

## LIVES OF THE ENGINEERS

**Samuel Smiles** 

## **Lives of the Engineers**

The Locomotive. George and Robert Stephenson

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## **INTRODUCTION.**

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Since the appearance of this book in its original form, some seventeen years since, the construction of Railways has continued to make extraordinary progress. Although Great Britain, first in the field, had then, after about twentyfive years' work, expended nearly 300 millions sterling in the construction of 8300 miles of railway, it has, during the last seventeen years, expended about 288 millions more in constructing 7780 additional miles.

But the construction of railways has proceeded with equal rapidity on the Continent. France, Germany, Spain, Sweden, Belgium, Switzerland, Holland, have largely added to their railway mileage. Austria is actively engaged in carrying new lines across the plains of Hungary, which Turkey is preparing to meet by lines carried up the valley of the Lower Danube. Russia is also occupied with extensive schemes for connecting Petersburg and Moscow with her ports in the Black Sea on the one hand, and with the frontier towns of her Asiatic empire on the other.

Italy is employing her new-born liberty in vigorously extending railways throughout her dominions. A direct line of communication has already been opened between France and Italy, through the Mont Cenis Tunnel; while another has been opened between Germany and Italy through the Brenner Pass,—so that the entire journey may now be made by two different railway routes (excepting only the short sea-passage across the English Channel) from London to Brindisi, situated in the south-eastern extremity of the Italian peninsula.

During the last sixteen years, nearly the whole of the Indian railways have been made. When Edmund Burke, in 1783, arraigned the British Government for their neglect of India in his speech on Mr. Fox's Bill, he said: "England has built no bridges, made no high roads, cut no navigations, dug out no reservoirs. . . . Were we to be driven out of India this day, nothing would remain to tell that it had been possessed, during the inglorious period of our dominion, by anything better than the ourang-outang or the tiger."

But that reproach no longer exists. Some of the greatest bridges erected in modern times—such as those over the Sone near Patna, and over the Jumna at Allahabad—have been erected in connection with the Indian railways. More than 5000 miles are now at work, and they have been constructed at an expenditure of about £88,000,000 of British capital, guaranteed by the British Government. The railways connect the capitals of the Indian three Presidencies—uniting Bombay with Madras on the south, and with Calcutta on the north-east—while a great main line, 2200 miles in extent, passing through the northwestern provinces, and connecting Calcutta with Lucknow, Delhi, Lahore, Moultan, and Kurrachee, unites the mouths of the Hooghly in the Bay of Bengal with those of the Indus in the Arabian Sea.

When the first edition of this work appeared, in the beginning of 1857, the Canadian system of railways was but in its infancy. The Grand Trunk was only begun, and the Victoria Bridge—the greatest of all railway structures—was

not half erected. The Colony of Canada has now more than 3000 miles in active operation along the great valley of the St. Lawrence, connecting Rivière du Loup at the mouth of that river, and the harbour of Portland in the State of Maine, *viâ* Montreal and Toronto, with Sarnia on Lake Huron, and with Windsor, opposite Detroit in the State of Michigan. During the same time the Australian Colonies have been actively engaged in providing themselves with railways, many of which are at work, and others are in course of formation. The Cape of Good Hope has several lines open, and others making. France has constructed about 400 miles in Algeria; while the Pasha of Egypt is the proprietor of 360 miles in operation across the Egyptian desert. The Japanese are also making railroads.

But in no country has railway construction been prosecuted with greater vigour than in the United States. There the railway furnishes not only the means of intercommunication between alreadv established settlements, as in the Old World; but it is regarded as the pioneer of colonization, and as instrumental in opening up new and fertile territories of vast extent in the west.-the food-grounds of future nations. Hence railway construction in that country was scarcely interrupted even by the great Civil War,—at the commencement of which Mr. Seward publicly expressed the opinion that "physical bonds—such as highways, railroads, rivers, and canals—are vastly more powerful for holding civil communities together than any mere covenants, though written on parchment or engraved on iron."

The people of the United States were the first to follow the example of England, after the practicability of steam proved on the locomotion had been Stockton and Darlington, and Liverpool and Manchester Railways. The first sod of the Baltimore and Ohio Railway was cut on the 4th of July, 1828, and the line was completed and opened for traffic in the following year, when it was worked partly by horse-power, and partly by a locomotive built at Baltimore, which is still preserved in the Company's workshops. In 1830, the Hudson and Mohawk Railway was begun, while other lines were under construction in Pennsylvania, Massachusetts, and New Jersey; and in the course of ten years, 1843 miles were finished and in operation. In ten more years, 8827 miles were at work; at the end of 1864, 35,000 miles; and at the 31st of December, 1873, not less than 70,651 miles were in operation, of which 3916 had been made during that year. One of the most extensive trunk-lines is the Great Pacific Railroad, connecting the lines in the valleys of the Mississippi and the Missouri with the city of San Francisco on the shores of the Pacific, by means of which it is possible to make the journey from England to Hong Kong, via New York, in little more than a month.

The results of the working of railways have been in many respects different from those anticipated by their projectors. One of the most unexpected has been the growth of an immense passenger-traffic. The Stockton and Darlington line was projected as a coal line only, and the Liverpool and Manchester as a merchandise line. Passengers were not taken into account as a source of revenue, for at the time of their projection, it was not believed that people would trust themselves to be drawn upon a railway by an "explosive machine," as the locomotive was described to be. Indeed, a writer of eminence declared that he would as soon think of being fired off on a ricochet rocket, as travel on a railway at twice the speed of the old stagecoaches. So great was the alarm which existed as to the locomotive, that the Liverpool and Manchester Committee pledged themselves in their second prospectus, issued in 1825, "not to require any clause empowering its use;" and as late as 1829, the Newcastle and Carlisle Act was conceded on the express condition that the line should not be worked by locomotives, but by horses only.

Nevertheless, the Liverpool and Manchester Company obtained powers to make and work their railway without any such restriction; and when the line was made and opened, a locomotive passenger train was advertised to be run upon it, by way of experiment. Greatly to the surprise of the directors, more passengers presented themselves as travellers by the train than could conveniently be carried.

The first arrangements as to passenger-traffic were of a very primitive character, being mainly copied from the old stage-coach system. The passengers were "booked" at the railway office, and their names were entered in a way-bill which was given to the guard when the train started. Though the usual stage-coach bugleman could not conveniently accompany the passengers, the trains were at first played out of the terminal stations by a lively tune performed by a trumpeter at the end of the platform; and this continued to be done at the Manchester Station until a comparatively recent date.

But the number of passengers carried by the Liverpool and Manchester line was so unexpectedly great, that it was very soon found necessary to remodel the entire system. Tickets were introduced, by which a great saving of time was effected. More roomy and commodious carriages were provided, the original first-class compartments being seated for four passengers only. Everything was found to have been in the first instance made too light and too slight. The prize 'Rocket,' which weighed only  $4\frac{1}{2}$  tons when loaded with its coke and water, was found quite unsuited for drawing the increasingly heavy loads of passengers. There was also this essential difference between the old stage-coach and the new railway train, that, whereas the former was "full" with six inside and ten outside, the latter must be able to accommodate whatever number of passengers came to be carried. Hence heavier and more powerful engines, and larger and more substantial carriages were from time to time added to the carrying stock of the railway.

The speed of the trains was also increased. The first locomotives used in hauling coal-trains ran at from four to six miles an hour. On the Stockton and Darlington line the speed was increased to about ten miles an hour; and on the Liverpool and Manchester line the first passenger-trains were run at the average speed of seventeen miles an hour, which at that time was considered very fast. But this was not enough. When the London and Birmingham line was opened, the mail-trains were run at twenty-three miles an hour; and gradually the speed went up, until now the fast trains are run at from fifty to sixty miles an hour,—the pistons in the cylinders, at sixty miles, travelling at the inconceivable rapidity of 800 feet per minute!

To bear the load of heavy engines run at high speeds, a much stronger and heavier road was found necessary; and shortly after the opening of the Liverpool and Manchester line, it was entirely relaid with stronger materials. Now that express passenger-engines are from thirty to thirty-five tons each, the weight of the rails has been increased from 35 lbs. to 75 lbs. or 86 lbs. to the yard. Stone blocks have given place to wooden sleepers; rails with loose ends resting on the chairs, to rails with their ends firmly "fished" together; and in many places, where the traffic is unusually heavy, iron rails have been replaced by those of steel.

And now see the enormous magnitude to which railway passenger-traffic has grown. In the year 1873, 401,465,086 passengers were carried by day tickets in Great Britain alone. But this was not all. For in that year 257,470 periodical tickets were issued by the different railways; and assuming half of them to be annual, one-fourth half-yearly, and the remainder quarterly tickets, and that their holders made only five journeys each way weekly, this would give an additional number of 47,024,000 journeys, or a total of 448,489,086 passengers carried in Great Britain in one year.

It is difficult to grasp the idea of the enormous number of persons represented by these figures. The mind is merely bewildered by them, and can form no adequate notion of their magnitude. To reckon them singly would occupy twenty-five years, counting at the rate of one a second for twelve hours every day. Or take another illustration. Supposing every man, woman, and child in Great Britain to make ten journeys by rail yearly, the number would greatly fall short of the passengers carried in 1873.

Mr. Porter, in his 'Progress of the Nation,' estimated that thirty millions of passengers, or about eighty-two thousand a day, travelled by coaches in Great Britain in 1834, an average distance of twelve miles each, at an average cost of 5s. a passenger, or at the rate of 5d. a mile; whereas above 448 millions are now carried by railway an average distance of  $8\frac{1}{2}$  miles each, at an average cost of 1s.  $1\frac{1}{2}$ d. per passenger, or about three halfpence per mile, in considerably less than one-fourth of the time.

But besides the above number of passengers, over one hundred and sixty-two million tons of minerals and merchandise were carried by railway in the United Kingdom in 1873, besides mails, cattle, parcels, and other traffic. The distance run by passenger and goods trains in the year was 162,561,304 miles; to accomplish which it is estimated that four miles of railway must have been covered by running trains during every second all the year round.

To perform this service, there were, in 1873, 11,255 locomotives at work in the United Kingdom, consuming about four million tons of coal and coke, and flashing into the air every minute some forty tons of water in the form of steam in a high state of elasticity. There were also 24,644 passenger-carriages, 9128 vans and breaks attached to passenger-trains, and 329,163 trucks, waggons, and other vehicles appropriated to merchandise. Buckled together, buffer to buffer, the locomotives and tenders would extend from London to Peterborough; while the carrying vehicles, joined together, would form two trains occupying a double line of railway extending from London to beyond Inverness.

A notable feature in the growth of railway traffic of late years has been the increase in the number of third-class passengers, compared with first and second class. Sixteen years since, the third-class passengers constituted only about one-third; ten years later, they were about one-half; whereas now they form more than three-fourths of the whole number carried. In 1873, there were about 23 million first-class passengers, 62 million second-class, and not less than 306 million third-class. Thus George Stephenson's prediction, "that the time would come when it would be cheaper for a working man to make a journey by railway than to walk on foot," is already verified.

The degree of safety with which this great traffic has been conducted is not the least remarkable of its features. Of course, so long as railways are worked by men they will be liable to the imperfections belonging to all things human. Though their machinery may be perfect and their organisation as complete as skill and forethought can make it, workmen will at times be forgetful and listless; and a moment's carelessness may lead to the most disastrous results. Yet, taking all circumstances into account, the wonder is, that travelling by railway at high speed should have been rendered comparatively so safe.

To be struck by lightning is one of the rarest of all causes of death; yet more persons are killed by lightning in Great Britain than are killed on railways from causes beyond their own control. Most persons would consider the probability of their dying by hanging to be extremely remote; yet, according to the Registrar-General's returns, it is considerably greater than that of being killed by railway accident.

The remarkable safety with which railway traffic is on the whole conducted, is due to constant watchfulness and highly-applied skill. The men who work the railways are for the most part the picked men of the country, and every railway station may be regarded as a practical school of industry, attention, and punctuality.

Few are aware of the complicated means and agencies that are in constant operation on railways day and night, to ensure the safety of the passengers to their journey's end. The road is under a system of continuous inspection. The railway is watched by foremen, with "gangs" of men under them, in lengths varying from twelve to five miles, according to circumstances. Their continuous duty is to see that the rails and chairs are sound, their fastenings complete, and the line clear of all obstructions.

Then, at all the junctions, sidings, and crossings, pointsmen are stationed, with definite instructions as to the duties to be performed by them. At these places, signals are provided, worked from the station platforms, or from special signal boxes, for the purpose of protecting the stopping or passing trains. When the first railways were opened, the signals were of a very simple kind. The station men gave them with their arms stretched out in different positions; then flags of different colours were used; next fixed signals, with arms or discs of rectangular or triangular shape. These were followed by a complete system of semaphore signals, near and distant, protecting all junctions, sidings, and crossings.

When Government inspectors were first appointed by the Board of Trade to examine and report upon the working of railways, they were alarmed by the number of trains following each other at some stations, in what then seemed to be a very rapid succession. A passage from a Report written in 1840 by Sir Frederick Smith, as to the traffic at "Taylor's Junction," on the York and North Midland Railway, contrasts curiously with the railway life and activity of the present day:—"Here," wrote the alarmed Inspector, "the passenger trains from York as well as Leeds and Selby, meet four times a day. No less than 23 passenger-trains stop at or pass this station in the 21 hours—an amount of traffic requiring not only the utmost perfect arrangements on the part of the management, but the utmost vigilance and energy in the servants of the Company employed at this place."

Contrast this with the state of things now. On the Metropolitan Line, 667 trains pass a given point in one direction or the other during the eighteen hours of the working day, or an average of 36 trains an hour. At the Cannon Street Station of the South-Eastern Railway, 627 trains pass in and out daily, many of them crossing each other's tracks under the protection of the station-signals. Forty-five trains run in and out between 9 and 10 A.M., and an equal number between 4 and 5 p.M. Again, at the Clapham Junction, near London, about 700 trains pass or stop daily; and though to the casual observer the succession of trains coming and going, running and stopping, coupling

and shunting, appears a scene of inextricable confusion and danger, the whole is clearly intelligible to the signalmen in their boxes, who work the trains in and out with extraordinary precision and regularity.

The inside of a signal-box reminds one of a pianoforte on a large scale, the lever-handles corresponding with the keys of the instrument; and, to an uninstructed person, to work the one would be as difficult as to play a tune on the other. The signal-box outside Cannon Street Station contains 67 lever-handles, by means of which the signalmen are enabled at the same moment to communicate with the drivers of all the engines on the line within an area of 800 yards. They direct by signs, which are quite as intelligible as words, the drivers of the trains starting from inside the station, as well as those of the trains arriving from outside. By pulling a lever-handle, a distant signal, perhaps out of sight, is set some hundred yards off, which the approaching driver reading it quickly as he comes along—at once interprets, and stops or advances as the signal may direct.

The precision and accuracy of the signal-machinery employed at important stations and junctions have of late years been much improved by an ingenious contrivance, by means of which the setting of the signal prepares the road for the coming train. When the signal is set at "Danger," the points are at the same time worked, and the road is "locked" against it; and when at "Safety," the road is open, —the signal and the points exactly corresponding.

The Electric Telegraph has also been found a valuable auxiliary in ensuring the safe working of large railway traffics. Though the locomotive may run at 60 miles an hour, electricity, when at its fastest, travels at the rate of 288,000 miles a second, and is therefore always able to herald the coming train. The electric telegraph may, indeed, be regarded as the nervous system of the railway. By its means the whole line is kept throbbing with intelligence. The method of working the electric signals varies on different lines; but the usual practice is, to divide a line into so many lengths, each protected by its signal-stations,—the fundamental law of telegraph-working being, that two engines are not to be allowed to run on the same line between two signal-stations at the same time.

When a train passes one of such stations, it is immediately signalled on—usually by electric signal-bells to the station in advance, and that interval of railway is "blocked" until the signal has been received from the station in advance that the train has passed it. Thus an interval of space is always secured between trains following each other, which are thereby alike protected before and behind. And thus, when a train starts on a journey, it may be of hundreds of miles, it is signalled on from station to station—it "lives along the line,"—until at length it reaches its destination and the last signal of "train in" is given. By this means an immense number of trains can be worked with regularity and safety. On the South-Eastern Railway, where the system has been brought to a state of high efficiency, it is no unusual thing during Easter week to send 600,000 passengers through the London Bridge Station alone; and on some days as many as 1200 trains a-day.

While such are the expedients adopted to ensure safety, others equally ingenious are adopted to ensure speed. In the case of express and mail trains, the frequent stopping of the engines to take in a fresh supply of water occasions a considerable loss of time on a long journey, each stoppage for this purpose occupying from ten to fifteen minutes. To avoid such stoppages, larger tenders have been provided, capable of carrying as much as 2000 gallons of water each. But as a considerable time is occupied in filling these, a plan has been contrived by Mr. Ramsbottom, the Locomotive Engineer of the London and North-Western Railway, by which the engines are made to feed themselves while running at full speed! The plan is as follows:-An open trough, about 440 feet long, is laid longitudinally between the rails. Into this trough, which is filled with water, a dippipe or scoop attached to the bottom of the tender of the running train is lowered; and, at a speed of 50 miles an hour, as much as 1070 gallons of water are scooped up in the course of a few minutes. The first of such troughs was laid down between Chester and Holyhead, to enable the Express Mail to run the distance of 841 miles in two hours and five minutes without stopping; and similar troughs have laid down at Bushev since been near London. at near Wolverton. and at Parkside Castlethorpe near Liverpool. At these four troughs about 130,000 gallons of water are scooped up daily.

Wherever railways have been made, new towns have sprung up, and old towns and cities been quickened into new life. When the first English lines were projected, great were the prophecies of disaster to the inhabitants of the districts through which they were proposed to be forced. Such fears have long since been dispelled in this country. The same prejudices existed in France. When the railway from Paris to Marseilles was laid out so as to pass through Lyons, a local prophet predicted that if the line were made the city would be ruined—"*Ville traversée, ville perdue*;" while a local priest denounced the locomotive and the electric telegraph as heralding *the reign of Antichrist*. But such nonsense is no longer uttered. Now it is the city without the railway that is regarded as the "city lost;" for it is in a measure shut out from the rest of the world, and left outside the pale of civilisation.

Perhaps the most striking of all the illustrations that could be offered of the extent to which railways facilitate the locomotion, the industry, and the subsistence of the population of large towns and cities, is afforded by the working of the railway system in connection with the capital of Great Britain.

The extension of railways to London has been of comparatively recent date; the whole of the lines connecting it with the provinces and terminating at its outskirts, having been opened during the last thirty years, while the lines inside London have for the most part been opened within the last sixteen years.

The first London line was the Greenwich Railway, part of which was opened for traffic to Deptford in February 1836. The working of this railway was first exhibited as a show, and the usual attractions were employed to make it "draw." A band of musicians in the garb of the Beef-eaters was stationed at the London end, and another band at Deptford. For cheapness' sake the Deptford band was shortly superseded by a large barrel-organ, which played in the passengers; but, when the traffic became established, the barrel organ, as well as the beef-eater band at the London end, were both discontinued. The whole length of the line was lit up at night by a row of lamps on either side like a street, as if to enable the locomotives or the passengers to see their way in the dark; but these lamps also were eventually discontinued as unnecessary.

As a show, the Greenwich Railway proved tolerably successful. During the first eleven months it carried 456,750 passengers, or an average of about 1300 a-day. But the railway having been found more convenient to the public than either the river boats or the omnibuses, the number of passengers rapidly increased. When the Croydon, Brighton, and South-Eastern Railways began to pour their streams of traffic over the Greenwich viaduct, its accommodation was found much too limited; and it was widened from time to time, until now nine lines of railway are laid side by side, over which more than twenty millions of passengers are carried yearly, or an average of about 60,000 a day all the year round.

Since the partial opening of the Greenwich Railway in 1836, a large extent of railways has been constructed in and about the metropolis, and convenient stations have been established almost in the heart of the City. Sixteen of these stations are within a circle of half a mile radius from the Mansion House, and above three hundred stations are in actual use within about five miles of Charing Cross.

To accommodate this vast traffic, not fewer than 3600 local trains are run in and out daily, besides 340 trains which depart to and arrive from distant places, north, south,

east, and west. In the morning hours, between 8.30 and 10.30, when business men are proceeding inwards to their offices and counting-houses, and in the afternoon between four and six, when they are returning outwards to their homes, as many as two thousand stoppages are made in the hour, within the metropolitan district, for the purpose of taking up and setting down passengers, while about two miles of railway are covered by the running trains.

One of the remarkable effects of railways has been to extend the residential area of all large towns and cities. This is especially notable in the case of London. Before the introduction of railways, the residential area of the metropolis was limited by the time occupied by business men in making the journey outwards and inwards daily; and it was for the most part bounded by Bow on the east, by Hampstead and Highgate on the north, by Paddington and Kensington on the west, and by Clapham and Brixton on the south. But now that stations have been established near the centre of the city, and places so distant as Waltham, Barnet, Watford, Hanwell, Richmond, Epsom, Croydon, Reigate, and Erith, can be more quickly reached by rail than the old suburban guarters were by omnibus, the metropolis has become extended in all directions along its railway lines, and the population of London, instead of living in the City or its immediate vicinity, as formerly, have come to occupy a residential area of not less than six hundred square miles!

The number of new towns which have consequently sprung into existence near London within the last twenty years has been very great; towns numbering from ten to twenty thousand inhabitants, which before were but villages,—if, indeed, they existed. This has especially been the case along the lines south of the Thames, principally in consequence of the termini of those lines being more conveniently situated for city men of business. Hence the rapid growth of the suburban towns up and down the river, from Richmond and Staines on the west, to Erith and Gravesend on the east, and the hives of population which have settled on the high grounds south of the Thames, in the neighbourhood of Norwood and the Crystal Palace, rapidly spreading over the Surrey Downs, from Wimbledon to Guildford, and from Bromley to Croydon, Epsom, and Dorking. And now that the towns on the south and southeast coast can be reached by city men in little more time than it takes to travel to Clapham or Bayswater by omnibus, such places have become as it were parts of the great metropolis, and Brighton and Hastings are but the marine suburbs of London.

The improved state of the communications of the City with the country has had a marked effect upon its population. While the action of the railways has been to add largely to the number of persons living in London, it has also been accompanied by their dispersion over a much larger area. Thus the population of the central parts of London is constantly decreasing, whereas that of the suburban districts is as constantly increasing. The population of the City fell off more than 10,000 between 1851 and 1861; and during the same period, that of Holborn, the Strand, St. Martin's-in-the-Fields, St. James's, Westminster, East and West London, showed a considerable decrease. But, as regards the whole mass of the metropolitan population, the increase has been enormous. Thus, starting from 1801, when the population of London was 958,863, we find it increasing in each decennial period at the rate of between two and three hundred thousand, until the year 1841, when it amounted to 1,948,369. Railways had by that time reached London, after which its population increased at nearly double the former ratio. In the ten years ending 1851, the increase was 513,867; and in the ten years ending 1861, 441,753: until now, to quote the words of the Registrar-General in a recent annual Report, "the population within the registration limits is by estimate 2,993,513; but beyond this central mass there is a ring of life growing rapidly, and extending along railway lines over a circle of fifteen miles from Charing Cross. The population within that circle, patrolled by the metropolitan police, is about 3.463.771"!

The aggregation of so vast a number of persons within so comparatively limited an area—the immense quantity of food required for their daily sustenance, as well as of fuel, clothing, and other necessaries—would be attended with no small inconvenience and danger, but for the facilities again provided by the railways. The provisioning of a garrison of even four thousand men is considered a formidable affair; how much more so the provisioning of nearly four millions of people!

The whole mystery is explained by the admirable organisation of the railway service, and the regularity and despatch with which it is conducted. We are enabled by the courtesy of the General Managers of the London railways to bring together the following brief summary of facts relating to the food supply of London, which will probably be regarded by most readers as of a very remarkable character.

Generally speaking, the railways to the south of the Thames contribute comparatively little towards the feeding of London. They are, for the most part passenger and residential lines, traversing a limited and not very fertile district bounded by the sea-coast; and, excepting in fruit and vegetables, milk and hops, they probably carry more food from London than they bring to it. The principal supplies of grain, flour, potatoes, and fish, are brought by railway from the eastern counties of England and Scotland; and of cattle and sheep, beef and mutton, from the grazing counties of the west and north-west of Britain. as far as the of Scotland. which have, through Highlands the instrumentality of railways, become part of the great grazing grounds of the metropolis.

Take first "the staff of life"—bread and its constituents. Of wheat, not less than 222,080 quarters were brought into London by railway in 1867, besides what was brought by sea; of oats 151,757 quarters; of barley 70,282 quarters; of beans and peas 51,448 quarters. Of the wheat and barley, by far the largest proportion is brought by the Great Eastern Railway, which delivers in London in one year 155,000 quarters of wheat and 45,500 quarters of barley, besides 600,429 quarters more in the form of malt. The largest quantity of oats is brought by the Great Northern Railway, principally from the north of England and the East of Scotland,—the quantity delivered by that Company in 1867 having been 97,500 quarters, besides 24,664 quarters of wheat, 5560 quarters of barley, and 103,917 quarters of malt. Again, of 1,250,566 sacks of flour and meal delivered in London in one year, the Great Eastern brings 654,000 sacks, the Great Northern 232,022 sacks, and the Great Western 136,312 sacks; the principal contribution of the London and North-Western Railway towards the London bread-stores being 100,760 boxes of American flour, besides 24,300 sacks of English. The total quantity of malt delivered at the London railway stations in 1867 was thirteen hundred thousand sacks.

Next, as to flesh meat. In 1867, not fewer than 172,300 head of cattle were brought to London by railway,—though this was considerably less than the number carried before the cattle-plague, the Great Eastern Railway alone having carried 44,672 less than in 1864. But this loss has since been more than made up by the increased quantities of fresh beef, mutton, and other kinds of meat imported in lieu of the live animals. The principal supplies of cattle are brought, as we have said, by the Western, Northern, and Eastern lines: by the Great Western from the western counties and Ireland; by the London and North-Western, the Midland, and the Great Northern from the northern counties and from Scotland; and by the Great Eastern from the eastern counties and from the ports of Harwich and Lowestoft.

In 1867, also, 1,147,609 sheep were brought to London by railway, of which the Great Eastern delivered not less than 265,371 head. The London and North-Western and Great Northern between them brought 390,000 head from the northern English counties, with a large proportion from the Scotch Highlands. While the Great Western brought up 130,000 head from the Welsh mountains and from the rich grazing districts of Wilts, Gloucester, Somerset, and Devon. Another important freight of the London and North-Western Railway consists of pigs, of which they delivered 54,700 in London, principally Irish; while the Great Eastern brought up 27,500 of the same animal, partly foreign.

While the cattle-plague had the effect of greatly reducing the number of live stock brought into London yearly, it gave a considerable impetus to the Fresh Meat traffic. Thus, in addition to the above large numbers of cattle and sheep delivered in London in 1867, the railways brought 76,175 tons of meat, which-taking the meat of an average beast at 800 lbs., and of an average sheep at 64 lbs.—would be equivalent to about 112,000 more cattle, and 1,267,500 more sheep. The Great Northern brought the largest quantity; next the London and North-Western;—these two Companies having brought up between them, from distances as remote as Aberdeen and Inverness, about 42,000 tons of fresh meat in 1867, at an average freight of about  $\frac{1}{2}$ d. a lb.

Again as regards Fish, of which six-tenths of the whole quantity consumed in London is now brought by rail. The Great Eastern and the Great Northern are by far the largest importers of this article, and justify their claim to be regarded as the great food lines of London. Of the 61,358 tons of fish brought by railway in 1867, not less than 24,500 tons were delivered by the former, and 22,000 tons, brought from much longer distances, by the latter Company. The London and North-Western brought about 6000 tons, the principal part of which was salmon from Scotland and Ireland. The Great Western also brought about 4000 tons, partly salmon, but the greater part mackerel from the southwest coast. During the mackerel season, as much as a hundred tons at a time are brought into the Paddington Station by express fish-train from Cornwall.

The Great Eastern and Great Northern Companies are also the principal carriers of turkeys, geese, fowls, and game; the quantity delivered in London by the former Company having been 5042 tons. In Christmas week no fewer than 30,000 turkeys and geese were delivered at the Bishopsgate Station, besides about 300 tons of poultry, 10,000 barrels of beer, and immense quantities of fish, oysters, and other kinds of food. As much as 1600 tons of poultry and game were brought last year by the South-Western Railway; 600 tons by the Great Northern Railway; and 130 tons of turkeys, geese, and fowls, by the London, Chatham and Dover line, principally from France.

Of miscellaneous articles, the Great Northern and the Midland each brought about 3000 tons of cheese, the South-Western 2600 tons, and the London and North-Western 10,034 cheeses in number; while the South-Western and Brighton lines brought a splendid contribution to the London breakfast-table in the shape of 11,259 *tons* of French eggs; these two Companies delivering between them an average of more than three millions of eggs a week all the year round! The same Companies delivered in London 14,819 tons of butter, for the most part the produce of the farms of Normandy,—the greater cleanness and neatness with which the Normandy butter is prepared for market rendering it a favourite both with dealers and consumers of late years compared with Irish butter. The London, Chatham and Dover Company also brought from Calais 96 tons of eggs.

Next, as to the potatoes, vegetables, and fruit, brought by rail. Forty years since, the inhabitants of London relied for their supply of vegetables on the garden-grounds in the immediate neighbourhood of the metropolis, and the consequence was that they were both very dear and limited in quantity. But railways, while they have extended the grazing-grounds of London as far as the Highlands, have at the same time extended the garden-grounds of London into all the adjoining counties—into East Kent, Essex, Suffolk, and Norfolk, the vale of Gloucester, and even as far as Penzance in Cornwall. The London, Chatham and Dover, one of the youngest of our main lines, brought up from East Kent in 1867 5279 tons of potatoes, 1046 tons of vegetables, and 5386 tons of fruit, besides 542 tons of vegetables from France. The South-Eastern brought 25,163 tons of the same produce. The Great Eastern brought from the eastern counties 21,315 tons of potatoes, and 3596 tons of vegetables and fruit; while the Great Northern brought no less than 78,505 tons of potatoes—a large part of them from the east of Scotland—and 3768 tons of vegetables and fruit. About 6000 tons of early potatoes were brought from Cornwall, with about 5000 tons of broccoli, and the quantities are steadily increasing. "Truly London hath a large belly," said old Fuller, two hundred years since. But how much more capacious is it now!

One of the most striking illustrations of the utility of railways in contributing to the supply of wholesome articles

of food to the population of large cities, is to be found in the rapid growth of the traffic in Milk. Readers of newspapers may remember the descriptions published some years since of the horrid dens in which London cows were penned, and of the odious compound sold by the name of milk, of which the least deleterious ingredient in it was supplied by the "cow with the iron tail." That state of affairs is now completely changed. What with the greatly improved state of the London dairies and the better quality of the milk supplied by them, together with the large quantities brought by railway from a range of a hundred miles and more all round London, even the poorest classes in the metropolis are now enabled to obtain as wholesome a supply of the article as the inhabitants of most country towns.

These great streams of food, which we have thus so summarily described, flow into London so continuously and uninterruptedly, that comparatively few persons are aware of the magnitude and importance of the process thus daily going forward. Though gathered from an immense extent of country—embracing England, Scotland, Wales, and Ireland the influx is so unintermitted that it is relied upon with as much certainty as if it only came from the counties immediately adjoining London. The express meat-train from Aberdeen arrives in town as punctually as the Clapham omnibus, and the express milk-train from Aylesbury is as regular in its delivery as the penny post. Indeed London now depends so much upon railways for its subsistence, that it may be said to be fed by them from day to day, having never more than a few days' food in stock. And the supply is so regular and continuous, that the possibility of its being

interrupted never for a moment occurs to any one. Yet in these days of strikes amongst workmen, such a contingency is quite within the limits of possibility. Another contingency, which might arise during a state of war, is probably still more remote. But were it possible for a war to occur between England and a combination of foreign powers possessed of stronger ironclads than ours, and that they were able to ram our ships back into port and land an enemy of overpowering force on the Essex coast, it would be sufficient for them to occupy or cut the railways leading from the north, to starve London into submission in less than a fortnight.

Besides supplying London with food, railways have also been instrumental in ensuring the more regular and economical supply of fuel,—a matter of almost as vital importance to the population in a climate such as that of England. So long as the market was supplied with coal brought by sea in sailing ships, fuel in winter often rose to a famine price, especially during long-continued easterly winds. But now that railways are in full work, the price is almost as steady in winter as in summer, and (but for strikes) the supply is more regular at all seasons.

But the carriage of food and fuel to London forms but a small part of the merchandise traffic carried by railway. Above 600,000 tons of goods of various kinds yearly pass through one station only, that of the London and North-Western Company, at Camden Town; and sometimes as many as 20,000 parcels daily. Every other metropolitan station is similarly alive with traffic inwards and outwards, London having since the introduction of railways become