND OPENING OF THROUGH LINES.

MR. STEPHENSON resided in Liverpool until some time after the completion and opening of the Liverpool and Manchester Railway. He then removed to Alton Grange, near Ashby-de-la-Zouch, in Leicestershire, where he lived for several years. Whilst his son Robert was engaged as engineer in superintending the construction of the Leicester and Swannington Railway in 1830, his experience as a coal-viewer and practical geologist suggested to him that coal was to be found in the estate of Snibston, near Ashby, then advertised for sale, and lying in the immediate neighbourhood of the line of railway. He mentioned the circumstance to his father, who inspected the ground, and came to the same conclusion.

The large manufacturing town of Leicester, about fourteen miles distant, had up to that time been exclusively supplied with coal brought by canal from Derbyshire; and Mr. Stephenson was quick to perceive that the railway under construction, from Swannington to Leicester, would furnish him with a ready market for any coals which he might find at Snibston. Having induced two of his Liverpool friends to join him in the venture, the Snibston estate was purchased in 1831: and shortly after, Mr. Stephenson removed his home from Liverpool to Alton Grange, for the purpose of superintending the sinking of the pit. He travelled thither by gig with his wife,—his favourite horse "Bobby" performing the journey by easy stages.

Sinking operations were immediately commenced, and

proceeded satisfactorily until the old enemy, water, burst in upon the workmen, and threatened to drown them out. But by means of efficient pumping-engines, and the skilful casing of the shaft with segments of cast-iron,—a process called "tubbing," which Mr. Stephenson was the first to adopt in the Midland Counties,—it was eventually made water-tight, and the sinking proceeded. When a depth of 166 feet had been reached, a still more formidable difficulty presented itself,—one which had baffled former sinkers, and deterred them from further operations. This was a dyke of fused granite, which had been brought down by volcanic action from the adjacent Charnwood Forest range, and here over-

Alton Grange.

lapped the coal bed of the district. Mr. Stephenson fell back upon his old motto, "Persevere:" he determined to go on boring; and down through the solid granite he went until, twenty-two feet lower, he came upon the coal measures. In the mean time, however, lest the boring at this point should prove unsuccessful, he had commenced sinking

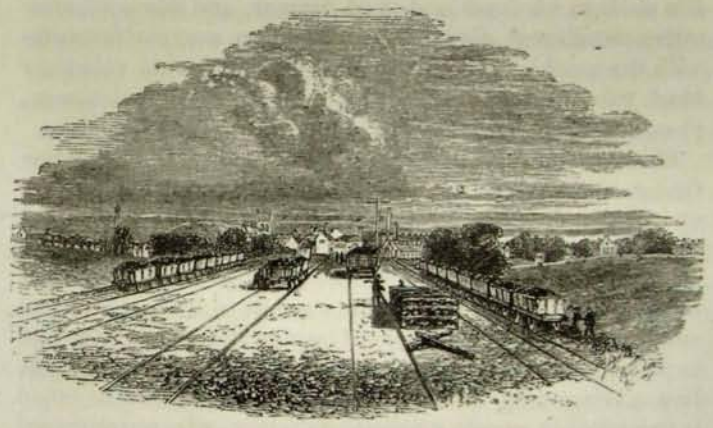
another pair of shafts about a quarter of a mile west of the "fault;" and after about nine months' labour he reached the principal seam, called the "main coal."

The works were then opened out on a large scale, and Mr. Stephenson had the pleasure and good fortune to send the first train of main coal to Leicester by railway. The price was immediately reduced there to about 8*s.* a ton, effecting a pecuniary saving to the inhabitants of the town of about 40,000*l.* per annum, or equivalent to the whole amount then collected in government taxes and local rates, besides giving an impetus to the manufacturing prosperity of the place, which has continued down to the present day. The correct and scientific principles upon which the mining operations at Snibston were conducted offered a salutary example to the neighbouring colliery owners. The numerous improvements thus introduced were freely exhibited to all, and they were afterwards reproduced in many forms all over the Midland Counties, greatly to the advantage of the mining interests.

At the same time Mr. Stephenson endeavoured to extend the benefit of railways throughout the district in which he now resided. He suggested to Lord Stamford the importance of constructing a branch line from the Leicester and Swannington Railway through his property, principally for the purpose of opening out his fine granite quarries at Groby. The valuable advice was taken by Lord Stamford, and Mr. Stephenson laid out the line for him and superintended the works gratuitously. Another improvement which he effected for Lord Talbot proved of even greater pecuniary value. He contrived for his lordship, with no slight difficulty, a plan for "tubbing off" the fresh water from the salt at his mines near Tamworth, which enabled the saltworks there to be subsequently carried on to a great profit, which had not before been practicable. Mr. Stephenson was less successful in his endeavours to induce the late Marquis of Hastings to consent to the Birmingham and Derby Railway, of which he was the engineer, passing through the mineral district of Ashby-de-la-Zouch. The Marquis was the principal owner

of the colliery property in the neighbourhood, and Mr. Stephenson calculated upon his lordship's influence in support of a scheme so certain to increase the value of his estate. But the Marquis, like many others of his class, did not yet detect the great advantages of railways, and he threatened his determined opposition if the Derby line were attempted to be brought through his coal field. The line was consequently taken further to the west, by way of Burton; and thus Ashby for a time lost the benefits of railway communication. Twenty years elapsed before Mr. Stephenson's designs for its accommodation were carried into effect.

Nor was Mr. Stephenson less attentive to the comfort and well-being of those immediately dependent upon him—the



Coalville, with part of Snibston Colliery on the left.

workpeople of the Snibston colliery and their families. Unlike many of those large employers who have "sprung from the ranks," he was one of the kindest and most indulgent of masters. He would have a fair day's work for a fair day's wages; but he never forgot that the employer had his duties as well as his rights. First of all, he attended to the proper home accommodation of his workpeople. He erected a village of comfortable cottages, each provided with a snug

little garden. He was also instrumental in erecting a church adjacent to the works, as well as Church schools for the education of the colliers' children; and with that broad catholicity of sentiment which distinguished him, he further provided a chapel and a school-house for the use of the Dissenting portion of the colliers and their families,—an example of benevolent liberality which was not without its salutary influence on the neighbouring employers.

When at home, in the intervals of his now extensive business as a railway engineer, Mr. Stephenson delighted to snatch an occasional hour to indulge his love of rural life. When he could, he went bird-nesting in spring, and nutting in autumn; occasionally he did a little gardening, or took a rural ride on his favourite "Bobby," now growing old.* His uniform kindness and good temper, and his communicative, intelligent disposition, made him a great favourite with the neighbouring farmers, to whom he would volunteer much valuable advice on agricultural operations, drainage, ploughing, and labour-saving processes.

Shortly after Mr. Stephenson had settled down at Alton Grange, railway projects of great magnitude began to spring up all over England, and he was often called away for the purpose of making surveys, and conferring with committees of directors as to their parliamentary procedure. For several years he spent most of his time in travelling about on such business, besides frequently going down to Lancashire to watch over the working of the Liverpool and Manchester line. His correspondence increased so much, that he found it necessary to engage a private secretary, who accompanied him on his journeys. He was himself exceedingly averse to writing letters. The comparatively advanced age at which he learnt the art of writing, and the nature of his duties while engaged at the Killingworth colliery, precluded that facility in correspondence which only constant practice can give. He possessed, however, great facility in dictation,

* "Bobby" was about twenty years old when he died, in 1845. During the last few years of his life he was a pensioner, living in clover and doing no work.

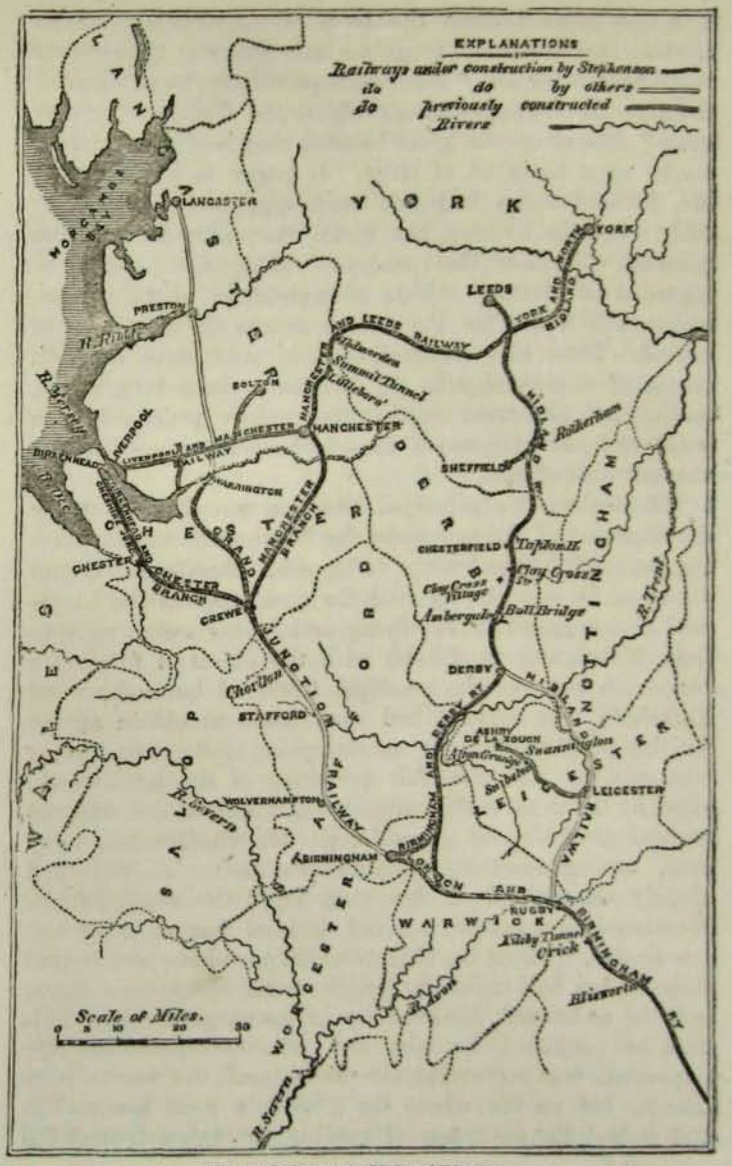
and was very particular and precise as to the terms in which his letters must be written. He also had the power of labouring continuously at dictation; the gentleman who acted as his secretary in the year 1835, stating that, during his busy season, he one day dictated not fewer than thirty-seven letters, several of them embodying the results of much close thinking and calculation. On another occasion, he dictated reports and letters for twelve continuous hours, until his secretary was ready to drop off his chair from sheer exhaustion, and at length he pleaded for a suspension of the labour. This great mass of correspondence, although closely bearing on the subjects under discussion, was not, however, of a kind to supply the biographer with matter for quotation, or to give that insight into the life and character of the writer which the letters of literary men so often furnish. They were, for the most part, letters of mere business, relating to works in progress, parliamentary contests, new surveys, estimates of cost, and railway policy,—curt, and to the point; in short, the letters of a man, every moment of whose time was precious.

Hence, also, there is very little to record of Mr. Stephenson's private life during this busy period. For he had scarcely a moment that he could call his own. What with the business of his colliery, his locomotive manufactory, and the various railways of which he was the principal engineer, there was little time left for private intercourse. During the three years ending in 1837—perhaps the busiest years of his life—his secretary travelled with him by post-chaise alone upwards of twenty thousand miles, and yet six months of the whole time were spent in London. During this period he was engaged on the survey of the North Midland, extending from Derby to Leeds; the York and North Midland, from Normanton to York; the Manchester and Leeds; the Birmingham and Derby, and the Sheffield and Rotherham Railways; the whole of these, of which he was principal engineer, having been authorised in 1836. In that session alone, powers were thus obtained to construct 214 miles of new railways at an expenditure of upwards of five

millions sterling. Fortunately Mr. Stephenson possessed a facility of sleeping, which enabled him to pass through this enormous amount of fatigue and labour without injury to his health. He had been trained in a hard school, and could bear with ease conditions which, to men more softly nurtured, would have been the extreme of physical discomfort. Many, many nights he snatched his sleep while travelling in his chaise; and at break of day he would be at work, surveying until dark, and this for weeks in succession. His whole powers seemed to be under the control of his will, for he could wake at any hour, and go to work at once. It was difficult for secretaries and assistants to keep up with such a man.

The amount of his parliamentary business having greatly increased with the projection of new lines of railway, Mr. Stephenson found it necessary to set up an office in London, in 1836; first at No. 9, Duke-street, Westminster, removed in the following year to 30½, Great George-street. That office was the busy scene of railway politics for several years. There consultations were held, schemes were matured, deputations were received, and many projectors called upon our engineer for the purpose of submitting their plans of railway working. During the same period in which he was occupied in carrying through Parliament the projects for which he was principally concerned as engineer in chief, he was also called upon to give evidence in support of many lines, such as the Great Western, with which he was not immediately connected. "In fact," as he said to a Committee of the House of Commons in 1841, "there is hardly a railway in England that I have not had to do with."

The rapidity with which railways were carried out, when the spirit of the country was fairly up, was indeed remarkable. This was doubtless in some measure owing to the increased force of the current of speculation, but chiefly to the desire which the public now entertained for the general extension of the system. It was even proposed to fill up the canals, and convert them into railways.



Map of Railways in Midland District.

The new roads became the topic of conversation in all circles; they were felt to give a new value to time; their vast capabilities for "business" peculiarly recommended them to the trading classes; whilst the friends of "progress" dilated on the great benefits they would eventually confer upon mankind at large. It began to be seen that Mr. Edward Pease had not been exaggerating when he said, "Let the country but make the railroads, and the railroads will make the country!" They also came to be regarded as inviting objects of investment to the thrifty, and a safe outlet for the accumulations of inert men of capital. Thus new avenues of iron road were soon in course of construction in all directions, branching north, south, east, and west, so that the country promised in a wonderfully short space of time to become wrapped in one vast network of iron.

Mr. Stephenson's principal attention was directed to the development of the system in the Northern Counties, leaving the south to the energy of his son. Besides the Grand Junction, he was, shortly after the completion of the Liverpool line, engaged in surveying and laying out a railway from Manchester to Leeds, with the object of forming a connexion between the principal towns of Lancashire and Yorkshire. An attempt had been made to obtain an act for this purpose as early as the year 1831; but having been met by the powerful opposition of the landowners, aided by the canal companies, it was defeated, and was not revived until several years later. Mr. Stephenson, however, having carefully examined the entire district, had already determined in his own mind the route of the Manchester and Leeds line, and decided that no other was practicable, without the objectionable expedient of a tunnel three and a half miles in length under Blackstone Edge, and the additional disadvantage of heavy gradients. This line, as projected by him and afterwards considerably improved, was somewhat circuitous, and the works were heavy; but on the whole the gradients were favourable, and it had the advantage of passing through a district full

of manufacturing towns and villages, teeming hives of population, industry, and enterprise. The act authorising the construction of the railway was finally obtained in the session of 1836: it was greatly amended in the succeeding year; and the first ground was broken on the 18th of August, 1837.

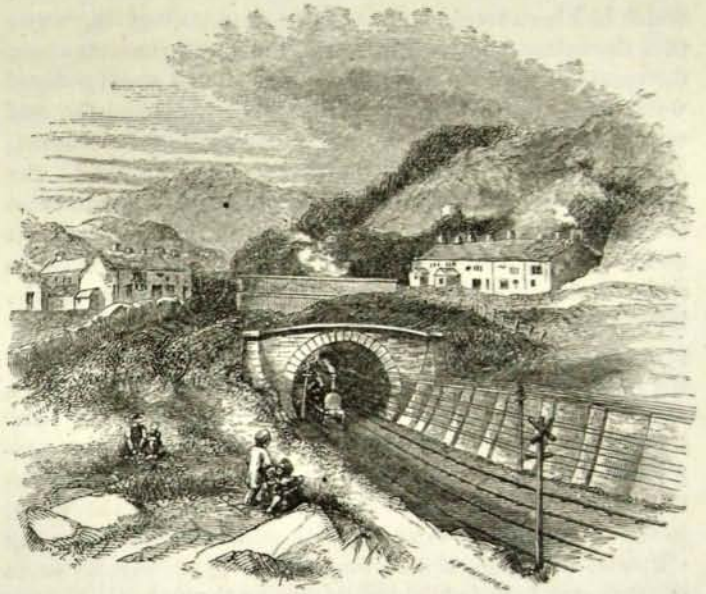
An incident occurred while the second Manchester and Leeds Bill was before the Committee of the Lords, which is worthy of passing notice in this place, as illustrative of Mr. Stephenson's character. The line which was authorised by Parliament in 1836 had been hastily surveyed within a period of less than six weeks; and before it received the royal assent, Mr. Stephenson became convinced that many important improvements might be made in it, and communicated his views to the directors. They determined, however, to obtain the act, although conscious at the time that they would have to go for a second and improved line in the following year. The second bill passed the Commons in 1837 without difficulty, and promised in like manner to receive the sanction of the Lords' Committee. Quite unexpectedly, however, Lord Wharncliffe, who was interested in the Manchester and Sheffield line, which passed through his colliery property in the south of Yorkshire, and conceived that the new Manchester and Leeds line might have some damaging effect, appeared as a strenuous opponent of the bill. He was himself a member of the Committee, and adopted the unusual course of rising to his feet, and making a set speech against the bill while Mr. Stephenson was under examination. After pointing out that the bill applied for and obtained in the preceding session was one that the promoters had no intention of carrying out, that they had secured it only for the purpose of obtaining possession of the ground and reducing the number of the opponents to their present application, and that in fact they had been practising a deception upon the House, his lordship turned full upon the witness, and, addressing him, said,—"I ask you, sir, do you call that conduct *honest?*" Mr. Stephenson, his voice trembling

with emotion, replied,—"Yes, my lord, I *do* call it honest. And I will ask your lordship, whom I served for many years as your enginewright at the Killingworth collieries, when did you ever know me to do anything that was not honest and honourable? You know what the collieries were when I went there, and you know what they were when I left them. Did you ever hear that I was found wanting when honest services were wanted, or when duty called me? Let your lordship but fairly consider the circumstances of the case, and I feel persuaded you will admit that my conduct has been equally honest throughout in this matter." He then briefly but clearly stated the history of the application to Parliament for the act, which was so satisfactory to the Committee that they passed the preamble of the bill without further objection. Lord Wharncliffe requested that the Committee would permit his observations, together with Mr. Stephenson's reply, to be erased from the record of the evidence, which, as an acknowledgment of his error, was permitted: Lord Kenyon and several other members of the Committee afterwards came up to Mr. Stephenson, shook him by the hand, and congratulated him on the manly way in which he had vindicated himself in the course of the inquiry.

In conducting this project to a successful issue, Mr. Stephenson had much opposition and many strong prejudices to encounter. Predictions were confidently made in many quarters, that the line could never succeed. It was declared, that the utmost engineering skill could not construct a railway through such a country of hills and hard rocks; and it was maintained that, even if the railway were practicable, it could only be formed at so enormous a cost as to prevent it from ever remunerating the proprietors.

During the progress of the works, as the Summit Tunnel, near Littleborough, was approaching completion, the alarming rumour was spread abroad in Manchester that the tunnel had fallen in and buried a number of workmen in the ruins. The last arch had been keyed in, and the work was all but finished, when the accident occurred which was

thus exaggerated by the lying tongue of rumour. An invert had given way through the irregular pressure of the surrounding earth and rock at a part of the tunnel



The Littleborough Tunnel. (The Walsden End.)

where a "fault" had occurred in the strata. A party of the directors accompanied the engineer to inspect the scene of the accident. They entered the tunnel's mouth preceded by upwards of fifty navvies, each bearing a torch. This extraordinary subterranean viaduct had occupied the labours of above a thousand men during nearly four years. Besides excavating the arch out of the solid rock, they had used 23,000,000 of bricks, and 8000 tons of Roman cement. Thirteen stationary engines, and about 100 horses, had also been employed in drawing the earth and stone out of the shafts. The entire length of the tunnel was 2869 yards, or nearly a mile and three quarters,—exceeding the famous Kilsby Tunnel by 471 yards.

After walking a distance of about half a mile, the inspecting party arrived at the scene of the "frightful accident," about which so much alarm had been spread in Manchester. All that was visible was a certain unevenness of the ground, which had been forced up by the invert under it giving way; thus the ballast had been loosened, the drain running along the centre of the road had been displaced, and small pools of water stood about. But the whole of the walls and the roof were as perfect there as in any other part of the tunnel. Mr. Stephenson explained the cause of the accident: the blue shale, he said, through which the excavation passed at that point, was considered so hard and firm, as to render it unnecessary to build the invert very strong there. But shale is always a deceptive material. Subjected to the influence of the atmosphere, it gives but a treacherous support. In this case, falling away like quicklime, it had left the lip of the invert alone to support the pressure of the arch above, and hence its springing inwards and upwards. Mr. Stephenson directed the attention of the visitors to the completeness of the arch overhead, where not the slightest fracture or yielding could be detected. Speaking of the work, in the course of the same day, he said, "I will stake my character, my head, if that tunnel ever give way, so as to cause danger to any of the public passing through it. Taking it as a whole, I don't think there is such another piece of work in the world. It is the greatest work that has yet been done of this kind, and there has been less repairing than is usual,—though an engineer might well be beaten in his calculations, for he cannot beforehand see into those little fractured parts of the earth he may meet with." As Mr. Stephenson had promised, the invert was put in; and the tunnel was made perfectly safe.

The North Midland Railway was a favourite line of Mr. Stephenson's for several reasons. Its works were of a formidable character; it passed through a rich mining district, in which it opened up many valuable coal-fields, and it formed part of the great main line of communication between London and Edinburgh. The line was originally projected

by gentlemen interested in the London and Birmingham Railway. Their intention was to carry the latter railway from Rugby to Leeds; but, finding themselves anticipated in part by the projection of the Midland Counties line from Rugby to Derby, they confined themselves to the district between Derby and Leeds. The projectors appointed Mr. Stephenson to examine the country, and lay out the best line; and after a careful survey, he reported the result to a public meeting held at Leeds, in September, 1835; and the result was, the approval of the line as laid out by him. A subscription list was at once opened, and Mr. John Marshall, one of the most public-spirited and influential manufacturers of Leeds, having put his name down for 35,000*l.*, the shares were soon taken and the project was fairly launched. The act was obtained in 1836, and the first ground was broken in February, 1837.

Although the North Midland Railway was only one of the many great works of the same kind executed at that time, it was enough of itself to be the achievement of a life. Compare it, for example, with Napoleon's much-vaunted military road over the Simplon, and it will at once be seen how greatly it excels that work, not only in the constructive skill displayed in it, but also in its cost and magnitude, and the amount of labour employed in its formation. The road of the Simplon is 45 miles in length; the North Midland Railway 72½ miles. The former has 50 bridges and 5 tunnels, measuring together 1338 feet in length; the latter has 200 bridges and 7 tunnels, measuring together 11,400 feet, or about 2¼ miles. The former cost about 720,000*l.* sterling, the latter above 3,000,000*l.* Napoleon's grand military road was constructed in six years, at the public cost of the two great kingdoms of France and Italy; while Stephenson's much more magnificent railway was formed in about three years, by a company of private merchants and capitalists out of their own funds, and under their own superintendence. And if the name of the Chevalier Fabbroni has been honoured for the design and construction of the military road across the Simplon, how much higher ought the name of George

Stephenson to rank as the engineer and architect of the North Midland, the Manchester and Leeds, the Liverpool and Manchester, and many other equally gigantic works of great public utility!

It is scarcely necessary that we should give any account in detail of the North Midland works. The making of one tunnel so much resembles the making of another,—the building of bridges and viaducts, no matter how extensive, so much resembles the building of others,—the cutting out of "dirt," the blasting of rocks, and the wheeling of the excavation into embankments, is so much a matter of mere time and hard work,—that it is quite unnecessary for us to detain the reader by any attempt at their description. Of course there were the usual difficulties to encounter and overcome,—but the railway engineer regarded these as mere matters of course, and would probably have been disappointed if they had not presented themselves. On the Midland, as on other lines, water was the great enemy to be fought against,—water in the Claycross and other tunnels,—water in the boggy or sandy foundations of bridges,—and water in cuttings and embankments. As an illustration of the difficulties of bridge building, we may mention the case of the five arch bridge over the Derwent, where it took two years' work, night and day, to get in the foundations of the piers alone. Another curious illustration of the mischief done by water in cuttings, may be briefly mentioned. At a part of the North Midland line, near Ambergate, it was necessary to pass along a hillside in a cutting a few yards deep. As the cutting proceeded, a seam of shale was cut across, lying at an inclination of 6 to 1; and very shortly, the water getting behind the bed of shale, the whole mass of earth along the hill above began to move down across the line of excavation,—completely upsetting the estimates of the contractor, who, instead of fifty thousand cubic yards, found that he had about five hundred thousand to remove; the execution of this part of the railway occupying fifteen months instead of two.

As a curiosity in construction, we may also mention a very delicate piece of work executed on the same line at Bull-

bridge in Derbyshire, where the line at the same point passes *over* a bridge which here spans the river Amber, and *under* the bed of the Cromford Canal. Water, bridge, railway, and canal, were thus piled one above the other, four stories high; such another curious complication probably not existing. In order to prevent the possibility of the waters

Bull-Bridge, near Ambergate.

of the canal breaking in upon the works of the railroad, Mr. Stephenson had an iron tank made 150 feet long, of the width of the canal, and exactly fitting the bottom. It was brought to the spot in three pieces, which were firmly welded together, and the trough was then floated into its place and sunk; the whole operation being completed without in the least interfering with the navigation of the canal; and the railway works underneath were then proceeded with and finished.

One of Mr. Stephenson's most important series of opera-

tions, upon which he shortly after entered, originated in his professional connexion with the Midland Railway as its engineer. There was an abundance of coal in the district, and his strong sagacity early detected the importance of the line in opening up new markets for its sale in the southern counties. At a time when everybody else was sceptical as to the possibility of coals being carried to London from the midland counties, and sold there at a price to compete with seaborne coals, he declared his firm conviction that the time was fast approaching when the London market would be regularly supplied with north-country coals led by railway. One of the greatest advantages of railways, in his opinion, was that they would bring coal and iron, the staple products of the country, to the doors of all England. "The strength of Britain," he would say, "lies in her coal-beds; and the locomotive is destined, above all other agencies, to bring it forth. The Lord Chancellor now sits upon a bag of wool; but wool has long ceased to be emblematical of the staple commodity of England. He ought rather to sit upon a bag of coals, though it might not prove quite so comfortable a seat. Then think of the Lord Chancellor being addressed as the noble and learned lord *on the coal-sack!* I am afraid it wouldn't answer, after all."

To one gentleman he said: "We want from the coal-mining, the iron-producing, and manufacturing districts, a great railway for the carriage of these valuable products. We want, if I may so say, a stream of steam running directly through the country, from the North to London, and from other similar districts to London; speed is not so much an object as utility and cheapness." And at a meeting of railway proprietors at York, in 1840, he told them "there was little doubt in his mind that coals would in a very short time be supplied to the London market from that county by means of their line." In this, as in some other matters, Mr. Stephenson was rather ahead of his time; and though he did not live to see his anticipations as to the supply of the London coal-market fully realised, yet he was the first to point out, and, to some extent, to prove, the practicability

of establishing a profitable coal trade by railway between the northern counties and the metropolis.

The York and North Midland line extended from Normanton—a point on the Midland Railway—to York; it was a line of easy formation, traversing a comparatively level country. The inhabitants of Whitby, as well as York, were busy projecting railways as early as 1832; and in the year following, Whitby succeeded in obtaining a horse line of twenty-four miles, connecting it with the small market-town of Pickering. The York citizens were more ambitious, and agitated the question of a locomotive line to connect them with the town of Leeds. A company was formed in 1833, and Mr. George Rennie was called upon to survey the road. About the same time, however, other engineers—Mr. Walker, Mr. Cundy, and Mr. Gibbs—were severally engaged in getting up the surveys of a direct main line from London to York. The local committee were perplexed by the conflicting views of the engineers, and at length called to their assistance Mr. George Stephenson, who had already been consulted by the provisional committee of the Midland Company as to the best line from Derby to Leeds. He recommended the York gentlemen to adapt their railway to that proposed line of communication, and they embraced his views. The company was formed, the shares were at once subscribed for, and Mr. Stephenson appointed his pupil and assistant, Mr. Swanwick, to lay out the line in October, 1835. The act was obtained in the following year, and the works were constructed without difficulty.

As the best proof of his conviction that the York and North Midland would prove a good investment, Mr. Stephenson invested in it a considerable portion of his savings, being a subscriber for 420 shares; and he also took some trouble in persuading several wealthy gentlemen in London and elsewhere to purchase shares in the concern. The interest thus taken in the line by the engineer was on more than one occasion specially mentioned by Mr. Hudson, then Lord Mayor of York, as an inducement to other persons of capital to join the undertaking; and had it not afterwards been

encumbered and overlaid by comparatively useless, and therefore profitless branches, in the projection of which Mr. Stephenson had no part, the sanguine expectations which he early formed of the paying qualities of the line would have been more than realised.

There was one branch, however, of the York and North Midland line in which he took an anxious interest, and of which he may be pronounced the projector—the branch to Scarborough; which proved to be one of the most profitable parts of the railway. He was so satisfied of its value, that, at a meeting of the York and North Midland proprietors, he volunteered his gratuitous services as engineer until the company was formed, in addition to subscribing largely to the undertaking. At that meeting he took an opportunity of referring to the charges brought against engineers of so greatly exceeding the estimates:—"He had had a good deal to do with making out the estimates of the North Midland Railway, and he believed there never was a more honest one. He had always endeavoured to state the truth as far as was in his power. He had known a director, who, when he (Mr. Stephenson) had sent in an estimate, came forward and said, 'I can do it for half the money.' The director's estimate went into Parliament, but it came out his. He could go through the whole list of the undertakings in which he had been engaged, and show that he had never had anything to do with stock-jobbing concerns. He would say that he would not be concerned in any scheme, unless he was satisfied that it would pay the proprietors; and in bringing forward the proposed line to Scarborough, he was satisfied that it would pay, or he would have had nothing to do with it."

During the same period in which he was engaged in superintending the execution of these great undertakings, he was occupied in *surveying other* lines of railway in various parts of the country. Thus he was called upon to examine districts in Scotland, in the neighbourhood of Glasgow; and on several occasions he surveyed routes along the east coast from Newcastle to Edinburgh, with the view of completing the main line of communication with London. On those occasions his companions noted with wonder his remarkable quickness of observation. Nothing escaped his attention—the trees, the crops, the birds, the farmer's stock; and he was usually full of lively conversation, everything in nature affording him an opportunity for making some striking remark, or propounding some ingenious theory. When taking a flying survey of a new line, this faculty proved very useful to him, for he rapidly noted the general configuration of the country, and inferred its geological structure. He afterwards remarked to a friend, "I have planned many a railway travelling along in a postchaise, and following the natural line of the country." And it was remarkable that his first impressions of the direction to be taken almost invariably proved the right ones; and there are few of the lines surveyed and recommended by him which have not been executed, either during his lifetime or since. As an illustration of his quick and shrewd observation on such occasions we may mention that when employed about this time to lay out a line to connect Manchester, through Macclesfield, with the Potteries, the gentleman who accompanied him on the journey of inspection cautioned him to provide large accommodation for carrying off the water, observing—"You must not judge by the appearance of the brooks: after heavy rains these hills pour down volumes of water, of which you can have no conception." "Pooh! pooh! *don't I see your bridges?*" replied the engineer. He had noted the details of each as he passed along.

Among the other projects which occupied his attention about the same time, were the projected lines between Chester and Holyhead, between Leeds and Bradford, and between Lancaster and Maryport by the western coast. This latter was intended to form part of a west-coast line to Scotland, Mr. Stephenson favouring it partly because of the flatness of the gradients, and also because it could be formed at comparatively small cost, whilst it would open out a valuable iron-mining district, from which a large traffic in ironstone was expected. One of its collateral advantages,

in the engineer's opinion, was, that by forming the railway directly across Morecambe Bay, on the north-east coast of Lancashire, a large tract of valuable land might be reclaimed from the sea, the sale of which would considerably reduce the cost of the works. He estimated that by means of a solid embankment across the bay, not less than forty thousand acres of rich alluvial land would be gained. His scheme was, to carry the road across the ten miles of sands which lie between Poulton, near Lancaster, and Humphrey Head on the opposite coast, forming the line in a segment of a circle of five miles' radius. His plan was to drive in piles across the entire length, forming a solid fence of stone blocks on the land side for the purpose of retaining the sand and silt brought down by the rivers from the interior. The embankment would then be raised from time to time as the deposit accumulated, until the land was filled up to high-water mark; provision being made, by means of sufficient arches, for the flow of the river waters into the bay. The execution of the railway after this plan would, however, have occupied more years than the promoters of the West Coast line were disposed to wait; and eventually Mr. Locke's more direct but uneven line by Shap Fell was adopted. A railway has, however, since been carried across the head of the bay, in a greatly modified form, by the Ulverstone and Lancaster Railway Company; but it is not impossible that Mr. Stephenson's larger scheme of reclaiming the vast tract of land now left bare at every receding tide, may yet be carried out.

To give an idea of the number of railway projects which at this time occupied Mr. Stephenson's attention, and of the extent and rapidity of his journeys, we subjoin from his private secretary's journal the following epitome of one of them, on which he entered immediately at the conclusion of the heavy parliamentary session of 1836.

"August 9th.—From Alton Grange to Derby and Matlock; and forward by mail to Manchester, to meet the committee of the South Union Railway. August 10th.—Manchester to Stockport, to meet Committee of the Manchester and

Leeds Railway; thence to Liverpool, to meet directors of the Chester and Birkenhead, and Chester and Crewe Railways. August 11th.—Liverpool to Woodside, to meet committee of the Chester and Birkenhead line; journey with them along the proposed railway to Chester; then back to Liverpool. August 12th.—Liverpool to Manchester, to meet directors of the Manchester and Leeds Railway, and travelling with them over the works in progress. August 13th.—Continued journey over the works, and arrival at Wakefield; thence to York. August 14th.—Meeting with Mr. Hudson at York, and journey from York to Newcastle. August 15th.—At Newcastle, working up arrears of correspondence. August 16th.—Meeting with Mr. Brandling, as to the station for the Brandling Junction at Gateshead, and stations at other parts of the line. August 17.—Carlisle to Wigton and Maryport, examining the railway. August 19th.—Maryport to Carlisle, continuing the inspection. August 20th.—At Carlisle, examining the ground for a station; and working up correspondence. August 21st.—Carlisle to Dumfries by mail; forward to Ayr by chaise, proceeding up the valley of the Nith, through Thornhill, Sanquhar, and Cumnock. August 22nd.—Meeting with promoters of the Glasgow, Kilmarnock, and Ayr Railway, and journey along the proposed line; meeting with the magistrates at Kilmarnock at Beith, and journey with them over Mr. Gale's proposed line to Kilmarnock. August 23rd.—From Kilmarnock along Mr. Miller's proposed line to Beith, Paisley, and Glasgow. August 24th.—Examination of site of proposed station at Glasgow; meeting with the directors; then from Glasgow, by Falkirk and Linlithgow, to Edinburgh, meeting there with Mr. Grainger, engineer, and several of the committee of the proposed Edinburgh and Dunbar Railway. August 25th.—Examining the site of the proposed station at Edinburgh; then to Dunbar, by Portobello and Haddington, examining the proposed line of railway. August 26th.—Dunbar to Tommy Grant's, to examine the summit of the country towards Berwick, with a view to a through line to Newcastle; then return

to Edinburgh. August 27th.—At Edinburgh, meeting the provisional committee of the proposed Edinburgh and Dunbar Railway. August 28th.—Journey from Edinburgh through Melrose and Jedburgh to Horsley, along the route of Mr. Richardson's proposed railway across Carter Fell. August 29th.—From Horsley to Mr. Brandling's, then on to Newcastle; engaged on the Brandling Junction Railway. August 30th.—Engaged with Mr. Brandling; after which, meeting a deputation from Maryport. August 31st.—Meeting with Mr. Brandling and others as to the direction of the Brandling Junction in connexion with the Great North o England line, and the course of the railway through Newcastle; then on to York. September 1st.—At York; meeting with York and North Midland directors; then journeying over Lord Howden's property, to arrange for a deviation; examining the proposed site of the station at York. September 2nd.—At York, giving instructions as to the survey; then to Manchester by Leeds. September 3rd.—At Manchester; journey to Stockport, with Mr. Bidder and Mr. Bourne, examining the line to Stockport, and fixing the crossing of the river there; attending to the surveys; then journey back to Manchester, to meet the directors of the Manchester and Leeds Railway. September 4th.—Sunday at Manchester. September 5th.—Journey along part of the Manchester and Leeds Railway. September 6th.—At Manchester, examining and laying down the section of the South Union line to Stockport; afterwards engaged on the Manchester and Leeds working plans, in endeavouring to give a greater radius to the curves; seeing Mr. Seddon about the Liverpool, Manchester, and Leeds Junction Railway. September 7th.—Journey along the Manchester and Leeds line, then on to Derby. September 8th.—At Derby; seeing Mr. Carter and Mr. Beale about the Tamworth deviation; then home to Alton Grange. September 10th.—At Alton Grange, preparing report to the committee of the Edinburgh and Dunbar Railway."

Such is a specimen of the enormous amount of physical and mental labour undergone by Mr. Stephenson during the

busy years above referred to. He was no sooner home, than he was called away again by some other railway or business engagement. Thus in four days after his arrival at Alton Grange from the above journey into Scotland, we find him going over the whole of the North Midland line as far as Leeds; then by Halifax to Manchester, where he stayed for several days on the business of the South Union line; then to Birmingham and London; back to Alton Grange, and next day to Congleton and Leek; thence to Leeds and Goole, and home again by the Sheffield and Rotherham and the Midland works. And early in the following month (October) he was engaged in the north of Ireland, examining the line, and reporting upon the plans, of the projected Ulster Railway. He was also called upon to inspect and report upon colliery works, salt works, brass and copper works, and such like, in addition to his own colliery and railway business. He usually staked out himself the lines laid out by him, which involved a good deal of labour since undertaken by assistants. And occasionally he would run up to London, attending in person to the preparation and depositing of the plans and sections of the projected undertakings for which he was engaged as engineer.

It is pleasant to record that, in the midst of these engrossing occupations, his heart remained as soft and loving as ever. Thus, during one of his brief sojourns at Alton Grange, he found time to write to his son a touching account of a pair of robins that had built their nest within one of the empty upper chambers of the house. One day he observed a robin fluttering outside the windows, and beating its wings against the panes, as if eager to gain admission. He went up stairs, and there found, in a retired part of one of the rooms, a robin's nest, with one of the parent birds sitting over three or four young—all dead. The excluded bird outside still beat against the panes; and on the window being let down, it flew into the room, but was so exhausted that it dropped upon the floor. Mr. Stephenson took up the bird, carried it down stairs, and had it warmed and fed.

The poor robin revived, and for a time was one of his pets. But it shortly died too, as if unable to recover from the privations it had endured during its three days' fluttering and beating at the windows. It appeared that the room had been unoccupied, and, the sash having been let down for some time, the robins had taken the opportunity of building their nest within it; but the servant having accidentally closed the window, the calamity befell them which so strongly excited Mr. Stephenson's sympathies. An incident such as this, trifling though it may seem, gives the true key to the heart of the man.

Besides his journeys at home, Mr. Stephenson was on more than one occasion called abroad on railway business. Thus, at the desire of King Leopold, he made several visits to Belgium to assist the Belgian engineers in laying out the national lines of that kingdom. That enlightened monarch at an early period discerned the powerful instrumentality of railways in developing a country's resources, and he determined at the earliest possible period to adopt them as the great high-roads of Belgium. The country, being rich in coal and minerals, had great manufacturing capabilities. It had good ports, fine navigable rivers, abundant canals, and a teeming, industrious population. Leopold perceived that railways were eminently calculated to bring the industry of the country into full play, and to render the riches of his provinces available to all the rest of the kingdom. He therefore openly declared himself the promoter of public railways throughout Belgium. The country had scarcely escaped from the throes of the revolution, when, by his command, the first project of a Belgian railway was laid before him. It was only a line from Antwerp to Liege, involving a capital expenditure of 400,000*l*. But modest though the project was, his ministers even feared that it was too ambitious, and that the king was about to embark his government in an enterprise beyond its strength. The bill struggled through the Chambers, and became law in 1834. But before the measure received legislative sanction, the plan had been enlarged, and powers were taken to construct an

almost entire system of lines embracing the principal districts of Belgium; connecting Brussels with all the chief cities; extending from Ostend eastward to the Prussian frontier, and from Antwerp southward to the French frontier. The total extent of railway thus authorised was 246 miles. The eventual success of this measure was mainly due to the energy and sagacious enterprise of the king. The execution of the works was immediately commenced, the money being provided by the state. Every official influence was called into active exertion for the purpose of carrying them forward to completion. And, in order to prevent the Belgian enterprise becoming in any way converted into a stock-jobbing speculation, it was wisely provided that the shares were not to be quoted on the Exchange at Antwerp or Brussels, until the railway was actually completed.

Mr. Stephenson and his son, as the leading railway-engineers of England, were consulted by the king as to the formation of the most efficient system of lines throughout his kingdom, as early as 1835. In the course of that year they visited Belgium, and had some interesting conferences with King Leopold and his ministers on the subject of the proposed railways. On that occasion the king appointed Mr. Stephenson by royal ordinance a Knight of the Order of Leopold. Improvements of the system were recommended and adopted; and in 1837 a law was passed, authorising the construction of additional lines,—from Ghent to Mouscron on the French frontier,—from Courtray to Tournai,—from Brain-le-Comte to Namur,—with several smaller branches. These, with the lines previously authorised, made a total length of 341 English miles. Much diligence was displayed by the government in pushing on the works; the representatives of the people in the Chambers now surpassing even the king himself in their anticipation of the great public benefits to be derived from railways. The first twelve miles between Brussels and Malines were opened in 1835, a year after the passing of the law; and successive portions were opened from time to time.

At the invitation of the king, Mr. Stephenson made a second visit to Belgium in 1837, on the occasion of the public opening of the line from Brussels to Ghent. At Brussels there was a public procession, and another at Ghent on the arrival of the train. Mr. Stephenson and his party accompanied it to the Public Hall, there to dine with the chief ministers of state, the municipal authorities, and about five hundred of the principal inhabitants of the city; the English ambassador being also present. After the king's health and a few others had been drank, that of Mr. Stephenson was proposed; on which the whole assembly rose up, amidst great excitement and loud applause, and made their way to where he sat, in order to jingle glasses with him, greatly to his own amazement. On the day following, Mr. Stephenson dined with the king and queen at their own table at Laaken, by special invitation; afterwards accompanying his majesty and suite to a public ball given by the municipality of Brussels, in honour of the opening of the line to Ghent, as well as of their distinguished English guest. On entering the room, the general and excited inquiry was, "Which is Stephenson?" The English engineer had never before known that he was esteemed as so great a man.

It is curious to contrast the conduct of the English government with that of Belgium at the same time. The House of Commons was still endeavouring to introduce the steam-carriage on common roads, and the government was expending large sums of money for the purpose of improving those roads, so as to enable them to compete with the railways which were in course of formation. It is a remarkable fact that during the time that the London and Birmingham Railway was under construction, 130,000*l.* was voted by Parliament to place the road between these two termini in an improved state, with this object. The alterations were carried out under the superintendence of Mr. Telford, the government engineer, and the money was expended just as the new turnpike-road was *not* wanted. The gradients were made easier, the line was straightened and

shortened, and even granite tramways were laid down—of which specimens may yet be seen between Towcester and Daventry—monuments of folly for the admiration of a scanty peasantry. At one place the government engineer was cutting down the gradients over the very same hill under which the railway engineer was tunnelling. Telford even tried upon this road the experiment of a steam-carriage, which proved a complete failure. Wherever any undue resistance was offered to its progress, the engine stuck or broke down; and after stopping at almost every blacksmith's shop to be repaired, and being beaten by every coach upon the road, to the infinite delight of the coachmen and guards, it reached Birmingham—then an eleven hours' journey—on the third day after its departure from London. The government engineers learnt discretion from these and similar failures. Since that time they have left the formation of the great high-roads of the country to private enterprise, and pursued the safer course of sitting in judgment upon what other engineers have done.

The London and Birmingham Railway having been completed in September, 1838, after being about five years in progress, the great main line of railway communication between London, Liverpool, and Manchester, was then opened to the public. For some months previously, the line had been partially opened, coaches performing the journey between Denbigh Hall (near Wolverton) and Rugby—the works of the Kilsby tunnel being still incomplete. It was already amusing to hear the complaints of the travellers about the slowness of the coaches as compared with the railway, though the coaches travelled at a speed of eleven miles an hour. The comparison of comfort was also greatly to the disparagement of the coaches. Then the railway-train could accommodate any quantity, whilst the road conveyances were limited; and when a press of travellers occurred—as on the occasion of the Queen's coronation—the greatest inconvenience was experienced, as much as 10*l.* being paid for a seat on a donkey-chaise between Rugby and Denbigh. On the opening of the railway throughout, of

course, all this inconvenience and delay was brought to an end.

Numerous other openings of railways constructed by Mr. Stephenson took place about the same time, and shortly after. The Sheffield and Rotherham line was opened in November, 1839; the Birmingham and Derby in August, 1839; and in the course of the following year, the Midland, the York and North Midland, the Chester and Crewe, the Chester and Birkenhead, the Manchester and Birmingham, the Manchester and Leeds, and the Maryport and Carlisle railways, were all publicly opened in whole or in part. Thus 321 miles of railway (exclusive of the London and Birmingham) constructed under Mr. Stephenson's superintendence, at a cost of upwards of eleven millions sterling, were, in the course of about two years, added to the traffic accommodation of the country.

The ceremonies which accompanied the public opening of these lines were often of an interesting character. The adjoining population held general holiday; bands played, banners waved, and assembled thousands cheered the passing trains amidst the occasional booming of cannon. The proceedings were usually wound up by a public dinner; and on such occasions Mr. Stephenson would often revert to his favourite topic—the difficulties which he had early encountered in the establishment of the railway system, and in proving, to the satisfaction of the public, the superiority of the locomotive. At the dinner which followed the opening of the Sheffield and Rotherham line, the Earl Fitzwilliam presided, and most of the notable personages of the district, including the Master Cutler, were present and made speeches.

On such occasions, Mr. Stephenson always took great pleasure in alluding to the services rendered to himself and the public by the young men brought up under his eye—his pupils at first, and afterwards his assistants. No great master ever possessed a more devoted band of assistants and fellow-workers than he did. And, indeed, it was one of the most marked evidences of his own admirable tact and judgment that he selected, with such undeviating correctness, the men best fitted to carry out his plans. The ability to accomplish great things, to carry grand ideas into practical effect, depends in no small measure on an intuitive knowledge of character, which Mr. Stephenson possessed in a remarkable degree. Thus, on the Liverpool and Manchester line, he secured the able services of Messrs. Vignolles and Locke; the latter had been his pupil, and had laid down for him several coal-lines in the North. John Dixon, trained by him on the Stockton and Darlington Railway, afterwards ably carried out his views on the Canterbury and Whitstable, the Liverpool and Manchester, and the Chester railways. Thomas Gooch was his able representative in superintending the execution of the formidable works of the Manchester and Leeds line. Swanwick on the North Midland, Birkenshaw on the Birmingham and Derby, and Cabrey on the York and North Midland, seconded him well and ably, and established their own reputation while they increased the engineering fame of their master. All these men, then comparatively young, became, in course of time, engineers of distinction, and were employed to conduct on their own account numerous railway enterprises of great magnitude.

At the dinner at York, which followed the partial opening of the York and North Midland Railway, Mr. Stephenson, as was his wont, prominently acknowledged the merit of his engineering pupils and assistants, and accompanied the recognition with many encouragements drawn from his own life and experience. On this occasion he said, "he was sure they would appreciate his feelings when he told them, that when he first began railway business, his hair was black, although it was now grey; and that he began his life's labour as but a poor ploughboy. He was only eight years old when he went to work, and he had been labouring hard ever since. About thirty years since, he had applied himself to the study of how to generate high velocities by mechanical means. He thought he had solved that problem. But when he afterwards appeared before a Committee of Parliament, and stated

that, in his opinion, a locomotive machine might, with safety, travel upon a railway at a speed of ten miles an hour, he was told that his evidence was not worth listening to. That, however, did not prevent him going forward with his plans, and they had for themselves seen, that day, what perseverance had brought him to. He was, on that occasion, only too happy to have an opportunity of acknowledging that he had, in the latter portion of his career, received much most valuable assistance, particularly from young men brought up in his manufactory. Whenever talent showed itself in a young man, he had always given that talent encouragement where he could, and he would continue to do so."

That this was no exaggerated statement, is amply proved by facts which redound to Mr. Stephenson's credit. He was no niggard of encouragement and praise when he saw honest industry struggling for a footing. Many were the young men whom, in the course of his useful career, he took by the hand and led steadily up to honour and emolument, simply because he had noted their zeal, diligence, and integrity. One youth excited his interest while working as a common carpenter on the Liverpool and Manchester line; and before many years had passed, he was recognised as an engineer of distinction. Another young man he found industriously working away at his bye-hours, and, admiring his diligence, engaged him for his private secretary; the gentleman shortly after rising to a position of eminent influence and usefulness. Indeed, nothing gave Mr. Stephenson greater pleasure than in this way to help on any deserving youth who came under his observation, and, in his own expressive phrase, to "make a man of him."

The openings of the great main lines of railroad communication shortly proved the fallaciousness of the numerous rash prophecies which had been promulgated by the opponents of railways. The proprietors of the canals were astounded by the fact that, notwithstanding the immense traffic conveyed by rail, their own traffic and receipts *continued to increase*; and that in common with other interests, they fully shared in the expansion of trade and commerce which had

been so effectually promoted by the extension of the railway system. The cattle-owners were equally amazed to find the price of horse-flesh increasing with the extension of railways, and that the number of coaches running to and from the new railway-stations gave employment to a greater number of horses than under the old stage-coach system. Those who had prophesied the decay of the metropolis, and the ruin of the suburban cabbage-growers, in consequence of the approach of railways to London, were also disappointed. For, whilst the new roads let citizens out of London, they let country-people in. Their action, in this respect, was centripetal as well as centrifugal. Tens of thousands who had never seen the metropolis could now visit it expeditiously and cheaply. And Londoners who had never visited the country, or but rarely, were enabled, at little cost of time or money, to see green fields and clear blue skies, far from the smoke and bustle of town. If the dear suburban-grown cabbages became depreciated in value, there were truck-loads of fresh-grown country cabbages to make amends for the loss: in this case, the "partial evil" was a far more general good. The food of the metropolis became rapidly improved, especially in the supply of wholesome meat and vegetables. And then the price of coals—an article which, in this country, is as indispensable as daily food to all classes—was greatly reduced. What a blessing to the metropolitan poor is described in this single fact!

The prophecies of ruin and disaster to landlords and farmers were equally confounded by the openings of the railways. The agricultural communications, so far from being "destroyed," as had been predicted, were immensely improved. The farmers were enabled to buy their coals, lime, and manure, for less money, whilst they obtained a readier access to the best markets for their stock and farm-produce. Notwithstanding the predictions to the contrary, their cows gave milk as before, their sheep fed and fattened, and even skittish horses ceased to shy at the passing locomotive. The smoke of the engines did not obscure the sky, nor were farmyards burnt up by the fire thrown from the

locomotives. The farming classes were not reduced to beggary; on the contrary, they soon felt that, so far from having anything to dread, they had very much good to expect from the extension of railways.

Landlords also found that they could get higher rents for farms situated near a railway, than at a distance from one. Hence they became clamorous for "sidings." They felt it to be a grievance to be placed at a distance from a station. After a railway had been once opened, not a landlord would consent to have the line taken from him. Owners who had fought the promoters before Parliament, and compelled them to pass their domains at a distance, at a vastly-increased expense in tunnels and deviations, now petitioned for branches and nearer station accommodation. Those who held property near towns, and had extorted large sums as compensation for the anticipated deterioration in the value of their building land, found a new demand for it springing up at greatly advanced prices. Land was now advertised for sale, with the attraction of being "near a railway station."

The prediction that, even if railways were made, the public would not use them, was also completely falsified by the results. The ordinary mode of fast travelling for the middle classes had heretofore been by mail-coach and stage-coach. Those who could not afford to pay the high prices charged for such conveyances went by waggon, and the poorer classes trudged on foot. George Stephenson was wont to say that he hoped to see the day when it would be cheaper for a poor man to travel by railway than to walk; and not many years passed before his expectation was fulfilled. In no country in the world is time worth more money than in England; and by saving time—the criterion of distance—the railway proved a great benefactor to men of industry in all classes.

Many deplored the inevitable downfall of the old stage-coach system. There was to be an end of that delightful variety of incident usually attendant on a journey by road. The rapid scamper across a fine country on the outside of the four-horse "Express," or "Highflyer;" the seat on the box

beside Jehu, or the equally coveted place near the facetious guard behind; the journey amid open green fields, through smiling villages and fine old towns, where the stage stopped to change horses and the passengers to dine,—was all very delightful in its way; and many regretted that this old-fashioned and pleasant style of travelling was about to pass away. But it had its dark side also. Any one who remembers the journey by stage from London to Manchester or York, will associate it with recollections and sensations of not unmixed delight. To be perched for twenty hours, exposed to all weathers, on the outside of a coach, trying in vain to find a soft seat—sitting now with the face to the wind, rain, or sun, and now with the back—without any shelter such as the commonest penny-a-mile parliamentary train now daily provides,—was a miserable undertaking, looked forward to with horror by many whose business required them to travel frequently between the provinces and the metropolis. Nor were the inside passengers more agreeably accommodated. To be closely packed up in a little, inconvenient, straight-backed vehicle, where the cramped limbs could not be in the least extended, nor the wearied frame indulge in any change of posture, was felt by many to be a terrible thing. Then there were the constantly-recurring demands, not always couched in the politest terms, for an allowance to the driver every two or three stages, and to the guard every six or eight; and if the gratuity did not equal their expectations, growling and open abuse were not unusual. These *désagrémens*, together with the exactions practised on travellers by innkeepers, seriously detracted from the romance of stage-coach travelling; and there was a general disposition on the part of the public to change the system for a better.

The avidity with which the public at once availed themselves of the railways proved that this better system had been discovered. Notwithstanding the reduction of the coach fares on many of the roads to one-third of their previous rate, the public preferred travelling by the railway. They saved in time; and they saved in money, taking the whole expenses

into account. In point of comfort there could be no doubt as to the infinite superiority of the railway carriage. But there remained the question of safety, which had been a great bugbear with the early opponents of railways, and was made the most of by the coach-proprietors to deter the public from using them. It was predicted that trains of passengers would be blown to pieces, and that none but fools would entrust their persons to the conduct of an explosive machine such as the locomotive. It appeared, however, that during the first eight years not fewer than five millions of passengers had been conveyed along the Liverpool and Manchester Railway, and of this vast number only two persons had lost their lives by accident. During the same period, the loss of life by the upsetting of stage-coaches had been immensely greater in proportion. The public were not slow, therefore, to detect the fact, that travelling by railways was greatly safer than travelling by common road; and in all districts penetrated by railways the coaches were very shortly taken off for want of support.

Mr. Stephenson himself had a narrow escape in one of the stage-coach accidents so common twenty years ago, but which are already almost forgotten. While the Birmingham line was under construction, he had occasion to travel from Ashby-de-la-Zouch to London by coach. He was an inside passenger with several others; and the outsides were pretty numerous. When within ten miles of Dunstable, he felt, from the rolling of the coach, that one of the linchpins securing the wheels had given way, and that the vehicle must upset. He endeavoured so to fix himself in his seat, holding on firmly by the arm-straps, that he might save himself on whichever side the coach fell. The coach soon toppled over, and fell crash upon the road, amidst the shrieks of his fellow-passengers and the smashing of glass. He immediately pulled himself up by the arm-strap above him, let down the coach window, and climbed out. The coachman and passengers lay scattered about on the road, stunned, and some of them bleeding, whilst the horses were plunging in their harness. Taking out his pocket-knife, he at once cut

the traces, and set the horses free. He then went to the help of the passengers, who were all more or less hurt. The guard had his arm broken; and the driver was seriously cut and contused. A scream from one of his fellow-passenger "insides" here attracted his attention: it proceeded from an elderly lady, whom he had before observed to be decorated with one of the enormous bonnets in fashion at the time. Opening the coach-door, he lifted the lady out; and her principal lamentation was that her large bonnet had been crushed beyond remedy! Mr. Stephenson then proceeded to the nearest village for help, and saw the passengers provided with proper assistance before he himself went forward on his journey.

It was some time before the more opulent classes, who could afford to post to town in aristocratic style, became reconciled to railway travelling. The old families did not relish the idea of being conveyed in a train of passengers of all ranks and conditions, in which the shopkeeper and the peasant were carried along at the same speed as the duke and the baron—the only difference being in price. It was another deplorable illustration of the levelling tendencies of the age.* It put an end to that gradation of rank in travelling, which was one of the few things left by which the nobleman could be distinguished from the Manchester manufacturer and bagman. But to younger sons of noble families the convenience and cheapness of the railway did not fail to recommend itself. One of these, whose eldest brother had just succeeded to an earldom, said one day to a railway

* At a meeting of the Chesterfield Mechanics' Institute, at which Mr. Stephenson was present, one of the speakers said of him, "Known as he is wherever steam and iron have opened the swift lines of communication to our countrymen, and regarded by all as the Father of Railways, he might be called, in the most honourable acceptation of the term, *the first and greatest leveller of the age.*" Mr. Stephenson joined heartily in the laugh which followed this description of himself. Sir Humphry Davy was once similarly characterised; but the remark was somewhat differently appreciated. When travelling on the Continent, a distinguished person about a foreign court inquired who and what he was, never having heard of his scientific fame. Upon being told that his discoveries had "*revolutionised chemistry*," the courtier promptly replied, "I hate all revolutionists; his presence will not be acceptable here."

manager: "I like railways—they just suit young fellows like me with 'nothing per annum paid quarterly.' You know, we can't afford to post, and it used to be deuced annoying to me, as I was jogging along on the box-seat of the stage-coach, to see the little Earl go by drawn by his four posters, and just look up at me and give me a nod. But now, with railways, it's different. It's true, he may take a first-class ticket, while I can only afford a second-class one, but *we both go the same pace*."

For a time, however, many of the old families sent forward their servants and luggage by railway, and condemned themselves to jog along the old highway in the accustomed family chariot, dragged by country post-horses. But the superior comfort of the railway shortly recommended itself to even the oldest families; posting went out of date; post-horses were with difficulty to be had along even the great high-roads; and nobles and servants, manufacturers and peasants, alike shared in the comfort, the convenience, and the despatch of railway travelling. The late Dr. Arnold, of Rugby, regarded the opening of the London and Birmingham line as another great step accomplished in the march of civilisation. "I rejoice to see it," he said, as he stood on one of the bridges over the railway, and watched the train flashing along under him, and away through the distant hedge-rows—"I rejoice to see it, and to think that feudality is gone for ever: it is so great a blessing to think that any one evil is really extinct."

It was long before the late Duke of Wellington would trust himself behind a locomotive. The fatal accident to Mr. Huskisson, which had happened before his eyes, contributed to prejudice him strongly against railways, and it was not until the year 1843 that he performed his first trip on the South-western Railway, in attendance upon her Majesty. Prince Albert had for some time been accustomed to travel by railway alone; but in 1842, the Queen began to make use of the same mode of conveyance between Windsor and London. Even Colonel Sibthorpe was eventually compelled to acknowledge its utility. For a time he continued to post

to and from the country as before. Then he compromised the matter by taking a railway ticket for the long journey, and posting only for a stage or two nearest town; until at length he undisguisedly committed himself like other people to the express train, and performed the journey throughout upon what he had formerly denounced as "the infernal railroad."

CHAPTER XV.

TAPTON HOUSE — MR. STEPHENSON'S PARTIAL RETIREMENT FROM THE PROFESSION OF ENGINEER — RAILWAY MANIA.

DURING the construction of the Midland Railway, Mr. Stephenson had frequently occasion to visit the neighbourhood of Chesterfield to inspect the progress of the Claycross tunnel, and the heavy stone cuttings in that neighbourhood. He then observed that the district was rich in coal, and it occurred to him that the opening of the railway would provide the means of a ready sale for the article. An opportunity shortly after presented itself of leasing the Claycross estate, and, other parties having joined him in the venture, a lease was taken with the object of working the coal which was known to exist on the estate. And in order that he might be able personally to superintend the sinking of the pits and the working of the coal, he about the same time took a lease of Tapton House, which continued his residence during the remainder of his life.

Tapton House is a large, roomy, brick mansion, beautifully situated amidst woods, upon a commanding eminence, about a mile to the north-east of the town of Chesterfield. Green fields dotted with fine trees slope away from the house in all directions. The surrounding country is exceedingly varied and undulating. North and south the eye ranges over a vast extent of lovely scenery; and on the west, looking over the town of Chesterfield, with its fine church and crooked spire, the extensive range of the Derbyshire hills bounds the distance. The Midland Railway skirts the western edge of the park in a deep rock cutting, and the shrill whistle of the locomotive sounds near at hand as the trains speed past. The gardens and pleasure-grounds adjoining the house were in a very neglected state when Mr. Stephenson first went to

Tapton; and he promised himself, when he had secured rest and leisure from business, that he would put a new face upon both. The first improvement he made was cutting a woodland footpath up the hill-side, by which he at the same time added a beautiful feature to the park, and secured

Tapton House.

a shorter road to the Chesterfield station. But it was some years before he found time to carry into effect his contemplated improvements in the adjoining gardens and pleasure grounds. He had so long been accustomed to laborious pursuits, and felt himself still so full of work, that he could not at once settle down into the habit of quietly enjoying the fruits of his industry.

Tapton House was a central point on the Midland Railway from which he could proceed north, south, and west, on his superintendence of the Midland, the York and North Midland, the Birmingham and Derby, and the Manchester and Leeds railways, all of which were under construction about

the same time. A considerable lull had now taken place in railway speculation, principally caused by the severe monetary pressure; only five new railway companies having obtained acts of incorporation in the two sessions of 1838 and 1839, and in 1840 not a single railway act was passed. Indeed it was not until 1844 that the tide of railway speculation rose again, and in the following year burst all bounds, breaking out in the wildest fury of speculation.

In the mean time Mr. Stephenson, though not engaged in surveys of new lines nor in parliamentary contests, continued fully occupied in superintending the large extent of railway under construction; in the intervals of his leisure—if leisure it could be called—directing the mining operations commenced at Claycross. He occasionally also paid visits to Newcastle to see how the locomotive works there were getting on, as well as to confer with the promoters of the East-coast line from Newcastle to Edinburgh, which, however, lay dormant for some years longer.

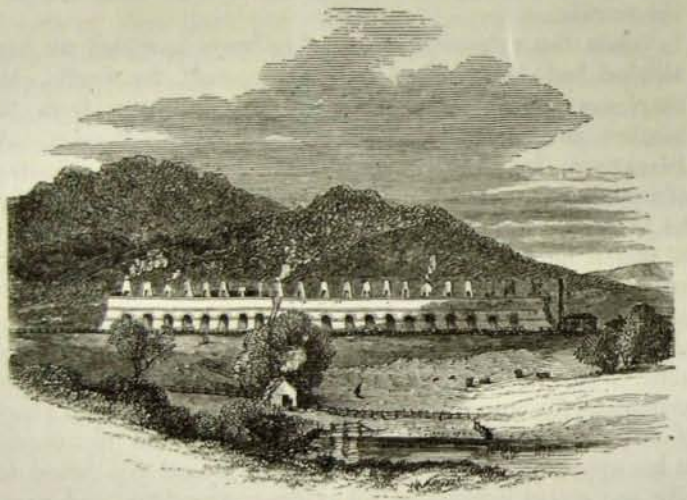
One of his most interesting visits to Newcastle was in 1838, on the occasion of the meeting of the British Association in that town, when he acted as one of the Vice-Presidents in the section of Mechanical Science. Extraordinary changes had occurred in his own fortunes, as well as in the face of the country, since he had first appeared before a scientific body in Newcastle—the members of the Literary and Philosophical Institute—to submit his safety-lamp for their examination. Twenty-three years had passed over his head, full of honest work, of manful struggle; and the humble "colliery enginewright of the name of Stephenson" had achieved an almost world-wide reputation as a great public benefactor. His fellow-townsmen, therefore, could not hesitate to recognise his merits and do honour to his fame. During the sittings of the Association, Mr. Stephenson took the opportunity of paying a visit to Killingworth, accompanied by some of the distinguished savans whom he numbered amongst his friends. He there pointed out to them, with a degree of honest pride, the cottage in which he had lived for so many years, showed what parts of it had been

his own handiwork, and told them the story of the sun-dial over the door, describing the study and the labour it had cost him and his son to calculate its dimensions, and fix it in its place. The dial had been serenely numbering the hours through the busy years that had elapsed since that humble dwelling had been his home; during which the Killingworth locomotive had become a great working power, and its contriver had established the railway system, which was now rapidly becoming extended in all parts of the world.

When the extensive series of railways to which we have alluded had been completed and opened for traffic, Mr. Stephenson began to express a wish to retire from the labours and anxieties of the engineering profession. At Blackburn, in 1840, he publicly expressed his intention of withdrawing from its active pursuit; and shortly after he proceeded to resign the charge of several of the railways of which he had been chief engineer. He was now sixty years of age, and though his constitution was sound, he could scarcely be expected much longer to exhibit that activity and energy which had heretofore distinguished him. There were now large numbers of rising engineers competing for employment; and, having done his full share of railway work, he naturally desired rest and retirement in his approaching old age. He nevertheless continued to take an active interest in all railway questions, and even to the last he was professionally concerned for several important companies.

After this comparative retirement from railway engineering, Mr. Stephenson extended his coal-mining operations in the neighbourhood of Chesterfield; in 1841, he entered into a contract with certain owners of land in the townships of Tapton, Brimington, and Newbold, for the working of the whole of the coal thereunder, and shortly after he proceeded to commence mining operations at Tapton on an extensive scale. About the same time he erected great limeworks, close to the Ambergate station of the Midland Railway, from which, when in full operation,

he was able to turn out upwards of two hundred tons a day. The limestone was brought on a tramway from the village of Crich, about two or three miles distant from the kilns, the coal wherewith to burn it being supplied from his adjoining Clay Cross colliery. The works were on a scale such as had not before been attempted by any private individual engaged in a similar trade; and their success amply compensated the projector.



Lime-works at Ambergate.

Mr. Stephenson's partial retirement from the profession of railway engineer led many persons interested in railways to moot the subject of presenting him with a testimonial, in consideration of the eminent services which he had rendered to the public by contributing so greatly to the establishment of this new power. Railways had now been in full work for ten years, and, having struggled through trials and difficulties almost unparalleled, were now established as the chief mode of internal communication throughout Great Britain; they had also been largely adopted by Belgium, France, and the United States.

Twenty-five hundred miles of railway, almost all of them double lines, had been laid down in these Islands alone, connecting the principal towns and provinces with the capital; joining in a more close and intimate union the various branches of the body politic, commercial and literary, with that great centre. Many new and important branches of industry had been entirely created by this new agency; and a stimulus had been given to all the existing departments of trade, as well as to the development of the bountiful resources of the soil, by which largely increased employment had been secured to the labouring classes. Some sixty millions of money had already been expended in forming railways; and this large investment was now returning about five millions yearly to the capitalists, for re-investment and further extension of the system. This vast iron revolution had been accomplished in a period of about ten years. So extraordinary a movement, powerfully affecting as it did all our social and commercial relations, and coming so closely home to the interests of every member of the community, had never before been experienced in our nation's history.

George Stephenson, above all others, had been the zealous propagandist of this great change. His ingenuity and perseverance had made the railway system practicable. His zeal and devotion had secured its success. What more natural than that some public mark of honour should be conferred upon him in recognition of his wonderful discovery,—for such, in point of fact, it was. Had he been a Frenchman or a Belgian, the honours of the state would have been showered upon him. Had he invented a shell or a bullet to the satisfaction of the Board of Ordnance, the British Government might have recognised him. Perhaps, had he pointed out to the country gentlemen some improved mode of patching up the old common roads and preserving turnpike trusts, he might have been honoured and rewarded as Macadam was. But who would now venture to compare the improver of turnpikes with the inventor of railroads, looking at the public benefits conferred

by the respective systems? Yet Mr. Stephenson, though he had solved the great social problem of rapid and easy transit from place to place—the subject of so much parliamentary inquiry—not only remained without any parliamentary recognition of his distinguished public services, but almost the whole of his professional career was a prolonged struggle against the obstructiveness of the legislature. Certain it is, that he never contemplated receiving any reward or recognition from that quarter. Amidst all his labours, it was the last thing that would have crossed his mind; and it is well that our greatest men in England can undertake questions of public utility, and carry them to a successful issue in the face of stupendous difficulties, without the stimulus of an expected medal or riband, or any government prize or acknowledgment whatever. Mr. Stephenson was, however, on one occasion offered a piece of government patronage, thus recorded by his son:—"I remember my father once refusing to accept from the Government what they thought a piece of valuable patronage, and it was almost, if not absolutely, the only piece of patronage they ever offered him. It was the appointment of a walking postman between Chesterfield and Chatsworth, who was to walk eight miles there and eight miles back every day with the letter-bags, and who was to receive the immense stipend of twelve shillings a week!" *

A movement was made by some leading railway men, in February, 1839, under the presidency of Alderman Thompson, M.P., to offer Mr. Stephenson some public testimonial in recognition of his distinguished services. A committee was formed, and an appeal was made to the public for subscriptions.

A list was opened, but filled slowly. Many other engineers who had been his pupils, and numerous resident engineers who had superintended the execution of the works planned by him, had received public recognition of their

* Reply of Robert Stephenson, Esq., M.P., President of the Institution of Civil Engineers, to Observations in the Second Report of the Postmaster General, May 20th, 1856.

services in many forms. But it was perhaps felt, that while these were generally of a local character, it was fitting that the testimonial to Mr. Stephenson, if offered at all, should express in some measure the gratitude of the British nation. No active effort was however made by the committee calculated to evoke any such result. The scheme then dropped, and the Stephenson Testimonial was not resumed for several years.

From an early period Mr. Stephenson manifested a lively interest in the cause of Mechanics' Institutes. He could not but remember the difficulties which he had early encountered in gathering together his own scientific knowledge,—the want of books from which he had suffered in his youth, and the miserable character of the instruction then within the reach of the working classes in the smaller towns and villages. A new spirit, however, had arisen on the subject of popular education. The exertions of Bell and Lancaster had led to the establishment of greatly improved agencies for the education of the children of the poor; and earnest efforts were also being made to introduce the adult working classes to the benefits of elementary and scientific instruction by means of Mechanics' Institutes. There were thus few manufacturing towns into which the spirit of Birkbeck and Brougham had not, to some extent, penetrated, exhibiting itself in the establishment of Working Men's Institutions, with their organisation of classes, lectures, and libraries. While residing at Newcastle in 1824, shortly after he had commenced his locomotive foundry in Forth Street, Mr. Stephenson was requested to preside at a public meeting held in that town for the purpose of establishing a Mechanics' Institute. The meeting was held; but George Stephenson was a man comparatively unknown even in Newcastle at that time, and his name failed to summon an "influential" attendance. The local papers scarcely noticed the proceedings; yet the Mechanics' Institute was founded, and struggled into existence. Years passed, and it was now felt to be an honour to secure Mr. Stephenson's presence at any public meetings

held for the promotion of popular education. Amongst the Mechanics' Institutes in his immediate neighbourhood at Tapton, were those of Belper and Chesterfield; and at their soirées he was a frequent and a welcome visitor. On those occasions he loved to tell them of the difficulties which had early beset him through want of knowledge, and of the means by which he had overcome them—always placing in the first rank perseverance. This was his grand text,—PERSEVERE. There was manhood in the very word. And he would remind them of their unspeakable advantages as mechanics compared with the workmen of his early days. They had books; but he remembered the time "when a good library of books would have been worth worlds to him."

A new stimulus was given to the Mechanics' Institutes of Derbyshire in 1841, by the adoption of visits to each other by railway. The civilising and educating influences of this great machine were thus carried on under Mr. Stephenson's own auspices, and almost at his very door. The Mechanics' Institution of Belper paid a visit, three hundred strong, to that of Chesterfield; and in a few weeks the latter returned the visit with interest. On both occasions Mr. Stephenson was the hero of the day. One after another the speakers acknowledged, that to him, the most distinguished mechanic living, they had been indebted for the improved means of transit which enabled them thus to hold intercourse with each other. Mr. Stephenson was, of course, a speaker on both occasions, and threw out many shrewd remarks and suggestions for the consideration of his friends the young mechanics present. After describing the great difficulties which he had to encounter in connexion with the locomotive, he said, "but that has been little compared with the difficulty I have had in the management of man. I have found the engineering of railways to be light work, compared with the engineering of men." A favourite subject of his observations at those mechanics' meetings was, the properties of the Crank, and the mistakes which mechanics had so often made with

respect to it. At Chesterfield he concluded with a piece of sound practical advice:—"As an encouragement to young mechanics, I may state to them, that I commenced my mechanical career with very scanty means; and by close application and study, I have succeeded in establishing a manufactory which sends machinery to almost every kingdom in Europe. I may add, that nothing conduces, in my opinion, so much to the success in life of a thinking mechanic as sobriety, coupled with a steady and persevering application to his employment; never, however, in the midst of all his engagements, forgetting to contribute, by every means in his power, to the comfort of his wife and family." At both Belper and Chesterfield, Mr. Stephenson invited the members, at any time when they thought they had found out any new invention, to bring their discovery to him, and he would always be ready to give them his opinion and assistance. This invitation got into the newspapers, and the consequence was, that he was very shortly flooded with letters, soliciting his opinion as to inventions which his correspondents thought they had made. He soon found that he had set himself a formidable task, and had roused the speculative and inventive faculties of the working men of nearly all England. He was, however, ready on all occasions to give his advice; and he frequently subscribed sums of money to enable struggling inventors to bring their schemes to a fair trial, when he considered them to be useful and feasible.

Nor did he remain a mere inactive spectator of the improvements in railway working, which increasing experience from day to day suggested. He continued to contrive improvements in the locomotive, and to mature his invention of the carriage-brake. And, strange to say, he had even to defend his favourite locomotive against more recent inventions, such as the atmospheric tube. When examined before the Select Committee on Railways in 1841, his mind seems principally to have been impressed with the necessity which existed for adopting a system of self-acting brakes: stating that, in his opinion, this was

the most important arrangement that could be provided for increasing the safety of railway travelling. "I believe," he said, "that if self-acting brakes were put upon every carriage, scarcely any accident could take place." His plan consisted in employing the momentum of the running train to throw his proposed brakes into action, immediately on the moving power of the engine being checked. He would also have these brakes under the control of the guard, by means of a connecting line running along the whole length of the train, by which they should at once be thrown out of gear when necessary.* At the same time he suggested, as an additional means of safety, that the signals of the line should be self-acting, and worked by the locomotives as they passed along the line. He considered the adoption of this plan of so much importance, that, with a view to the public safety, he would even have it enforced upon railway companies by the legislature. At the same time he was of opinion that it was the interest of the railway companies themselves to adopt the plan, as it would save great tear and wear of engines, carriages, tenders, and brake-vans, besides greatly diminishing the risk of accidents upon railways.

Whilst before the same Committee, he took the opportunity of stating his views with reference to railway speed, of which wild ideas were then afloat,—one gentleman of celebrity having publicly expressed the opinion that a speed of a hundred miles an hour was practicable in railway travelling! Not many years had passed since Mr. Stephenson had been pronounced insane for stating his conviction that twelve miles an hour could be performed by the locomotive; but now that he had established the fact, and greatly exceeded that speed, he was thought behind the age because he recommended the rate to be limited to forty miles an hour. He said: "I do not like either forty or fifty miles an hour upon any line—I think

* A full description, with plans, of Mr. Stephenson's self-acting brake, since revived in a modified form by M. Guérin, is given in the 'Practical Mechanics' Journal,' vol. i. p. 53.

it is an unnecessary speed; and if there is danger upon a railway, it is high velocity that creates it. I should say no railway ought to exceed forty miles an hour under the most favourable gradient; but upon a curved line the speed ought not to exceed twenty-four or twenty-five miles an hour." He had, indeed, constructed for the Great Western Railway an engine capable of running fifty miles an hour with a load, and eighty miles without one. But he never was in favour of a hurricane speed of this sort, believing it could only be accomplished at an unnecessary increase both of danger and expense. On this subject he afterwards observed: "The first time I went to Parliament to give evidence on the locomotive engine, when I stated that I would make that machine travel twelve miles an hour, I was thought to be mad. You will be surprised when I tell you that, during my recent examination before a Committee of the House of Commons on the Management of Railways, I stated, in my opinion, that the speed of the locomotive should not exceed forty miles an hour. I have been censured by many for giving that opinion. It is true that I have said the engine might be made to travel 100 miles an hour; but I always put a qualification on this, namely, as to what speed would best suit the public. I assure you I have been buffeted about in Parliament not a little on this question of railway speed."

Another railway innovation that Mr. Stephenson strongly set his face against was the promulgation of the idea that undulating railways of uneven, and even severe gradients, were as favourable for working as flat lines. Some engineers even went so far as to say that they were *better* adapted for the locomotive. Many years before, Mr. Stephenson had ascertained by experiment at Killingworth, that the engine expends half of its full power in overcoming a rising gradient of 1 in 260; and that when the gradient is so steep as 1 in 100, not less than three-fourths of its propelling power is sacrificed in ascending the acclivity. Hence his invariable practice, throughout his professional career, of securing a road as nearly as possible upon a level, following the course of

the valleys and the natural line of the country,—preferring to go round a difficulty rather than to tunnel through it or run over it, and often making a considerable circuit in order to secure good workable gradients; for he saw clearly that the longer flat line would eventually beat the shorter line of steep gradients as respected its paying qualities; and, throughout all his engineering, he was actuated by a just regard for the commercial part of the question. He had no desire to build up a reputation at the expense of railway shareholders, nor to obtain engineering *éclat* by making "ducks and drakes" of their money. He was persuaded that, in order to secure the practical success of railways, they must be so laid out as not only to prove of decided public utility, but also to be worked economically and to the advantage of their proprietors. They were not government roads, but private ventures, — in fact, commercial speculations. He therefore endeavoured to render them commercially profitable; and he repeatedly declared that if he did not believe they could be "made to pay" he would have nothing to do with them.

These extravagant notions as to railway construction became increasingly prevalent during the mania of speculation which sprang up in 1844, and continued throughout the following year. The success which had attended the working of the first railways now led to a period of wild excitement, and a rage for railway shares took possession of all classes of the community. Mr. Stephenson kept himself very much aloof from this irrational and headlong folly of the hour, and endeavoured, but in vain, to check it. Had he been less scrupulous, and lent his name to the numerous projects about which he was consulted, he might have largely added to his fortune; but he had no desire to earn money without labour and without honour. He himself never speculated in shares. When he was satisfied as to the merits of any line, he subscribed for a certain amount of capital, and held on, neither buying nor selling. At a time when the shares in most of the lines in which he held were selling at high premiums, some sagacious friends, fore-

seeing the inevitable panic, urged him to realise. His answer was "No: I subscribed for those shares to hold during my life-time, not to speculate with." Thus, all the railway stock that he had subscribed for continued in his possession until his death, although much of it by that time had become greatly depreciated in value in consequence of the over-speculation in railways.

At a dinner of the Leeds and Bradford directors at Ben Rydding in October, 1844, before the mania had reached its height, he warned those present against railway speculation. It was, he said, like walking upon a piece of ice with shallows and deeps; the shallows were frozen over, and they would carry, but it required great caution to get over the deeps. He was satisfied that in the course of the next year many would step on places not strong enough to carry them, and would get into the deeps; they would be taking shares, and afterwards be unable to pay the calls upon them. Yorkshiremen were reckoned clever men, and his advice to them was, to stick together and promote communication in their own neighbourhood,—not to go abroad with their speculations. If any had done so, he advised them to get their money back as fast as they could, for if they did not they would not get it at all. He informed the company, at the same time, of his earliest holding of railway shares; it was in the Stockton and Darlington Railway, and the number he held was *three*—"a very large capital for him to possess at the time." But a Stockton friend was anxious to possess a share, and he sold him *one* at a premium of 33*s.*; he supposed he had been about the first man in England to sell a railway share at a premium.

During 1845, his son's offices in Great George Street, Westminster, were crowded with persons of various conditions seeking interviews, and presented very much the appearance of the levee of a minister of state. Mr. Hudson, the "Railway King," surrounded by an admiring group of followers, was often a prominent figure there; and a still more interesting person, in the estimation of many, was George Stephenson, dressed in black, his coat of somewhat

old-fashioned cut, with square pockets in the tails. He wore a white neckcloth, and a large bunch of seals was suspended from his watch-ribbon. Altogether, he presented an appearance of health, intelligence, and good humour, that rejoiced one to look upon in that sordid, selfish, and eventually ruinous saturnalia of railway speculation.

Being still the consulting engineer for several of the older companies, he necessarily appeared before Parliament in support of their branches and extensions. In 1845 his name was associated with that of his son as the engineer for the Southport and Preston Junction. In the same session he gave evidence in favour of the Syston and Peterborough branch of the Midland Railway; but his principal attention was confined to the promotion of the line from Newcastle to Berwick, in which he had never ceased to take the deepest interest. At the same time he was engaged in examining and reporting upon certain foreign lines of considerable importance.

Powers were granted by Parliament, in 1845, to construct not less than 2883 miles of new railways in Britain, at an expenditure of about forty-four millions sterling! Yet the mania was not appeased; for in the following session of 1846, applications were made to Parliament for powers to raise 389,000,000*l.* sterling for the construction of further lines; and powers were actually conceded for forming 4790 miles (including 60 miles of tunnels), at a cost of about 120,000,000*l.* sterling. During this session, Mr. Stephenson appeared as engineer for only one new line, —the Buxton, Macclesfield, Congleton, and Crewe Railway —a line in which, as a coal-owner, he was personally interested; — and for three branch-lines in connexion with existing companies for which he had long acted as engineer. During the same session, all the leading professional men were fully occupied, some of them appearing as consulting engineers for upwards of thirty lines each!

One of the features of the times was the rage for "direct lines" which everywhere displayed itself. There were "Direct Manchester," "Direct Exeter," "Direct York," and,

indeed, new direct lines between most of the large towns. The Marquis of Bristol, speaking in favour of the "Direct Norwich and London" project, at a public meeting at Haverhill, said, "If necessary, they might *make a tunnel beneath his very drawing-room*, rather than be defeated in their undertaking!" And the Rev. F. Litchfield, at a meeting in Banbury, on the subject of a line to that town, said "He had laid down for himself a limit to his approbation of railways,—at least of such as approached the neighbourhood with which he was connected,—and that limit was, that he did not wish them to approach any nearer to him than *to run through his bedroom, with the bedposts for a station!*" How different was the spirit which influenced these noble lords and gentlemen but a few years before!

The course adopted by Parliament in dealing with the multitude of railway bills applied for during the prevalence of the mania, was as irrational as it proved to be unfortunate. The want of foresight displayed by both Houses in obstructing the railway system so long as it was based upon sound commercial principles, was only equalled by the fatal facility with which they now granted railway projects based only upon the wildest speculation. Parliament interposed no check, laid down no principle, furnished no guidance, for the conduct of railway projectors, but left every company to select its own locality, determine its own line, and fix its own gauge. No regard was paid to the claims of existing companies, which had already expended so large an amount in the formation of useful railways; and speculators were left at full liberty to project and carry out lines almost parallel with theirs.

The House of Commons became thoroughly influenced by the prevailing excitement. Even the Board of Trade began to favour the views of the fast school of engineers. In their "Report on the Lines projected in the Manchester and Leeds District," they promulgated some remarkable views respecting gradients, declaring themselves in favour of the "undulating system." Thus they cited the case of the Lickey incline on the Birmingham and Gloucester Railway, as "a

conclusive proof that a gradient of 1 in 37½ for a length of two miles may be worked by the aid of an engine constructed for the purpose, without serious inconvenience to an extensive traffic;"—that "gradients of from 1 in 50 to 1 in 100 are perfectly practicable to the ordinary locomotive engine, with moderate loads;"—that lines of an undulating character "which have gradients of 1 in 70 or 1 in 80 distributed over them in short lengths, may be positively *better* lines, *i. e., more susceptible of cheap and expeditious working*, than others which have nothing steeper than 1 in 100 or 1 in 120!" They concluded by reporting in favour of the line which exhibited the most gradients, and the sharpest curves, chiefly on the ground that it could be constructed for less money.

Sir Robert Peel took occasion, when speaking in favour of the continuance of the Railways Department of the Board of Trade, to advert to this Report in the House of Commons on the 4th of March following, as containing "a novel and highly important view on the subject of gradients, which, he was certain, never could have been taken by any Committee of the House of Commons, however intelligent;" but he might have added, that the more intelligent, the less likely they were to arrive at any such conclusions. When Mr Stephenson saw this report of the Premier's speech in the newspapers of the following morning, he went forthwith to his son, and asked him to write a letter to Sir Robert Peel on the subject. He saw clearly that if these views were adopted, the utility and economy of railways would be seriously curtailed. "These members of parliament," said he, "are now as much disposed to exaggerate the powers of the locomotive, as they were to under-estimate them but a few years ago." Mr. Robert Stephenson wrote a letter for his father's signature, embodying the views which he so strongly entertained as to the importance of flat gradients, and referring to the experiments conducted by him many years before, in proof of the great loss of working power which was incurred on a line of steep as compared with easy gradients. It was clear, from the tone of Sir Robert Peel's speech in a subsequent

debate, that he had carefully read and considered Mr. Stephenson's practical observations on the subject; though it did not appear that he had come to any definite conclusion thereon, further than that he strongly approved of the Trent Valley Railway, by which Tamworth would be placed upon a direct main line of communication.

The last great measure in which Mr. Stephenson took an active personal interest was the completion of the East Coast Railway between London and Edinburgh. He had done much to form that route, both by constructing the lines from Derby to York, and by bringing before the public his plan for carrying the main line northwards to Edinburgh. A bill with this object was again brought before Parliament in 1844. On the 18th of June in that year, the Newcastle and Darlington line—an important link of the great main highway to the north—was completed and publicly opened—thus connecting the Thames and the Tyne by a continuous line of railway. On that day, Mr. Stephenson and a distinguished party of railway men, travelled by express train from London to Newcastle in about nine hours. It was a great event, and was worthily celebrated. The population of Newcastle held holiday; and a banquet given in the Assembly Rooms the same evening, assumed the form of an ovation to Mr. Stephenson and his son. Thirty years before, in the capacity of a workman, he had been labouring at the construction of his first locomotive in the immediate neighbourhood. By slow and laborious steps, he had worked his way on, dragging the locomotive into notice, and raising himself in public estimation; and at length he had victoriously established the great railway system, and went back amongst his townsmen to receive their greeting.

After the opening of this railway, the completion of the East Coast line, by effecting a connexion between Newcastle and Berwick, was again revived; and Mr. Stephenson, who had already identified himself with the question, and was intimately acquainted with every foot of the ground, was called upon to assist the promoters with his judgment and experience.

By this time, the plan of substituting atmospheric pressure for locomotive steam-power in the working of railways, had become very popular. Many eminent engineers avowedly supported atmospheric in preference to locomotive lines; and there was a strong party in parliament, headed by the Prime Minister, who were much disposed in its favour. When Mr. Stephenson was taken by his friend Mr. Vignolles to see the model of the atmospheric tube, after carefully examining the arrangements, he declared emphatically, "*It won't do*; it is only the fixed engines and ropes over again in another form; and I don't think this rope of wind will do so well as the rope of wire did." This first impression proved to be correct, notwithstanding the reports of Committees of the House of Commons and of the Board of Trade in favour of the atmospheric system. The locomotive had never been favoured with any such reports, except as applied to common roads. Yet it had vitality enough in it to live through all. "Nothing will beat it," said George Stephenson, "for efficiency in all weathers, for economy in drawing loads of heavy weight, and for power and speed as occasion may require."

The parliamentary party in favour of the atmospheric as opposed to locomotive railways included amongst its number Lord Howick, one of the members for Northumberland; and, possessing great local influence, he succeeded, in 1844, in forming a powerful confederacy of the landed gentry in favour of an atmospheric line through that county. Mr. Stephenson could not brook the idea of seeing the locomotive, for which he had fought so many stout battles, pushed to one side by the atmospheric system, and that in the very county in which its great powers had been first developed. Nor did he relish the appearance of Mr. Brunel as the engineer of Lord Howick's atmospheric railway, in opposition to the line which had occupied his thoughts and been the object of his strenuous advocacy for so many years. When Mr. Stephenson first met Mr. Brunel in Newcastle, he good-naturedly shook him by the collar, and asked "what business he had north of the Tyne?" Mr. Stephenson gave him to understand that they were to have a fair stand-up fight for the

ground, and, shaking hands before the battle like Englishmen, they parted in good humour. A public meeting was held at Newcastle in the following December, when, after a full discussion of the merits of the respective plans, Mr. Stephenson's line was almost unanimously adopted as the best.

The rival projects went before Parliament in 1845, and a severe contest ensued. The display of ability and tactics on both sides was great. Mr. Hudson and the Messrs. Stephenson were the soul of the struggle for the locomotive line, and Lord Howick and Mr. Brunel in support of the atmospheric system of working. Mr. Brunel set forth as the strongest recommendations of the latter, its superior "rapidity, comfort, safety, and economy." Sir William Cubitt also was of opinion that the atmospheric line was preferable; and that it "could work a greater number of trains than Mr. Stephenson's, at a cheaper rate." After a desperate struggle, the locomotive again triumphed; Mr. Stephenson's Coast-line secured the approval of Parliament, and the shareholders in the Atmospheric Company were happily saved from expending their capital in the perpetration of an egregious blunder; for Mr. Stephenson's first verdict of "It won't do," proved the correct one; the whole of the atmospheric tubes on all the lines having been pulled up and sold by the end of 1848, to make way for the locomotive engine.

So closely was Mr. Stephenson identified with this measure, and so great was the personal interest which he was known to take in his success, that, on the news of the triumph of the bill reaching Newcastle, a sort of general holiday took place, and the workmen belonging to the Stephenson Locomotive Factory, upwards of eight hundred in number, walked in procession through the principal streets of the town, accompanied by music and banners.

At a meeting of the York, Newcastle, and Berwick Company, held shortly after the passing of the bill, Mr. Hudson thus acknowledged the services rendered to them by their consulting engineer. "This Company," said he, "is indeed

under great obligations to Mr. Stephenson. Every shareholder who is about to get his additional share is almost entirely indebted to him for it. I know, and my brother directors know full well, the resolute and energetic manner in which he held us from any compromise in reference to the Berwick bill. He felt so strong in the integrity of his case, that whenever compromise was named, he always resisted the offer, and urged us to fight the battle on principle. By his indomitable perseverance and high tone of feeling we were induced to do so, and thus at length we have so successfully accomplished our object."

Mr. Hudson accordingly suggested to the proprietors that they should present some fitting testimonial to Mr. Stephenson, as a recognition of the important services which he had rendered to them, as well as to the railway interest generally. With the same object, he appealed to the proprietors in the Midland, the York and North Midland, and the Newcastle and Darlington Companies, of which he was chairman, and they unanimously adopted resolutions, voting 2000*l.* each for the erection of a statue of George Stephenson on the High Level Bridge at Newcastle, and the presentation to him of a service of plate, "in testimony of the deep obligations under which the above-mentioned Companies, in common with the whole country, feel themselves placed towards that eminent person."

Mr. Ellis, M.P., then deputy-chairman of the Midland, in seconding the resolution voting 2000*l.* for the purpose indicated by Mr. Hudson, said, it might appear to many strange that he should do so [statues not being recognised objects amongst the Society of Friends]; but he did so with all his heart. He believed he had the distinguished honour of having known George Stephenson longer than any one then present. Perhaps he could not say more of him than that he had always found in him an upright, honourable, and honest man."

At the meeting of the York and North Midland Company, the great benefits which Mr. Stephenson had conferred on the public, by opening up to them cheap and abundant

supplies of fuel by means of railways, were strongly expressed; and Mr. Hudson, in concluding his observations, said:—"By adopting this step, we shall show that we are not the sordid persons whom some have represented us to be—merely looking for our own pecuniary benefit; but that we are a body of men who know how to appreciate and admire genius and talent, and that we are not unmindful of the benefits which that talent has conferred upon us and upon mankind. This resolution, like those passed by the other Companies, was adopted unanimously with "loud applause;" but there ended the shareholders' recognition of Mr. Stephenson's services. The Hudson Testimonial was a much more taking thing; for Mr. Hudson could create paper wealth in those days almost without limit, and he had it in his power to allot shares (selling at a premium) to the subscribers to his testimonial. But Mr. Stephenson pretended to fill no man's pocket with premiums; he was no creater of shares, and could not therefore work upon shareholders' gratitude for "favours to come." The proposed testimonial accordingly ended with resolutions and speeches. The York, Newcastle, and Berwick Board—in other words, Mr. Hudson—did indeed mark their sense of the "great obligations" which they were under to Mr. Stephenson for helping to carry their bill through Parliament, by making him an allotment of thirty of the new shares authorized by the Act. But, as afterwards appeared, the chairman had at the same time appropriated to himself not fewer than 10,894 of the same shares, the premiums on which were then worth, in the market, about 145,000*l.* This shabby manner of acknowledging the gratitude of the Company to their engineer, was strongly resented by Mr. Stephenson at the time, and a coolness took place between him and Mr. Hudson which was never wholly removed,—though they afterwards shook hands, and Mr. Stephenson declared that all was forgotten.

There was still another great work connected with Newcastle and the East Coast route which Mr. Stephenson projected, but which he did not live to see completed,—the

High Level Bridge over the Tyne, of which his son Robert was the principal engineer. Mr. R. W. Brandling—to the public spirit and enterprise of whose family the prosperity of Newcastle has been in no small degree indebted, and who first brought to light the strong original genius of George Stephenson in connexion with the safety-lamp—is entitled to the merit of originating the idea of the High Level Bridge as it was eventually carried out, with a central terminus for the northern railways in the Castle Garth at Newcastle. He first promulgated the plan in 1841; and in the following year it was resolved that Mr. George Stephenson should be consulted as to the most advisable site for the proposed bridge. A prospectus of a High Level Bridge Company was issued in 1843, the names of George Stephenson and George Hudson appearing on the committee of management, Mr. Robert Stephenson being the consulting engineer. The project was eventually taken up by the Newcastle and Darlington Railway Company, and an act for the construction of the bridge was obtained in 1845. The designs of the bridge were Mr. Robert Stephenson's: and the works were executed under the superintendence of Mr. Thomas Harrison, one of Mr. Stephenson's many able assistants. The High Level Bridge is certainly the most magnificent and striking of all the erections to which railways have given birth,—more picturesque as an object than the tubular bridge over the Menai Straits, and even more important as a great public work. It has been worthily styled "the King of railway structures."

It remains for us, before concluding the account of Mr. Stephenson's railway career, now drawing to a close, to allude to the visits of inspection of foreign railways, which he made in 1845. In that year, the Sambre and Meuse Company having obtained the concession of a line from the Belgian legislature, Mr. Stephenson, accompanied by his friends Mr. Sopwith and Mr. Starbuck, proceeded to Belgium for the purpose of examining the district through which the proposed line was to pass. Arrived on the ground, he went carefully over its entire length, as far as Couvin, the

Forest of Ardennes, and Rocroi, across the French frontier; examining the bearings of the coal-field, the slate and marble quarries, and the numerous iron mines in existence between the Sambre and the Meuse, as well as carefully exploring the ravines which extended through the district, in order to satisfy himself that the best possible route had been selected. Mr. Stephenson was delighted with the novelty of the journey, the beauty of the scenery, and the industry of the population. His companions were entertained by his ample and varied stores of practical information on all subjects; and his conversation was full of reminiscences of his youth, on which he always delighted to dwell when in the society of his more intimate friends and associates. The journey was varied by a visit to the coal-mines near Jemappe, where Mr. Stephenson examined with interest the mode adopted by the Belgian miners of draining the pits, their engines, and brakeing machines, so familiar to him in early life. At intervals of their journey, Mr. Stephenson prepared, in conjunction with Mr. Sopwith, the draft of a Report embodying the result of their investigations, which was presented to the Sambre and Meuse Company, and afterwards published.

The engineers of Belgium took the opportunity of Mr. Stephenson's visit to their country to invite him to a magnificent banquet at Brussels. The Public Hall, in which they entertained him, was gaily decorated with flags, prominent amongst which was the Union Jack, in honour of their distinguished guest. A handsome marble pedestal, ornamented with his bust, crowned with laurels, occupied one end of the room. The chair was occupied by M. Massui, the Chief Director of the National Railways of Belgium; and the most eminent scientific men of the kingdom were present. Their reception of "the Father of railways" was of the most enthusiastic description. Mr. Stephenson was greatly pleased with the entertainment. Not the least interesting incident of the evening was his observing, when the dinner was about half over, a model of a locomotive engine placed upon the centre table, under a triumphal arch. Turning suddenly

to his friend Sopwith, he exclaimed, "Do you see the 'Rocket?'" It was indeed the model of that celebrated engine; and Mr. Stephenson prized the compliment thus paid him, perhaps more than all the encomiums of the evening.

The next day (April 5th) King Leopold invited him to a private interview at the palace. Accompanied by Mr. Sopwith, he proceeded to Laaken, and was very cordially received by his Majesty. Nothing was more remarkable in Mr. Stephenson than his extreme ease and self-possession in the presence of distinguished and highly-educated persons. The king immediately entered into familiar conversation with him, discussing the railway project which had been the object of Mr. Stephenson's visit to Belgium, and then the structure of the Belgian coal-fields,—his Majesty expressing his sense of the great importance of economy in a fuel which had become indispensable to the comfort and well-being of society, which was the basis of all manufactures, and the vital power of railway locomotion. The subject was always a favourite one with Mr. Stephenson, and, encouraged by the king, he proceeded to describe to him the geological structure of Belgium, the original formation of coal, its subsequent elevation by volcanic forces, and the vast amount of denudation. In describing the coal-beds, he used his hat as a sort of model to illustrate his meaning; and the eyes of the king were fixed upon it as he proceeded with his interesting description. The conversation then passed to the rise and progress of trade and manufactures,—Mr. Stephenson pointing out how closely they everywhere followed the coal, being mainly dependent upon it, as it were, for their very existence.

The king seemed greatly pleased with the interview, and at its close expressed himself obliged by the interesting information which Mr. Stephenson had communicated. Shaking hands cordially with both the gentlemen, and wishing them success in all their important undertakings, he bade them adieu. As they were leaving the palace Mr. Stephenson, bethinking him of the model by which he had just been

illustrating the Belgian coal-fields, said to his friend, "By the bye, Sopwith, I was afraid the king would see the inside of my hat; it's such a shocking bad one!" Little could George Stephenson, when brakesman at a coal-pit, have dreamt that, in the course of his life, he should be admitted to an interview with a monarch, and describe to him the manner in which the geological foundations of his kingdom had been laid!

Mr. Stephenson paid a second visit to Belgium in the course of the same year, on the business of the West Flanders Railway; and he had scarcely returned from it ere he was requested to proceed to Spain, for the purpose of examining and reporting upon a scheme then on foot for constructing "the Royal North of Spain Railway." A concession had been made by the Spanish Government of a line of railway from Madrid to the Bay of Biscay, and a numerous staff of engineers was engaged in surveying the proposed line. The directors of the Company had declined making the necessary deposits until more favourable terms had been secured; and Sir Joshua Walmsley, on their part, was about to visit Spain and press the Spanish Government on the subject. Mr. Stephenson, whom he consulted, was alive to the difficulties of the office which Sir Joshua was induced to undertake, and offered to be his companion and adviser on the occasion,—declining to receive any recompense beyond the simple expenses of the journey. The railway mania was then at its height: and though Mr. Stephenson was not concerned in the multitude of new schemes which were daily coming out, he was engaged in several important measures, and, besides, had his own extensive collieries at Clay Cross to look after. He could therefore only arrange to be absent for six weeks, and he set out from England about the middle of September, 1845.

The party was joined at Paris by Mr. Mackenzie, the contractor for the Orleans and Tours Railway, then in course of construction, who took them over the works, and accompanied them as far as Tours. Sir Joshua Walmsley was struck during the journey by Mr. Stephenson's close and

accurate observation. Nothing escaped his keen eye. The external features of the district passed through, every fissure or disruption in the mountain ridges, the direction of the rivers, the stratification and geological formation of the country, were carefully, though rapidly, noted. The modes of farming were also observed; and he compared the herds of cattle, the horses and mules, with those which he had observed in his own and other countries. Nor did he fail to observe closely the agricultural products, and the fruits and flowers grown in the gardens of the villages through which they passed. Of course he was fully alive to any important engineering works which came in his way. Thus, in crossing the river Dordogne, on the road to Bordeaux, he was struck with the construction of the stupendous chain-bridge which had recently been erected there. Not satisfied with his first inspection, he walked back and again crossed the bridge. On reaching the shore he said: "This bridge cannot stand; it is impossible that it can sustain the necessary pressure. Supposing a large body of troops to march over it, there would be so much oscillation as to cause the greatest danger; in fact it could not stand." And he determined to write to the public authorities, warning them on the subject; which he did. His judgment proved to be quite correct, for only a few years after, no improvement having been made in the bridge, a body of troops marching over it under the precise circumstances which he had imagined, the chains broke, the men were precipitated into the river, and many lives were lost.

They soon reached the great chain of the Pyrenees, and crossed over into Spain. It was on a Sunday evening, after a long day's toilsome journey through the mountains, that the party suddenly found themselves in one of those beautiful secluded valleys lying amongst the Western Pyrenees. A small hamlet lay before them, consisting of some thirty or forty houses and a fine old church. The sun was low on the horizon, and, under the wide porch, beneath the shadow of the church, were seated nearly all the inhabitants of the place. They were dressed in their holiday attire. The

bright bits of red and amber colour in the dresses of the women, and the gay sashes of the men, formed a striking picture, on which the travellers gazed in silent admiration. It was something entirely novel and unexpected. Beside the villagers sat two venerable old men, whose canonical hats indicated their quality as village pastors. Two groups of young women and children were dancing outside the porch to the accompaniment of a simple pipe; and within a hundred yards of them, some of the youths of the village were disporting themselves in athletic exercises; the whole being carried on beneath the fostering care of the old church, and with the sanction of its ministers. It was a beautiful scene, and deeply moved the travellers as they approached the principal group. The villagers greeted them courteously, supplied their present wants, and pressed upon them some fine melons, brought from their adjoining gardens. Mr. Stephenson used afterwards to look back upon that simple scene, and speak of it as one of the most charming pastorals he had ever witnessed.

They shortly reached the site of the proposed railway, passing through Irun, St. Sebastian, St. Andero, and Bilbao, at which places they met deputations of the principal inhabitants who were interested in the subject of their journey. At Raynosa Mr. Stephenson carefully examined the mountain passes and ravines through which a railway could be formed. He rose at break of day, and surveyed until the darkness set in; and frequently his resting-place at night was the floor of some miserable hovel. He was thus laboriously occupied for ten days, after which he proceeded across the province of Old Castile towards Madrid, surveying as he went. The proposed plan included the purchase of the Castile canal; and that property was also surveyed. He next proceeded to El Escorial, situated at the foot of the Guadarama mountains, through which he found that it would be necessary to construct two formidable tunnels; added to which he ascertained that the country between El Escorial and Madrid was of a very difficult and expensive character to work through. Taking these circumstances into account, and looking at the

expected traffic on the proposed line, Sir Joshua Walmsley, acting under the advice of Mr. Stephenson, offered to construct the line from Madrid to the Bay of Biscay, only on condition that the requisite land was given to the Company for the purpose; that they should be allowed every facility for cutting such timber belonging to the Crown as might be required for the purposes of the railway; and also that the materials required from abroad for the construction of the line should be admitted free of duty. In return for these concessions the Company offered to clothe and feed several thousands of convicts while engaged in the execution of the earthworks. General Narvaez, afterwards Duke of Valencia, received Sir Joshua Walmsley and Mr. Stephenson on the subject of their proposition, and expressed his willingness to close with them; but it was necessary that other influential parties should give their concurrence before the scheme could be carried into effect. The deputation waited ten days to receive the answer of the Spanish government; but no answer of any kind was vouchsafed. The authorities, indeed, invited them to be present at a Spanish bull-fight, but that was not quite the business that Mr. Stephenson had gone all the way to Spain to transact; and the offer was politely declined. The result was, that Mr. Stephenson dissuaded his friend from making the necessary deposit at Madrid. Besides, he had by this time formed an unfavourable opinion of the entire project, and considered that the traffic would not amount to one-eighth of the estimate.

Mr. Stephenson was now anxious to be in England. During the journey from Madrid he often spoke with affection of friends and relatives; and when apparently absorbed by other matters, he would revert to what he thought might then be passing at home. Few incidents worthy of notice occurred on the journey homeward, but one may be mentioned. While travelling in an open conveyance between Madrid and Vittoria, the driver was urging his mules down hill at a dangerous pace. He was requested to slacken speed; but suspecting his passengers to be afraid, he only flogged the brutes into a still more furious gallop. Observing this, Mr. Stephenson coolly said, "Let us try him on the other tack; tell him to show us the fastest pace at which Spanish mules can go." The rogue of a driver, when he found his tricks of no avail, pulled up and proceeded at a moderate rate for the rest of his journey.

Urgent business required Mr. Stephenson's presence in London on the last day of November. They travelled, therefore almost continuously, day and night; and the fatigue consequent on the journey, added to the privations voluntarily endured by the engineer while carrying on the survey among the Spanish mountains, began to tell seriously on his health. By the time he reached Paris, he was evidently ill, but he nevertheless determined on proceeding. He reached Havre in time for the Southampton boat; but when on board, pleurisy developed itself, and it was necessary to bleed him freely. During the voyage, he spent his time chiefly in dictating letters and reports to Sir Joshua Walmsley, who never left him, and whose kindness on the occasion he gratefully remembered. His friend was struck by the clearness of his dictated composition, which exhibited a vigour and condensation which to him seemed marvellous. After a few weeks' rest at home, Mr. Stephenson gradually recovered, though his health remained severely shaken.

On his report being presented to the shareholders in the projected "Royal North of Spain Railway" in the course of the following month, it was so decidedly unfavourable, that the project was abandoned, and the Company forthwith dissolved.

CHAPTER XVI.

CLOSING YEARS — ILLNESS AND DEATH — CHARACTER.

TOWARDS the close of his life, Mr. Stephenson almost entirely withdrew from the active pursuit of his profession as a railway engineer. He devoted himself chiefly to his extensive collieries and lime-works, taking a local interest only in such projected railways as were calculated to open up new markets for their products.

At home he lived the life of a country gentleman, enjoying his garden and his grounds, and indulging his love of nature, which, through all his busy life, had never left him. It was not until the year 1845 that he took an active interest in horticultural pursuits. Then he began to build new melon-houses, pineries, and vineries of great extent; and he now seemed as eager to excel all other growers of exotic plants in the neighbourhood, as he had been to surpass the villagers of Killingworth in the production of gigantic cabbages and cauliflowers some thirty years before. He had a pine-house built sixty-eight feet in length, and a pinery one hundred and forty feet. The workmen were never idle about the garden, and the additions to the forcing-houses proceeded until at length he had no fewer than ten glass forcing-houses, heated with hot water, which he was one of the first to introduce in that neighbourhood. He did not take so much pleasure in flowers as in fruits. At one of the county agricultural meetings, he said that he intended yet to grow pine-apples at Tapton as big as pumpkins. The only man to whom he would "knock under" was his friend Paxton, the gardener to the Duke of Devonshire; and he was so old in the service, and so skilful, that he could scarcely hope to beat him. Yet his "Queen" pines did take the first prize at a competition with the Duke,—though this was not until shortly after his

death, when the plants had become more fully grown. His grapes also recently took the first prize at Rotherham, at a competition open to all England. He was extremely successful in producing melons, having invented a method of suspending them in baskets of wire gauze, which, by relieving the stalk from tension, allowed nutrition to proceed more freely, and better enabled the fruit to grow and ripen. Amongst his other erections, he built a joiner's shop, where he kept a workman regularly employed in carrying out his many ingenious contrivances of this sort.

He took much pride also in his growth of cucumbers. He raised them very fine and large, but he could not make them grow straight. Place them as he would, notwithstanding all his propping of them, and humouring them by modifying the application of heat and the admission of light for the purpose of effecting his object, they would still insist on growing crooked in their own way. At last he had a number of glass cylinders made at Newcastle, for the purpose of an experiment; into these the growing cucumbers were inserted, and then he succeeded in growing them perfectly straight. Carrying one of the new products into his house one day, and exhibiting it to a party of visitors, he told them of the expedient he had adopted, and added gleefully, "I think I have bothered them noo!"

Mr. Stephenson also carried on farming operations with some success. He experimented on manure, and fed cattle after methods of his own. He was very particular as to breed and build in stock-breeding. "You see, sir," he said to one gentleman, "I like to see the *coo's* back at a gradient something like this" (drawing an imaginary line with his hand), "and then the ribs or girders will carry more flesh than if they were so, or so." When he attended the county agricultural meetings, which he frequently did, he was accustomed to take part in the discussions, and he brought the same vigorous practical mind to bear upon questions of tillage, drainage, and farm economy, which he had been accustomed to exercise on mechanical and engineering matters. At one of the meetings of the North Derbyshire Agricultural

Society, he favoured the assembled farmers with an explanation of his theory of vegetation. The practical conclusion to which it led was, that the agriculturist ought to give as much light and heat to the soil as possible. At the same time he stated his opinion that, in some cold soils, water contributed to promote vegetation, rather than to impede it, as was generally believed; for the water, being exposed to the sun and atmosphere, became specifically warmer than the earth it covered, and when it afterwards irrigated the fields, it communicated this additional heat to the soil which it permeated.

All his early affection for birds and animals revived. He had favourite dogs, and cows, and horses; and again he began to keep rabbits, and to pride himself on the beauty of his breed. There was not a bird's nest upon the grounds that he did not know of; and from day to day he went round watching the progress which the birds made with their building, carefully guarding them from injury. No one was more minutely acquainted with the habits of British birds, the result of a long, loving, and close observation of nature.

At Tapton he remembered the failure of his early experiment in hatching birds' eggs by heat, and he now performed it successfully, being able to secure a proper apparatus for maintaining a uniform temperature. He was also curious about the breeding and fattening of fowls; and when his friend Edward Pease of Darlington visited him at Tapton, he explained a method which he had invented for fattening chickens in half the usual time. The chickens were shut up in boxes, which were so made as to exclude the light. Dividing the day into two or three parts, the birds were shut up at each period after a heavy feed, and went to sleep. The plan proved very successful, and Mr. Stephenson jocularly said that if he were to devote himself to chickens he could soon make a little fortune.

Mrs. Stephenson tried to keep bees, but found they would not thrive at Tapton. Many hives perished, and there was no case of success. The cause of failure was a puzzle to Mr.

Stephenson; but one day his acute powers of observation enabled him to unravel it. At the foot of the hill on which Tapton House stands, he saw some bees trying to rise up from amongst the grass, laden with honey and wax. They were already exhausted, as if with long flying; and then it occurred to him that the height which the house stood above the bees' feeding-ground rendered it difficult for them to reach their hives when heavy laden, and hence they sank exhausted. Mr. Stephenson afterwards stated the case to Mr. Jesse the naturalist, who concurred in his view as to the cause of failure, and was much struck by the keen observation which had led to its solution.

Mr. Stephenson had none of the in-door habits of the student. He read very little; for reading is a habit which is generally acquired in youth; and his youth and manhood had been for the most part spent in hard work. Books wearied him, and sent him to sleep. Novels excited his feelings too much, and he avoided them, though he would occasionally read through a philosophical book on a subject in which he felt particularly interested. He wrote very few letters with his own hand; nearly all his letters were dictated, and he avoided even dictation when he could. His greatest pleasure was in conversation, from which he gathered most of his imparted information; hence he was always glad in the society of intelligent, conversible persons.

It was his practice, when about to set out on a journey by railway, to walk along the train before it started, and look into the carriages to see if he could find "a conversible face." On one of these occasions, at the Euston Station, he discovered in a carriage a very handsome, manly, and intelligent face, which he shortly found belonged to the late Lord Denman. He was on his way down to his seat at Stony Middleton, in Derbyshire. Mr. Stephenson entered the carriage, and the two were shortly engaged in interesting conversation. It turned upon chronometry and horology, and Mr. Stephenson amazed his lordship by the extent of his knowledge on the subject, in which he displayed as much minute information, even down to the latest improvements

in watchmaking, as if he had been bred a watchmaker and lived by the trade. Lord Denman was curious to know how a man whose time must have been mainly engrossed by engineering, had gathered so much knowledge on a subject quite out of his own line, and he asked the question. "I learnt clockmaking and watchmaking," was the answer, "while a working man at Killingworth, when I made a little money in my spare hours by cleaning the pitmen's clocks and watches; and since then I have kept up my information on the subject." This led to further questions, and then Mr. Stephenson told Lord Denman the interesting story of his life, which held him entranced during the remainder of the journey.

Many of his friends readily accepted invitations to Tapton House to enjoy his hospitality, which never failed. With them he would "fight his battles o'er again," reverting often to his battle for the locomotive; and he was never tired of telling, nor were his auditors of listening to, the lively anecdotes with which he was accustomed to illustrate the struggles of his early career. Whilst walking in the woods or through the grounds, he would arrest his friends' attention by allusion to some simple object,—such as a leaf, a blade of grass, a bit of bark, a nest of birds, or an ant carrying its eggs across the path,—and descant in glowing terms upon the creative power of the Divine Mechanician, whose contrivances were so exhaustless and so wonderful. This was a theme upon which he was often accustomed to dwell in reverential admiration, when in the society of his more intimate friends.

One night, when walking under the stars, and gazing up into the field of suns, each the probable centre of a system, forming the Milky Way, a friend said to him, "What an insignificant creature is man in sight of so immense a creation as that!" "Yes!" was his reply, "but how wonderful a creature also is man, to be able to think and reason, and even in some measure to comprehend works so infinite!"

A microscope, which he had brought down to Tapton

was a source of immense enjoyment to him; and he was never tired of contemplating the minute wonders which it revealed. One evening, when some friends were visiting him, he induced each of them to puncture his skin so as to draw blood, in order that he might examine the globules through the microscope. One of the gentlemen present was a teetotaller, and Mr. Stephenson pronounced his blood to be the most lively of the whole. He had a theory of his own about the movement of the globules in the blood, which has since become familiar. It was, that they were respectively charged with electricity, positive at one end and negative at the other, and that thus they attracted and repelled each other, causing a circulation. No sooner did he observe anything new, than he immediately set about devising a reason for it. His training in mechanics, his practical familiarity with matter in all its forms, and the strong bent of his mind, led him first of all to seek for a mechanical explanation. And yet he was ready to admit that there was a *something* in the principle of *life*—so mysterious and inexplicable—which baffled mechanics, and seemed to dominate over and control them. He did not care much, either, for abstruse mechanics, but only for the experimental and practical, as is usually the case with those whose knowledge has been self-acquired.

Even at this advanced age, his spirit of frolic had not left him. When proceeding from Chesterfield station to Tapton House with his friends, he would almost invariably challenge them to a race up the steep path, partly formed of stone steps, along the hill side. And he would struggle, as of old, to keep the front place, though by this time his "wind" had greatly failed. He would even invite an old friend to take a quiet wrestle with him on the lawn, in memory of former times. In the evening, he would sometimes indulge his visitors by reciting the old pastoral of "Damon and Phyllis," or singing his favourite song of "John Anderson my Joe." But his greatest glory amongst those with whom he was most intimate, was "a crowdie!" "Let's have a crowdie night," he would say; and forthwith a kettle of

boiling water was ordered in, with a basin of oatmeal. Taking a large bowl, containing a sufficiency of hot water, and placing it between his knees, he then poured in oatmeal with one hand, and stirred the mixture vigorously with the other. When enough meal had been added, and the stirring was completed, the crowdie was made. It was then supped with new milk, and Mr. Stephenson generally pronounced it "capital!" It was the diet to which he had been accustomed when a working man, and all the dainties with which he had been familiar in recent years had not spoiled his simple tastes. To enjoy crowdie at his years, besides, indicated that he still possessed that quality on which no doubt much of his practical success in life had depended, —a strong and healthy digestion.

He would also frequently invite to his house the humbler companions of his early life, and take pleasure in talking over old times with them. He never assumed any of the bearings of a great man on these occasions, but treated such visitors with the same friendliness and respect as if they had been his equals, sending them away pleased with themselves and delighted with him. At other times, needy men who had known him in youth would knock at his door, and they were never refused access. But if he had heard of any misconduct on their part, he would rate them soundly. One who knew him intimately in private life has seen him exhorting such backsliders, and denouncing their misconduct and imprudence, with the tears streaming down his cheeks. And he would generally conclude by opening his purse, and giving them the help which they needed "to make a fresh start in the world."

Young men would call upon him for advice or assistance in commencing a professional career. When he noted their industry, prudence, and good sense, he was always ready. But, hating foppery and frippery above all things, he would reprove any tendency to this weakness which he observed in the applicants. One day, a youth desirous of becoming an engineer called upon him, flourishing a gold-headed cane: Mr. Stephenson said, "Put by that stick, my man,

and then I will speak to you." To another extensively decorated gentleman, he one day said, "You will, I hope, Mr. ——, excuse me; I am a plain-spoken person, and am sorry to see a nice-looking and rather clever young man like you disfigured with that fine-patterned waistcoat, and all these chains and fang-dangs. If I, sir, had bothered my head with such things when at your age, I would not have been where I am now."

Mr. Stephenson's life at Tapton during his later years was occasionally diversified with a visit to London. His engineering business having become limited, he generally went there for the purpose of visiting friends, or "to see what there was new going on." He found a new race of engineers springing up on all hands—men who knew him not; and his London journeys gradually ceased to yield him real pleasure. A friend used to take him to the opera, but by the end of the first act, he was generally observed in a profound slumber. Yet on one occasion he enjoyed a visit to the Haymarket, with a party of friends on his birthday, to see T. P. Cooke, in "Black-eyed Susan;"—if that can be called enjoyment which kept him in a state of tears during half the performance. At other times he visited Newcastle, which always gave him great pleasure. He would, on such occasions go out to Killingworth and seek up old friends, and if the people whom he knew were too retiring and shrunk into their cottages, he went and sought them there. Striking the floor with his stick, and holding his noble person upright, he would say, in his own kind way, "Well, and how's all here to-day?" To the last Mr. Stephenson had always a warm heart for Newcastle and its neighbourhood.

Sir Robert Peel, on more than one occasion, invited Mr. Stephenson to his mansion at Drayton, where he was accustomed to assemble round him men of the greatest distinction in art, science, and legislation, during the intervals of his parliamentary life. The first invitation Mr. Stephenson declined. Sir Robert invited him a second time, and a second time he declined: "I have no great ambition," he

said, "to mix in fine company, and perhaps should feel out of my proper place among such high folks." But Sir Robert a third time pressed him to come down to Tamworth early in January, 1845, when he would meet Buckland, Follett, and others well known to both. "Well, Sir Robert," said he, "I feel your kindness very much, and can no longer refuse: I will come down and join your party."

Mr. Stephenson's strong powers of observation, together with his native humour and shrewdness, imparted to his conversation at all times much vigour and originality, and made him, to young and old, a delightful companion. Though mainly an engineer, he was also a profound thinker on many scientific questions: and there was scarcely a subject of speculation, or a department of recondite science, on which he had not employed his faculties in such a way as to have formed large and original views. At Drayton, the conversation often turned upon such topics, and Mr. Stephenson freely joined in it. On one occasion, an animated discussion took place between himself and Dr. Buckland on one of his favourite theories as to the formation of coal. But the result was, that Dr. Buckland, a much greater master of tongue-fence than Mr. Stephenson, completely silenced him. Next morning, before breakfast, when he was walking in the grounds deeply pondering, Sir William Follett came up and asked what he was thinking about? "Why, Sir William, I am thinking over that argument I had with Buckland last night; I know I am right, and that if I had only the command of words which he has, I'd have beaten him." "Let me know all about it," said Sir William, "and I'll see what I can do for you." The two sat down in an arbour, where the astute lawyer made himself thoroughly acquainted with the points of the case; entering into it with all the zeal of an advocate about to plead the dearest interests of his client. After he had mastered the subject, Sir William rose up, rubbing his hands with glee, and said, "Now I am ready for him." Sir Robert Peel was made acquainted with the plot, and adroitly introduced the subject of the controversy after dinner. The result was, that in the

argument which followed, the man of science was overcome by the man of law; and Sir William Follett had at all points the mastery over Dr. Buckland. "What do *you* say, Mr. Stephenson?" asked Sir Robert, laughing. "Why," said he, "I will only say this, that of all the powers above and under the earth, there seems to me to be no power so great as the gift of the gab."

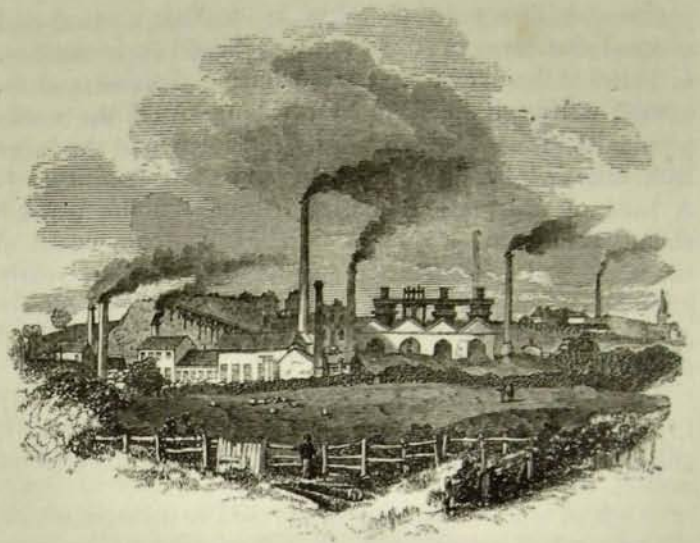
One day, at dinner, during the same visit, a scientific lady asked him the question: "Mr. Stephenson, what do you consider the most powerful force in nature?" "Oh!" said he, in a gallant spirit, "I will soon answer that question: it is the eye of a woman for the man who loves her; for if a woman look with affection on a young man, and he should go to the uttermost ends of the earth, the recollection of that look will bring him back: there is no other force in nature which could do that."

One Sunday, when the party had just returned from church, they were standing together on the terrace near the Hall, and observed in the distance a railway train flashing along, throwing behind it a long line of white steam. "Now, Buckland," said Mr. Stephenson, "I have a poser for you. Can you tell me what is the power that is driving that train?" "Well," said the other, "I suppose it is one of your big engines." "But what drives the engine?" "Oh, very likely a canny Newcastle driver." "What do you say to the light of the sun?" "How can that be?" asked the doctor. "It is nothing else," said the engineer: "it is light bottled up in the earth for tens of thousands of years,—light, absorbed by plants and vegetables, being necessary for the condensation of carbon during the process of their growth, if it be not carbon in another form,—and now, after being buried in the earth for long ages in fields of coal, that latent light is again brought forth and liberated, made to work as in that locomotive, for great human purposes." The idea was certainly a most striking and original one: like a flash of light, it illuminated in an instant an entire field of science.

During the same visit, Mr. Stephenson one evening re-

peated his experiment with blood drawn from the finger, submitting it to the microscope in order to show the curious circulation of the globules. He set the example by pricking his own thumb; and the other guests, by turns, in like manner gave up a small portion of their blood for the purpose of ascertaining the comparative liveliness of their circulation. When Sir Robert Peel's turn came, Mr. Stephenson said he was curious to know "how the blood globules of a great politician would conduct themselves." Sir Robert held forth his finger for the purpose of being pricked; but once, and again, he sensitively shrunk back, and at length the experiment, so far as he was concerned, was abandoned. Sir Robert Peel's sensitiveness to pain was extreme, and yet he was destined, a few years after, to die a death of the most distressing agony.

From these visits to distinguished persons, Mr. Stephenson went back to Tapton with an increased love for home and its pleasures. He must see after his garden, his birds, and his favourite animals. There were also his thousand workpeople to be looked after, at Tapton and Clay Cross; and Mechanics' Institutes to be visited, and many other things to be attended to. One of the subjects that gave him most pleasure during the later years of his life was the encouragement of educational institutes for the working classes, in which he took the deepest interest. He had many discussions on the subject with his intimate friend Mr. Binns, the manager of the extensive works at Clay Cross. A large population had now settled down at that place, and the original hamlet, consisting of about twelve cottages, had assumed the dimensions of a town. Iron-smelting furnaces had been added to the colliery, and decided prosperity at length promised to attend Mr. Stephenson's original enterprise. How were these workpeople to be morally and intellectually improved, and their children efficiently educated? Such was the question which occupied the attention of Mr. Stephenson and his friend. Small beginnings were made, educational institutes of all kinds growing but slowly; but at length a system was established, so admirable and calculated to be so



Clay Cross Works.

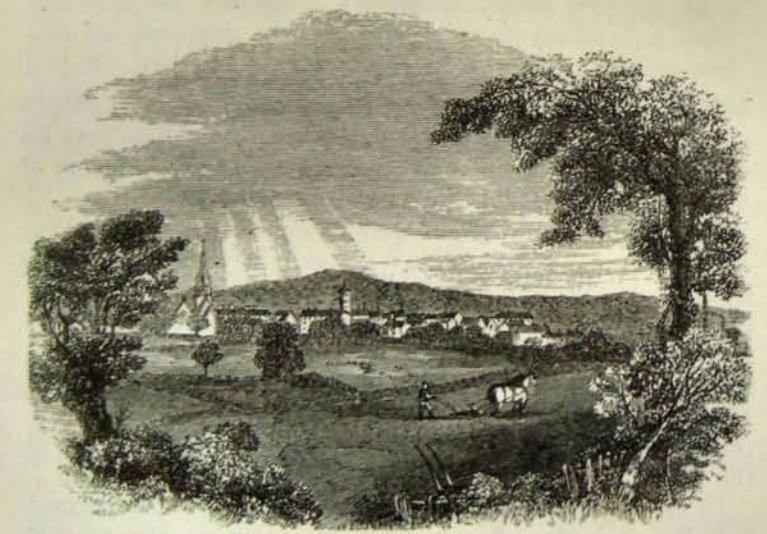
beneficial to all parties concerned, employers and workpeople alike, that we think the institution at Clay Cross may be cited as a model for general imitation by large employers of labour in all districts. It is briefly as follows:—

It is made a condition of employment at the works that every man and boy shall pay a fortnightly rate for educational and other purposes. Every married man pays a shilling a fortnight, every single man eight pence, every boy five pence. Of these respective contributions, two pence a fortnight from each is appropriated exclusively for education. It is further made a condition, that the fund shall be administered by the manager of the works; the concentration of the power in his hands ensuring efficiency to the system.

In return for these contributions, the following important benefits are conferred:—1. Free education in day schools for all the children of the workpeople. 2. Free education in night schools for all the boys and young men desiring instruction. 3. Free access to a Workmen's Institute, with its lectures, reading-room supplied with daily and weekly news-

papers, and library of 1600 volumes. 4. Free medical and surgical attendance to all the workpeople and their families. 5. Relief at the rate of 4*s*. a week during sickness, and 5*s*. a week during disablement by accident, to all the workpeople. 6. Free access to a fortnightly dance in the large hall, attended by the workpeople and their families. 7. A band of instrumental music, a drum and fife band, a choral society, and a cricket club, are maintained out of the rate. 8. Between thirty and forty pounds are yearly granted out of the rate as prizes for the best cottage garden vegetables; the competition for which is held three times a year in the Public Hall.

Such is the admirable institution now existing at Clay Cross. The number of persons employed on the works is about fifteen hundred; and the amount of good daily effected



Clay Cross Village.

by agencies of the character thus briefly stated can be better imagined than described. Schools, with a fine public hall, and a handsome church, have been erected, at a cost of many

thousand pounds, towards the expenses of which the Clay Cross Company have munificently contributed; but the main element of success in the Institution unquestionably consists in the truly philanthropic action of the manager, Mr. Binns, who was for so many years the private secretary of George Stephenson, and in whom his spirit strongly lives and nobly works.

"The *good* men do, lives after them," happily holds true quite as often as the converse maxim embodied in Shakespere's well-known couplet.* The example and influence exercised by a good man upon his fellows, as by George Stephenson at Clay Cross during his life, is never lost; but goes on fructifying into good, long after his body has mouldered into dust.

In 1847, the year before his death, Mr. Stephenson was again invited to join a distinguished party at Sir Robert Peel's mansion at Drayton Manor, and to assist in the ceremony of formally opening the Trent Valley Railway, which had been originally designed and laid out by him many years before. The first sod of the railway was cut by the Prime Minister himself, in November, 1845, during the time when Mr. Stephenson was abroad on the business of the Spanish railway. The formal opening took place on the 26th of June, 1847, the line having thus been constructed in less than two years.

What a change had come over the spirit of the landed gentry since the time when George Stephenson had first projected a railway through that district! Then they were up in arms against him, characterising him as a devastator and spoiler of their estates; now he was hailed as one of the greatest benefactors of the age. Sir Robert Peel, the chief political personage in England, welcomed him as a guest and a friend, and spoke of him as the chief of our practical philosophers. A dozen members of parliament, seven baronets, with all the landed magnates of the district, assembled

* "The evil that men do, lives after them;
The good is oft interrèd with their bones."
Julius Cæsar.

to celebrate the opening of the railway. The clergy were there to bless the enterprise, and to bid all hail to railway progress, as "enabling them to carry on with greater facility those operations in connexion with religion which were calculated to be so beneficial to the country." The army, speaking through the mouth of General A'Court, acknowledged the vast importance of railways, as tending to improve the military defences of the country. And representatives from eight corporations were there to acknowledge the great benefits which railways had conferred upon the merchants, tradesmen, and working classes of their respective towns and cities.

Shortly after this celebration at Tamworth, Mr. Stephenson was invited to be present at an assemblage of railway men in Manchester, at which a testimonial was presented to Mr. J. P. Westhead, the former chairman of the Manchester and Birmingham Railway. The original Liverpool and Manchester line had now swelled into gigantic proportions. It formed the nucleus of the vast system now known as the London and North-western Railway. First one line, and then another, of which Mr. Stephenson had been engineer, became amalgamated with it, until the main line extended from London to Lancaster, stretching out its great arms to Leeds in one direction and Holyhead in the other, and exercising an influence over other northern lines as far as Glasgow, Edinburgh, and Aberdeen. On the occasion to which we refer, Mr. Stephenson, the father of railways, was not forgotten. It was mainly his ingenuity, energy, and perseverance that had called forth the commercial enterprise which issued in this magnificent system of internal communication; and the railway men who assembled to do honour to Mr. Westhead did not fail to recognise the great practical genius through whose labours it had been established. He was "the rock from which they had been hewn," observed Mr. Westhead, — the father of railway enterprise, — and the forerunner of all that had been done to extend the locomotive system throughout England and throughout the world.

This was the last railway meeting that Mr. Stephenson attended, and the last occasion on which he appeared in public, with the exception of a soirée of the Leeds Mechanics' Institute, in December, 1847. The words which he then addressed to the young men at Leeds were highly characteristic. Though crowned with honours, the architect of the railway system, and the constructor of some of the greatest works of his time, "he stood before them," he said, "but as a humble mechanic. He had risen from a lower standing than the meanest person there; and all that he had been enabled to accomplish in the course of his life had been done through perseverance. He said this for the purpose of encouraging youthful mechanics to do as he had done—to persevere." The words were simple, but forcible and pregnant with life and instruction for all men.

In the spring of 1848 Mr. Stephenson was invited to Whittington House, near Chesterfield, the residence of his friend and former pupil, Mr. Swanwick, to meet the distinguished American, Emerson. It was interesting to see those two remarkable men, so different in most respects, and whose lines of thought and action lay in such widely different directions, yet so quick to recognise each other's merits. Mr. Stephenson was not, of course, acquainted with Mr. Emerson as an author; and the contemplative American might not be supposed to be particularly interested beforehand in the English engineer, whom he knew by reputation only as a giant in the material world. But there was in both an equal aspiration after excellence, each in his own sphere,— the æsthetic and abstract tendencies of the one complementing the keen and accurate perceptions of the material of the other. Upon being introduced, they did not immediately engage in conversation; but presently Mr. Stephenson jumped up, took Emerson by the collar, and, giving him one of his friendly shakes, asked how it was that in England we could always tell an American? This led to an interesting conversation, in the course of which Emerson said how much he had everywhere been struck by the haleness and comeliness of the English men and women; and

then they diverged into a further discussion of the influences which air, climate, moisture, soil, and other conditions exercised upon the physical and moral development of a people. The conversation was next directed to the subject of electricity, upon which Mr. Stephenson launched out enthusiastically, explaining his views by several simple and striking illustrations. From thence it gradually turned to the events of his own life, which he related in so graphic a man ner as completely to rivet the attention of the American. Afterwards Emerson said, "that it was worth crossing the Atlantic to have seen Stephenson alone; he had such native force of character and vigour of intellect." Although Emerson does not particularly refer to this interview in the interesting essay afterwards published by him, entitled 'English Traits,' embodying the results of the observations made by him in his journeys through England, one cannot help feeling that his interview with such a man as Stephenson must have tended to fix in his mind those sterling qualities of pluck, bottom, perseverance, energy, shrewdness, bravery, and freedom, which he so vividly depicts in his book as the prominent characteristics of the modern Englishman.

The rest of Mr. Stephenson's days were spent quietly at Tapton, amongst his dogs, his rabbits, and his birds. When not engaged about the works connected with his collieries, he was occupied in horticulture and farming. He continued proud of his flowers, his fruits, and his crops; and the old spirit of competition still lived strong within him. Although he had for some time been in delicate health, and his hand shook from nervous affection, he appeared to possess a sound constitution. Emerson had observed of him that he had the lives of many men in him. But perhaps the American spoke figuratively, in reference to his vast stores of experience. It appeared that he had never completely recovered from the attack of pleurisy which seized him during his return from Spain. As late, however, as the 26th of July, 1848, he felt himself sufficiently well to be able to attend a meeting of the Institute of Mechanical Engineers at Birmingham, and to read to the members his paper "On the fallacies of the Rotatory Engine." It was his last appearance before them. Shortly after his return to Tapton, he had an attack of intermittent fever, from which he seemed to be recovering, when a sudden effusion of blood from the lungs carried him off, on the 12th of August, 1848, in the sixty-seventh year of his age.

His remains were followed to the grave by a large body of his workpeople, by whom he was greatly admired and beloved. They remembered him as a kind master, who was ever ready actively to promote all measures for their moral, physical, and mental improvement. The inhabitants of Chesterfield evinced their respect for the deceased by suspending business, closing their shops, and joining in the funeral procession, which was headed by the corporation of the town. Many of the surrounding gentry also attended the funeral. The body was interred in Trinity Church, Chesterfield, where a simple tablet marks the great engineer's last resting-place.

The statue of George Stephenson, which the Liverpool and Manchester and Grand Junction Companies had commissioned, was on its way to England when his death occurred; and the statue served for a monument, though his best monument will always be his works. The Liverpool Board placed a minute on their books, embodying also the graceful tribute of their secretary, Mr. Henry Booth, in which they recorded their admiration of the life, and their esteem for the character of the deceased. "The directors," they say, "on the present occasion look back with peculiar interest to their first connexion with Mr. Stephenson, in the construction of the Liverpool and Manchester Railway; to a period now twenty years past, when he floated their new line over Chat Moss, and cut his way through the rock-cutting at Olive Mount. Tracing the progress of railways from the first beginning to the present time, they find Mr. Stephenson foremost in urging forward the great railway movement; earning and maintaining his title to be considered, before any other man, the author of that universal

system of locomotion which has effected such mighty results —commercial, social, and political—throughout the civilized world. Two years ago, the directors entrusted to Mr. Gibson, of Rome, the duty and the privilege of producing a statue that might do honour to their friend, then living amongst them. They did not anticipate that on the completion of this work of art the great original would be no more,—that they should be constrained to accept the marble effigy of the engineer in lieu of the living presence of the man." The statue here referred to was placed in St. George's Hall, Liverpool. A full-length statue of the deceased, by Bailey, was also erected a few years later, in the noble vestibule of the London and North Western Station, in Euston Square. A subscription for the purpose

Statue of Stephenson at Euston Square.

was set on foot by the Society of Mechanical Engineers, of which he had been the founder and president. A few advertisements were inserted in the newspapers, inviting subscriptions; and it is a notable fact that the voluntary offerings shortly received included an average of two shillings each from 3150 working men, who embraced this opportunity of doing honour to their distinguished fellow workman.

The portrait prefixed to this volume gives a good indication of George Stephenson's shrewd, kind, honest, manly, face. His fair, clear countenance was ruddy, and seemingly glowed with health. The forehead was large and high, projecting over the eyes; and there was that massive breadth across the lower part, which is usually observed in men of eminent constructive skill. The mouth was firmly marked; and shrewdness and humour lurked there as well as in the keen grey eye. His frame was compact, well-knit, and rather spare. His hair became grey at an early age, and towards the close of his life it was of a pure silky whiteness. He dressed neatly in black, wearing a white neckcloth; and his face, his person, and his deportment at once arrested attention, and marked the Gentleman.

The life of George Stephenson, though imperfectly portrayed in the preceding pages, will be found to contain many valuable lessons. His was the life of a true man, and presented a striking combination of those sterling qualities which we are proud to regard as essentially English.

Doubtless he owed much to his birth, belonging as he did to the hardy and persevering race of the north,—a race less supple, soft, and polished than the people of the more southern districts of England, but, like their Danish progenitors, full of courage, vigour, ingenuity, and persevering industry. Their strong, guttural speech, which sounds so harsh and unmusical in southern ears, is indeed but a type of their nature. When Mr. Stephenson was struggling to give utterance to his views upon the locomotive before the Com

mittee of the House of Commons, those who did not know him supposed he was "a foreigner." Before long the world saw in him an Englishman, stout-hearted and true,—one of those master minds who, by energetic action in new fields of industry, impress their character from time to time upon the age and nation to which they belong.

The poverty of his parents being such that they could not give him any, even the very simplest, education, beyond the good example of integrity and industry, he was early left to shift for himself, and compelled to be self-reliant. Having the will to learn, he soon found a way for himself. No beginning could have been more humble than his; but he persevered: he had determined to learn, and he did learn. To such a resolution as his, nothing really beneficial in life is denied. He might have said, like Sebastian Bach, "I was industrious; and whoever is equally sedulous will be equally successful."

The whole secret of Mr. Stephenson's success in life was his careful improvement of time, which is the rock out of which fortunes are carved and great characters formed. He believed in genius to the extent that Buffon did when he said that "patience is genius;" or as some other thinker put it, when he defined genius to be the power of making efforts. But he never would have it that he was a genius, or that he had done anything which other men, equally laborious and persevering as himself, could not have accomplished. He repeatedly said to the young men about him: "Do as I have done—persevere!"

Every step of advance which he made was conquered by patient labour. When an engineman, he systematically took his engine to pieces on Saturday afternoons while the works were at a stand, for the purpose of cleaning it thoroughly, and "gaining insight." He thus gradually mastered the mechanism of the steam-engine, so that, when opportunity offered, he was enabled to improve it, and to make it work even when its own maker was baffled. He practically studied hydraulics in the same plodding way, when acting as plugman; and when all the local pump-doctors at Killing-

worth were in despair, he stepped in, and successfully applied the knowledge which he had so laboriously gained. A man of such a temper and purpose could not but succeed in life.

Whether working as a brakesman or an engineer, his mind was always full of the work in hand. He gave himself thoroughly up to it. Like the painter, he might say that he had become great "by neglecting nothing." Whatever he was engaged upon, he was as careful of the details as if each were itself the whole. He did all thoroughly and honestly. There was no "scamping" with him. When a workman he put his brains and labour into his work; and when a master he put his conscience and character into it. He would have no slop-work executed merely for the sake of profit. The materials must be as genuine as the workmanship was skilful. The structures which he designed and executed were distinguished for their thoroughness and solidity; his locomotives were famous for their durability and excellent working qualities. The engines which he sent to the United States in 1832 are still in good condition; and even *the engines built by him for the Killingworth colliery*, upwards of thirty years ago, are working steadily there to this day. All his work was honest, representing the actual character of the man.

The battle which Mr. Stephenson fought for the locomotive—and he himself always spoke of it as a "battle"—would have discouraged most other men; but it only served to bring into prominence that energy and determination which formed the back-bone of his character. "I have fought," said he, "for the locomotive single-handed for nearly twenty years, having no engineer to help me until I had reared engineers under my own care." The leading engineers of the day were against him, without exception; yet he did not despair. He had laid hold of a great idea, and he stuck by it; his mind was locked and bolted to the results. "I put up," he says, "with every rebuff, *determined* not to be put down." When the use of his locomotive on the Liverpool and Manchester line was reported against, and the employment of fixed engines recommended instead, Mr.

Stephenson implored the directors, who were no engineers, only to afford a fair opportunity for a trial of the locomotive. Their common sense came to his rescue. They had immense confidence in that Newcastle engine-wright. He had already made stedfast friends of several of the most influential men amongst them, who valued his manly uprightness and integrity, and were strongly disposed to believe in him, though all the engineering world stood on the one side, and he alone on the other. His patient purpose, not less than his intense earnestness, carried them away. They adopted his recommendation, and offered a prize of 500*l.* for the best locomotive. Though many proclaimed the Liverpool men to be as great maniacs as Stephenson, yet the result proved the practical sagacity of the directors and the skill of their engineer; but it was the determined purpose of the latter which secured the triumph of the locomotive. His resolution, founded on sound convictions, was the precursor of what he eventually achieved; and his intense anticipation was but the true presentiment of what he was afterwards found capable of accomplishing.

He was ready to turn his hand to anything,—shoes and clocks, railways and locomotives. He contrived his safety-lamp with the object of saving pitmen's lives, and perilled his own life in testing it. Whatever work was nearest him, he turned to and did it. With him to resolve was to do. Many men knew far more than he; but none was more ready forthwith to apply what he did know to practical purposes.

Sir Joshua Walmsley mentions, that, when examining the works of the Orleans and Tours Railway, Mr. Stephenson, seeing a large number of excavators filling and wheeling sand in a cutting, at a great waste of time and labour, after the manner of foreign navvies, went up to the men and said he would show them how to fill their barrow in half the time. He showed them the proper position in which to stand so as to exercise the greatest amount of power with the least waste of strength; and he filled the barrow with comparative ease again and again in their presence, to the

great delight of the workmen. When passing through his own workshops, he would point out to his men how to save labour and to get through their work skilfully and with ease. His energy imparted itself to others, quickening and influencing them as strong characters always do,—flowing down into theirs, and bringing out their best powers.

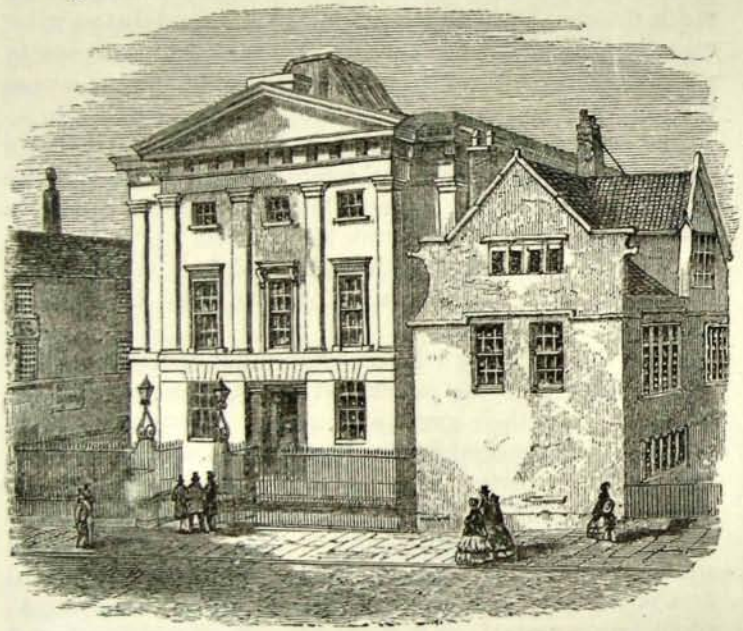
His deportment towards the workmen employed under him was familiar, yet firm and consistent. As he respected their manhood, so did they respect his masterhood. Although he comported himself towards his men as if they occupied very much the same level as himself, he yet possessed that peculiar capacity for governing others which enabled him always to preserve amongst them the strictest discipline, and to secure their cheerful and hearty services.

One of the most beautiful features of Mr. Stephenson's character was the affectionate interest which he took in the education of his son, stinting himself when only a poor working man in order to provide his boy with useful learning. He was not satisfied till he had obtained for him the advantages of a University course. Then he found him a most valuable fellow-worker.

From the opening of the Liverpool and Manchester Railway, the works of the father and the son can scarcely be separated. In their great engineering enterprises, and in the successive improvements effected by them in the arrangement and construction of the locomotive, their names are indissolubly united. Of the distinguished works of the son, it would be out of place to speak at length. But the London and Birmingham Railway, the Tubular Bridge over the Menai Straits, and the High Level Bridge at Newcastle, are works which future generations will point to as worthy of the greatest engineer of his day, and as noble results of George Stephenson's self-denying determination to educate his son to the fullest extent of his ability.

We cannot, however, refrain from mentioning the manner in which Mr. Stephenson's son has repaid the obligations which both were under to the Newcastle Literary and Philo-

sophical Institute, when working together as humble experimenters in their cottage at Killingworth. The Institute was until quite recently, struggling under a debt of 620*l*., which seriously impaired its usefulness as an educational agency. Mr. Robert Stephenson offered to pay one-half of the entire sum, provided the local supporters of the Institute would raise the remainder; and conditional also on the annual subscription being reduced from two guineas to one, in order that the usefulness of the institution might be extended. The generous offer was accepted, and the debt extinguished.



Newcastle Literary and Philosophical Institute.

Probably no military chiefs were ever more beloved by their soldiers than were both father and son by the army of men who, under their guidance, worked at labours of profit, made labours of love by their earnest will and purpose. True leaders of men and lords of industry, they were always

ready to recognise and encourage talent in those who worked for and with them. It was pleasant, at the openings of the Stephenson lines, to hear the chief engineers attributing the successful completion of the works to their able assistants; whilst the assistants, on the other hand, ascribed the entire glory to their chiefs.

A fine trait in Mr. Stephenson's character was his generosity, which would not permit an attack to be made upon the absent or the weak. He would never sanction any injustice of act or opinion towards those associated with himself. On one occasion, during the progress of the Liverpool and Manchester works, while he had a strong party to contend with at the Board, the conduct of one of his assistants was called in question, as he thought unjustly, and a censure was threatened. Rather than submit to this injustice to his assistant, Mr. Stephenson tendered his resignation: but it was not accepted, and the censure was not voted. The same chivalrous protection was on many occasions extended by him to the weaker against the stronger. Even if he were himself displeased with any one engaged about him, any attack from another quarter would rouse him in defence, not in the spirit of opposition, but from a kind and generous impulse to succour those in difficulty.

Mr. Stephenson, though a thrifty and frugal man, was essentially unsordid. His rugged path in early life made him careful of his resources. He never saved to hoard, but saved for a purpose, such as the maintenance of his parents or the education of his son. In later years, he became a prosperous and even a wealthy man; but riches never closed his heart, nor stole away the elasticity of his soul. He enjoyed life cheerfully, because hopefully. When he entered upon a commercial enterprise, whether for others or for himself, he looked carefully at the ways and means. Unless they would "pay," he held back. "He would have nothing to do," he declared, "with stock-jobbing speculations." His refusal to sell his name to the schemes of the railway mania,—his survey of the Spanish lines without remuneration,—his offer to postpone his claim for payment

from a poor company until their affairs became more prosperous,—are instances of the unsordid spirit in which he acted.

Another marked feature in Mr. Stephenson's character was his patience. Notwithstanding the strength of his convictions as to the great uses to which the locomotive might be applied, he waited long and patiently for the opportunity of bringing it into notice; and for years after he had completed an efficient engine he went on quietly devoting himself to the ordinary work of the colliery. He made no noise nor stir about his locomotive, but allowed another to take credit for the experiments on velocity and friction made with it by himself upon the Killingworth railroad.

By patient industry and laborious contrivance, he was enabled to do for the locomotive what James Watt had done for the condensing engine. He found it clumsy and inefficient; and he made it powerful, efficient, and useful. Both have been described as the improvers of their respective engines; but, as to all that is admirable in their structure or vast in their utility, they are rather entitled to be described as their Inventors. While the invention of Watt increased the power, and at the same time so regulated the action, of the steam-engine, as to make it capable of being applied alike to the hardest work and to the finest manufactures, the invention of Stephenson gave an effective power to the locomotive, which enabled it to perform the work of teams of the most powerful horses, and to outstrip the speed of the fleetest. Watt's invention exercised a wonderfully quickening influence on every branch of industry, and multiplied a thousand-fold the amount of manufactured productions; and Stephenson's enabled these to be distributed with an economy and despatch such as had never before been thought possible. They have both tended to increase indefinitely the mass of human comforts and enjoyments, and to render them cheap and accessible to all. But Stephenson's invention, by the influence which it is daily exercising upon the civilisation of the world, is even more remarkable than that of Watt, and is calculated to have still more important consequences.

In this respect, it is to be regarded as the grandest application of steam power that has yet been discovered.

The Locomotive, like the condensing engine, exhibits the realisation of various capital, but wholly distinct, ideas, promulgated by many ingenious inventors. Stephenson, like Watt, exhibited a power of selection, combination, and invention of his own, by which—while availing himself of all that had been done before him, and superadding the many skilful contrivances devised by himself — he was at length enabled to bring his engine into a condition of marvellous power and efficiency. He gathered together the scattered threads of ingenuity which already existed, and combined them into one firm and complete fabric of his own. He realised the plans which others had imperfectly formed; and was the first to construct, what so many others had unsuccessfully attempted, the practicable working locomotive.

In his deportment, Mr. Stephenson was simple, modest, and unassuming, but always manly. He was frank and social in spirit. When a humble workman, he had carefully preserved his sense of self-respect. His companions looked up to him, and his example was worth even more to many of them than books or schools. His devoted love of knowledge made his poverty respectable, and adorned his humble calling. When he rose to a more elevated station, and associated with men of the highest position and influence in Britain, he took his place amongst them with perfect self-possession. They wondered at the quiet ease and simple dignity of his deportment; and men in the best ranks of life have said of him that "He was one of Nature's gentlemen."

If he was occasionally impatient of the opposition of professional brethren, it is scarcely to be wondered at when we look at the simple earnestness of his character, and consider that his sole aim was the establishment of his own well-founded convictions. No wonder that he should have been intolerant of that professional gladiatorship against which his life had been one prolonged struggle. Nor could he forget that the engineering class had been arrayed against him dur-

ing his arduous battle for the Locomotive, and that, but for his own pluck and persistency, they would have strangled it in its cradle. A man of his stern resolution might well be a little positive sometimes. Who that has made his way through so many difficulties would not be so? Especially was he annoyed at the "quirks and quiddities" of the barristers, who subjected him to annoying cross-examinations before the Parliamentary Committees. On coming down from the witness-box on one occasion, he went up to the counsel who had been severely cross-examining him, and said—"Oh T——, I'm ashamed of you! You know my line's the best, and that I'm in the right, and you're in the wrong, and yet you've been worrying me as if you didn't know that I was right."

Mr. Stephenson's close and accurate observation provided him with a fulness of information on many subjects, which often appeared surprising to those who had devoted to them a special study. On one occasion the accuracy of his knowledge of birds came out in a curious way at a convivial meeting of railway men in London. The engineers and railway directors present knew each other as railway men and nothing more. The talk had been all of railways and railway politics. Mr. Stephenson was a great talker on those subjects, and was generally allowed, from the interest of his conversation and the extent of his experience, to take the lead. At length one of the party broke in with—"Come now, Stephenson, we have had nothing but railways; cannot we have a change, and try if we can talk a little about something else?" "Well," said Mr. Stephenson, "I'll give you a wide range of subjects; what shall it be about?" "Say *birds' nests!*" rejoined the other, who prided himself on his special knowledge of this subject. "Then birds' nests be it." A long and animated conversation ensued: the bird-nesting of his boyhood, the blackbird's nest which his father had held him up in his arms to look at when a child at Wylam, the hedges in which he had found the thrush's and the linnet's nests, the mossy bank where the robin built, the cleft in the branch of the young

tree where the chaffinch had reared its dwelling,—all rose up clear in his mind's eye, and led him back to the scenes of his boyhood at Callerton and Dewley Burn. The colour and number of the birds' eggs, the period of their incubation, the materials employed by them for the walls and lining of their nests,—were described by him so vividly, and illustrated by such graphic anecdotes, that one of the party remarked that, if George Stephenson had not been the greatest engineer of his day, he might have been one of the greatest naturalists.

Mr. Stephenson had once a conversation with a watchmaker, whom he astonished by the extent and minuteness of his knowledge as to the parts of a watch. The watchmaker knew him to be an eminent engineer, and asked how he had acquired so extensive a knowledge of a branch of business so much out of his sphere. "It is very easy to be explained," said Mr. Stephenson; "I worked long at watch-cleaning myself, and when I was at a loss, I was never ashamed to ask for information."

It is Göthe, we believe, who has said that no man ever receives a new idea, at variance with his preconceived notions, after forty. But this observation, though it may be generally, is not invariably true. There are many great minds which never close. Mr. Stephenson, to the last, was open to the reception of new ideas, new facts, new theories. He was a late learner; but he went on learning to the end. He shut his mind, however, against what he considered humbugs—especially mechanical humbugs. Thus, he said at Tamworth, that he had not been to see the atmospheric railway, because it was a great humbug. He had gone to see Pinkus's model of it, and that had determined him on the subject. He then declared the atmospheric system to be "a rope of sand;" that it could never hold together, and he would not countenance it.

When he heard of Perkins's celebrated machine, which was said to work at a tremendous pressure, without steam, but with water in the boiler almost at red heat, he went with his son to see it. The engine exhibited was of six-

horse power, and the pressure was said to be not less than 1500 lbs. to the square inch. Mr. Stephenson said he thought it humbug; but he would test its power. Taking up a little oakum, and wrapping some round each hand, he firmly seized hold of the piston rod and held it down with all his strength. The machine was at once brought to a stand, very much to Mr. Perkins's annoyance. But the humbug had been exploded to Mr. Stephenson's satisfaction.

Towards the close of his life he frequently went down to Newcastle, and visited the scenes of his boyhood. "I have been to Callerton," said he one day to a friend, "and seen the fields in which I used to pull turnips at twopence a day; and many a cold finger, I can tell you, I had."

On one occasion, he accidentally met a gentleman and his wife at an inn in Derbyshire, whom he entertained for some time with his shrewd observations and playful sallies. At length the lady requested to know the name of the remarkable stranger. "Why madam," said he, "they used once to call me plain George Stephenson; I'm now called George Stephenson, *Esquire*, of Tapton House, near Chesterfield. And further let me say, that I've dined with princes, and peers, and commoners—with persons of all classes, from the highest to the humblest; I've made my dinner off a red-herring in a hedge bottom, and gone through the meanest drudgery; I've seen mankind in all its phases, and the conclusion I have arrived at is—that if we were all stripped, there's not much difference."

His hand was open to his former fellow-workmen whom old age had left in poverty. To poor Robert Gray, of Newburn, who acted as his bridesman on his marriage to Fanny Henderson, he left a pension for life. He would slip a five-pound note into the hand of a poor man or a widow in such a way as not to offend their delicacy, but to make them feel as if the obligation were all on his side.

About the beginning of 1847, Mr. Stephenson was requested to state what were his "ornamental initials," in order that they might be added to his name in the title of a work proposed to be dedicated to him. His reply was

characteristic. "I have to state," said Mr. Stephenson, "that I have no flourishes to my name, either before or after; and I think it will be as well if you merely say 'George Stephenson.' It is true that I am a Belgian knight, but I do not wish to have any use made of it. I have had the offer of knighthood of my own country made to me several times, but would not have it. I have been invited to become a fellow of the Royal Society, and also of the Civil Engineers' Society, but objected to the empty additions to my name. I am a member of the Geological Society; and I have consented to become President of, I believe, a highly respectable Mechanics' Institution at Birmingham."

During the summer of 1847, Mr. Stephenson was invited to offer himself as a candidate for the representation of South Shields in Parliament. But his politics were at best of a very undefined sort; indeed his life had been so much occupied with subjects of a practical character, that he had scarcely troubled himself to form any decided opinion on the party political topics of the day; and to stand the cross fire of the electors on the hustings might have been found an even more distressing ordeal than the cross-questioning of the barristers in the Committees of the House of Commons. "Politics," he used to say, "are all matters of theory—there is no stability in them; they shift about like the sands of the sea: and I should feel quite out of my element amongst them." He had accordingly the good sense respectfully to decline the honour of contesting the representation of South Shields.

Sir Robert Peel made him an offer of knighthood more than once; but Mr. Stephenson had no desire to hang on the outskirts of the titled class, or to get perched into high places of any kind. Arago, in his *Éloge*, complained that Watt was not made a baron. But what lustre would such a title have added to the name of either Watt or Stephenson? Thank Heaven, the strongest and best men of England do their work without hope of any such reward. Never were men less the creatures of government, or of patronage, than James

Watt and George Stephenson; and, as representing the genius of the people from whom they sprang, we would rather have their simple names descend to posterity unadorned, than disguised and hidden under any unmeaning title borrowed from the middle ages.

As respects the immense advantages of railways to mankind, there cannot be two opinions. They exhibit, probably, the grandest organization of capital and labour that the world has yet seen. Although they have unhappily occasioned great loss to many, the loss has been that of individuals; whilst, as a national system, the gain has already been enormous. As tending to multiply and spread abroad the conveniences of life, opening up new fields of industry, bringing nations nearer to each other, and thus promoting the great ends of civilisation, the founding of the railway system by George Stephenson must be regarded as one of the most important events, if not the very greatest, in the first half of this nineteenth century.

Tablet in Trinity Church, Chesterfield.

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THE END.

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