# BRITISH RAILWAYS

*Their*

*Passenger Services, Rolling Stock,*

*Locomotives, Gradients,*

*and*

*Express Speeds.*

BY

J. PEARSON PATTINSON.

WITH NUMEROUS PLATES.

SECOND EDITION.

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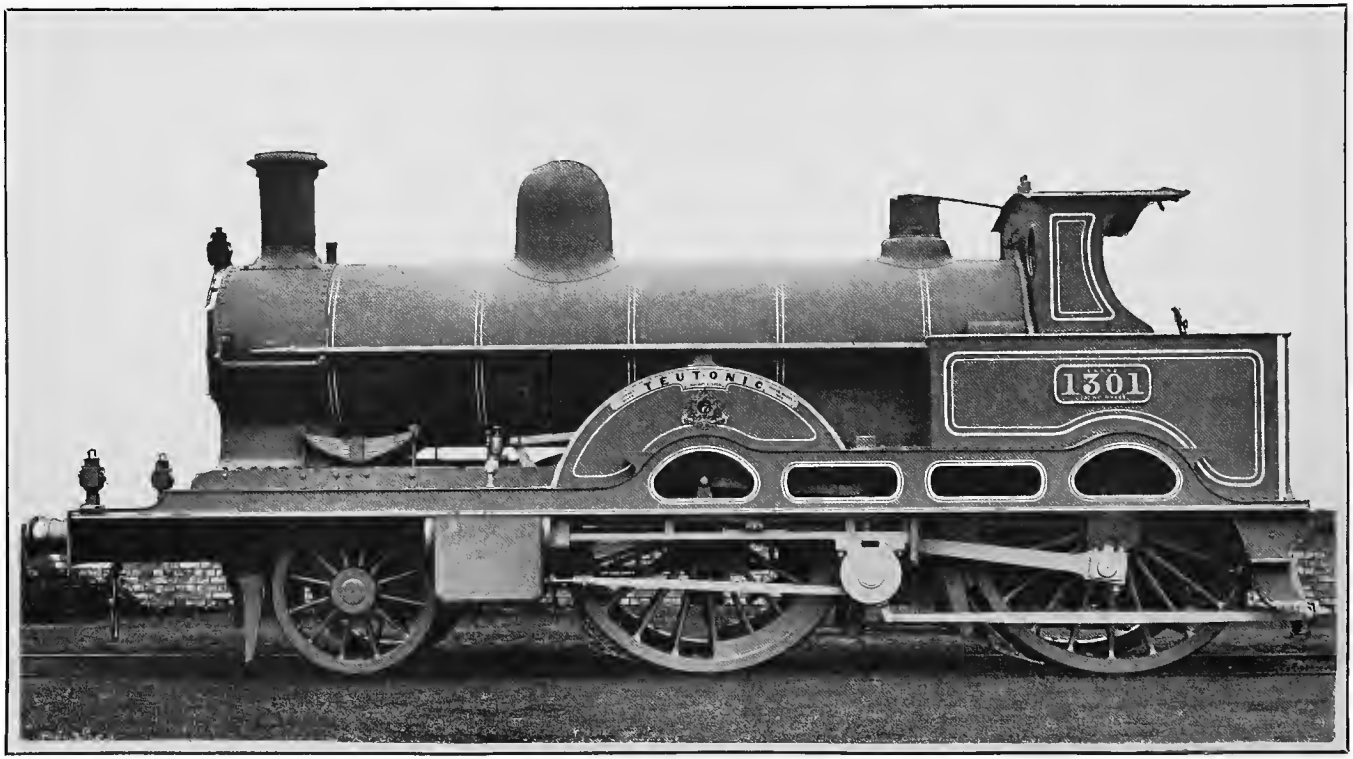


*Frontispiece.*

*See page 206.*

THREE-CYLINDER COMPOUND EXPRESS ENGINE.

(DESIGNED BY MR F W WEBB)

TO

THE RAILWAY ADMINISTRATIONS

OF ENGLAND AND SCOTLAND,

WHOSE PRINCIPAL AIM IT IS

TO MAKE A JOURNEY ALL THAT THE MOST EXACTING OF TRAVELLERS

COULD REQUIRE:

AND TO

STUDENTS OF RAILWAY WORKING

AT HOME AND ABROAD,

This Book is respectfully Dedicated.

# PREFACE.

It is somewhat curious that in a country which was the birthplace of railways, and which has seen a most active and enterprising development of this means of internal communication, so few standard works on the subject have made their appearance. In France, Germany, Belgium, and Italy, exhaustive and learned treatises, dealing with almost every department of railway working in a manner quite unknown here, have been issued at frequent intervals, and it is necessary for the English student of railway management and economics to acquire a reading knowledge of the languages of these countries before he can study a subject so thoroughly investigated by the scientific foreigner in all its detail.

The present volume is not intended in any way to compare with those referred to above. Its scope is much more limited. The subject of railway travelling is alone considered, and that mainly from a statistical standpoint. Particulars of the commercial speed of all the leading British lines are given, followed by a description of the locomotives at present used in express traffic, the gradients over which they run, and the actual work they perform. Prefaced to this detailed description of the

various systems is an introductory section dealing in the most general manner with the subject of railway travelling in this and other countries, and commenting briefly on the train services, the rolling stock, and the safety appliances used in passenger-train working, not only in this country, but on the Continent and in the United States of America.

Several of the leading railway companies have kindly rendered assistance in the illustration of the work by furnishing profiles of sections of the line and photographs or diagrams of locomotives. For such the writer here tenders all due acknowledgment.

The lithographs have been executed for the most part from drawings prepared by Mr. G. R. Sisterson of the London and South-Western Railway.

J. P. P.

LONDON, S.W.,
*March*, 1893.

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## PART II.

### THE BRITISH SYSTEMS IN DETAIL.

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# INDEX OF PLATES.

**GRADIENT PROFILES.**
*Vertical Scale,* 300 *ft.* = 1 *inch.*

**LOCOMOTIVES.**
*Scale,* $\frac{1}{60}$ *actual size.*

*** *This Engine, in common with others of the practically extinct "Newton" class of Mr. Ramsbottom's design, though retaining its old name and number, has all the dimensions of Mr. F. W. Webb's larger and more powerful "Precedent" type of* 1874.

# EXPLANATORY NOTES TO PART II.

(1) **General Description of the Line.**—In this section mention is made of the main routes and branches of the railways under review. The length of each system is given approximately, and includes only the lines actually owned by the Company, without reference to those leased or rented, or simply worked over.

(2) **Travelling Facilities.**—An examination of the opportunities and obligations of each system to run frequent and fast services of trains is here made. Tables showing the train services for the month of August, 1892, between the principal points served by each Company are given. This month has been chosen so as to include the tourist and seaside trains running only in the summer. So far as can be judged at present, the figures for August, 1892, will not be materially altered for the coming summer of 1893. The distances in such tables, in cases where there are two or more routes from one town to another, invariably state the length in miles of the route taken by the fastest train between the places mentioned. It has not been thought necessary to burden the *Remarks* column with unnecessary detail. Accordingly, in those cases where trains run only on certain days of the week, they have been, as a rule, inserted without a note to that effect.

Punctuality and local train services are then discussed. Following this, under the sub-title of *Rolling Stock and General Accommodation*, the safety appliances, stations, etc., of each Company are briefly described.

(3) **Locomotive Work.**—This part of the subject is distinct from what precedes it, as the subject is no longer discussed from the traveller's point of view, but with a desire to consider in a general manner the work of the locomotive and the resistances to be overcome by it. Accordingly, under the separate sub-titles of (a) *Speed*, (b) *Gradients*, (c) *Locomotives*, (d) *Actual Performances*, we consider respectively :—(a) the demands made on the locomotive in the way of speed, (b) the contour of the line over which these speeds are to be maintained, (c) the machines actually doing the work indicated in the previous sections, and (d) the manner in which these machines actually perform this work, as illustrated by a very large number of examples observed, personally, in actual daily practice. These examples furnish details as to the weight of the train, and—to

avoid confusion and misapprehension—this is always exclusive of engine and tender; further, the types of passenger rolling stock being so numerous, the weight has been given in coaches of ten tons each. Thus, a train with six eight-wheeled coaches weighing twenty tons each, would be described as a train of twelve coaches. By this means, wearisome detailed description of the various types of carriages composing each train has been avoided.

In the subdivisions describing Gradients and Locomotives, some of the steepest main-line sections and some of the best-known recent English and Scotch locomotives have been illustrated to a uniform scale. The distances given in the section under the head of Actual Performances have been taken from authentic sources, and the figures representing the running of the various trains are, in nearly every instance, the result of very careful personal observation.

# PART I.

## INTRODUCTORY REMARKS.

I. Speed and Punctuality.

II. Passenger Rolling Stock.

III. Safety and Safety Appliances.

IV. Locomotives, Gradients, Curves, Train Loads, and Train Timing.

# INTRODUCTORY REMARKS.

## I.

### Speed and Punctuality.

Perhaps the most important adjunct to railway travelling is speed. It is, at any rate, the quality most highly prized by the travelling public, as may readily be seen from the preference given by them to trains running at high speeds over those at a lower rate. We have only to look back to the conditions of travel in England before 1870, or thereabouts, to see how great is the value placed by the public on express trains. Continental countries even now afford us an example. In England, at the present time, it is common ground for complaint among railway managers that their first- and second-class carriages run almost empty, and that everybody, including even "gentlemen of the first position," as one well-known railway chairman has remarked, goes third class. So marked has been the desertion of the upper classes, that on several of the great lines the seconds have been either wholly or partially abolished. The reason is not far to seek: nearly all our best English trains carry all classes of passengers at the present time, and the slight increase of comfort in the firsts and seconds is not sufficient to compensate for the higher fares demanded, considering that the superior classes are not conveyed at any greater speed. But before the revolutionary changes introduced by the Midland Railway some twenty years ago things were far different. The firsts and seconds were then well filled, although the fares demanded were even higher in proportion to the thirds than they are now; the reason being that many of those who would at the present day travel third class were compelled at the earlier period to go first or second in order to economise their valuable time. We find to-day the same sort of thing on the Continent, where the differences between fast and slow trains are even more strongly accentuated. Not only is the third-class passenger

refused admittance, in nearly all cases, to express trains, but even those who decide to pay the higher rates for conveyance in first- and second-class carriages are subjected to an extra express fare, in most European countries, ranging from ten to twenty-five per cent. of the ordinary fare; and yet, even under conditions so onerous as these, the Continental railways succeed in obtaining full train-loads for their expresses. All this simply goes to prove how attractive to the public are these trains at high speeds, seeing that the traveller will frequently pay two, three, or even four times the price of an ordinary third-class ticket in order to save a few hours. It is thus evidently a matter of great importance to the community that a railway company should provide frequent fast services of trains; and to what extent this is done by British railway systems we shall endeavour at a later stage to show. With the view of furnishing material for the necessary comparisons, statistics of several European lines are also given.

I. *Speed.*—In dealing with this subject we are, at the outset, confronted with the question as to what constitutes a good service between important centres of population. To solve this question with exactness, we should be compelled to take each pair of important towns separately and discuss the service of trains between them, having due regard to the necessities of the places served and the numerous local conditions under which the traffic of each particular district is worked. Needless to say we do not intend to go into such detail as this. It is, however, indispensable to have some rough standard of comparison by which to gauge the efforts made in various countries and by different railway administrations to supply the needs of the public in this direction; and this, we think, may best be done by making, at this point, an examination in brief of the express services in Continental Europe, and comparing them with our own. This will bring into stronger relief the very high position held by Great Britain in the matter of express train running, and show that in one department of railway working at least the British companies are far ahead of their Continental brethren. This point clearly established, we shall, when we come to treat in detail of the various British systems, discuss and compare the results achieved by each.

In our remarks below, then, will be found a series of comparisons showing the relative extent to which the demand on the part of the public for express trains is responded to by British and European railway administrations. It will be noticed that, to a

great extent, the different classes are treated separately, and this arrangement has been necessitated by the fact, as mentioned above, that few Continental trains carry third-class passengers at high speed, and several go so far as to refuse even second-class. Some references to the fares charged are also made. This has been done because on the Continent first-, second- and third-class fares are cheaper than in England in nearly every instance, and it was felt that it would be manifestly unjust to expose the inferiorities of the Continental systems in one department of working without at the same time presenting certain other facts which tell in their favour. It is also necessary to remark that the amount of travelling per head of population on the Continent is less than in England, and one would, therefore, scarcely expect so many expresses between two towns, say of half-a-million inhabitants each, there as we should here. We certainly do not find nearly so many, but the fact that the travel movement on the Continent is less than it is here may be insisted upon as, in some degree, an extenuating circumstance, although, on the other side, it may, of course, be argued that the insufficient number of express trains on the Continent has been partly the cause of the smaller amount of travel.

Among the various Continental countries we naturally give the first place to

*France.*—Here we find that train-speeds, although at a very considerable distance behind those of our own country, are, perhaps, higher than in any other part of Europe. Most of the best work is found on the Orleans Railway, on the Swiss frontier services of the Est, and on the trains to Calais (for England) of the Nord. The last-named, alone, are equal to the best English practice, and, as such, the most creditable trains in France. On the Ouest and the P. L. M. the speed of the expresses is much lower, rarely, if ever, attaining an inclusive rate of forty miles an hour. Moreover, the number of trains at this moderate speed is very small on these last, as on the above-mentioned systems, the Nord alone excepted. One or two expresses per day in each direction is generally deemed sufficient.

Third-class passengers—rarely indeed allowed access to such trains as the foregoing—are usually relegated to those running at an inclusive rate of less than thirty-three miles an hour. Very frequently this is the speed of one train only in each direction, the others being timed at a much lower rate, and often stopping at all stations. Exceptionally, passengers of this class are admitted to trains at higher rates, on the condition that they are travelling a

certain distance (generally considerable) without break of journey; and sometimes this condition is imposed even when the speed is lower. Thus, third-class passengers may travel by the 8.50 a.m. from Paris (Est), provided that they proceed as far as Troyes, a distance of about 104 miles, which they are thus enabled to reach in just over three hours; or by the 11.15 a.m. from Paris (Lyon), on the understanding that they travel without break of journey to Macon (some 275 miles), in a trifle over nine hours. Such instances as the above sufficiently show the facilities given to the third-class traveller in France. As some set-off to such discouragements, it is only fair to state that the fares for the various classes are now apparently—taking into account allowance of free luggage, reduction on return tickets, etc.—somewhat lower than the British average. Contrary also to the practice in Germany, Austria, and Italy, no additional percentage on the ordinary first- and second-class fares is charged for travelling in express trains; it may, however, be remembered that, until the revision of the passenger tariff little more than a year ago, the fares in France were the highest in Europe.

*Germany.*—In Germany we have many points in common with French usage. The chief points of difference may be summarised thus: the fares on most lines are lower; but, inasmuch as an additional percentage is charged on the ordinary fare for travelling by express train, there is very little to choose between the two countries in the charges levied for fast travelling in the two higher classes. Third-class passengers are not excluded from the best trains to the same extent as in France; hence, in many parts of Germany, travelling at a fairly high rate of speed is much cheaper than in the former country. A fourth class is provided on some of the German lines (though never used in express traffic) at exceedingly cheap fares.

All things considered, speed is a little lower than in France, and on some of the "Administrations" it ranks on a par with that of a British express goods train. The speediest service is that between Berlin and Hamburg, where, although the trains are very light, the performance is creditable. As local time is kept at the stations, many, forgetting this fact, have supposed these expresses to be the fastest in the world; that this is not the case we shall endeavour to show in a future chapter. This practice (whatever its local convenience) is liable to cause confusion in estimating the rates of speed between any two towns on German railways.

*Austria-Hungary.*—In this country German usages prevail to a great extent, and third-class passengers are allowed to travel by

some of the faster trains. Owing, however, to the mountainous nature of Western Austria and the sparse population of Hungary, train-speeds are appreciably lower here than in Germany. The best trains would seem to be those between Vienna and Buda-Pesth, and Vienna and Brünn. Fairly good third-class facilities are given between the two latter places. As some compensation for poverty of speed we find that the fares are as low as (or lower than) any in Europe. This is due, in great measure, to the introduction some little time back of the zone system on the Hungarian lines. The consequent great reduction in the tariff—resulting in loss to many of the Austrian lines—compelled the latter to adopt the lower scale of fares. At present it is cheaper to travel second class on the Hungarian State lines than third on British railways. An addition of about one-fifth to the ordinary fare is generally made for travelling by express trains.

*Belgium and Holland.*—These two countries, though of small extent, have each their distinctive characteristics. The Belgian lines, while scarcely coming up to the French and German express standard (mainly on account of the propinquity of large towns) exhibit a lower scale of fares than any other European State, Hungary alone excepted. The best performances are those between Brussels and Ostend, where third-class passengers are not excluded from some creditable trains. The line from Brussels to Luxembourg, *viâ* Namur, forms part of the through route to Basle. It is extremely hilly, crossing the Ardennes on gradients of 1 in 62.

The Netherlands is not so conspicuous for cheap fares as Belgium. But if the tariff is somewhat higher, a considerable proportion of the express trains is open to the third-class passenger, and the carriages of that class are much superior to those usually found on Continental railways. Dutch travel, in fact, seems to be largely modelled on the British system, and excellent speeds at over forty miles an hour are tolerably frequent.

*Italy.*—The railway aspect of Italy has greatly improved during recent years, but the nation is still, in point of express train services, much below the average of the other Continental powers. Only the very best trains attain an inclusive rate of thirty-five miles per hour, and to these, almost as a matter of course, the third-class passenger is not admitted. With an ample population there is much scope for improvement; and a reduction of the third-class rate to that charged on some of the foregoing railways is much needed. To travel with any approach to comfort second-class fares must be

paid, the rate for such accommodation being much higher than the British third-class tariff. For travelling by express trains an increase of ten per cent. on the ordinary fare is demanded.

*Other Countries.*—In other European countries speed rules low. Russia, Sweden, Norway, Denmark, Turkey, Spain, Portugal, and Switzerland, all appear to rank below the thirty miles an hour average. For Switzerland, with its extensive mountain ranges, there is ample excuse. Travelling, in fact, in this small territory is almost as speedy as it possibly could be; gradients, even in the comparatively level northern portions, being severe and incessant. The Gotthard express, which runs from Lucerne to Bellinzona (109¼ miles) in less than four hours and a half with five stops (one of twenty minutes' duration) is most creditable, and, indeed, superior to the best trains over the similar mountain routes of the Arlberg and the Mont Cenis. The fares, also, in this enterprising country are lower than in England, and the carriage stock excellent in all classes.

The other countries, while possessing train services at speeds adapted to national requirements, scarcely merit detailed notice.

*United States.*—The United States ranks, apparently, second only to Great Britain in providing the travelling public with a good service of express trains. A few of these are exceptionally brilliant, and one, at least, is faster than any train in England. If a table showing the services between some of the chief towns in the States were prepared, it would give undue prominence to the brighter aspect of the case, of necessity including some of the best trains, without affording any clue to the extensive area monopolised by slow travel. It would also be of no permanent value in the face of the present rapid development of railway facilities in so progressive a country. The year 1893 will, to all appearances, see the American railways at their best in the fierce competition for the traffic from Europe to the Chicago Exhibition. It is, however, we think, unlikely that any permanent reduction will be made in the passenger fares as now existing in the States. With the exception of the special palace and emigrant cars, there is, practically, only one class, and for this accommodation, which is probably not superior to our best third-class carriages in England, a fare generally somewhat higher than our own is charged. High-speed travelling is thus seen to be more costly in the United States than in the United Kingdom.

*Great Britain.*—In our own country, as will be shown in detail

when the various systems are dealt with separately, nearly all Continental restrictions are absent. The great majority of trains carry third-class passengers in carriages of varying, but always reasonable, degrees of comfort, and, for the most part, equal to the Continental second class. In speed we are very greatly superior. Not only is the pace of our express trains quite ten miles an hour higher on the average, but their frequency is much greater than elsewhere. No British railway of any importance is content with its two or three expresses daily in each direction, as is the case with all the leading French and German lines, for instance: more usually eight or ten appears to be the prescribed limit here; and between London and Manchester, and Liverpool and Manchester, the numbers rise to about twenty and forty-five respectively. The fares, it should be observed, are a little higher than on the greater part of the Continent, and much more so than in Belgium and Hungary. But here again the Continental second-class fares, when compared with our own third-class rates—the accommodation in the former being frequently inferior to that provided in the latter—are generally higher, and slow travelling with scant comfort is reserved for the less fortunate section of our Continental neighbours.

As this work is written with the intention of discussing the subject of railway travelling from the public point of view, and of examining what accommodation (using the word in a broad sense) the railway companies give, it is, perhaps, outside our limits to discuss the more strictly economical question, whether the running of such fast and frequent trains is remunerative to the shareholders. The matter is one worth inquiring into, however, from another point of view. It has been frequently asserted by those interested in the reduction of railway rates for merchandise that much money is needlessly squandered by the British railways in running unnecessary express trains which, if saved, might have been used as a set-off against the reduction of goods rates, with consequent advantage to the trade of the country. They further assert that these fast trains hardly pay their way. In this contention they are probably correct. So eminent an authority as the late Sir G. Findlay apparently supports this statement, which, in fact, hardly requires any demonstration, it being beyond dispute that express trains seriously disorganise the other and slower traffic of a railway, and render the capacity of a line considerably less than if all the traffic were run at a fairly uniform rate of speed. Such trains necessitate the erection of more signal boxes, and the permanent way of the line must be kept in

perfect condition at great cost. Specially designed machines have also to be built for the hauling of these swift trains, and in many other ways additional expense is incurred. The answer to all this is, however, a very direct one. The general feeling on the part of the travelling public is in favour of frequent express-train service, and the railway companies of England and Scotland probably know that they are better consulting public convenience by increasing the speed and number of their trains than by decreasing to a slight extent their goods and other rates. The amount of saving in goods rates which could be effected by a reduction in the number of express trains would not sensibly affect the selling price of commodities to the general consumer, and it is unlikely that he would be willing to forego the privilege he has at present of leaving London for any of the large provincial towns at almost any hour of the day, in return for such a remote possibility of benefit.

Before closing our remarks on the subject of speed in train services, it will, perhaps, be as well to point out that the railways of England and Scotland have been consistently improving their train services, both in speed and frequency, for a long time, and especially so during the last twenty years. Some interesting statistics have been published on this point in Mr. Foxwell's *Express Trains.* In 1871, according to Lieut. Willock, there were only 57 trains in England and Scotland which exceeded 39 miles an hour from start to destination, including stops, and only 225 which exceeded 36 miles an hour. How great an improvement has been effected, may be seen from a glance at the following table. It will be noticed that the figures for 1883 and 1888 only refer to trains attaining or exceeding an inclusive speed of 40 miles an hour. Even at this higher standard they, however, considerably exceed the 1871 figures, both in number of expresses and in speed :—

| Year. | Number of Expresses. | Average Speed. | | Daily Mileage. |
|---|---|---|---|---|
| | | Including Stops. | Excluding Stops. | |
| 1871 | 225 | $37\frac{3}{5}$ | $40\frac{2}{5}$ | 23,700 |
| 1883 | 409 | $41\frac{2}{5}$ | $44\frac{3}{10}$ | 42,600 |
| 1888 | 672 | $41\frac{2}{3}$ | $44\frac{1}{2}$ | 62,900 |

If we multiply the total mileage by the inclusive speed for each of these three years, we get figures showing the increased advantages to the public :—

| Year. | Product. | Equal to, if reduced, |
|---|---|---|
| 1871 | 891,120 | 9 |
| 1883 | 1,772,160 | 18 |
| 1888 | 2,620,410 | 26 |

These figures, which we extract from Mr. Foxwell's work, must not be taken as absolutely accurate, as they do not by any means exhaust all the speed we have in this country above 40 miles an hour. They, however, serve as a reliable means of comparing what our railways did in 1883 and 1888 with what was done in 1871. Since then train services have been still further improved, and a few remarks on the probable amount of speed in England and Scotland in the year 1890 will be found in a subsequent section, under the heading of *Amount of Express Speed.*

A few remarks may here be inserted on local train services. These, as in the case of express and fast trains, are distinguished by greater speed and frequency here than is generally found on the Continent. It is not unusual by any means in England to find trains which stop at all stations timed at an inclusive rate of 25 miles an hour. This means a speed of, at least, 40 to 45 miles an hour when running in the "open," and is, of course, not approached on the Continental systems, where the speed for stopping trains rules from 20 miles an hour *downwards.*

II. *Punctuality.*—When discussing the question of speed in the previous section, it was necessary, in order to bring out the high qualities of the British lines, to consider the work on the Continental systems, and so raise a standard of comparison. This is no longer necessary in the present instance, as the standard of punctuality is the published times of the various trains. We will, however, make some remarks on the punctuality of Continental trains, mainly in order to combat some erroneous opinions on the subject.

It is generally believed that British railways, and particularly those in the Southern part of the island, pay but little attention to ensuring a punctual arrival for their trains. On the Continent punctuality is believed to reign supreme. Both these beliefs require considerable qualification. It is rather unfortunate that we have no reliable statistics to prove the matter one way or the other. It is true that in England a return of the arrival of trains at the principal London termini for the year 1890 was drawn up for the information of the House of Commons. It, however, proved nothing, as through, long-distance, express and suburban trains were indiscriminately treated.

We must, therefore, trust almost entirely to personal observation, and, in the result, are inclined to think that punctuality on the Continent is rather in advance of what it is here, but not nearly so much as is generally supposed. When we deal separately with the various British systems, we will give our observations on each line in detail.

In yielding the palm to our Continental neighbours for punctuality, it must not be supposed that we are inclined to the opinion that their work is any more meritorious than ours. It is, in fact, less so. Their trains are generally timed so that, if necessary, a few minutes lost can be made up in running between stations; ours are generally booked to run so fast that making up time is a remarkable feat; their trains are allowed long spells of time at stations, in order that the station work should not be hurried; ours get such extremely short intervals as are quite inadequate for the taking up and setting down of passengers and luggage; finally, their trains get a clear course on a road only moderately filled with trains, while ours have to run the gauntlet of numerous trains of all descriptions—goods, mineral, and live-stock—all running at varying rates of speed on a crowded road. The conditions are utterly dissimilar, and it is really very creditable to the British lines that they have approached so closely to the Continental systems while working under such disadvantages.

It may, however, be argued that, although the conditions under which British railways labour are hard, yet there are many instances in which trains are late day after day. By way of illustration let us take two dissimilar cases. There is a very great deal of unpunctuality, to the extent of from five to fifteen minutes, in the working of South-Eastern trains into Cannon Street and Charing Cross stations. There is also a much more conspicuous absence of punctuality in the arrivals of the Perth and North of Scotland expresses at Euston, St. Pancras, and King's Cross in August, September, and October. It is admitted that the conditions under which both kinds of traffic are worked are onerous, but the cry is that other and more favourable conditions should be substituted. But can we substitute other conditions? Let us consider each case more in detail.

The South-Eastern Company have a very large traffic into London during the morning hours up to about 10.30 a.m. It is important that this traffic should be worked with absolute punctuality, as most of the travellers using the line have business engagements to meet at fixed hours. Yet punctuality is certainly not

maintained, and is very frequently seriously departed from. The cause is that the company's lines are greatly overcrowded with trains at the hours mentioned. Three different remedies are proposed. The most general is, that as all or most of the trains average at least five to ten minutes late, they should all be allowed that amount of time longer on the journey. It is not quite clear what good would come from the adoption of this remedy, as, even supposing that all the newly-timed trains ran punctually, which is very unlikely, passengers would arrive at their destinations no sooner than before. It is obvious, in fact, that even with the extra allowance of time, just about as much unpunctuality would result, as the cause, namely, the crowded state of the lines, has not been removed. It is clear, then, that this remedy, which is the one generally proposed by those quite ignorant of railway working, will not answer. It would, perhaps, be better to adopt the contrary course, and give the trains less time on the journey and make their times of arrival earlier. Some years ago a leading English company tried this with a Scotch express due to arrive in London in the early morning. It was almost always half an hour late. Under such circumstances one would have thought that acceleration was the last course to try with such a train; but it was accelerated to arrive half an hour earlier. It continued to be just about as much late as before, and thus succeeded in arriving at its old booked time—a result never previously achieved.

The second remedy proposed is one altogether in the interests of the public. It is, that the South-Eastern Company should provide extra lines of rails, so as to avoid crowding the existing metals with trains. But what does this involve? It probably means the expenditure of two or three millions of money by the railway company; and with what object? Simply to accommodate traffic which the company would probably rather not have at all than at such a price. It scarcely seems to be realised by the public that the provision of, say, two millions of capital, requires, at 4 per cent., a net income of £80,000 per annum extra, involving, probably, a gross income of twice as much. It is altogether unlikely that an addition of traffic so great as this will accrue to the company before the lapse of many years; and as railways must be conducted on business, and not on philanthropic, lines, it is necessary to carefully weigh all these considerations before deciding on so vast an expenditure. It may, however, be argued on the side of the travelling public, that after having paid their money for conveyance on the railway, it is somewhat unfair to them to find that the company have not a sufficient

number of lines to accommodate all the trains that will be filled by the ticket-holders in such a way that the trains will run punctually. But this argument is equivalent to asking the railways to provide for every emergency, and is manifestly unreasonable. The number of rails provided by most of our suburban and metropolitan systems is ample for the circulation of trains at all hours of the day, except when the morning and evening business traffic has to be accommodated.

The third remedy is one seldom proposed, but would probably result in punctuality if it were tolerated. Such would be to reduce the number of trains, and so clear the lines and ensure punctual running. But this would be regarded by the travelling public as a much greater evil than the continuance of the present moderate amount of unpunctuality. We may therefore dismiss it from consideration. The difficulty of the problem lies in the following factors. Railway companies are compelled to book all passengers who present themselves for conveyance on their lines. Up to a certain point the capacity of the road equals the demand. Then more passengers arrive, but for some years not in sufficient numbers to guarantee the railway company against loss if they build an extra double road to accommodate the traffic. We have thus a choice of two evils. The first would be to retain the original number of trains and keep the constantly increasing numbers of passengers waiting; the second, to put on several extra trains, overcrowd the road, and produce a little unpunctuality. The latter course is, we think, much the more sensible one to pursue, and most of the lines having suburban systems around London have adopted it. The Great Eastern and London and South-Western have built new lines to accommodate the increased traffic, but it may be assumed that they did not do so before assuring themselves that their expenditure would not result in loss.

And now let us look at another and altogether dissimilar case. During the months of August, September, and October, and often at other times of the year as well, the expresses coming from Perth, Inverness, and the far north of Scotland are very unpunctual in arriving at the termini of the London and North-Western, Midland, and Great Northern Companies. Let us see how this lateness is occasioned. This may best be done by tracing the course of a train from Wick southwards. It is probable that, somewhere along the route, it receives an unexpected addition to its weight in the shape of several waggon-loads of fish or live-stock. These cause delay in attach-

ing, and consequently a few minutes loss results from a wholly unforeseen and non-preventable occurrence. This lateness may throw the train out of its course at the next crossing-point (nearly all the Highland is single line). When it gets south of Inverness it will very probably meet with a heavy north-bound train, which, on account of its length, is being run in two portions, to accommodate the rush of summer-tourist traffic from London and the south; if so, then more delay is occasioned, and when the train arrives at Perth the lateness will be considerable and far-reaching in its effects. At Perth the train is split up into portions for the three great routes to the south—the West Coast, the East Coast, and the Midland Scotch. All these portions start considerably late; and as they have to run out of their course, perhaps get in the way of other trains, thereby disarranging the traffic of the line, and adding to their own lateness. At each junction they form connections, all of which are in like manner delayed, until, at last, the effect of the unpunctual arrival of the Highland train at Perth is felt almost all over the kingdom. Nor is this all, for until the Highland line be doubled throughout there seems to be little prospect of amelioration, as these special trains of fish, live-stock, etc., cannot be foreseen and provided for when preparing the monthly working time table of the line, and their presence on a single line of railway is, of necessity, totally subversive of punctuality. If we adopt the only existing remedy, and double the line throughout, we should, very probably, cut away the whole of the Highland Company's dividend and impoverish the shareholders: this, besides being unfair to that body, would result in such diminution of train services and general accommodation as is nearly always the rule with lines of low financial standing. In the end we should be worse off than before.

On a careful review of the whole question we are inclined to the opinion that nearly all the unpunctuality in England and Scotland is, as in the South-Eastern and Highland instances referred to above, excessively difficult to remedy. Working under such conditions as these, Continental managers would fail to secure equally good results; and at present, when the rare combination of high speed, heavy loads, and steep grades occurs on the Continent, unpunctuality nearly always results.

III. *Amount of Express Speed.*—In our remarks above we have given the census figures for British express trains as taken out for three different periods by Lieut. Willock and Mr. Foxwell. These figures are obtained by summation of the daily mileage of

all trains, having an inclusive speed of 40 miles or above per hour, running between the large towns on each line of railway. Statistics, however, had better not be given at all than given so as to produce error, as they undoubtedly do in this method of calculation, and for the following reasons:—To begin with, there is no justification for the adoption of the 40-miles-per-hour limit as constituting an express. If all trains under 40 miles per hour are to be rigidly excluded, what becomes of that numerous class of trains which just fails to reach the limit? If these are to be kept out of the summary, then we must recognise that a large amount of meritorious speed is left altogether unrecorded. Of course, it will be said that the line must be drawn somewhere. But our contention is that the line cannot be drawn anywhere if a faithful record of each company's express services be sought. If we want to know how much speed a line has above 40 or 45 miles an hour, then we must exclude all below those speeds; but if we want to know how many express and meritoriously fast trains are run on each system, then we are not justified in stopping at any particular point. Indeed, Mr. Foxwell has seen this difficulty in the case of the southern railways, on whose systems many trains just fail to reach the limit of 40 miles an hour. These have been specially provided for under a kind of supplementary mileage. The same course has, however, not been pursued with the northern railways, although if done in one case, it would seem requisite that it should be done in all.

Another source of error affecting Mr. Foxwell's statistics is to be found in his practice of taking a train as express only to a certain point on its journey, when it is not express throughout to destination. Thus, the Flying Dutchman of the Great Western Company takes nine hours to reach Penzance from Paddington, and so fails to attain Mr. Foxwell's limit. That writer, however, would probably call this an Exeter express, with the result that the very high speed, London to Exeter, would go to the credit of the company. Now, suppose this train were accelerated so as to take rank as express to Penzance, it would so appear in Mr. Foxwell's summary, and its speed from London to that point (still being less in miles per hour than in its former timing between London and Exeter) would cause the general speed average of the company to drop a point or two. We have, therefore, an additional reason to doubt the accuracy of Mr. Foxwell's figures, and our incredulity is strengthened when we notice here and there a few errors in crediting mileage to a company not actually performing it. For instance, the mileage of the Cheshire Lines

expresses is divided between the three owning railways, when it should be given altogether to the Manchester, Sheffield and Lincolnshire, as the company running the trains. Other instances might be cited, so that we think we are justified in saying that these statistics, although sufficient for purposes of comparison, are yet not so strictly accurate as to give us a tolerably exact idea of the amount of express and fast travelling on British railways.

Another method, and one by which we may gain a much more precise idea of the amount of fast travelling in England and Scotland, involves the summation of all runs from one stopping point to the next, at a speed of 40 miles an hour or more. This plan has certainly the advantage of chronicling all the speed over 40 miles an hour, much of which is omitted in Mr. Foxwell's statistics. It also, however, requires us to fix a speed limit which, as previously shown, is arbitrary, and without justification. Again, to search through all the time tables of all the companies, for the purpose of selecting all runs which satisfy such requirements, would be a most laborious task not lightly to be taken in hand. Were the results likely to prove of permanent value the task might profitably be undertaken, but railway companies change their arrangements considerably almost month by month, and what would accurately represent the running times in July would be entirely misleading a few months later.

Notwithstanding these objections, however, a census table summarising all runs from one stopping point to the next has been prepared from the time tables of the three companies mentioned below. Comparison with Mr. Foxwell's statistics will show how much really meritorious speed has been omitted in the results obtained by the adoption of that writer's method.

| Railway. | Month chosen for Census. | Daily Mileage at or over | | | Rate per hour of total Daily Express Mileage. | Mr. Foxwell's figures. | | Increase % as shown by our figures. |
|---|---|---|---|---|---|---|---|---|
| | | 40 miles per hour. | 45 miles per hour. | 50 miles per hour. | | Date. | Total Daily Express Mileage. | |
| | | | | | | | Miles. Rate. | |
| Midland | July 1890 | 18,123 | 10,810 | 2,157 | 45·36 | Aug. 1888 | 11,381 at 46¼ | 59 |
| G. & S. W. | July 1890 | 2 672 | 1,486 | 109 | 45·02 | do. | 1,387½ at 45½ | 93 |
| M. S. & L. | Nov. 1890 | 3,426 | 1,972 | 612 | 45·77 | do. | 2,106 at 43¼ | 63 |

How these figures compare with Continental work may best be shown by the inclusion here of a table given in the *Encyklopädie des gesamten Eisenbahnwesens* (Carl Gerold's Sohn, Vienna), under

the article "Fahrgeschwindigkeit." It must also be remembered that the mileage given in the table below does not mean speed over 40 miles an hour as our English figures do, but includes all those trains which on the Continent they are pleased to call express, and the majority of which are rather below 35 miles an hour than above it.

Summer of 1890.

| Country. | Miles. | Speed in Miles per hour. |
|---|---|---|
| North Germany ... ... ... ... | 35,751 | 32¼ |
| Holland ... ... ... ... ... | 7,598 | 30¾ |
| France ... ... ... ... ... | 59,114 | 30¼ |
| Belgium ... ... ... ... ... | 8,059 | 30 |
| Denmark ... ... ... ... ... | 997 | 29 |
| South Germany ... ... ... ... | 19,504 | 28¾ |
| Austria and Hungary ... ... ... | 23,582 | 28 |
| Italy ... ... ... ... ... | 13,004 | 26½ |
| Roumania ... ... ... ... ... | 1,473 | 25¾ |
| Russia ... ... ... ... ... | 16,005 | 23¼ |
| Switzerland ... ... ... ... | 6,328 | 22½ |
| Sweden ... .. ... ... ... | 4,313 | 22½ |
| Norway .. .. ... ... ... | 989 | 19½ |

## II.

## Passenger Rolling Stock.

Almost as important a factor in railway travel as speed is the accommodation provided in the passenger rolling stock. This varies considerably on the British lines, but it may be said that even the very worst of them is, to all appearance, in advance of the best of the Continental systems. To discuss the subject in further detail, it will be necessary, after a few preliminary remarks, to describe separately the accommodation offered in the different classes by British and European railways.

The division of railway travel into three classes is found to be pretty general all over Europe. The most noticeable exceptions are the introduction of a fourth class in Germany on some of the State railway administrations; and, on the other hand, a tendency in England to gravitate towards the one-class system adopted in America, by suppressing the second class. In England, the second class will probably, at no very distant date, be abolished, as people can now travel third class at the same speed, with almost equal comfort, and at a sensibly lower fare. On the Continent, however, class distinctions will probably remain, as the difference in speed between second and third class is quite sufficient to ensure the former always being well filled.

We will now briefly describe the accommodation offered in the various classes, and conclude our remarks on this subject with a few references to the lighting and heating of railway passenger rolling stock.

(*a*) *Third Class.*—In England and Scotland the great majority of travellers use the third-class carriages. In general they are very comfortable, being divided into five compartments as a rule—

although in eight- or twelve-wheeled bogie carriages, and some other varieties, seven are found. These compartments are generally upholstered in some kind of cloth or plush material to a height sufficient to enable passengers to lean comfortably back on the material and avoid resting their heads against the hard woodwork; each compartment is provided with four side and two door windows of convenient size, which are in many cases furnished with blinds or curtains. The roof is generally painted white, or perhaps picked out in one or two colours, and the partitions are, as a rule, utilized for the display of company's notices, and in some cases maps of the system are given. A more pleasing feature is the adornment of a portion of the wall space with photographs of places of interest accessible from the line. Above these a rack for light articles is provided. The smoking carriages on the best lines are fitted with suitable accessories, and on some of the long-distance express trains lavatory accommodation is added to the third-class compartments.

On the lines south of the Thames, however, the third-class carriages are by no means so good. Cushions are seldom seen, luggage racks and blinds only occasionally supplied, and the dimensions of the carriage are much smaller throughout. These remarks hold good of some of the older stock of the Lancashire and Yorkshire, Caledonian, North British, Great Eastern, and one or two other lines. All English and Scotch companies, without exception, have of late years adopted an enlightened policy in the building of passenger rolling stock, and at the present time the newest types afford every reasonable accommodation.

We wish as much could be said of the Continental lines. The third-class rolling stock in Europe is miserable indeed. The internal dimensions are extremely mean, and in many cases no complete division exists between one compartment and the next. Cushioned seats are, almost everywhere, unknown, and such conveniences as luggage racks and blinds to windows are apparently not considered necessary. On very few lines do we find carriages with side windows —the one in the door of the compartment, although very small, being evidently thought sufficient. Little attention is given to keeping the carriage clean, and frequently—at any rate in France—the badly-constructed roofs are by no means water-tight. Switzerland is a very creditable exception, and possesses really good carriages. They are constructed on the American principle, and are entered from the ends. The third-class carriages are nearly always mounted

on eight wheels and divided into two long compartments, one for smokers and the other for non-smokers. Although the seats are destitute of cushions, the carriage is rendered very cheerful by the large amount of window space, and in many cases by the use of various woods in the building of the vehicle. All over the Continent, however, the outside painting and decoration is not nearly so tasteful as on our own systems, and the outlines of the carriage are both angular and clumsy.

(*b*) *Second Class.*—There is but little difference between the third-class carriages on our leading British lines and the seconds. The lines south of the Thames, however, make a great distinction, and their really comfortable seconds are much superior to the wretched vehicles of the lowest class. Leaving these out of consideration, it may be said that, generally speaking, an English second is only a third-class compartment with a little extra upholstery and perhaps a little more decoration. There are, in fact, several lines in England, some of whose best thirds are better than their seconds. Of course, the second-class traveller has generally more room to himself, as well as more privacy.

On the Continent the second-class compartments are very much superior to the thirds, and in their upholstery and appointments nearly similar to the English seconds. In France they are not so good as in Belgium, Germany, and Italy, where, on the fast trains, some really excellent second-class coaches, sometimes fitted with lavatory conveniences, are run. In Switzerland the open system prevails for the second class as for the third, and the carriage stock is exceedingly comfortable for this class. Sets of two or three compartments are divided off from the others, and thus the carriage appears very roomy, without losing much of the privacy of the separate-compartment system. In Italy, on some of the best trains, first- and second-class composite carriages are run with a lavatory placed between the different classes in the centre of the carriage, and approached by a corridor running along one side. These vehicles are excellently upholstered and provided with a platform at both ends, which passengers are allowed to occupy while the train is in motion. It must be said, however, that all over the Continent, the second class compartments used on the local and suburban trains are much inferior to those employed for long-distance expresses. In Paris many of the suburban trains are double-decked—the lower compartment being very low in the roof and upholstered in white cloth, and the higher provided only with

rough boards for seats, and destitute of protection of any kind from the weather cr other unpleasant vicissitudes of upper-deck railway travelling.

(*c*) *First Class.*—Our remarks on the comparison between second and third class will hold good here if we consider firsts and seconds. The tendency is to make the first class a sort of superior second—not, perhaps, so much by increasing the conveniences offered, as by using more valuable materials in the construction of the carriage. Thus we find on the best English railways that valuable woods and expensive upholstery is the rule: carpets and rugs are provided; the carriage is brightened up by tastefully-mounted photographs, or gilt racks for light luggage; mirrors are often used, and lavatory accommodation is provided in nearly all cases. The interior is also considerably more roomy than the seconds, as a rule. Some lines, of course, content themselves with vehicles which do not furnish these expensive luxuries; and the local and suburban first-class coaches on most systems are, naturally, not so good as those on the main line. In spite, however of the really excellent first-class vehicles now running on most English and Scotch railways, those using them are, without doubt, a gradually decreasing number. As we remarked when speaking of the second class, the reason is that people can usually travel just as quickly in England in the third as in the first class, and the greater amount of comfort in the firsts is not sufficient to induce any but the most exclusive to pay the much higher fare. Third-class carriages are generally quite comfortable enough in England, nowadays, to satisfy the great bulk of passengers.

On the Continent, first-class carriages on the main routes are almost as good as in Great Britain, except in France, where the firsts might with advantage be more roomy and better decorated and upholstered. In Germany, Austria, Belgium, Italy, etc., there is small ground for complaint, but, generally speaking, the ornamentation of the carriages is not so tasteful or harmonious as in England. On the slower trains in the countries named the firsts are not nearly so good as on their long-distance expresses. In Switzerland, however, all the firsts are distinctly good, and are divided into separate compartments, with a door of communication from one compartment to the next, and a central passage the full length of the carriage.

(*d*) *Dining, Sleeping, and Special Carriages.*—On some of the long-distance trains in Europe and the United Kingdom special

carriages for dining, or, when a night has to be passed before the train reaches its destination, for sleeping, are provided. These carriages, for which, in nearly every case, an extra charge in addition to the ordinary first-class fare is made, are generally built either on the Pullman-car model or as saloon carriages. They are, as a rule, upholstered with considerable luxury, and lavatories are always provided. In the case of the dining cars, fixed seats are placed opposite one another with a table between ; and a kitchen at one end of the vehicle furnishes all requisites for dining, etc. In the sleeping cars there are sometimes two berths, one above the other, but the upper one is not much used except in times of pressure. The bed is generally prepared by drawing out the seats facing one another and arranging the bed linen on this foundation. In some cases however, as on the North-Western Railway, very comfortable beds are provided, and the saloons of this company seem to meet with more favour than the Pullman sleeping cars which have been introduced into this country. On the Continent, although journeys are, in general, longer than in Great Britain, the sleeping accommodation provided in special cars—usually the property of the Wagon-Lits Company—is scarcely equal to what we are accustomed to in this country; their extra fares for the accommodation are also much higher than ours.

In America, with the exception of some of their most important trains composed wholly of Pullman cars (to ride in which one must pay a higher fare, and with which we have nothing to compare in England, except the Brighton Company's Pullman Limited), most of the traffic is carried in long cars, which are of one class only. The fares charged in these ordinary cars are, in general, rather higher than third class in England, and in some cases (as in the Western States) very much higher. The Americans are fond of comparing this solitary class with the English firsts, and of commenting on the cheaper rate their lines can give. The accommodation offered, however, is not superior to our best thirds, so that their comparison is valueless.

(*e*) *Heating of Railway Carriages.*—In this one respect only are the English and Scotch railway companies behind the Continental systems. This is scarcely what we should have expected, having regard to the fact that the climate is so much colder here. It nevertheless remains the fact that many of our local and suburban trains run all the year round without the slightest provision for warming the carriages ; and that on nearly all the trains in which some attempt is made to warm the vehicles composing them, it has

been done in a very half-hearted fashion by the introduction of so called "foot-warmers"—with which antiquated metal hot-water cases the travelled Englishman can scarcely feel satisfied. They rapidly become cold, and are at all times in the way of passengers leaving or entering the carriage. One or two lines fill the cases with acetate of soda, which, on being shaken up from time to time, emits heat and thus remains warm longer. The only companies which have set themselves to remedy this deficiency in heating are the Midland, Caledonian, and Glasgow and South-Western. These three lines have heated a few of their trains for some time past with the waste steam from the engine, but their experiment has only been a very limited one. This method, however, is in very general use in Germany and Switzerland, and the only fault to be found with it is, that in winter the German carriages are kept far too warm for comfort. In France, although several methods of heating are in use, things are nearly as far behind German and Swiss practice as they are here.

(*f*) *Lighting of Railway Carriages.*—Even more important, perhaps, than heating, is the lighting of railway passenger rolling stock. This is particularly necessary in the case of all metropolitan and suburban services. In these trains nearly every one wishes to utilize the time spent in the train in reading of some kind, and it is extremely annoying to find that the light in the carriage does not permit of this. Nor is it less vexatious to have an inadequate light during a lengthened journey by night—reading being impossible there is nothing to while away the time. In this important requisite British railways have an unequal, but improving, record. Gas and electric light—the former especially—are rapidly supplanting oil for the suburban traffic in the vicinity of large towns, and there are few companies which have not yet made a move in the right direction. It is noticeable, however, in many cases where gas is used that the pressure is very low and the light unsatisfactory. This should be at once remedied, as the result in such cases is hardly any better than when the old oil lamps were employed. On many suburban lines a duplex gas burner is used. Pope's and Pintsch's systems of gas lighting seem to be most in favour.

Things are not quite so satisfactory on trains running long distances, but even here competition has worked wonders, and we hope soon to see all British express and long-distance trains well lighted. Those of the North-Western Company have long been so. The Midland, after experimenting for some time with the electric light have now, it is understood, decided in favour of gas

illumination, and much of their passenger rolling stock has already been fitted. The Brighton Company have also a large number of trains fitted with gas or electric-lighting plant; and most of the lines having a large suburban and metropolitan traffic in the vicinity of London use gas extensively. In Scotland, until within the last two or three years, passenger trains were better lighted than in England: in fact, the Glasgow and South-Western was one of the first companies to introduce gas lighting into railway carriages in place of the antiquated oil lamps.

The worst lighted trains in England are those running in the local services on lines in the country, and away from the large towns. It is, in fact, only in districts where passenger traffic is light and competition generally absent that the English railways have not made proper provision for carriage lighting. The necessity for a good illuminant is, of course, not as pressing here as in the vicinity of large towns and in express trains, and attention will probably be paid to it as soon as work in other directions is completed.

On the Continent the lighting of railway carriages is not in so forward a state as with us. Gas is, however, frequently used, but is not, as a rule, of sufficient pressure to produce good illumination. Moreover, one burner is often made to serve two compartments, and the result is, of course, an extremely poor light. In England, on the contrary, the tendency is to provide each compartment with duplex burners.

## III.

## Safety and Safety Appliances.

No remarks on railway travelling can be considered complete which do not refer to the important factor of safety. In this country we have so few serious accidents to chronicle, and the number of killed and wounded bears so infinitesimal a proportion to the total number of travellers, that the subject has, perhaps, less interest for the public than the kindred ones of speed and comfort. It would, doubtless, be otherwise if we had so large a number of accidents here as are recorded in America, in proof of which we have only to point to the temporary interest displayed after the occurrence of any of the comparatively rare accidents of importance in this country. The subject, therefore, is worth examining, in order to study the methods by which our British companies have made travelling so safe on their lines. We will, first of all, discuss briefly the means adopted, and afterwards consider the results achieved. Before doing so, however, it may be pointed out that although, generally speaking, the adoption of safety appliances results in fewer accidents, yet there is no apparent connection between the one and the other in the results obtained by various British lines, as may be seen by comparing the returns of accidents on the different systems, and noting how frequently a line well equipped with safety appliances shows a worse record than one not so well equipped. In fact, the majority of railway accidents are not so much the result of the absence of any one safety appliance, as the combination of fortuitous and unforeseen circumstances, of little moment in themselves, but fraught with the gravest consequences when happening together. The recent accident on the North-Eastern Railway at Thirsk affords us an example. Here we have

a disaster of the first magnitude occurring on the main line of one of the largest English companies—with a well-maintained permanent way, and signal appliances of the best description—to a train fitted with automatic continuous brakes and composed of solidly-built rolling stock.

One would think that with such a train on such a road accident was a most remote contingency. And yet, mainly owing to the fact of the death of a signalman's child, and the consequent anxiety which led to the bereaved father's falling asleep in his cabin after some seven hours of duty, added to the equally significant fact that no relief men were available (five of them having been sent to a spot where a bridge had been washed away), an accident involving the loss of ten lives took place. Instances of this kind obviously ought not to deter those entrusted with the management of our lines from adopting all necessary appliances for safety, although they show that, however much is done in this direction, accidents due to unforeseen and unpreventable causes, coupled with human liability to err, will always occur.

It is advisable, disasters such as this notwithstanding, to limit the safety appliances to the essential and necessary. Excessive complication in the working of the line is more harmful than otherwise, and the multiplication of apparatus to check other apparatus is, to say the least, apt to produce embarrassment. There is also another side to the question. Financial possibilities must be considered. If all the known suitable or promising contrivances intended to further secure safety in railway travel were provided, the result would be that traffic could not be worked remuneratively, and that in all probability increased safety would not be attained. In the case of main lines with heavy traffic, it is manifestly necessary that a complete system of safety appliances should be adopted, but on branch lines with a small number of trains, less elaborate precautions are required. On this head, the Board of Trade, backed by the weight of public opinion, has in recent requirements inclined to the idea that a uniform system of precautions should be adopted on all lines in this country, whatever their traffic. Such stringent demands as these will merely defeat their own ends, and landowners and others interested in the promotion of local lines in rural districts may be discouraged from carrying out their projects if called upon to face heavy expenditure for unnecessarily elaborate precautions.

The most important requisites for the safe working of railways

are signals and continuous brakes. The former, by various pre-arranged indications, give warning to the driver of the train of the state of the track in front of him. The latter enable him to reduce speed and to stop before any temporary obstruction to the free circulation of traffic is reached.

1. *SIGNALS.*—In the early days of railways, the means used for indicating whether the road was clear or not were of a very primitive nature. As traffic increased it was seen that, unless some other system were introduced, confusion and danger would result. Ultimately, the old system of maintaining a time interval between trains on the same line of rails was gradually done away with, and the more rational one of a space interval substituted. This latter method, generally known as the Block System, is now, and has been for some time past almost universally employed in England and Scotland. On the Continent the Time System is still to be found in too frequent operation, and is sometimes combined with the Block in a sort of permissive system of Block working. Some excuse there certainly is for Continental administrations in the fact that the smaller traffic on their lines does not render necessary the more elaborate precautions required in England. At the same time, it should be borne in mind that the Block system is quite as simple as any other for working either heavy or light traffic, besides being undoubtedly safer. Its complete adoption on the Continent of Europe is only a matter of time, and most of the important lines already use it to a greater or less extent.

The interlocking of points and signals at junctions and fouling points is a matter of no less importance in railway signalling than the maintenance of a proper space interval between the trains. Without a complex system of interlocking, the traffic at our principal terminal, through, and junction stations could not be carried on with either safety or despatch. Briefly stated, the object of interlocking points and signals is that the signals should never indicate a free passage to a fouling point to more than one train at the same time, and that the road thrown open by the manipulation of the points should always be followed by the exhibition of the corresponding semaphore indications on the signal-post. British railways have long since provided complete and elaborate interlocking apparatus at almost every point at which lines foul or cross one another. On the Continent, also, much has been done in this way, although foreign lines are still considerably behind our own in this additional element of security.

2. *Continuous Brakes.*—Next to a complete system of signalling, the use of continuous brakes is the most important requisite for safety in railway working. The English railways have, however, not been nearly so ready to adopt these improved appliances as they were to block-signal their roads and interlock their signalling apparatus. Indeed, several of the leading railway companies have brought into use two or three kinds of brakes before settling down to any particular variety. Even at the present time practice is by no means uniform—most of the English rolling stock being fitted with the Automatic Vacuum Brake, and most of the Scotch with the Westinghouse type. As may be supposed, the consequence has been a certain confusion in cases where stock is run through from one line to another, and the necessity for fitting all main-line carriages with brake-hose connections of both types having arisen, the requisite adaptations have been extensively carried out by the systems having a large through traffic.

While differences of opinion exist as to the relative merits of Vacuum and Westinghouse brakes, there are nowadays but few champions of non-automatic varieties such as were in use on many lines till quite recently. These non-automatic types failed to prevent many accidents, and were actually the cause of some. All their efficacy vanished if the train broke in two, or if the hose-pipes connecting the carriages became ruptured. The automatic varieties, on the contrary, instantly apply themselves if the hose-pipes become damaged in any way, or in the case of the train breaking into two parts through the failure of the couplings or from other causes.

Probably the reason for the comparatively slow adoption by British railways of continuous brakes is to be found in the fact that those in charge of the administration of the various systems considered themselves scarcely justified in incurring a heavy expenditure for the provision of these appliances, when it was quite possible that other and more perfect means of retarding trains in motion might shortly be discovered. If this had proved to be the case the alternative of continuing to use a second-rate appliance or incurring further expense would have had to be faced. The smaller lines had also an additional excuse for delay. They naturally waited to see how the larger lines would decide, and then fitted their stock with a brake identical with, or similar to. that of the larger line with which they worked in most intimate connection.

At the present time, however, all the British railways, of which

we shall treat in detail further on, are well equipped with reliable continuous brakes. Stimulated as they have been to some slight extent during the last few years by Board of Trade interference, the popular idea has arisen that the present satisfactory solution of the brake question is due to the action of the Board. That this is not the case the table given below, showing the extent to which trains were run under the protection of continuous brakes in the year 1890 —prior to any determined action on the part of the Board of Trade —fully attests. On the Continent of Europe all trains running at any appreciable speed are fitted with continuous brakes, but these appliances are not nearly in such general use for the slower trains as in this country. In America most of the passenger, and even some of the goods, rolling stock is fitted with the Westinghouse brake; and, in this respect, that country is apparently still ahead of our own, as it has undoubtedly been in the past.

TABLE SHOWING THE PROGRESS MADE BY THE LEADING ENGLISH AND SCOTCH RAILWAY COMPANIES UP TO 31ST DECEMBER, 1890, IN FITTING TO THE TRAINS CONTINUOUS BRAKES WHICH COMPLY WITH THE REQUIREMENTS OF THE BOARD OF TRADE.

| Names of Railway Companies using | | Number of Carriages fitted. | Percentage of Pass. mileage run under protection of brake |
|---|---|---|---|
| Automatic Vacuum. | Westinghouse. | | |
| — | Great Eastern ... ... ... | 3,485 | 99 |
| Great Northern ... ... | — | 2,305 | 100 |
| Great Western ... ... | — | 4,500 | 96 |
| Lancashire & Yorkshire ... | — | 3,289 | 100 |
| London & North-Western ... | — | 5,105 | 79 |
| London & South-Western ... | — | 2,576 | 100 |
| — | London, Brighton & South Coast | 2,651 | 100 |
| London, Chatham & Dover ... | — | 12 | 1 |
| — | London, Chatham & Dover ... | 930 | 67 |
| Manchester, Sheffield & Lincoln | — | 899 | 100 |
| Midland ... ... ... | — | 4,026 | 95 |
| — | Midland ... ... ... | 202 | — |
| — | North-Eastern ... ... ... | 3,064 | 100 |
| South-Eastern ... ... | — | 742 | — |
| — | Caledonian ... ... ... | 1,356 | 97 |
| Glasgow & South-Western ... | — | 556 | 58 |
| — | Glasgow & South-Western ... | 369 | 39 |
| — | North British ... ... ... | 1,717 | 89 |

*INTERCOMMUNICATION IN TRAINS.*—Closely connected with the foregoing subjects of Signals and Brakes is that of Intercommunication in trains. The Board of Trade has made it imperative upon

railway companies, to provide, in all trains which run twenty miles without stopping, some means by which the passengers, in case of emergency, may communicate with the officials in charge of the train.

To accomplish this two systems are in vogue on British railways, namely, the cord and electric communicators. The first is that in general use, though by no means reliable in fulfilling the purpose for which it was intended. It has the disadvantages of being awkwardly placed outside the carriage in a position difficult of access, and of involving, in most cases, the necessity of hauling in two or three yards of slack rope if the train is on a descending grade; moreover the passenger is afforded no indication that the alarm has been effectual.

The electric communicator, on the other hand, is swift and sure in its operation—recommendations which have led to its adoption, so far, by only two or three English systems. Its use will probably extend, as, although the experience of English railways shows that recourse is very seldom had to these contrivances, it is an additional safeguard in travelling when a reliable communicator is available in case of emergency.

In concluding these general remarks on safety appliances, it should not be forgotten that safety is assured not only by the use of signals and brakes, but by careful attention to details of equipment and conditions of working. Into these points we cannot here enter at length, but it may be taken for granted that the proper upkeep of the permanent way, the stability of the bridges, tunnels, cuttings, etc., along the line of route, the absence of facing points on running lines, the careful maintenance of locomotive, carriage, and wagon rolling stock, the due regulation of the hours on duty of that section of the staff employed in the actual working of the line, are all matters which require the closest attention if safety be desired.

*Results of Working.*—We present below two statistical tables, showing the number of passengers killed and injured from 1884 to 1891 and for part of the year 1892. It will be observed, as pointed out in the opening remarks on the subject of safety, that the results achieved in the various years are by no means similar, although during the whole of the time in question continuous improvement in the provision of safety appliances was going on.

TABLE SHOWING NUMBER OF PASSENGERS KILLED AND INJURED, FROM CAUSES BEYOND THEIR OWN CONTROL, DURING THE YEARS 1884 TO 1891.

| Year. | Number of Passengers exclusive of Season-ticket Holders. | Killed. | Injured. | Remarks. |
|---|---|---|---|---|
| 1884 | 694,991,860 | 31 | 864 | |
| 1885 | 697,213,031 | 6 | 436 | |
| 1886 | 725,584,390 | 8 | 615 | |
| 1887 | 733,670,000 | 25 | 538 | |
| 1888 | 742,499,164 | 11 | 594 | *80 killed and 262 injured in Armagh accident. |
| 1889 | 775,183,073 | 88* | 1,016* | |
| 1890 | 817,744,046 | 18 | 496 | |
| 1891 | 845,463,000 | 5 | 875 | |

| Year. | Killed. | Injured. |
|---|---|---|
| 1884 | 1 in 22,419,092 | 1 in 804,400* |
| 1885 | ,, 116,202,171 | ,, 1,600,000 |
| 1886 | ,, 90,698,049 | ,, 1,180,000 |
| 1887 | ,, 29,346,800 | ,, 1,363,700 |
| 1888 | ,, 67,530,000 | ,, 1,250,000 |
| 1889 | ,, 8,808,875* | ,, 763,000* |
| 1890 | ,, 45,430,000 | ,, 1,648,000 |
| 1891 | ,, 169,093,000 | ,, 966,000 |

TABLE SHOWING THE NUMBER OF PASSENGERS KILLED AND INJURED, FROM CAUSES BEYOND THEIR OWN CONTROL, DURING THE FIRST NINE MONTHS OF 1891, WITH AN ANALYSIS OF THE CAUSES OF THE ACCIDENTS.

| Particulars of Accident. | Killed. | Injured. |
|---|---|---|
| Collisions between Passenger Trains ... ... ... | 11 | 203 |
| Collisions between Passenger and Goods Trains ... | — | 109 |
| Passenger Trains leaving the Rails... ... ... ... | 1 | 44 |
| Trains or Engines travelling in the wrong direction through points ... ... ... ... ... ... ... | — | 45 |
| Trains or Engines entering Stations at too high a speed ... ... ... ... ... ... ... ... | — | 69 |
| Failures of Axles... ... ... ... ... ... ... | — | 1 |
| ,, of Couplings ... ... ... ... ... ... | — | 2 |
| Other Causes ... ... ... ... ... ... ... | — | 3 |
| Total ... ... ... ... | 12 | 476 |

# IV.

## Locomotives Gradients, Curves, Train Loads, and Train Timing.

The locomotive engine plays so important a part in railway travelling that we have thought it necessary, in the remarks which follow, to give dimensions of the types adopted by the various English and Scotch systems for the working of their fast and express trains. No attempt, however, will be made in this chapter to give any detailed description of locomotive construction. One or two salient characteristics of British locomotives will be pointed out, after which the subject of train resistances, comprising the effect of gradients, curves, train loads, etc., will be generally discussed.

Perhaps the most striking feature of British locomotive practice is the extensive use of "single-driver" engines. This does not prevail to any extent elsewhere, and, in fact, it is only lately that their use has become general in this country. It is true that thirty or forty years ago, when speeds were low and trains light, they were very numerous, but coupled engines gradually began to take their place, and fears were expressed in the technical journals that the time would soon come when "single" engines might be "placed on pedestals"—as rare objects of curiosity presumably. Nowadays, however, "singles" are by no means rare, and have to a certain extent been adopted by many lines. The Great Northern and Great Western have always had a liking for them, and recently the Midland, Great Eastern, and North-Eastern have built them in considerable numbers. These, notwithstanding, are exceptional cases, and the coupled classes, as better adapted to our hilly English roads, are at present much more numerous.

Another point worthy of notice is the dissimilarity which prevails in the details of locomotive practice. As will be noticed hereafter, when the dimensions are given in detail, our locomotive superintendents seem unable to agree on very many points. Some lines use bogies, inside cylinders, steam domes, and large heating surface; others radial axles, outside cylinders, etc. The marked uniformity of construction which prevails on many Continental and American lines is entirely wanting here, and the locomotives of each line have a distinct individuality, and often even a particular "company" colour of their own. In one respect, however, British locomotives have a strong national resemblance. They invariably bear traces of careful design and good workmanship, and present in nearly all their varieties a truly admirable combination of power, compactness and simplicity.

The resistances to be overcome by the locomotive are either fixed, as in the case of gradients, curves, train loads, etc.; or variable, as in the case of bad weather, high winds, or greasy rails. With the former alone we will for the present deal, and that in a general manner only, referring the reader desirous of further studying the subject to the various scientific works on train-resistances.

The effect of gradients on train-speeds is very great, and its importance is seldom sufficiently realised. Unless complete particulars of the rise and fall of a line of railway be given, it is impossible to correctly estimate the performance of the locomotive thereon. Thus, if it be mentioned that the run from Preston to Carlisle, a distance of 90 miles, is accomplished in 105 minutes, the traveller gets no idea of the immense power and speed qualities to be developed in order to keep bare time between these two points, until he is told that the course is one of the steepest in the kingdom, surmounting the Shap Fells at an elevation of some 900 feet above sea level. If, on the other hand, it be mentioned that on the Great Northern Railway trains will often stop in Peterborough in sixty-two to sixty-four minutes after passing Potter's Bar ($63\frac{1}{2}$ miles), our admiration exceeds what we felt for the Preston-Carlisle run. But, on knowing that the course is favourable for nearly all the distance, we then come to regard it merely as a respectable performance and nothing more, and much inferior to the 90 miles' run in 105 minutes. We thus see that gradients may alter our conceptions as to merit of a performance very materially indeed. We have, therefore, determined to devote some considerable space to this subject and its complexities, which are so likely to be misunderstood.

In Mr. Foxwell's two works on the subject (*English Express Trains*, Stanford, 1884; *Express Trains, English and Foreign*, Smith, Elder & Co., 1889), which have done so much to popularise the study of express speeds, the gradients on each line are stated with such exceptional brevity that the information given is of but little use to enable us to determine the work done by the locomotive. Many sections, indeed, are almost unnoticed. This we hope to remedy here. But not only does the author give very few particulars of the gradients as occurring on our express lines; he is equally brief in his remarks on the effect of gradients. Indeed, those who read his statistics would almost imagine that a ten-mile stretch of 1 in 100 in a piece of line, say, 50 miles long is no more detrimental to speed than five stretches of two miles each of the same gradient disposed at intervals along a similar length. The latter case is infinitely more easy for the locomotive to negotiate than the former, since the impetus before reaching the short pieces of uphill is sufficient to carry the train over the top almost before the influence of the incline is felt, and before there is any sensible diminution of speed. Not so with the long ten-mile stretch, of which the last seven or eight miles are done at a slow, steady rate. It is, in fact, to assist the locomotive that short rests, wherever possible, are inserted about the middle of long and steep banks. The short piece of level and easy up-gradient near the middle of the 14 miles of 1 in 100 up between Settle and Blea Moor Tunnel, on the Midland, is a case in point. It gives the locomotive a sort of fresh start over the remainder of the incline. In short, so various are the effects produced by judicious grading that we may as well devote a separate section of the subject to the consideration of how far speed is influenced by the various "Dispositions of Gradients," giving a few instances from our main lines showing the effects produced.

*Disposition of Gradients.*—In considering railway speeds, it is, nowadays, too generally assumed that the effect of a gradient of given length and steepness is always the same wherever that gradient may occur. This is far from being the case. A rise of, say, 10 miles of 1 in 200, immediately from a large junction station at which all trains stop, is much more detrimental than if the gradient succeeds a downhill stretch, the impetus from which carries the train up the opposing slope. Instances of the first of these cases are very numerous; most towns in England, lying low, are at the foot of two opposing inclines. Bedford on the Midland, Carstairs on the Caledonian, Kilmarnock on the Glasgow and South-Western, at

once present themselves as examples. This, of course, is largely a matter for engineering skill to obviate or modify, and as railways must follow the contour of the country, and as towns are best served by railways on a level with them, it may be questioned whether modification of gradients, even if possible, would be desirable. Nevertheless, the presence of stopping points at the foot of opposing inclines cannot but be regretted, as exerting a prejudicial effect on express speeds. On the other hand, in the few cases where we find stations at the top of slopes extending downward on either side, the adverse effect of gradients is least felt. The train approaches the summit at a low speed and loses very little by the stop. On starting down the other side it rapidly attains speed, and altogether very little loss is sustained.

Again, it may be concluded, as explained in a previous paragraph, that short stretches of up and down slopes are less prejudicial than a long continuous one of the same length as the aggregate of the shorter stretches. This holds good especially as regards heavy trains and steep slopes. With a light train, the impetus from the preceding down-hill piece carries the train over the short up-slope without the speed suffering appreciable diminution. Even with a heavy train and a heavy gradient the speed just begins to fall sensibly when the welcome short stretch of downhill intervenes. But on a long continuous bank the speed of a light train even has much diminished before the summit is reached, and with a very heavy train and heavy gradient the diminution of speed is so great that pilot engines have frequently to be employed. Compare the ten-mile bank of 1 in 80, north of Beattock on the Caledonian Railway; the yet steeper nine miles and a half north of Newcastleton on the North British; the fourteen miles of 1 in 100 on the Settle and Carlisle. On all these sections, and many others of a similar nature, pilot engines are frequently employed; while on the London, Chatham, and Dover, which has, perhaps, as much hard road to cover as some of those referred to, pilots are very rarely employed, the reason being that the line rises and falls in short undulations.

There are many other ways in which gradients will have dissimilar effects on trains according to their situation. For instance, if the approaches to a large town be on a rising gradient the general speed will be little diminished thereby, as, whether the line rises or not, the speed must be kept down over crowded pieces of line. But these and other instances will readily occur to those who make a frequent practice of timing trains passing the mileposts. They will

often be surprised to notice the apparently dissimilar effects of similar gradients, but a little reflection will show other causes in operation to produce the difference.

We now come to examine the compensating effects of gradients. This part of the subject has, until now, been completely ignored, or but little touched upon; indeed, a reader of, say, Mr. Foxwell's article on the Midland in either of his books, would imagine that the adverse gradients mentioned were great hindrances, but that the corresponding downhill stretches gave no compensation whatever. In fact, it seems to be the common practice, when questions are asked in the railway journals on the subject of gradients, to give in reply simply the adverse gradients in one direction. With a view, then, to clearing away erroneous ideas on this part of the subject, we will now proceed to make a few remarks on the

*Compensating Effects of Gradients.*—Railway runs almost invariably include a proportion of both up and down gradients. It has generally been the custom simply to consider the up-grades as adverse to speed, and to leave the downhill pieces out of consideration. But this is clearly a totally incorrect way of estimating the amount of work to be done by the locomotive. Take in illustration, the Midland Railway main line from London to Bedford. It rises, by short, steep stretches, to Leagrave, near Luton. The rest is almost wholly downhill, along which trains can, and, in fact, habitually do, run at seventy to seventy-five miles an hour. There is nothing meritorious or out of the common in running downhill at this pace, as most of the oldest and weakest locomotives in the kingdom, wholly unfit for present express work, can do the same. But here we have part of the time lost in travelling uphill out of London to Leagrave made up down the bank. Again, take the Great Northern out of London. The first $12\frac{3}{4}$ miles consists of short but very steep pieces and one long piece of moderate ascent. We often find this company's expresses take 21 to 22 minutes to get over this distance—a performance that is rather the reverse of creditable. But once over the summit the line falls gradually, except for two short pieces near Hatfield and Huntingdon, to Peterboro', $63\frac{1}{2}$ miles away. These $63\frac{1}{2}$ miles are often covered in the same number of minutes (a performance of fair merit) thus landing us on Peterboro' platform in from 84 to 85 minutes after leaving London. This looks well for $76\frac{1}{4}$ miles; and, no doubt, much of the reputation of the Great Northern is due to runs like the above; but it seems altogether forgotten how slowly we ran uphill

(and therein the true test of locomotive merit lies), and how much of our fast journey was due to the compensating effect of the down-grades. The London and North-Western main line out of London is rather different. It rises with moderate, but almost continuous, ascent from London to Tring, $31\frac{3}{4}$ miles away. Then there is a moderate fall for 15 miles to Bletchley; after that the line rises and falls in moderately steep grades to Rugby. Thus, although there is not so much to climb on this route, we miss the compensating effect of the down-grades, except for the short piece before Bletchley. The work, therefore, done by the locomotive falls but little short of that done on the steeper routes previously referred to.

Numerous instances of this sort might be cited. We will not go so far as to say that the presence of gradients (allowing for their compensating effect) can ever become an assistance to the locomotive—that would be absurd. But we will say that with light trains gradients do not make their presence much felt when there is a possibility of a sharp run down the other side; but with heavy trains the case is greatly different. A light train can mount a hill at 50 miles an hour and come down at 75, but a heavy train, which mounts the same bank at 30 to 35 miles an hour, cannot come down at 90 miles an hour, and thus great loss of time is experienced. Similarly, there is not nearly so much of the compensating effect experienced when the grade is, say 1 in 70, as when it is 1 in 200: trains which mount the latter grade at 50 miles an hour will hardly touch 30 on the former. The speed down the other side, however, will differ but slightly. Seventy-five miles an hour can easily be attained down the 1 in 200, and this rate is hardly likely to be exceeded down even 1 in 70. As a matter of fact, the highest recorded speed down 1 in 200 is 80 miles an hour for one mile; and down 1 in 75 we have two miles recorded at $81\frac{4}{5}$ miles an hour.

Many other things besides those indicated above in the sections on the Disposition of Gradients and their Compensating Effects might be recorded, as showing how difficult it is to deal with this subject. Similar gradients, owing in great measure to the causes we have pointed out, affect the locomotive in such different ways that perhaps the only way to obtain a correct notion of their various effects is to make a practice of timing by the mile posts every express train in which we travel. This will give greater insight into the working than pages of written matter. It will also serve as a standard by which we can accurately measure the performances of the various classes of locomotives, for it is on up-grades that the true test of

merit is applied. Many out-of-date locomotives can gallantly charge downhill at 70 to 75 miles an hour; try them on 1 in 100 up, and give them a long continuous stretch of it, and they will fail miserably. What is wanted in the locomotive of to-day is the capacity for mounting severe gradients at high speed. By timing trains passing each milepost on up-grades we can arrive at a very correct idea as to which locomotives most fully satisfy this test. Not once or twice should these experiments be made, but each locomotive should be tested time after time, in order to get an idea of its *average* performance, and not until then should conclusions be arrived at. It is this habit of rash judgment, coupled with an utter ignorance of the hindrances placed in the way by gradients, and the advantages to be derived from their compensating effects, which leads to the unreasoning statements one so frequently sees in the railway journals. We find, for instance, a correspondent writing to say he has run from London to Grantham in two hours or less. No particulars are given, or if they are, they are generally limited to the statement that "we attained seventy-five miles an hour down such and such a bank," altogether oblivious of the fact that some of the oldest and feeblest engines of thirty years ago could do the same as the locomotive in whose praise this statement is unsuspiciously made. But occasionally we happen to come across some other correspondent in the same journals who has at last found out that uphill, not downhill, work is the proper test of efficiency in the locomotive. In these rare cases, however, the statements set forth are garnished with very absurd arguments and deductions. We find, perhaps, someone stating that he ran from (passing) Hatfield to (passing) Potter's Bar, 5 miles of 1 in 200 up in five minutes, or equal to 60 miles an hour. Then, very probably, follows the usual deduction, that "the Great Northern locomotive can maintain, and has maintained, 60 miles an hour up a bank of 1 in 200." How absurd the deduction is may be seen when it is stated that the train probably rushed through Hatfield (after the descent of the Woolmer Green bank) at nearly 70 miles an hour. The first two of the five miles to Potter's Bar were done at a speed rather lower than this, and the last three at a speed diminishing with each mile, so that, perhaps, when the summit was reached the speed had sunk to 45 miles an hour, or thereabouts. This latter figure is the correct normal speed up the bank, and not the 60 miles an hour, which is the average of five miles two of which received considerable impetus from what had gone before. All statements, therefore, which give the inclusive

speed from the bottom to the top of a bank, should not be regarded as indicating the normal speed of the locomotive up that bank. The last few miles of the bank only should be taken and results worked out from them.

Before closing this section it will be as well to reply to an objection that may be raised. It may be said that locomotive merit can be just as well tested on the level as on an up-grade, and that, therefore, uphill work is not the only test of a good performance. This is quite so, but the only reason why running on the level is so seldom a proper test is that there are very few lines on which we have any long continuous piece of level ground. The slightest inclination one way or the other vitiates all our conclusions. Thus the comparatively insignificant gradient of 1 in 1,320 between London and Reading on the Great Western is sufficient to make the down run much longer than the up. We have, therefore, in our remarks on this subject preferred to restrict ourselves to tolerably long banks rising at a generally uniform grade.

In *CURVES* we meet with another resistance to speed. Here, however, the indirect effect is more to be feared than the actual augmentation of the resistance. In England, all curves except the sharpest are passed over with only that slight diminution of speed caused by the friction of the flanges against the rails. Now and again, however, we meet with a curve of such small radius that, in the interests of safety, speed is purposely greatly decreased while passing over it. This, of course, entails a much greater loss of time than in the previous case, where it is scarcely appreciable. Especially is the loss felt if the curve is on a steep down grade, as are many on the North British Company's Waverley Route. Here, where the speed ought, of course, to be highest, the reduction round sharp curves means even a greater loss than if the curve was otherwise situated.

Much might be said on the subject of *TRAIN LOADS.* To properly estimate the work done by the locomotive, it is, of course, necessary to know the weight of the train hauled. Train loads are, however, so variable that it is with caution we venture to state, under each railway, the average weight of some of the principal trains.

It has recently been urged by at least one writer of eminence on railway matters that, looking to the fact that our express mileage in England and Scotland is so very large, and that at certain times of the day the main lines of some of our largest railways are occupied solely by express trains, to the prejudice of the more profitable goods

traffic, some effort should be made to reduce their number by combining two trains into one, and building heavier locomotives, so as to retain the same speed with the greater load. It is stated that, even after such combination, the resulting load of the train would still be lighter than that of some of the fast long-distance trains of the United States, which are hauled by locomotives much more powerful than those in use in this country. The answer to these criticisms is that express trains here are heavier than is generally supposed; an assertion which may be substantiated by reference to the sections on Actual Performances in the case of the various English and Scotch lines, and more especially in those instances of fast running, cited as having occurred on the "express" lines. Most of the performances there described show work quite equal to the best the States can produce, and this work has probably been accomplished with a much lower consumption of coal. Combination of trains could, of course, be effected without greatly adding to the load, by crowding the carriages with passengers to a greater extent than at present, but such interference with the comfort of travellers would doubtless be resented. In France, this is the ordinary practice—no new express trains being inaugurated until the railway companies feel sure they can fill them, while in England express trains are put on to stimulate travel, or to create a new traffic. Interference, therefore, would scarcely be desirable. Moreover, traffic questions, such as forming numerous and convenient connections at junctions, have a most important bearing on the matter, and it would probably be extremely difficult for critics of the English system of frequent express trains to specify any one in particular as a suitable train to be struck out of the time-table without being confronted with several excellent reasons for its retention.

# PART II.

## THE BRITISH SYSTEMS IN DETAIL.

I. The Lines to the Continent.

II. The Seaside Lines.

III. The Lines to the West.

IV. Some Country Lines.

V. The Express Lines.

VI. The Minor Lines.

I.

## THE LINES TO THE CONTINENT.

The lines running the fast Continental services are :—

(1) *The London Chatham and Dover.*

(2) *The South-Eastern.*

These railways have so many points of resemblance that, for purposes of comparison, it will be well to treat of them as nearly together as possible. They both run fast services to the Continent and to several sea-side resorts ; both have severe gradients ; and both have the reputation of disregarding the interests of the public. Further details are now given in regard to each line separately.

# I.

## THE LONDON, CHATHAM AND DOVER.

### (1) General Description of the Line.

The London, Chatham and Dover Railway is over 175 miles in length, and extends from London through Rochester, Chatham and Canterbury, to Dover. It has a branch from Sittingbourne to Queenboro' Pier, and from this port and Dover boats run to Flushing and Calais respectively, with the company's valuable Continental traffic. There is also an important branch from Faversham to the popular watering-places on the Kentish coast, Ramsgate, Margate, and Westgate-on-Sea. Other and smaller off-shoots leave the main line at Swanley for Sevenoaks, Maidstone, and Ashford, and at Farningham Road for Gravesend. Numerous suburban lines, with an ever-increasing season-ticket traffic, give convenient access to the districts south of London. The main line, in its direct course through the hop-gardens and orchards of Kent, affords fine panoramic views up and down the Medway on approaching Rochester from Sole Street, and a glimpse of Canterbury Cathedral is obtained further on.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—With the opportunities indicated above, it might have been expected that the Chatham and Dover Company would have presented an excellent record of express services. Such, however, is far from being the case. In common with other southern lines, the custom prevails of limiting the fastest

trains to first and second classes only. For this, the French railways are mainly responsible, as their connections with the English Continental services are similarly limited. With the speed of these exclusive trains we have no fault to find, there being four excellent and quickly-timed down trains to Dover (Admiralty Pier)—78 miles—in 105, 110, 105 (this one is first class only) and 112 minutes respectively; and four up trains in 115, 105, 105 and 105 (this one first class only) minutes. Again, to Queenboro' Pier for the Flushing route—now growing into quite an important outlet for Continental traffic—the trains are first and second class only, at a speed by no means so good, the best down trains taking 75 minutes, and the best up 80 minutes for the run of 50¼ miles. As regards punctuality, these trains run fairly well from London to Dover and Queenboro', but they are notoriously unpunctual in their arrival from the Continent. This, doubtless, arises from delays on the opposite side, detention of steamboats, and other causes, many of which are probably avoidable.

Turning now to trains which carry third-class passengers, we find the "Chatham" in no respect a "people's" line. The way in which important towns are served (or neglected) from London may be seen from the record below, which affords food for reflection on comparison with the tables of the northern lines.

| Between London and | Miles. | No. of Trains at or over | | | | | | Fastest. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hour. | | 40 mls. per hour. | | 45 mls. per hour. | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. Min. | |
| Rochester . | 33 | 3 | 3 | 1 | None. | None. | None. | 0 49 | The distances are from Victoria to the places named in the table. |
| Chatham . | 34¼ | 4 | 3 | 1 | None. | None. | None | 0 50 | |
| Canterbury . | 61¾ | 3 | 2 | 2 | None. | None. | None. | 1 30 | |
| Ramsgate . | 79 | 1 | 3 | None. | None. | None. | None. | 2 0 | |
| Margate . | 73¾ | 1 | 3 | 1 | 1 | None. | None. | 1 45 | |
| Dover (Town) | 78 | 3 | None. | None. | None. | None. | None. | 2 0 | |

Local services are generally on a par with those of other English systems, and call for no comment. Near London, a large number of short-distance trains is run to accommodate a very heavy traffic. The punctuality of these services cannot be considered very good, although it is better than it used to be. The Chatham and Dover Company's neighbours, the South-Eastern and Brighton and South Coast lines, are also in this respect joint owners

of an evil reputation, but they are not quite such notorious offenders as the line under review, and have, moreover, certain excuses to offer which the system in question has not. A singular anomaly to be noted in connection with this company's suburban traffic is that many of the Crystal Palace trains do not carry third-class passengers.

(*b*) *Rolling Stock and General Accommodation.*—With the exception of a few good coaches on the Continental and sea-side services, and two or three Pullman cars supplied by the Wagon-Lits Company and run in the Club-Train services, the carriages are, without exception, the shabbiest in England. They are of most antiquated description, and one fears to guess at what date they were built, and when they were last cleaned, redecorated and repaired. Generally mounted on four wheels only, their dimensions are of the meanest, and for rigid discomfort, want of space, bad lighting, and rough travelling, they can nowhere be surpassed. Their more venerable and much-reviled neighbours—the South-Eastern Company—are well ahead of them here. Again, until recently, few of the crowded trains run on this line had any continuous brake whatever, and it is only within the last few years that the Westinghouse continuous brake has been adopted. On the other hand, it is only fair to notice that the line is excellently signalled with the latest appliances throughout, and that the stations on the line are, broadly speaking, fairly well suited to requirements and possess tolerably good accommodation. The smaller details of passenger traffic management have yet, however, to be mastered by the London, Chatham and Dover Company, and how long it will be before this line reaches the standard of, say, the Great Northern, it would be very hard to predict. Poverty, doubtless, is the excuse for many shortcomings, but in spite of this the company have, during recent years, built a fine additional bridge over the Thames at Blackfriars, a new London terminus at St. Paul's, and increased their Channel fleet by one or two fast boats.

### (3) Locomotive Work.

(*a*) *Speed.*—With the exception of the Continental expresses and some of the fast seaside trains, there is not much scope for any brilliant locomotive work on this system. The most we can say of it is that it is fairly good. There are not many booked runs at 45

miles an hour, and only a few exceed this pace. The load of these trains is generally moderate. Fuller particulars of the gradients of the line, the locomotives working the trains, and a few instances to show the passenger traffic in actual daily working, will be found below in the three subdivisions of this subject.

(*b*) *GRADIENTS.*—The London, Chatham and Dover is the steepest of the southern lines, having nearly 50 miles between London and Dover between 1 in 100 and 1 in 132, and only 18 easier than 1 in 200. The line begins with a 27-mile ascent, broken by four minor descents, to Sole Street (300 feet above sea-level), then undulates to Canterbury, from which it rises 9 miles to Shepherd's Well (290 feet), and drops 7 miles into Dover. The ascents, however, are not sufficiently long at a time to materially reduce the speed average. In addition to this there are several awkward curves to be run over; and, for a little way south of Herne Hill, the line is crowded with suburban traffic. It may therefore be said that what small amount of express travelling this company furnishes is of good quality and demands good locomotives.

(*c*) *LOCOMOTIVES.*—The unpunctuality so prevalent on this system can hardly be ascribed to the locomotive stock, which is under the superintendence of Mr. William Kirtley. The dimensions of the principal classes are as under :—

| Description. | Cylinders. | Boiler Pressure. | Heating Surface. | Grate Area. | Diameter of Driving Wheels. | Diameter of Bogie Wheels. | Capacity of Tank. | Weight of Coal carried. | Weight of Engine in Working Order. | Weight of Tender in Working Order. |
|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | lbs. per sq. in. | sq. ft. | sq. ft. | ft. | ft. | galls. | tons. | tons. | tons. |
| Four-coupled bogie express | 18 × 26 | 150 | 1,120 | 17 | 6½ | 3½ | 2,600 | 3 | 42½ | 31 |
| Four-coupled Metropolitan bogie tank | 17½ × 26 | 140 | 1,095 | 16½ | 5½ | 3 | 970 | 1¾ | 51 | |
| Four-coupled Main-line bogie tank | 17 × 24 | 150 | 1,071 | 16¼ | 5½ | 3 | 1,100 | 2 | 47½ | |

(*d*) *ACTUAL PERFORMANCES.*—It is not usual for the booked time of the express trains on this system to be much improved on in actual running. The following instances are simply average performances and show what is believed to be a fair sample of the locomotive work of the line with trains of varying weight.

## DOVER TOWN TO HERNE HILL.

Engine 54 "Asia" and 10 Coaches.

| Stations. | Mls. | Chns. | Time Due. | Time Actual. | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | A.M. | H. | M. | S. | |
| **Dover Town** . *dep.* | — | | **4 0** | **4** | **17** | **11** | |
| Kearsney . | 2 | 18 | — | 4 | 23 | 23 | |
| Shepherd's Well . | 3 | 34 | — | 4 | 28 | 56 | |
| Canterbury | 9 | 67 | — | 4 | 41 | 24 | |
| Selling . | 6 | 42 | — | 4 | 51 | 10 | |
| Faversham | 3 | 25 | — | 4 | 54 | 43 | |
| Sittingbourne . | 7 | 21 | — | 5 | 3 | 14 | |
| Newington | 3 | 9 | — | 5 | 7 | 11 | |
| **Chatham** *arr.* | 7 | 21 | **4 59** | **5** | **15** | **33** | |
| **Chatham** *dep.* | | | **5 2** | **5** | **18** | **31** | |
| Rochester Bridge | 1 | 33 | — | 5 | 21 | 15 | Ran slowly round Rochester curve. |
| Sole Street . | 6 | 6 | — | 5 | 33 | 48 | |
| Fawkham . . | 3 | 41 | — | 5 | 37 | 22 | |
| Swanley Junction | 5 | 56 | — | 5 | 44 | 54 | |
| Beckenham Junction | 8 | 78 | — | 5 | 55 | 31 | |
| **Herne Hill** . . *arr.* | 4 | 56 | **5 45** | **6** | **2** | **25** | |

## VICTORIA TO DOVER.

Engine 160 (4-coupled bogie) and 16 Coaches.

| Stations. | Mls. | Chns. | Time due. | Time actual. | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | A.M. | H. | M. | S. | |
| **Victoria** . . *dep.* | — | | **10 0** | **10** | **0** | **55** | |
| **Herne Hill** . *arr.* | 3 | 78 | — | **10** | **7** | **38** | |
| **Herne Hill** . *dep.* | | | **10 12** | **10** | **13** | **9** | |
| Dulwich . . . | 1 | 2 | — | 10 | 16 | 10 | |
| Sydenham Hill . | 0 | 58 | — | 10 | 17 | 52 | |
| Penge . | 1 | 37 | — | 10 | 20 | 23 | |
| Beckenham | 1 | 39 | — | 10 | 22 | 8 | |
| Shortlands | 1 | 26 | — | 10 | 24 | 1 | |
| Bromley . | 0 | 66 | — | 10 | 25 | 4 | |
| Bickley . | 1 | 8 | — | 10 | 27 | 1 | |
| St. Mary Cray. | 2 | 71 | — | 10 | 31 | 33 | |
| Swanley . . | 2 | 67 | — | 10 | 35 | 23 | |
| Farningham Road . | 2 | 67 | — | 10 | 39 | 2 | |
| Fawkham . . | 2 | 69 | — | 10 | 42 | 56 | |
| Meopham . . . | 2 | 47 | — | 10 | 46 | 57 | |
| Sole Street . | 0 | 74 | — | 10 | 48 | 25 | Slowly round curve at Rochester. |
| Rochester . . . | 6 | 6 | — | 10 | 55 | 9 | |
| **Chatham** . *arr.* | 1 | 33 | — | **10** | **57** | **20** | |
| **Chatham** . *dep.* | | | **10 53** | **11** | **0** | **57** | |
| New Brompton . | 1 | 47 | — | 11 | 5 | 12 | |
| Rainham | 3 | 2 | — | 11 | 9 | 42 | |
| Newington | 2 | 52 | — | 11 | 13 | 9 | |
| Sittingbourne . | 3 | 9 | — | 11 | 17 | 3 | |
| Teynham . . | 3 | 20 | — | 11 | 20 | 37 | |
| **Faversham** . *arr.* | 4 | 1 | **11 14** | **11** | **26** | **26** | Only 9 coaches hence. |
| **Faversham** . *dep.* | | | **11 17** | **11** | **31** | **5** | |
| Selling . . . | 3 | 25 | — | 11 | 37 | 20 | |
| Canterbury . | 6 | 42 | — | 11 | 45 | 29 | |
| Bekesbourne . | 2 | 70 | — | 11 | 49 | 6 | |
| Adisham . . | 3 | 5 | — | 11 | 52 | 51 | |
| Shepherd's Well . | 3 | 72 | — | 11 | 58 | 41 | |
| Kearsney . | 3 | 34 | — | 12 | 2 | 23 | |
| **Dover Town** . *arr.* | 2 | 18 | **11 55** | **12** | **4** | **41** | |

# II.

## THE SOUTH-EASTERN.

### (1) General Description of the Line.

The South-Eastern Railway is over 350 miles in length, and possesses a very direct route to Dover and Folkestone (its ports for the Continent) through Sevenoaks and Ashford. In addition there are important branches from Tunbridge Junction to Tunbridge Wells and Hastings, and from Ashford to Canterbury, Ramsgate and Margate. Besides these, there is a great number of minor lines, the most important of which are those from Reading to Tunbridge Junction *viâ* Red Hill, and from London to Chatham and Maidstone *viâ* Gravesend, at which point a line diverges to Port Victoria. The numerous ramifications of the system in the London district are very important.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—This line in many points is similar to its neighbour, the Chatham Company. Its efforts are concentrated on the Continental traffic, which we again find limited to "first only," or "first and second only." There are twelve up and down expresses between London and Dover, and one each way between London and Folkestone. All these are excellent trains; the duration of the journeys between Cannon Street and Dover ($75\frac{1}{2}$ miles) varying from about 100 to 115 minutes. One of the trains starts from Charing Cross and is first class only, reaching Dover in 105 minutes. This is known as the "Club Train," and there is a corresponding express in the other direction. Between Cannon Street and Folkestone ($69\frac{3}{4}$ miles) the time allowed is 100 minutes down, and 95 minutes up. Punctuality is fairly maintained from

London, but the arrivals from the Continent are very erratic, due, of course, to the same causes which operate on the Chatham and Dover services. It will be noticed that Cannon Street is taken as the starting point, except in the case of the Club Train, which departs from, and arrives at, Charing Cross. To Charing Cross the time is several minutes longer, and more on an equality with the London, Chatham and Dover from Victoria.

Looking now at the third-class services we actually find one or two bright spots on a dark background. Very creditable expresses (one each way) run between London and Hastings, as shown below; while the up train from Canterbury, in 102 minutes, is not at all bad. The best up from Ramsgate connects with this Canterbury train and forms a rather spirited competition with the shorter Chatham route. But to other points the South-Eastern service is decidedly poor, and from the subjoined statement may be gathered food for further comparisons with the energetic northern lines.

| Between London (Cannon Street) and | Miles. | No. of Trains at or over | | | | | | Fastest. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hr. | | 40 mls. per hr. | | 45 mls. per hr. | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. Min | |
| Chatham . . . | 31¾ | None. | 2* | None. | None. | None. | None. | 0 48* | *To London Bridge. |
| Tunbridge Wells | 33¾ | 1 | None. | None. | None. | None. | None. | 0 54 | Between London and the towns in this table there are about four or five trains each way per day, at from 30 to 35 miles per hour. |
| Hastings . . . | 61½ | 1 | 1 | None. | None. | None. | None. | 1 37 | |
| Canterbury . . | 69¼ | 3 | 2 | None. | 1 | None. | None. | 1 42 | |
| Ramsgate. . | 85 | 1 | 2 | None. | None. | None. | None. | 2 10 | |
| Margate . | 88 | None. | 2 | None. | None. | None. | None. | 2 20 | |
| Folkestone (Town) | 69¾ | 1 | 1 | None. | None. | None. | None. | 1 53 | |
| Dover (Town) . | 75½ | 1 | None. | None. | None. | None. | None. | 2 5 | |

Besides this moderate record, there is, further, no doubt of the unpunctuality of this system. But it is different from the London, Chatham and Dover unpunctuality, and more excusable, inasmuch as the South-Eastern trains arrive at London Bridge Station with some approximation to their proper time; it is after this point that most of the delays occur, the entrance into Cannon Street and the loop line outside rendering the quick working of trains a matter of great difficulty. Improvements might be effected in the company's local and suburban services, chiefly in the more punctual running of the trains, as commented on in the introductory chapter on Speed and Punctuality. The services are convenient and frequent enough, but might, with advantage, be run at a faster pace. Passengers using

the South-Eastern are brought more into the heart of London than by any other line, its stations at Cannon Street and Charing Cross being admirably situated.

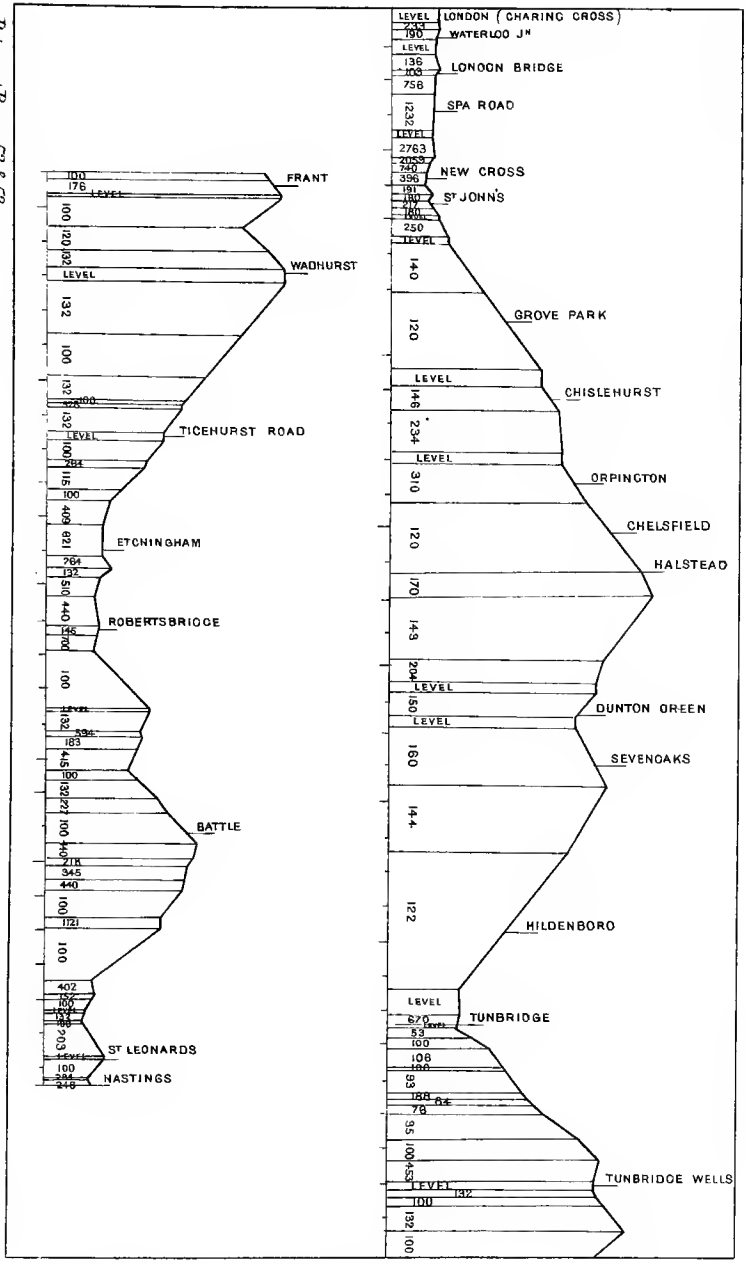
(*b*) *Rolling Stock and General Accommodation.*—The accommodation for passengers on the South-Eastern Railway is extremely bad; yet one does not like to say hard things about it, considering that recently a praiseworthy determination to amend seems to have taken hold of the management. Numbers of antiquated, badly-lighted vehicles of small dimensions remain; but of late, many new and roomy carriages, quite up to present-day standards, have made their appearance. In the course of a few years the South-Eastern will doubtless be able to look on its carriage stock with satisfaction; but, just now, things are all the other way. No one, however, would think of anything but praise for the Continental rolling stock, which actually furnishes lavatory accommodation for second- as well as first-class passengers; the upholstering and general fittings also are of the highest class. The vacuum brake is largely used, and many trains are fitted with an electrical communication between the passengers and guard. The line is excellently signalled throughout, the permanent way in good condition, and most of the stations up to every-day requirements. With such cheering indications, the future of the South-Eastern need not be despaired of.

### (3) Locomotive Work.

(*a*) *Speed.*—Although there is very little booked speed on the South-Eastern which exceeds 45 miles per hour, yet the locomotive work on this system is entitled to some considerable attention, and is certainly superior to the work on the lines of its neighbours, the London, Chatham and Dover, and Brighton Companies. This is chiefly owing to the fact that the South-Eastern main line is a very steep section, and the fastest trains are generally heavily laden. The Continental expresses have, as a rule, a booked speed of about 45 to maintain when once clear of London, and some slightly exceed this. Although limited to first and second classes only, they are usually heavy trains. The seaside trains run by the company have seldom booked speeds much above 40 per hour.

(*b*) *Gradients.*—The South-Eastern main line is, like the Chatham and Dover, a heavy course. The gradients, however, occur differently and are met with all at once, instead of being short yet

Plate I.




Between Pages 52 & 53.

incessant, as on the other route. The accompanying diagram of the gradients from London to Hastings shows the profile of the main line as far as Tunbridge Junction. Thence the line is fairly level to Ashford, and after that point descends gently past Shorncliffe into Dover. The Tunbridge and Hastings section is extremely severe. It consists of steep ascents and descents; half the distance being 1 in 132, or steeper, and there is a short bit of 1 in 53. The fast trains between London and Hastings have thus no enviable time of it.

(*c*) *Locomotives.*—The South-Eastern Company employs for the working of its Continental traffic an exceedingly powerful type of locomotive. As these engines have aroused considerable attention, and become popular through their generally admirable performances, we here give their principal dimensions. They are as follows:—

Cylinders, 19 inches by 26.
Diameter of bogie wheels, 3 feet 9⅛ inches.
,, ,, driving wheels, 7 feet.
,, ,, tender wheels, 4 feet.
Weight on bogie wheels, 13 tons 8 cwts.
,, ,, driving wheels, 15 tons 5 cwts.
,, ,, trailing wheels, 12 tons 17 cwts.
Total weight of engine, 41 tons 10 cwts.
,, ,, ,, tender, 30 tons 10 cwts.
Coal space, 4 tons (about).
Tank capacity, 2,650 gallons.
Length over all, 52 feet 4 inches.

These engines were first built in 1884. One of them, No. 240, was shown in the Paris Exhibition and attracted much attention. A full description of it appeared in the *Revue Générale des Chemins de Fer* for July, 1890. The general appearance is handsome, the engine being painted black with red stripes. Some of the class have only 18-inch cylinders. The design, in many particulars, recalls the engines of the Glasgow and South-Western. Among such may be mentioned the rounded shape of the cab, and the absence of a dome. This is explained by the fact that Mr. James Stirling, at present in charge at Ashford, was formerly Locomotive Superintendent at the Kilmarnock shops of the South-Western Railway.

Another useful class introduced by Mr. Stirling is the 6-feet 4-coupled passenger type, with cylinders 18 inches by 26, and

bogie. This also recalls Glasgow and South-Western practice, as does a serviceable class of six-coupled goods engines. As these, however, are not strictly express locomotives, we must dismiss them here with but brief comment; nor can we do more than mention Mr. Watkin's 6 feet 6 inches, coupled with cylinders 17 inches by 24; and the interesting "old-time" locomotives of Mr. Cudworth, built about thirty years ago, which, in their day, have done excellent work.

The rolling stock is fitted with the Automatic Vacuum brake. The Chatham and Dover, on the other hand, use the Westinghouse automatic.

(*d*) *ACTUAL PERFORMANCES.*—Third-class passengers have few opportunities of enjoying high-class speed on the South-Eastern. Perhaps their only chance is with the best Canterbury and Hastings trains—the latter for choice. The writer has frequently known the distance from Cannon Street to St. Leonards to be covered in 86 minutes, and, as the road is terribly rough, this must be accounted an excellent performance. For first-class passengers, however, the line provides an excellent display of speed at very aristocratic fares. These fares are, of course, similar to those in vogue on the London, Chatham and Dover, but we think South-Eastern speed is better than that of their rivals. The London, Chatham and Dover expresses, on leaving Herne Hill, have got rid of a portion of the suburban traffic, which, when crowding the metals, is so detrimental to express work; and, although their grades may *look* worse than the South-Eastern, yet they are never long enough at a time to check express speed. Again, the loads on the London, Chatham and Dover are generally much lighter than by the rival route. It is, in fact, this dragging of heavy loads at high velocities over a heavy road, that has made the South-Eastern "240" class so popular. Among their best performances, and, indeed, among the best performances in the kingdom, may be cited the following: London to Dover, with 18 coaches, in 93½ minutes; Cannon Street to Folkestone in 85¼ minutes, with a similarly heavy load; and Dover to Cannon Street in 91¾ minutes, with equal to 21 coaches. These splendid performances were not due to excessive speed in running downhill, but rather to the excellent work up the banks. It may, perhaps, surprise admirers of the Great Northern Railway to hear that the long Halstead bank (averaging 1 in 120) is generally negotiated in faster time than it would averagely take a Great Northern express, with an equal load, to reach Potter's Bar from King's Cross.

# SPEED RECORDER DIAGRAM.

S.E.R. No. 1.

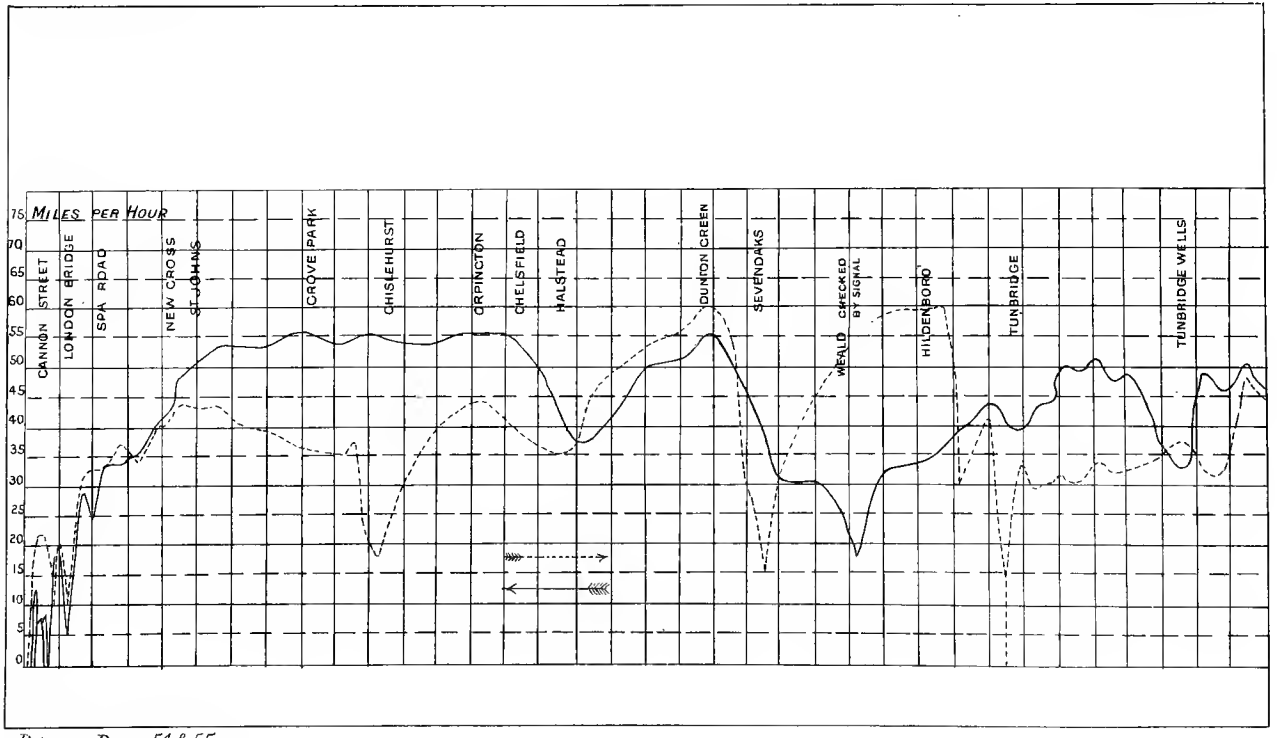
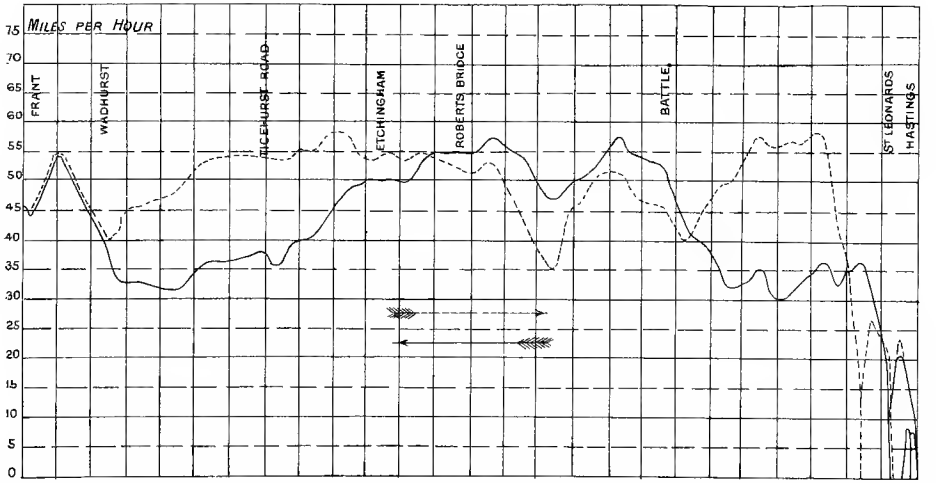



Plate II.

*Between Pages 54 & 55.*

# SPEED RECORDER DIAGRAM.

S.E.R. Nº 2.




8.50 A.M TRAIN HASTINGS TO CANNON ST. LOAD 14 VEHICLES. BOOKED TIME 95 MINS ACTUAL TIME 98½ MINS DELAY BY SIGNAL 7 MINS

3.40 P.M TRAIN CANNON ST TO HASTINGS. LOAD 11 VEHICLES. BOOKED TIME 96 MINS ACTUAL TIME 101½ MINS DELAY BY SIGNAL 8 MINS

Plate III.

Between Pages 54 & 55.

In this latter case, except for a very short bit, the gradients are never worse than 1 in 200, while the distance is about the same.

Particulars of a creditable performance made by the up boat-express between Shorncliffe and London Bridge are given below.

SHORNCLIFFE CAMP TO LONDON BRIDGE.

67½ mls. in 83m. 23s., with engine 240 (19-in. cyls.) and 13 coaches.

| Stations. | Mls. | Chns. | Time Due. | Time Actual. | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | P.M. | H. | M. | S. | |
| **Shorncliffe Camp** . *dep.* | – | – | 3 3 | 3 | 39 | 4 | Weather: Wet |
| Sandling . . . . | 3 | 76 | — | 3 | 45 | 53 | |
| Westenhanger . . | 1 | 21 | — | 3 | 47 | 35 | |
| Smeeth . . . . | 3 | 61 | — | 3 | 52 | 25 | |
| Ashford . . . . | 4 | 25 | — | 3 | 56 | 31 | |
| Pluckley . . . . | 5 | 46 | — | 4 | 2 | 50 | |
| Headcorn. . . . | 5 | 22 | — | 4 | 8 | 43 | |
| Staplehurst . . . | 3 | 27 | — | 4 | 12 | 20 | |
| Marden . . . . | 2 | 41 | — | 4 | 15 | 22 | |
| Paddock Wood . . | 4 | 43 | — | 4 | 20 | 30 | |
| Tunbridge Junction . | 5 | 23 | — | 4 | 27 | 8 | |
| Hildenborough . . | 2 | 47 | — | 4 | 30 | 45 | |
| Sevenoaks . . . | 4 | 72 | — | 4 | 39 | 13 | |
| Dunton Green . . | 1 | 43 | — | 4 | 40 | 58 | |
| Halstead . . . . | 3 | 78 | — | 4 | 46 | 0 | |
| Chelsfield . . . | 1 | 23 | — | 4 | 47 | 20 | |
| Orpington . . . | 1 | 34 | — | 4 | 48 | 45 | |
| Chislehurst . . . | 2 | 77 | — | 4 | 51 | 20 | |
| Grove Park . . . | 1 | 73 | — | 4 | 53 | 38 | |
| St. John's. . . | 3 | 30 | — | 4 | 57 | 17 | |
| New Cross . . . | 0 | 53 | — | 4 | 58 | 10 | |
| Spa Road. . . . | 2 | 9 | — | 5 | 0 | 56 | |
| **London Bridge** . *arr.* | 0 | 75 | 4 31 | 5 | 2 | 27 | |

Through the kindness of Sir Myles Fenton, the General Manager, and Mr. Stirling (of Ashford), we are enabled to give records of two performances of the London and Hastings expresses. These diagrams were taken by means of a speed recorder, and indicate locomotive work of great merit.

## II.

## THE SEASIDE LINES.

We now come to consider two lines which, in many points, possess similar characteristics. These lines are :—

(1) *The London, Brighton and South Coast.*

(2) *The Great Eastern.*

Both these systems, generally speaking, run services distinguished more by their frequency than by any remarkable exhibition of speed. Each depends on sea-side traffic to a great degree ; each has a roundabout (though cheap) route to the Continent ; and each has only one strictly competitive line, viz., that to Portsmouth on the Brighton, and to Doncaster on the Great Eastern—longer in both cases than the rival route.

# I.

## THE LONDON, BRIGHTON AND SOUTH COAST.

### (1) General Description of the Line.

The most important part of this system is, of course, its direct route between London and Brighton, *viâ* Three Bridges. A branch leaves this at Keymer Junction for Hastings, Eastbourne, Lewes, and the company's Continental port—Newhaven. Then there is the main line to Portsmouth, *viâ* Epsom, Horsham, Ford Junction and Chichester; a route to Tunbridge Wells *viâ* Oxted; and a circuitous route to Brighton *viâ* Oxted and East Grinstead. In addition to these, we have several other branch lines of minor importance, and a continuous and strategically valuable coast line from Hastings *viâ* Lewes, Brighton, Ford Junction, and Chichester, to Portsmouth. The watering places served on, or from, this line are Hastings, Eastbourne, Seaford, Brighton, Shoreham, Worthing, Littlehampton, Bognor, and Portsmouth (for the Isle of Wight). The company's system also forms an intricate network embracing Surrey and Sussex; has numerous and important suburban lines in the London district, and extends altogether to a length of something over 400 miles.

### (2) Travelling Facilities.

(*a*) *Services Between Chief Towns.*—There is no railway in the kingdom on which we find so many trains limited (with true Continental exclusiveness) to the superior classes, as on the Brighton.

Here the plea put forward on behalf of the South-Eastern and Chatham Companies is no valid excuse for the restriction. It has, we believe, been argued that the restricted trains are even now so heavy that an extra class added to them would be impracticable from a traffic point of view, rendering the trains unmanageable and subjecting them to great delay. All this sounds plausible enough, but cannot be accepted as any real ground of excuse until third-class passengers are conveyed as quickly as those in the restricted trains. Let us look at the latter first.

We find there are nine expresses (taking an express to be a train which runs to its destination at an inclusive speed of 40 miles per hour) between London and Brighton. Of these, four are not available even to the second-class passenger. The times are as under:—

| Leave London. | | Arrive Brighton. | Classes. | Leave Brighton. | Arrive London. | | Classes. |
|---|---|---|---|---|---|---|---|
| Victoria. | London Bridge. | | | | London Bridge. | Victoria. | |
| 3.50 p.m. | — | 5.5 | 1st only | 8.45 a.m. | 9.55 | — | 1st only |
| — | 4.0 p.m. | 5.15 | 1st, 2nd, 3rd | 9.25 a.m. | 10.38 | — | 1st, 2nd, 3rd |
| 4.30 p.m. | — | 5.45 | 1st & 2nd | 9.55 a.m. | 11.5 | — | 1st & 2nd |
| — | 5.0 p.m. | 6.5 | 1st only | 5.45 p.m. | — | 7.0 | 1st only |
| 11.55 p.m. (Sat. only) | — | 1.5 a.m. | 1st, 2nd, 3rd | | | | |

As the distance is just over 50 miles, none of these, except the 5 p.m. down and the 8.45 p.m. up, can be said to be good. Nor is the punctuality of these exclusive trains of the highest order. This is, doubtless, due to detentions between Redhill and London, over which section the South-Eastern have running powers—part, in fact, of the line belongs to that company. It should also be mentioned, before treating of the third-class services, that there are several other restricted trains which take longer than an hour and a quarter between London and Brighton, and, consequently, do not attain an inclusive speed of 40 miles an hour. What special inducements are offered to sea-side travellers by such slow trains at such excessive fares we cannot point out, nor do we think the company would be able to furnish any sufficient justification for their policy.

The best Newhaven trains also are restricted to first and second class, and run in summer only. They are not run specially to accommodate Newhaven, but as a cheap means of transit to the Continent, in connection with the Ouest of France. The down day train is allowed 83 minutes for the 56¾ miles, and the corresponding up train gets 90 minutes. The night trains are slightly slower, carry third class passengers, and run all the year round.

About the third-class services there is a good deal to say. As with the South-Eastern and Chatham and Dover, we give below a summary of the services between London and the most important points. Brighton itself is very badly off, the fastest down taking 75 minutes (70 minutes on Saturday nights), and the fastest up, 73 minutes. This is not so good as it looks, as all the other third-class trains are longer on the journey, and the up service is distinctly worse than the down. To Portsmouth, Chichester, and Eastbourne, however, better services are rendered, and the up and down trains to Portsmouth in two hours, and the two up expresses from Eastbourne in one and a half hours, are much above what the average southern railway manager thinks good enough for the ubiquitous third-class passenger. Worthing, however, is very shabbily treated. To this point there are only two down trains and one up, with an inclusive speed of over 35 miles an hour, which carry third-class passengers. Probably this poor service is the result of the absence of competition, as in so many other cases. An excellent opportunity might also be utilized by running a coast-line service through from Hastings to Portsmouth. So many important places dot this route that it is rather a reflection on the company that the fastest trains at present take about 3¾ hours to connect the two places.

Punctuality needs improving. It has undoubtedly been better lately than ever before, and the Parliamentary Return, obtained for the information of the House some two or three years ago, and again recently, shows the line up fairly well; doubtless, also, the dual control north of Redhill and the intricate nature of the company's system near London, especially out of Victoria, are not conducive to punctuality. Still, one misses the high-pressure energy of some of the northern lines. The table referred to above is here given :—

| Between London and | Miles. | No. of Trains at or over | | | | | | Fastest. | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hr. | | 40 mls. per hr | | 45 mls. per hr. | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. Min. | |
| Brighton. | 50¾ | 3 | 3 | 2 | 1 | None. | None. | 1 10 | Best Train is from Victoria on Saturdays only. |
| Worthing | 60 | 2 | 1 | None. | None. | None. | None. | 1 33 | From Victoria, *viâ* Preston Park. |
| Chichester | 70¾ | 3 | 2 | 1 | 1 | None. | None. | 1 35 | Best Trains are to and from London Bridge, from which point the distance is calculated. |
| Portsmouth . | 86¾ | 3 | 2 | 1 | 1 | None. | None. | 2 0 | |
| Eastbourne . | 65¾ | 6 | 2 | 2 | 2 | None. | None. | 1 30 | |
| Hastings . | 76¼ | 1 | None. | None | None. | None. | None. | 2 3 | |

On its numerous local lines in Surrey and Sussex the Brighton has a large local traffic, conducted under much the same conditions as we find elsewhere. In the neighbourhood of London the company's suburban lines are very extensive and complex and the traffic most important. Generally speaking, there is a fair sprinkling of fast suburban and local trains, and the service is tolerably frequent, and, except when delayed by heavy traffic, fogs, etc., the punctuality is good. Here and there an extra pair of rails might be put down for the better working of the traffic, and this is especially the case near Victoria, where the pressure occasions frequent delay, and will continue to do so until the extra down road now being built by the company is completed. In the matter of local and suburban accommodation generally, however, we have a considerable amount of praise for this railway. As on the other southern lines, many of the earlier suburban trains are intended almost solely for the conveyance of workmen at very cheap fares.

(*b*) *ROLLING STOCK AND GENERAL ACCOMMODATION.*—As regards the accommodation given by the company, there is great credit due in certain directions and very little in others. The third- and even the second-class carriages are still, in nearly all cases, much inferior to the northern lines. Many of the thirds are without cushions of any kind, and, except where the carriage is an open one throughout, the compartments are often stuffy and of small capacity. The exceptions to this general inferiority are to be found in some really excellent thirds built for main-line service, and in good and well-lighted seconds on the suburban trains. The first-

class carriages, on the other hand, are good, and a service of luxurious Pullman cars runs frequently from London to Brighton and other points during the day. The electric light is employed in these cars. The suburban trains are generally lighted by electricity or gas, but at present a good deal of the stock used outside the London area is fitted with the old oil lamps. In all other respects the Brighton deserves unlimited praise. All trains are worked under the protection of the Westinghouse brake; most carriages have continuous footboards; electrical communication exists between passengers and guard, and is far superior to the cord communication found on the northern lines. Besides this, the line is, perhaps, more efficiently signalled than any other in the kingdom, and its reputation for safety is among the best. The permanent way is in good condition, and the roadside and terminal stations are in every way suited for the accommodation and convenience of passengers. It seems, therefore, a pity that a line so excellent in the details of its management, should yet, in some respects, fall considerably below the average.

### (3) Locomotive Work.

(*a*) *Speed.*—Were it not for the uniformly heavy loads hauled by the Brighton engines, its locomotive work could hardly be considered as very good. The speed of the best trains is generally below 45 miles an hour. Some excuse for this low average is probably to be found in the fact that the main line is a very short course, and so great a proportion of it is hampered by London district traffic. This, and further matters bearing on this point, are referred to below.

(*b*) *Gradients.*—The Brighton is much easier than either the South-Eastern or the London, Chatham and Dover. It certainly has nearly three miles of 1 in 100 up immediately south of New Cross, and again on each side of the Merstham, Balcombe and Clayton tunnels there are ascents and descents of 1 in 264, each measuring respectively about 8, 5, and 4 miles, but with these exceptions the company's main route is nearly level. The Eastbourne branch from Keymer presents several sharp curves, which have to be taken slowly. The Portsmouth line, however, is very hilly, and the trains now performing the journey each way in two hours, have some smart work to do. Then again, the system abounds in

numerous big junctions, and running near London is greatly impeded by the crowded state of the lines.

(*c*) *LOCOMOTIVES.*—Mr. Stroudley's locomotives have always excited the greatest admiration. When he became Locomotive Superintendent almost every engine on the line formed a class by itself. He immediately set to work to reduce such a preposterous variety of types, and eventually brought the number of his predecessor's classes down to six, of which two varieties are express passenger engines, and three tanks (two passenger tanks and one goods). The dimensions of all the classes used in passenger work are here given.

| Dimensions. | | Class A. Passenger Tank. | Class B. Express Passenger. | Class D. Passenger Tank. | Class E. Goods Tank. | Class F. Single-driver Express Passenger. |
|---|---|---|---|---|---|---|
| Cylinders | inches | 13 by 20 | $\left\{\begin{matrix}18\frac{1}{4}\\18\frac{1}{2}\end{matrix}\right\}$ by 26 | 17 by 24 | 17 by 24 | 17 by 24 |
| Wheels (Diameter). | feet | 4 | $6\frac{1}{2}$ | $5\frac{1}{2}$ | $4\frac{1}{2}$ | $6\frac{1}{2}$ |
| Heating Surface | sq. ft. | 506 | 1,492 | 1,036 | 1,032 | 1,184 |
| Grate Area | sq. ft. | 10 | $20\frac{3}{4}$ | $15\frac{1}{2}$ | $15\frac{1}{2}$ | 17 |
| Weight on Wheels available for adhesion. | tons | $24\frac{1}{2}$ | $28\frac{1}{2}$ | 27 | $39\frac{1}{2}$ | $13\frac{1}{2}$ |
| Capacity of Tank | gals. | 500 | 2,250 | 860 | 900 | 2,250 |
| Weight of Engine and Tender in working order | tons | $24\frac{1}{2}$ | 66 | $38\frac{1}{2}$ | $39\frac{1}{2}$ | $60\frac{3}{4}$ |
| Total Length | feet | 26 | $51\frac{1}{2}$ | $31\frac{1}{2}$ | $32\frac{1}{2}$ | 51 |

A large proportion of the stock consists of tank engines of class "D," which are employed in working the valuable suburban traffic. These do their work admirably. Class "A" is also employed to some extent on this kind of work, and is, besides, much used for station shunting purposes. Class "F" is mainly for the lighter express trains, and the extremely powerful "B" class is for the fastest and heaviest work. This "B" class is one of the finest in England, and is capable of the very hardest work. In fact, there is no locomotive work on the line quite worthy of it. The most noticeable peculiarity is the very unusual coupling of the large 6-feet 6-inch leading wheels with the drivers, and this apparently unique feature has excited considerable discussion among engineers, and, so far, no other line has followed the "B" design to any extent. Painted a showy yellow picked out with various

colours in lavish style, these powerful engines never appear to show signs of toil and grime, even after the hardest day's work. It may be remarked that the celebrated Caledonian locomotive, No. 123, designed by Mr. Drummond (formerly an assistant of the late Mr. Stroudley), is but an enlargement of the "F" class. Mr. Billinton, the present Locomotive Superintendent, has recently built a class of tank engines in which some of the well-known Brighton characteristics are considerably modified.

None of the Brighton locomotives have bogies, the turntables on the system not being large enough to permit this; nearly all have names, and the driver's name and the number of miles run is painted up in the "cab." The average coal consumption for all the locomotives on the line for the half-year ending with June, 1884, was 29·74 lbs. per mile. The Westinghouse automatic brake is in universal use on the system.

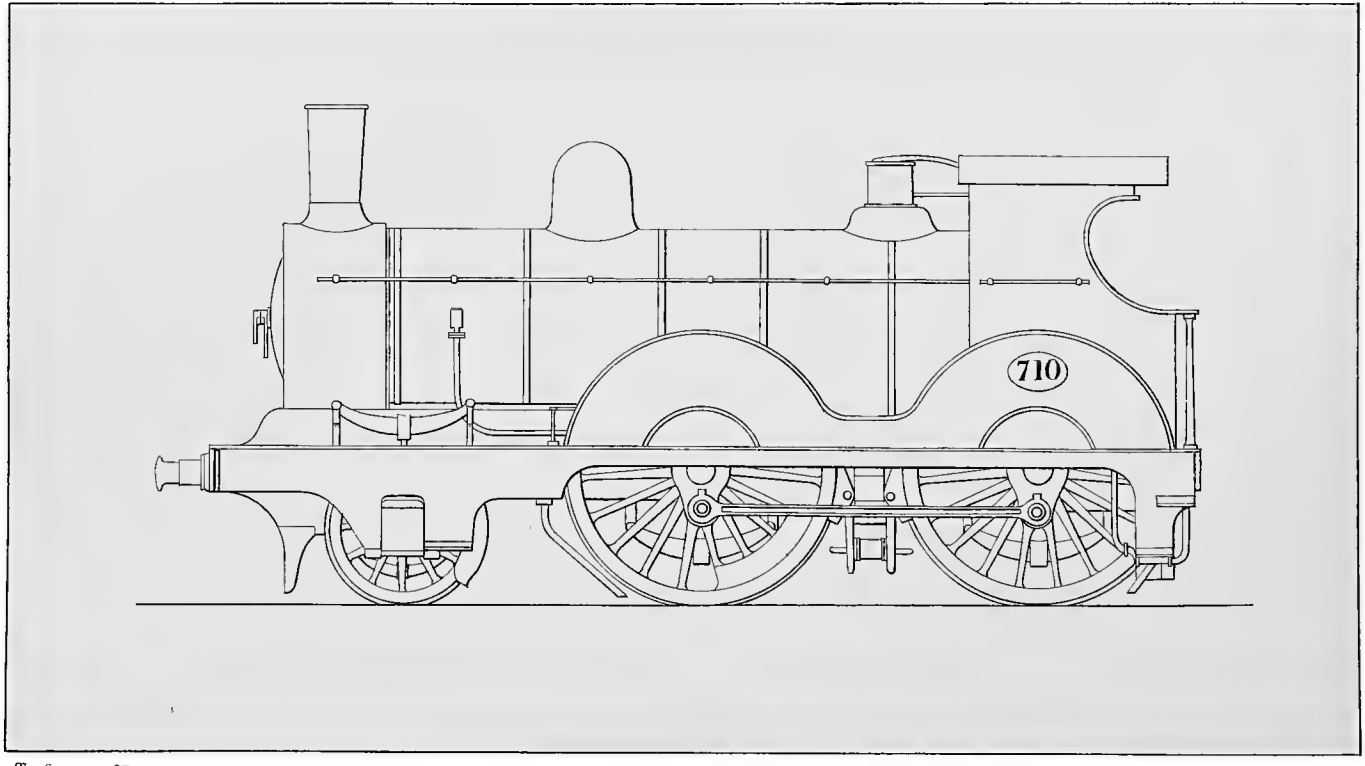
(*d*) *Actual Performances.*—As we said before, Mr. Stroudley's "B" class are such fine locomotives that there is no work on the line quite good enough to show off their qualities. The 8·45 a.m. up is, however, a very heavy train, and one of this class has frequently passed Redhill in 40 minutes, from Brighton, with a load of over 20 coaches. Mr. Rous-Marten, in his *Notes on the Railways of Great Britain*, mentions the following which came under his notice: "London Bridge to Brighton (50½ miles) in 62 minutes, with a load equal to 174 tons; and Brighton to Croydon (40¼ miles) in 50 minutes with 199 tons." In both cases the weight given is exclusive of engine and tender. But, perhaps, the best idea of the capabilities of the class may be gathered from a paper read by Mr. Stroudley some years ago before the Institute of Civil Engineers. A description is there given of a performance of the "B" class, or, as they are more often called, the "Gladstone" type, with a gross load of 335 tons 14 cwts., on the 8·45 a.m. up express, Brighton to London Bridge. In this case the locomotive, even with such a heavy load, never fell below 39 miles an hour on the long banks of 1 in 264, and the speed generally on that gradient was over 40 miles an hour. No engines in the kingdom could much improve on a performance like this, and it is much to be regretted that the Brighton locomotives have not more opportunities for the display of their undoubted qualities. Below will be found a detailed performance of the day-express to Newhaven as far as Keymer Junction, where the train quits the main line. The figures are intended to illustrate an average express performance.

EAST CROYDON TO KEYMER JUNCTION (passing).

With engine 188, "Allen Sarle" (4-coupled), and 13 coaches.

| Stations. | Mls. | Chns. | Time Due. | Time Actual. | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | A.M. | H. | M. | S. | |
| **East Croydon** . *dep.* | — | | **9 20** | **9** | **26** | **3** | |
| South Croydon | 0 | 70 | — | 9 | 28 | 32 | |
| Purley | 2 | 3 | — | 9 | 32 | 7 | |
| Merstham | 5 | 42 | — | 9 | 39 | 48 | |
| Redhill . | 1 | 68 | — | 9 | 41 | 57 | |
| Earlswood | 0 | 70 | — | 9 | 43 | 3 | |
| Horley . . | 3 | 73 | — | 9 | 47 | 27 | |
| Three Bridges | 3 | 59 | — | 9 | 52 | 6 | |
| Balcombe . . | 4 | 45 | — | 9 | 58 | 6 | |
| Hayward's Heath | 3 | 74 | — | 10 | 2 | 22 | |
| **Keymer** *pass* | 2 | 68 | — | **10** | **5** | **27** | Slowly round curve. |

Plate IV.




To face p. 67

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR. J. HOLDEN.)

Description p. 73

## II.

## THE GREAT EASTERN.

### (1) General Description of the Line.

The Great Eastern, one of our longest systems, is almost entirely non-competitive, and covers the whole of the Eastern Counties with a net-work of local lines. The total length, excluding nearly 120 miles of joint lines, is about 900 miles. From London there set out two distinct main routes. One is the Cambridge line, running through that town, then passing Ely, March, and Spalding, and reaching northward as far as Doncaster, *viâ* Lincoln and the Great Northern and Great Eastern joint line. Many important places are served off this section. For instance, there are branches from Cambridge *viâ* Newmarket to Bury St. Edmunds, from Ely *viâ* Thetford to Norwich (this forming an alternative route from London to Norwich), from Ely *viâ* Lynn to Hunstanton and Wells, and from March to Peterborough. All these important offshoots are in direct and convenient communication with London by through carriages.

The other main line is that running close to the eastern coast *viâ* Chelmsford, Colchester, Ipswich, and Beccles to Yarmouth. From Ipswich another main route runs *viâ* Stowmarket to Norwich, and is continued northwards to the favourite watering-place of Cromer. These are most important sections, and have several branches. Inland they run from Mark's Tey *viâ* Bury to Thetford and Swaffham, from Haughley Road to Bury, from Yarmouth to Norwich, and thence, *viâ* Dereham, to Wells in the north and

Lynn in the west. On the other side we have numerous branches to the seaside places served by the Great Eastern. For instance, there are Shenfield to Southend and Southminster, Colchester to Clacton and Walton, Ipswich *viâ* Westerfield to Felixstowe, Saxmundham to Aldeburgh, Beccles to Lowestoft, and the very important line from Manningtree to Harwich, whence the company dispatch their passengers for the Continent in vessels which have acquired a reputation for comfort and speed. Besides all these seaside places, to which the company convey thousands from London in the summer, there are many other cross-country branches of less importance which we need hardly specify here. Then, of course, there are the numerous local and suburban lines near London, over which the stream of traffic is very extensive, and from which great part of the company's revenue is derived.

### (2) Travelling Facilities.

(*a*) *Services Between Chief Towns.*—From what has already been stated it will be seen that the Great Eastern, though serving several important places, is yet almost wholly non-competitive. We should, therefore, expect a service not greatly distinguished by speed or frequency of trains. We find more than this. Although not so fast as even the London, Chatham and Dover, and South-Eastern Companies, its services are more convenient, frequent, and punctual than those of the lines named. Unlike most of the railways of southern England, the Great Eastern is extremely democratic, and runs third class by all trains. In considering, therefore, the times and durations of the journeys, we shall not, as hitherto, be compelled to draw the wearisome distinctions between limited trains and those open to all comers.

As noticed above, the Great Eastern is not remarkable for quickness of transit between its most important points. Taking an express train to be one which averages 40 miles an hour from start to destination, we find many trains just below this standard. An analysis of the chief express routes is given in tabular form below, and a few remarks may be made thereon here.

From Liverpool Street, by the coast main line, some excellent trains are run to Ipswich. To Norwich, Yarmouth, and Lowestoft the service is frequent, but the speed might be improved. To Cromer two or

three convenient trains run each way; and, considering the smallness of this seaside resort, the company must be congratulated on the service. In fact, the services to nearly all the insignificant but rising East Coast watering-places reflect infinite credit on the management, which has been the means of introducing them to Londoners, and thus, in great measure, ensuring their future prosperity.

By the Cambridge line, the towns of Doncaster, Lincoln, Ely, and Cambridge are excellently served from London. Lynn and Hunstanton have easy and frequent communication. Norwich can also be reached with tolerable quickness by this route. In fact, by one or other of these main lines, almost any place, however humble, can be reached with reasonable speed from London. The key-note of the Great Eastern traffic arrangements seems to be a frequent service of trains to all parts, as fast as is consistent with requirements.

It is on this system that we first meet with fast cross-country travelling. Harwich, the port for the Continent, is in direct and fast communication with Doncaster, Sheffield, and Manchester *viâ* Bury, Ely, and March. Again, a cross-country service exists to Birmingham *viâ* Peterborough, in conjunction with the North-Western Company. A very fast seaside express connects Doncaster and Peterborough with Yarmouth. Direct through carriages are run on these trains.

It must, therefore, be granted that the Great Eastern Company, in the matter of through and cross-country services, deserve the good opinion of the public. Never giving a bad service, they always rise above a respectable mediocrity in speed, and as regards the frequency and convenience of their services, and the generally excellent "dovetailing" at junctions (a matter of much importance), they are worthy of great praise. Punctuality, a virtue too rare south of the Thames, here flourishes in full vigour, and the discipline of the Great Eastern is rarely disturbed, except in the greatest stresses of the tourist and seaside season.

We now present the table mentioned above, giving some idea of the state of communication between the chief points served by the company. It will be noticed that the times and distances are given from Liverpool Street. We have selected this station, as the bulk of the traffic is sent from it, and not from St. Pancras, which is also a starting-point for Great Eastern Cambridge line expresses.

| Between London and | Miles. | Number of trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hr. | | 40 mls. per hr. | | 45 mls. per hr. | | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr | Min. | |
| Cambridge . | 55¾ | 10 | 10 | 9 | 6 | None. | None. | 1 | 15 | |
| Ely . . . . | 70½ | 9 | 10 | 5 | 1 | None. | None. | 1 | 38 | |
| Spalding . . | 105¼ | 4 | 3 | 3 | 1 | None. | None. | 2 | 30 | |
| Lincoln. . . | 145¼ | 3 | 3 | 3 | 2 | None. | None. | 3 | 28 | |
| Gainsborough . | 160¾ | 3 | 3 | 3 | 2 | None. | None. | 3 | 50 | |
| Doncaster . . | 182½ | 3 | 3 | 3 | 2 | None. | None. | 4 | 18 | |
| Lynn . . | 97 | 3 | 4 | 1 | None | None. | None. | 2 | 25 | Best Train is from St. Pancras (97¾ mls.). |
| Hunstanton . | 112¼ | 1 | None. | None. | None. | None. | None. | 3 | 4 | Good service at just under 35 m. per hr. Best Train is from St. Pancras (113 m.). |
| Newmarket . | 69½ | 3 | 1 | None. | None. | None. | None. | 1 | 48 | |
| Chelmsford . | 29¾ | 5 | 5 | None. | 3 | None. | None. | 0 | 43 | |
| Colchester. . | 51¾ | 12 | 8 | 7 | 6 | None. | None. | 1 | 10 | |
| Harwich . . (Parkeston Quay) | 68¾ | 1 | 1 | 1 | None. | None. | None. | 1 | 40 | |
| Ipswich . . | 68¾ | 11 | 11 | 7 | 7 | None. | None. | 1 | 32 | |
| Lowestoft . . | 117¾ | 5 | 3 | None. | None. | None. | None. | 3 | 0 | |
| Yarmouth . . | 121¾ | 5 | 4 | None. | 1 | None. | None. | 3 | 0 | |
| Norwich . . (Thorpe) | 115 | 5 | 5 | 2 | 2 | None. | None. | 2 | 40 | |
| Cromer. . . | 138¾ | 3 | 3 | None. | None. | None. | None. | 3 | 30 | |

One very creditable feature of the Great Eastern is the management of the local traffic round about London. This is so fast, frequent and punctual that the traffic has developed during the past few years at a marvellous rate. So much has this been the case that Liverpool Street, already a very big station, is just now being greatly enlarged. At present the station is rather cramped for space. Another terminus exists at Fenchurch Street, thus again bringing City people close to their business premises.

(*b*) *Rolling Stock and General Accommodation.*—The rolling stock of the Great Eastern Company is not uniformly good throughout, but shows signs of improvement. No fault, however, can be found with the carriages provided for through traffic. These are fairly roomy, lighted by gas, and occasionally have lavatories. There is nothing very remarkable in the upholstering of the stock, except that in many coaches there are photographs of the places of interest on the route of the railway. The North-Western originally introduced these in first-class carriages, but to the Great Eastern belongs the honour of placing them in the humbler class. Besides brightening up the carriages these

photographs form an admirable advertisement, and it seems strange that few of the other large lines have made use of them. Between the North and Harwich some dining saloons, with accommodation for third class, are run. The carriages used in the conduct of the extensive suburban and local traffic contrast greatly with those just mentioned. Any one looking at the Great Eastern suburban trains and not knowing their reputation for punctuality and speed, would be at a loss to account for the company's popularity in this direction. Certainly the stock is miserably inferior to the London and North-Western, Great Northern, or Midland, and many of the carriages are open throughout, and almost without cushions or other conveniences. They may readily be compared with the apologies for rolling stock seen south of the Thames. The management, so enterprising in other directions, should make extensive improvements here as early as possible.

Many years ago, when the Great Eastern was the Eastern Counties Railway, its services and appointments were a byword. To-day things are greatly different. Journeying down the line we certainly notice stations inadequate to the traffic, and comparisons with the wealthier and more firmly established lines may be made in other directions, to the disadvantage of the line we are considering. But this is hardly the proper way to regard the Great Eastern. By sheer force of enterprising management it has removed almost all traces of its former delinquencies as the Eastern Counties, and this should be remembered whenever one is inclined to blame. As a safe line it occupies a high position, all trains having the Westinghouse brake, and the signalling being in a forward state. The boats on the Harwich route are well appointed, and the accommodation for traffic at Parkeston Quay very extensive. Already many travellers use this route, and the trade done through the port is a growing one.

### (3) Locomotive Work.

(*a*) *Speed.*—Few instances of very high booked speed exist on the Great Eastern Railway. The general average is rather under 45 miles an hour than over it, and the only reason why the locomotive work is entitled to any recognition is that the train loads are nearly always heavy, and, in some cases, especially so. Between London and Cambridge ($55\frac{3}{4}$ miles) there is no train quicker than 75 minutes, and between London and Ipswich ($68\frac{3}{4}$ miles) the best

is 92 minutes. Between Ipswich and Norwich (46¼ miles) the speed is, perhaps, more meritorious on account of the gradients, but in rate it is generally appreciably below 45 miles an hour, the fastest between the points named being 64 minutes. One good train each way daily runs between Liverpool Street and Southend, and there is a train from Ely to Norwich at about the same speed. In further excuse for this rather low average it may be stated that those trains mentioned above, which start from, or arrive at, the London terminus are delayed considerably by the crowded state of the lines between Liverpool Street and Stratford, and generally in the London suburban district. The widenings now in progress will probably remove this cause of delay.

North of Ely the trains running through to Doncaster and York show better speed than in the south. The reason is, perhaps, that the loads are considerably lighter. Speeds of 45 to 48, with one or two exceptional instances at an even higher figure, are here tolerably numerous. Of these, perhaps, the best are the runs from Lincoln to Gainsboro' (15¾ miles) in 19 minutes; from Lincoln to Spalding (40¼ miles) in 47; and from Doncaster to Gainsboro' (21 miles) in 27 minutes.

(*b*) *GRADIENTS.*—The Great Eastern Cambridge line is very easy running. It rises gently from London to Bishop's Stortford, then five miles more steeply, of which the two last are 1 in 130 to Elsenham. Then comes a four-mile drop averaging 1 in 230 to Newport; a slight rise to Audley End, then three miles of 1 in 150 down, and the rest gently falling to Cambridge. From Cambridge right on to Doncaster there is very little ascent or descent, the line being almost all level, or nearly so. Cross country from Ely to Norwich is extremely easy. There are three miles of 1 in 130 down past Hethersett, but the rest is either easy ups and downs or level.

The Colchester, or coast main line, is rather harder travelling. It starts with a gradual ascent for 15 miles, followed by three miles of 1 in 95 up to Brentwood, 240 feet. A gentle fall of 11 miles succeeds this as far as Chelmsford. Thence to Colchester it is practically level. After this the route becomes a stiff one for express work. For nearly 30 miles we have short steep ups and downs, averaging from 1 in 100 to 1 in 150; then, from Melton to Beccles the stretches become shorter and steeper; onwards to Yarmouth they subside again. Consequently, the hauling of a heavy train from Ipswich to Yarmouth requires good tractive effort.

There are other things the Great Eastern trains have to contend

with. Several sharp curves and swing bridges dot the route here and there; but, worst of all, the crowded state of the lines near London causes the express traffic to be conducted very slowly thereon, as previously commented upon, and the speed when once clear of these obstructions is much better than it appears on paper.

(*c*) *Locomotives.*—The locomotives on the Great Eastern Railway are admirably fitted for the moderately hard work they are called upon to perform. Some of the heaviest trains in England are hauled very creditably over the bank approaching Brentwood. A few of the passenger types are distinguished by the continuous splasher over both the driving and trailing wheels. The colour of the locomotives is blue, with a red stripe, and the brake used is the Westinghouse automatic. Mr. Holden, the Locomotive Superintendent, is at present building a set of ten main-line tank engines, with 5 feet 8 inch drivers, and cylinders 17½ by 24. We now give details of some of the most important types in the following table:—

| Dimensions. | Mr. Bromley's singles. | Mr. Worsdell's 4-coupled express. | Mr. Worsdell's Compounds. | Mr. Holden's T 26 Class, 4 coupled. | Mr. Holden's 4-coupled express. | Mr. Holden's 7-ft. singles. |
|---|---|---|---|---|---|---|
| Diameter of driving wheels ft. | 7½ | 7 | 7 | 5⅔ | 7 | 7 |
| Cylinders . . in. | 18 by 24 | 18 by 24 | High Pres 18<br>Low do. 26<br>Stroke 24 | 17½ by 24 | 18 by 24 | 18 by 24 |
| Heating Surface, Tubes sq. ft. | 1095·23 | 1115 | 1082·5 | 1107·4 | 1107·4 | 1107·4 |
| do. Box sq. ft. | 110·35 | 113·2 | 117·5 | 101·9 | 100·9 | 100·9 |
| do. Total sq. ft. | 1205·58 | 1228·2 | 1200 | 1208·3 | 1208·3 | 1208·3 |
| Number of Tubes . . . | 203 | 223 | 201 | 252 | 2-2 | 252 |
| Diameter do. (outside) in. | 1¾ | 1⅝ | 1¼ | 1⅝ | 1⅝ | 1⅝ |
| Boiler Pressure . . lbs. | 140 | 140 | 150 | 140 | 140 | 140 |
| Grate Area . . sq. ft. | 17·1 | 17·3 | 17·3 | 18 | 18 | 18 |
| Height ft. & ins. | 12 11 | 12 11 | 12 11 | 12 11 | 12 11 | 12 11 |
| | t. c. qrs. | t. c. qrs | t. c. qrs. | t. c. qrs. | t. c. qrs. | t. c. qrs. |
| Weight on Drivers, Empty tons | 13 13 2 | 12 15 1 | 14 3 2<br>13 12 1 | 12 10 0<br>11 12 2 | 13 4 3<br>12 13 2 | 14 15 1 |
| do. Loaded tons | 15 2 0 | 15 0 0 | 14 16 2<br>14 18 0 | 13 13 0<br>12 10 1 | 14 1 0<br>13 10 3 | 16 2 2 |
| Weight of Engine, Empty tons | 38 1 1 | 38 1 0 | 41 2 3 | 37 3 2 | 38 18 3 | 36 15 1 |
| do. Loaded tons | 41 13 3 | 41 3 0 | 44 10 0 | 40 6 0 | 42 0 1 | 40 3 2 |
| Weight of Tender, Empty tons | 18 3 0 | 18 3 0 | 16 6 2 | 16 0 0 | 16 0 0 | 16 0 0 |
| do. Loaded tons | 35 18 1 | 35 18 1 | 32 8 3 | 30 12 2 | 30 12 2 | 30 12 2 |
| Capacity of Tank . gals. | 3066 | 3066 | 2755 | 2640 | 2640 | 2640 |
| Coal . . tons | 3 | 3 | 3 | 3 | 3 | 3 |
| Engines in Class | 240 to 254<br>600 to 609 | 562 to 571<br>640 to 649 | 230<br>700 to 709 | 417 to 426<br>427 to 446 | 710 to 769 | Eleven |
| Notes . . | 600 to 609 have 17½ in. cyls., & weight & heating surface is smaller. | Radial boxes. | The Compound system tends to become extinct on this line. | 427 to 446 have only 17 in. cylinders. | Nos. 759 to 761 are fitted for burning liquid fuel. | |

(*d*) *ACTUAL PERFORMANCES.*—The Cambridge line expresses are not generally so heavy as those on the other main route. We have, however, known the 55¾ miles from London to Cambridge to be run in 70¼ minutes, with a load of 15 coaches, and on another occasion in 75 minutes with 22 behind. The latter performance was accomplished by a 7-feet coupled of Mr. Worsdell's design, and the former by one of Mr. Bromley's singles. To illustrate the work on the Colchester line we give two performances below. They are both excellent in their way.

The only very serious obstacle on the southern section of the Great Eastern is the bank west of Brentwood. We have thus few opportunities of testing the value of the work done by the company's locomotives on rising gradients. So far as we have examined the matter, however, the result is satisfactory.

We now present the two performances referred to above:—

IPSWICH TO LIVERPOOL STREET (68¾ miles) in 87 mins. 37 secs.
COLCHESTER TO ILFORD (44¼ miles) in 60 mins. 23 secs.

| Stations. | Mls. Chns. | Ipswich to London. 16 Coaches. | | Colchester to Ilford. 23 Coaches. | |
|---|---|---|---|---|---|
| | | Time Due. | Time Actual. | Time Due. | Time Actual. |
| | | P.M. | H. M. S. | P.M. | H. M. S. |
| **Ipswich** . *dep.* | — | **2 28** | **2 40 12** | | |
| Manningtree . | 9 20 | — | 2 53 7 | | |
| **Colchester** . *dep.* | 7 61 | — | 3 2 28 | **8 23** | **8 40 45** |
| Mark's Tey . | 5 0 | — | 3 9 11 | — | 8 50 58 |
| Kelvedon . | 4 37 | — | 3 15 3 | — | 8 57 16 |
| Witham . . . | 3 49 | — | 3 18 56 | — | 9 1 43 |
| Chelmsford . . | 8 69 | — | 3 30 2 | — | 9 13 28 |
| Ingatestone . . | 6 11 | — | 3 38 21 | — | 9 22 40 |
| Brentwood . | 5 37 | — | 3 43 52 | — | 9 28 29 |
| Romford . . . | 5 63 | — | 3 50 23 | — | 9 35 40 |
| Ilford . . | 5 1 | — | 3 55 43 | — | 9 41 8 |
| Manor Park . . | 1 5 | — | 3 57 8 | — | Pulled up by signals near Manor Park, and ran slowly thence to Stratford. |
| Forest Gate . . | 1 1 | — | 3 58 28 | — | |
| Stratford . . | 1 19 | — | 3 59 54 | **9 35** | |
| **Liverpool St.** *arr.* | 4 6 | **4 0** | **4 7 49** | — | |

III.

## THE LINES TO THE WEST.

We have here two lines with few points of resemblance, except that they both serve the West of England. They are :—

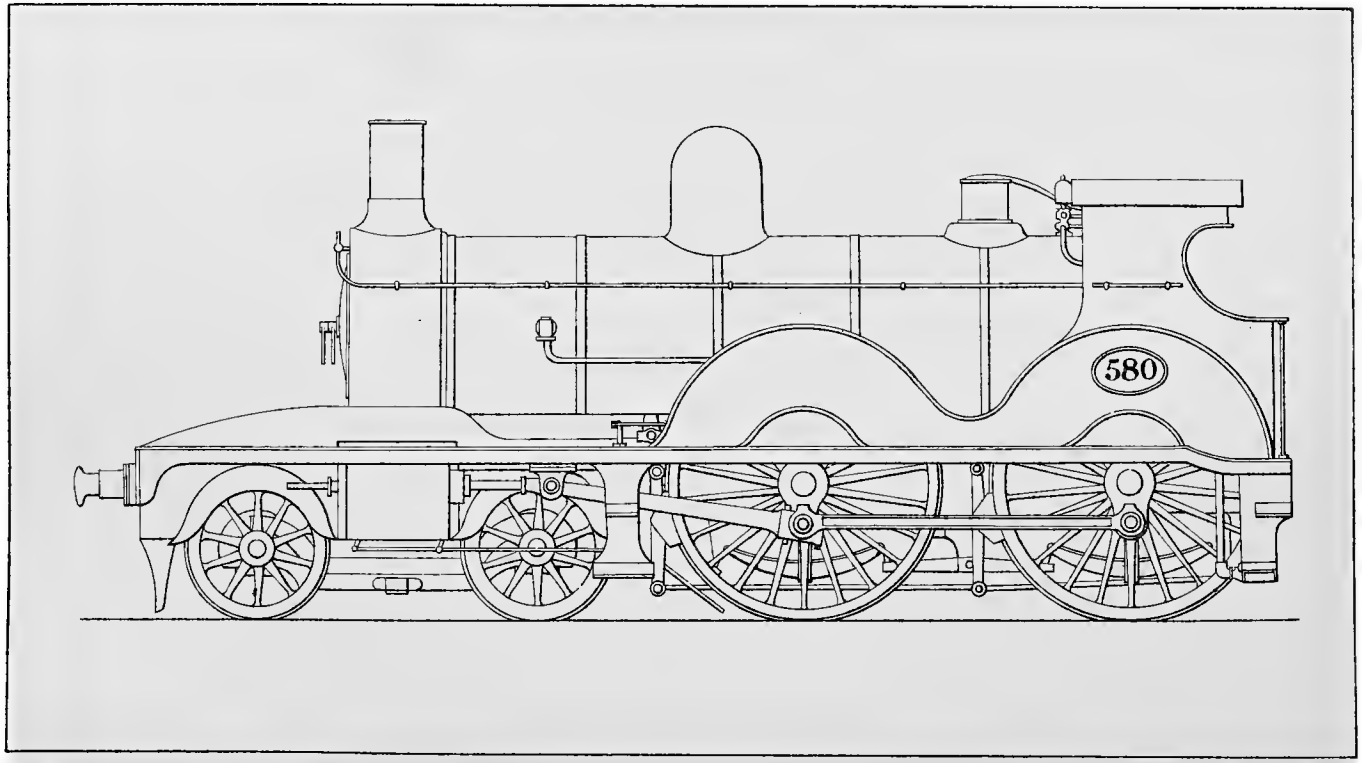
(1) *The London and South-Western.*

(2) *The Great Western.*

Between these scarcely any comparisons can be made. They are, however, in competition to Exeter and the Devon and Cornwall districts, and for this reason we have decided on classing them together.

# LONDON & SOUTH WESTERN.

Plate V.




*To face p. 77.*

**EXPRESS PASSENGER ENGINE.**

(DESIGNED BY Mr W. ADAMS.)

*Description p 84*

# I.

## THE LONDON AND SOUTH-WESTERN.

### (1) General Description of the Line.

With the exception of the North-Eastern this line is, perhaps, less competitive than any other. It certainly has some little rivalry with the Brighton Company at Portsmouth and the Great Western at Exeter and Weymouth. But, with these exceptions, the district is peculiarly its own. Its main line extends very directly from London to Exeter through Basingstoke, Salisbury and Yeovil Junction. Thence to Plymouth *viâ* Okehampton is somewhat roundabout, crossing the moorlands, while the Great Western, which is also a circuitous route, keeps to the sea-coast. At Yeoford Junction on the Plymouth line, is a branch to the well-known watering-place of Ilfracombe. An important main artery of the system leaves the Exeter line at Woking and travels *viâ* Guildford, Petersfield and Havant to Portsmouth for the Isle of Wight. Then again, from Basingstoke the Southampton line leaves the main route and, passing through Winchester and Southampton West, divides at Brockenhurst, one line going south-west to Bournemouth, and the other west and then south to Swanage and Weymouth. From Southampton there are frequent boat services to the Channel Islands, as well as to the French ports of Havre, Honfleur, Cherbourg and St. Malo. Besides these three principal sections, we have numerous other branches of more length than importance, many of them forming lines almost parallel to those already described. But perhaps the most productive area from which the company gather their passenger receipts is that surrounding the metropolis in a south-westerly direction. Here their lines form a very intricate network, while further west we find them in competition, at Windsor and Reading, with the Great

Western. Again, at Aldershot and Brookwood (for Bisley) a considerable Volunteer traffic is dealt with. The total length of the system is nearly 800 miles, and the company are joint owners with the Midland of the Somerset and Dorset Joint Railway, which connects Bath with the favourite and rapidly increasing watering-place of Bournemouth.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—It is greatly to the credit of the South-Western that, in spite of demoralising surroundings, all their trains carry third-class passengers. We are thus relieved of the task of eliminating trains carrying first- and second-class passengers only, as was the case on the South-Eastern, London, Chatham and Dover, and London, Brighton and South Coast railways. Beyond this commendation, however, we cannot very highly praise the services given by this system, except, perhaps, those to Exeter and Bournemouth. Southampton and Salisbury undoubtedly have good trains, but they are too few in number, while Portsmouth would appear to have been almost entirely neglected. We here find ourselves returning from the pleasant frequency of expresses, which forms so attractive a feature in the Great Eastern programme, to the more usual style in vogue on the lines south of the Thames, of running one or two good trains and no more, to the most important points. Thus, the 11 a.m. and 3.0 p.m. trains to Exeter are admirable specimens; but the unfortunate traveller who is unable to arrange his journey at the above times must rest contented with the slower and more sedate pace of the other South-Western trains. This state of things will doubtless in time be remedied. Without looking for the dispatch and frequency common to the northern lines, with their more important centres of traffic, the South-Western might still add a few more smart trains to their time-tables.

The system has, however, of late years been steadily developing into a first-class line. The services to Exeter have been quickened up, and this acceleration has, of course, benefited intermediate towns. The new line to Bournemouth has, in fact, revolutionised the services between that place and London; and Southampton West is now, at length, by means of these very fast trains, brought within a reasonable time of the metropolis. We give below, in

tabular form, some particulars of the duration of journeys between London and the principal towns.

| Between London and | Miles. | Number of Trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 Miles an hour. | | 40 Miles an hour. | | 45 Miles an hour. | | | | |
| | | Down. | Up. | Down | Up. | Down. | Up. | Hr. | Min. | |
| Basingstoke . . | 47¾ | 11 | 17 | 7 | 10 | 2 | None | 1 | 0 | * Several others at or over 35 m.p.h. to Southampton (Docks), about same distance. Service will probably be improved when Southampton becomes a port for America. |
| Portsmouth Tn. | 73½ | 3 | 1 | None | None | None | None | 1 | 59 | |
| Southampton W. | 79 | 4 | 4 | 1 | 2 | 1 | 2 | 1 | 40* | |
| Bournemouth E. | 107½ | 4 | 4 | 2 | 2 | 1 | None | 2 | 23 | |
| Weymouth . . | 145½ | 1 | None | None | None | None | None | 4 | 8 | |
| Salisbury. . . | 83½ | 6 | 7 | 3 | 3 | 1 | None | 1 | 50 | |
| Exeter. . | 171½ | 5 | 4 | 2 | 4 | 1 | None | 3 | 46 | |
| Ilfracombe . | 225½ | 2 | 1 | None | None | None | None | 5 | 56 | |
| Plymouth . . | 229½ | 4 | 3 | 1 | None | None | None | 5 | 23 | |

Another detail in which the South-Western has noticeably improved is that of punctuality. Some of their trains are very sharply timed, and it is extremely creditable that they should run as they now do, seeing, moreover, that only a few years back the line had acquired a most unenviable reputation for unpunctuality. In the Parliamentary Return of Punctuality—which, by the way, gives merely an approximate idea of the state of affairs—the South-Western occupies a good position. So many delays occurred in the past over the last few miles into London that we may now reasonably hope that, with the advantage of the two additional lines of rail, much of the former lateness will disappear.

On the country branches of the system there is nothing remarkable to record as far as the train-services are concerned. They are carried on at the usual 20–25 miles an hour (including stops) which is characteristic of English local trains. Near London, however, the company vie with the Great Eastern in the magnitude of their suburban traffic. This is worked at a tolerable speed, and there is little fault to find, either on the score of frequency of service or punctuality. The company's territory includes most of the riverside resorts, and the population abounds in season-ticket holders. There is also a connection with Epsom, and on the Derby Day the resources of the line are taxed to the utmost to cope with the enormous racing traffic.

(*b*) *Rolling Stock and General Accommodation.*—The accommodation given, though at present only moderate, is rapidly improving. Making every allowance for the very large number of small and antiquated carriages running on the suburban and branch lines, we should still be inclined to rank the South-Western carriage stock as, on the whole, superior to that of any of the three other southern lines. With newly-infused energy, for some time past the company have been building most roomy and comfortable vehicles of all classes. The seconds and thirds are excellent, and the North-Western itself might be proud to own some of the firsts, with their lavatory conveniences and tasteful decoration and upholstery. Besides these comfortable compartments, there are now on the Bournemouth fast expresses some handsome Pullman cars, representing, one would suppose, the ultimatum in railway-carriage construction and decoration. That such is the opinion of the directors may be gathered from the imposition of an additional charge, over and above the first-class fare, on those travelling in them.

Much, nevertheless, remains to be done on the South-Western as regards rolling stock. The local and branch line stock is still much more frequently seen than the newer vehicles. The present management has of late shown so much enterprise in various ways, that we are justified in assuming that this state of affairs will very soon be remedied. In other departments of working there is much to praise. Almost all the passenger rolling stock has been for some time fitted with the Automatic Vacuum brake, and the station accommodation is generally of an excellent character.

### (3) Locomotive Work.

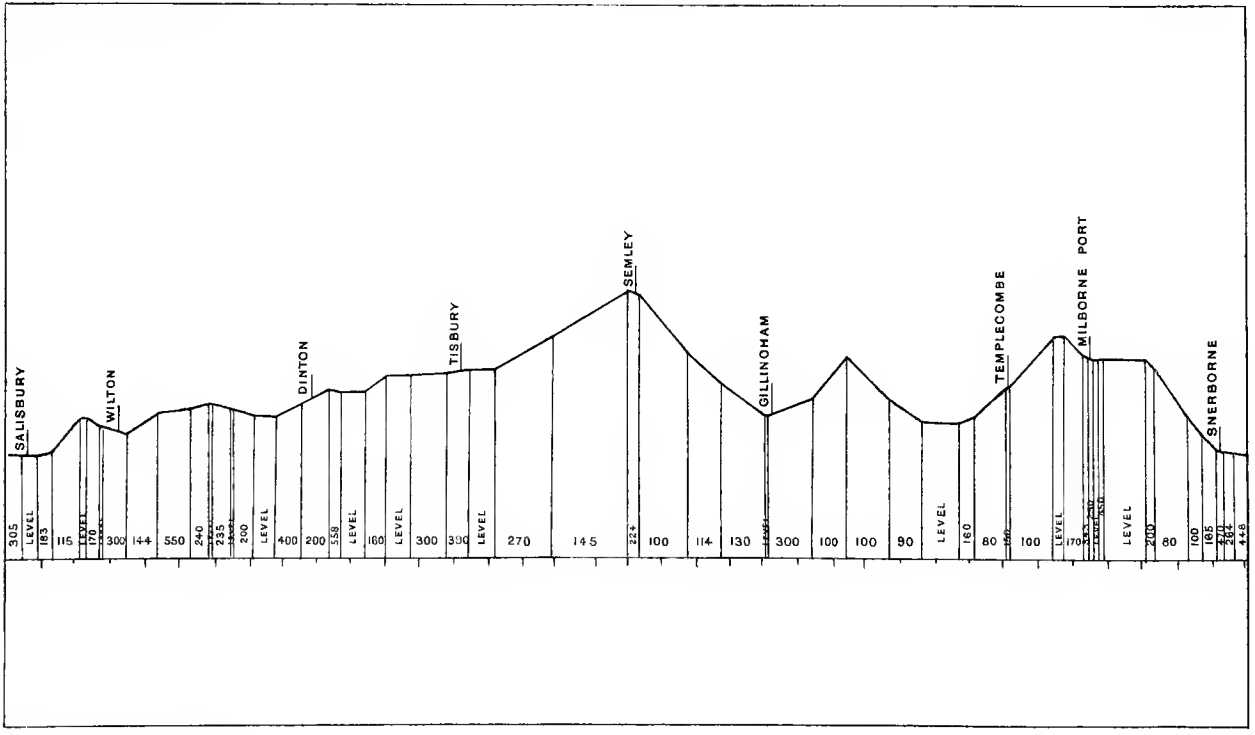
(*a*) *Speed.*—On the London and South-Western Railway the time-table speed is curiously unequal, and we find many instances of faster work on steep gradients than on the more level sections. Thus, east of Salisbury, speed rarely exceeds 45 miles an hour, and the best instances are exceptional, and are, perhaps, those of the up and down Bournemouth expresses, which are timed, over some parts of their journey, at from 48 to 50, and two of which make excellent runs from Southampton to Woking and Vauxhall respectively in 68 and 94 minutes ($54\frac{3}{4}$ and $77\frac{3}{4}$ miles). On the hard grades west of Salisbury we have much better work, on the average. The Exeter expresses furnish us with such fine performances as 66

# SALISBURY TO EXETER.

## GRADIENT PROFILE.

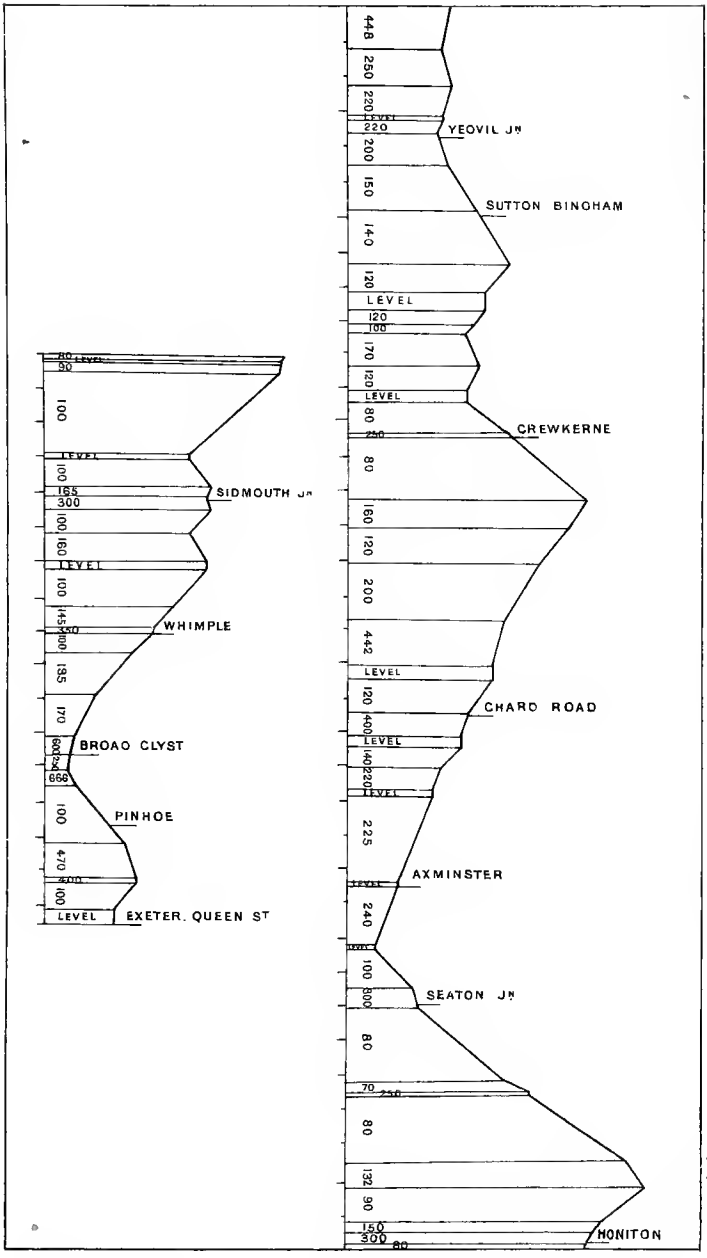
L. & S. W. R. No. 1.

Plate VI.




*Between Pages 80 & 81.*

Plate VII.




*Between Pages 80 & 81*

minutes from Sherborne to Exeter ($53\frac{1}{2}$ miles), and 61 and 62 minutes between Exeter and Yeovil (49 miles). Considering the heavy gradients this is, indeed, admirable work. On the other parts of the London and South-Western system no speeds of importance are attained. This is generally due to steep gradients, and to the absence of competition.

(*b*) *Gradients.*—The fast expresses to Exeter, especially the 3.0 p.m. down, are really such fine examples of locomotive work that we purpose giving under this head more detailed information than has been done when treating of the other southern lines. This particular train (the 3.0 p.m.) not only starts well on its west-bound journey, but improves as it gets further on its course, until at last its performance over the heavy banks near Chard and Honiton quite entitles it to rank with the North-Western and Midland displays on their heavy roads south of Carlisle. It will, therefore, be necessary to examine the gradients closely, so as properly to estimate the value of the performance.

From Waterloo the South-Western rises very gently, with frequent undulations, for twenty miles. This is followed by eleven miles of 1 in 300 up, five miles level and six miles easy rise. Three miles gentle fall are followed by about nine miles of varying rising grades, mostly about 1 in 300. This takes us 54 miles from London. The road now becomes stiffer, but still undulates until the 62nd mile-post. Then follow three and a half miles of 1 in 178 down, two and a half miles of 1 in 220 up and 1 in 330 down, one and a half miles of 1 in 264 up, and three miles of 1 in 165 up. Thence to Salisbury, 11 miles, is a descent, of which the steepest part is from post 75 to 81, being 1 in 245, 140, and 169. The 3.0 p.m. down gets 110 minutes for the $83\frac{1}{2}$ miles (including two stops). This is very excellent, but not so good as what follows.

From Salisbury to Exeter the gradients are very steep, and are massed together in such a way as to seriously diminish speed. The profile of this section is here given.

From Exeter to Yeoford Junction there is a continuous rise for ten miles, averaging about 1 in 300 but varying greatly and frequently. The next four miles are a steeper rise, two of them being 1 in 97 and 1 in 80 up, and the next four undulate very steeply (1 in 80 to 1 in 132). These are followed by a rise of four miles (bringing us to post 195) of 1 in 76; after which the line rocks up and down very steeply for one and a half miles to near Okehampton. The next five miles are about 1 in 80 up (quarter mile of it is 1 in

58 up), and then the line descends, with many undulations, four miles of 1 in 80. After this (205 miles) the undulations, ascents, and descents are as follows :—

Two miles down at 1 in 78, 110 and 200; half mile level; three miles down at 1 in 75, 79, 89; one mile down at 1 in 82; four miles steep undulations with descending tendency; two miles up at 1 in 75 and 98; one and a quarter miles down at 1 in 75; two miles moderate ascent (post 220); four miles down at 1 in 73, followed by two miles down at 1 in 75, then by rather easier undulations descending gradually into Devonport. This road is, one would have thought, quite enough to frighten express trains off it. To run over it at about 40 miles an hour, as many of the South-Western expresses do, is a remarkable feat. The gradients are certainly not massed together to obstruct speed so badly as they might be. If they had been, the present speeds could not be maintained. A rather similar line is the piece from Carlisle to Hawick. This is not so hard as this South-Western stretch; the speed is, however, much the same.

The other sections we shall describe are those from London to Southampton, London to Portsmouth, and from Brockenhurst to Bournemouth. With the exception of the Bournemouth expresses, which run exceedingly well between London and Southampton West, there is not much speed on any of these sections, and we shall dismiss them in few words.

As far as post 48 the Southampton and Bournemouth expresses use the Exeter line (see details above). There is then a four-miles rise of 1 in 250, followed by three miles of easy ups and downs. Then occurs 17 miles of unbroken descent averaging 1 in 240, and seven miles falling gradually into Southampton. Thence to Bournemouth the line undulates easily for six miles, descends three averaging 1 in 220, and undulates about five miles at 1 in 200 to Brockenhurst, rises one and a half miles at 1 in 103, 200 and 241, undulates moderately easily for six miles, descends four miles gently and rises three miles (one of which is 1 in 99).

The Weymouth line continues from Brockenhurst for four miles on ups and downs, rises two miles at about 1 in 200, falls five miles on varying grades averaging 1 in 200, undulates eight miles moderately easily, rises one and a quarter miles at 1 in 100 just beyond Wimborne, falls five miles rather steeply past Hamworthy (one of them 1 in 100), undulates six miles easily, then rises seven miles averaging 1 in 300 to post 133 (from post 131 to 132 is 1 in 100), undulates four miles at about the same rate, rises one mile at

1 in 110, undulates two miles steeply, and then, after rising one mile at 1 in 74, drops steeply into Weymouth on gradients of 1 in 53, 51, 75 and 188 for three and a half miles.

The Portsmouth trains use the main road to Exeter as far as Woking, 24 miles from London. They then undulate easily over the branch line until they reach post 33. This is followed by a five-miles rise (two of them 1 in 200, one at 1 in 100, and two at 1 in 82). A short sharp descent follows for a mile, and then we rise three and a half miles at 1 in 80 to the summit near Haslemere. A long rest now occurs for 13 miles, as far as post 55, with breaks near post 46 of a mile at 1 in 250 up, near post 49 of a mile level, and near post 54 of a mile at 1 in 115 up. This long descent includes a variety of grades from 1 in 80 (two miles after post 49) to 1 in 686. From post 55 we rise two miles at 1 in 105, drop two miles at 1 in 80, and then descend nine miles averaging about 1 in 300, but containing two or three short stretches about 1 in 100. Thence to Portsmouth is a gradual descent, with breaks here and there. It will, therefore, be seen that this section is a very steep one. Allowing for this, however, the speed on it might be improved.

Though not strictly an express section, we may mention that between Morthoe and Ilfracombe are two miles of 1 in 40 up, followed by two and a quarter miles of 1 *in* 36 *down.*

(*c*) *Locomotives.*—To perform the work thus briefly sketched out, the company have some excellent locomotives. Most of them have been constructed from the designs of the well-known Locomotive Superintendent, Mr. W. Adams. A list of some of the newer types, with dimensions as here given, will be found useful for purposes of comparison. The heavy express and other new stock is painted a bright green, picked out with black, in strong contrast with the dark-brown "Vivids," and other well-known names of Mr. Beattie's design. A large proportion, as may be supposed, consists of very serviceable tank engines. These, and, indeed, nearly all the locomotives for passenger traffic (except two classes of tanks, and a powerful type of mixed traffic engine lately built), have the combination of a leading bogie and outside cylinders. For passenger trains, indeed, the outside cylinder would seem to have been the rule on this line almost from the earliest date. The goods engines, on the contrary, are furnished with inside cylinders. Many old specimens still doing duty by the side of the much more powerful constructions of recent date serve to indicate the vast strides made by the company in this direction. The coal consumption for all

classes is about 27 lbs. per mile. This low figure is, of course, explained by the fact that passenger traffic bears a large proportion to the total. The brake used is the Automatic Vacuum. We now present the dimensions of the various recent classes of passenger engines. Quite lately, a new express type, closely approximating to his 19 by 26 engines described below, but with 6 ft. 7 in. wheels, has been built by Mr. Adams.

TABLE 1.—MOST RECENT TYPES.

| Dimensions. | | Bogie Express. | Mixed Traffic. | Bogie Tanks. |
|---|---|---|---|---|
| Cylinders | inches | 19 by 26 | 18 by 26 | 17½ by 24 |
| Coupled Wheels, diameter | ft. in. | 7 1 | 6 0 | 4 10 |
| Bogie ,, ,, ,, | ft. in. | 3 9¾ | — | 3 0 |
| Trailing ,, ,, ,, | ft. in. | — | 4 0 | — |
| Heating Surface | sq. ft. | 1,367·76 | 1,248·10 | 987·51 |
| Grate Area . | sq. ft. | 18 | 17 | 13·83 |
| No. of Tubes | | 240 (brass) | 218 (brass) | 201 (steel) |
| Boiler Pressure . . . | lbs. | 175 | 160 | 160 |
| Weight on Leading-Wheels | tons cwt. | — | 15 6 0 | 14 10 2 |
| ,, Bogie ,, ,, ,, | | 18 7 2 | — | — |
| ,, Driving ,, ,, ,, | | 15 9 0 | 16 8 0 | 15 0 0 |
| ,, Trailing ,, ,, ,, | | 14 17 0 | 10 13 0 | 15 1 0 (bogie) |
| Total Weight of Engine . | ,, ,, | 48 13 2 | 42 7 0 | 44 11 2 |
| ,, ,, Tender | ,, ,, | 32 0 0 | 32 0 0 | — |
| Tank Capacity . . . | gals. | 3,300 | 3,300 | 800 |

TABLE 2.—OTHER TYPES IN DAILY WORK.

| Description. | Diameter of Drivers. | Cylinders. | Weight on Drivers. | Weight on Trailers. | Weight of Engine. | Weight of Tender. | Total length. | Capacity of Tank. |
|---|---|---|---|---|---|---|---|---|
| | ft. in. | inches. | tns. ct. | tns. ct. | tns. ct. | tns. ct. | ft. in. | gals. |
| 4-wheel Coupled Bogie Tank, 1879 | 5 7 | 18 by 24 | 17 14 | 12 2 | 50 16 | — | 32 6 | — |
| ,, ,, Exp., 188 | 6 7 | 18 by 24 | 15 0 | 15 4 | 46 15 | 30 2 | 51 11 | — |
| ,, ,, 1883 | 7 1 | 18 by 24 | 14 16 | 14 14 | 45 11 | 30 2 | — | 2,800 |
| ,, Tank, 1882 | 5 7 | 17½ by 24 | 15 0 | 14 10 | 52 0 | — | 38 6 | 1,000 |
| ,, ,, 1889 | 5 7 | 18 by 26 | 17 3 | 18 0 | 52 3 | — | — | — |

(*d*) *Actual Performances.*—For the best of these we must look to the Bournemouth and Exeter expresses. The former are very sharply timed over a moderately hard course, and generally manage to run within their time. The long uphill piece from Southampton (17 miles averaging 1 in 240) is run over by the best up express in very creditable style. Of the Exeter expresses we have already

said something. The 3.0 p.m. down makes good runs between its stopping points right through from London, and the other trains have also very quickly-timed pieces here and there. Perhaps the most creditable timing is the run from Exeter to Yeovil Junction in 62 minutes (12.45 p.m. and 6.0 p.m. up). This is at the rate of about 47 miles an hour over an exceedingly difficult course—much harder than the reverse way. We append herewith a run by the 6 p.m., with a load of 14 coaches. It takes rank, we think, with some of the best performances of other lines.

EXETER TO YEOVIL JUNCTION (49 miles) in 60 mins. 36 secs.

| Station. | | Miles. | Time Due. | Time Actual. | | |
|---|---|---|---|---|---|---|
| | | | P.M. | H. | M. | S. |
| **Exeter** . | *dep.* | — | **6 0** | **6** | **12** | **2** |
| Pinhoe . | | $2\frac{3}{4}$ | — | 6 | 15 | 53 |
| Broad Clyst . | | 2 | — | 6 | 18 | 1 |
| Whimple | | $3\frac{11}{16}$ | — | 6 | 22 | 47 |
| Sidmouth Junction | | $3\frac{3}{4}$ | — | 6 | 27 | 41 |
| Honiton . . | | $4\frac{9}{16}$ | — | 6 | 36 | 2 |
| Seaton Junction | | $6\frac{15}{16}$ | — | 6 | 44 | 10 |
| Axminster | | $3\frac{3}{16}$ | — | 6 | 47 | 14 |
| Chard Road . | | $5\frac{1}{8}$ | — | 6 | 53 | 37 |
| Crewkerne . | | 8 | — | 7 | 2 | 44 |
| Sutton Bingham | | $6\frac{9}{16}$ | — | 7 | 9 | 42 |
| **Yeovil Junction** . . | *arr.* | $2\frac{5}{16}$ | **7 2** | **7** | **12** | **38** |

## II.

## THE GREAT WESTERN.

### (1) General Description of the Line.

This is much the longest of the English systems, and has a most formidable array of main lines and branches, extending in the aggregate to nearly 1,900 miles. The other large companies are, as a rule, content with one main line; the Great Western has no fewer than three, all converging to its terminus at Paddington. The oldest, though perhaps not the most important, of these—except in so far that it gives the company its name—is the route from London through Swindon, Bath, Bristol, and Taunton, to Exeter, on to Plymouth, and beyond that to Truro and Penzance. This is the longest stretch of main line in the kingdom, the distance from Paddington to Penzance being 326½ miles; whereas from London to Carlisle *viâ* Nottingham, Sheffield, and Leeds by the Midland route is only 316¾, and the length of the Highland main line from Perth to Wick only 305¼ miles. Besides this distinction, it has another, and that, too, a most interesting one. The whole of the above distance was, until May, 1892, laid with a gauge of 7 feet, although—excepting on the extreme westerly portion—an extra rail for narrow-gauge (4 ft. 8½ in.) traffic requirements was inserted between the broad-gauge metals. It would be beside our purpose to enter into the prolonged controversy which in the infancy of the railway system was carried on with such enthusiastic warmth by the respective partisans of the broad and narrow gauges. The narrow gauge has been—at least, in England—so universally adopted that we may regard all discussion of the relative merits of the rival systems as at an end. Time after time has it been shown that the initial

outlay and subsequent cost of maintenance of the wider gauge is on a proportionately higher scale than with the narrow, and the only defence put forward by the few remaining adherents (mostly of the sentimental order) of the broad gauge is its greater adaptability to speedy travelling. This contention may have some truth in it, as —a higher centre of gravity being permissible—the wheels could be made of greater diameter and the parts of the engine larger in every way, with so wide a base as the 7 ft. gauge, than with the 4 ft. 8½ in. But advantage was never taken of this opportunity, and the broad gauge, except in 1848, never really surpassed the narrow in speed. The latter, moreover, has always been able to supply every demand for further speed up to the present, and will probably continue to do so, in spite of the limits it imposes on the construction of the locomotive. It may, therefore, fairly be concluded that Brunel's magnificent mistake has cost the Great Western Company much money in the purchase of needless land, with the additional disadvantages of working for some considerable time in the past a mixed gauge for a great distance, and incurring much loss in the transhipment of goods from broad- to narrow-gauge wagons. The line is laid to a great extent with bridge rails on longitudinal sleepers, cross-ties being inserted at fixed intervals, with a view to prevent the rails spreading wide of gauge.

The principal branches diverging from this main route are:—On the south, from Slough to Windsor; Reading to Basingstoke; Reading *viâ* Hungerford and Devizes to Bath; Chippenham *viâ* Westbury to Salisbury, and *viâ* Frome and Yeovil to Weymouth, from which port the company have of late years established an excellent service to the Channel Islands in competition with the South-Western; from Yatton to Wells; from Newton Abbott to Torquay and Dartmouth; and from Truro to Falmouth. On the north the chief offshoots are—from Maidenhead to Oxford *viâ* Thame; Yatton to Clevedon; Puxton to Weston-super-Mare, a rising watering-place; Taunton to Minehead, for Lynton and the picturesque North Devonshire coast; and from Taunton to Barnstaple and Ilfracombe *viâ* Dulverton. Besides these, there are many other branches of secondary importance, which it is scarcely necessary to mention here.

The second main route of the Great Western is that deflecting from the line we have just described at Swindon, and proceeding up the Stroud valley to Gloucester, thence trending south-west and west through Newport, Cardiff, Neath, Llanelly, and Carmarthen Junction

to New Milford. Much of the traffic, however, between South Wales and London is conducted through the famous Severn Tunnel, and by this route trains continue along the first of our main routes, through Bath and Bristol (Stapleton Road), dive below the Severn, and emerge at Severn Tunnel Junction, nearly ten miles east of Newport. On this main line there are several branches, but scarcely any of the first importance, generally being of more account from a mineral than from a passenger-traffic point of view. Of greater consequence, however, are those from Newport to Pontypool Road, with the deflecting portions going north and east to Hereford, and by way of Malvern to Worcester, and going west through Merthyr and Neath to Swansea; and the line between Gloucester and Hereford *viâ* Ross.

Our third main line is the most valuable of all. It leaves the Exeter route at Didcot, and runs north through Oxford, Leamington, and Warwick to Birmingham. From this important centre it continues northwards past the thickly-studded towns of the Black Country and Shrewsbury, runs through the far-famed vale of Llangollen, touches Chester, and finally reaches Birkenhead. Few main lines of similar length have so many populous or interesting places on their route. The branches are numerous, and generally leave the main line on the west. From Oxford a line runs to Chipping Norton Junction, at which point one line goes west to Cheltenham, and another north to Worcester, and then along the Severn Valley line past Bridgnorth to Shrewsbury, there joining the direct route *viâ* Birmingham. The other branches of importance are:—Warwick to Stratford-on-Avon; Birmingham and Wolverhampton, *viâ* Stourbridge, Kidderminster, and Droitwich, to Worcester, there connecting with lines to the west and south; Wellington to Market Drayton, and over the North-Western to Crewe—thus securing a ready means of access to Manchester; Ruabon to Bala and Dolgelly, through the delightful scenery of Wales. Besides these, there are others of less consequence, and numerous small offshoots in the Birmingham district, which form a local network. The company are also joint owners with the London and North-Western Railway of certain lines in Wales, over which a through service of expresses runs between Manchester, Liverpool, and the north, and Bristol and the south-west.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—There is such a large number of important towns on the Great Western that perhaps the most concise method of treating the services thereto will be as shown in the concluding table of this section. In discussing the distinguishing features of the three main routes described above, we find that the first has excellent express services; the second, distinctly poor; and the third, tolerably good. Along or adjacent to the first route we have such populous centres or thriving ports as Reading, Bath, Bristol, Weymouth, Taunton, Exeter, and Plymouth. In the annexed summary will be found a succinct view of the facilities afforded by the company to these places. Until two or three years ago this service to the west and south-west was the reverse of creditable, but with the establishment of the 10.15 a.m. down and 7.50 p.m. up, and the removal of third-class restrictions from the two up and down 4¼-hours Exeter expresses, a marked improvement took place. The popular seaside resorts of Weston, Ilfracombe, Torquay, and the South Devon coast generally, are made readily accessible by these convenient trains. Weston is now within some 3½ hours from London (137½ miles) by the fastest train; Ilfracombe (232½ miles) is just over 6½ hours away; and Torquay (220 miles) 5 hours. Thus, considering their distance from London, these health resorts are by no means badly treated. The service to Plymouth also is a really excellent one, bearing in mind that the Plymouth trains are run for Plymouth alone, there being further west no towns of any importance all the way to that Ultima Thule, Penzance, and this also is still within the reasonable time of 9 hours from Paddington, although in 1891 it could be reached in 8 hours 40 minutes.

It is not a little curious to look back from the year 1892—which has witnessed the complete abolition of the broad gauge on the Great Western system—to the year 1848, when the gauge on which Brunel so greatly prided himself was at its zenith. At that time the speed from London to Bristol and Exeter was about as high as now, but, as a matter of course, with vastly lighter loads. We give below in parallel columns the services for the years 1848 and 1884, at both of which dates the line to Exeter was broad gauge. For these figures we are indebted to an article entitled *Train Services, Old and New*, published in a railway journal about eight years ago. A further comparison with our figures for 1892 may be instituted.

## PADDINGTON AND EXETER.

### DOWN TRAINS.

| Miles. | | | October, 1848. | | July, 1884. | |
|---|---|---|---|---|---|---|
| | | | A.M. | P.M. | A.M. | P.M. |
| — | Paddington | *dep.* | 9 50 | 5 30 | 11 45 | 3 0 |
| 35¾ | Reading . | *arr.* | — | — | [5 p.m. from | |
| — | Ditto | *dep.* | — | 6 13 | Paddington | |
| 53 | Didcot | *arr.* | — | — | reaches Exeter | |
| — | Ditto | *dep.* | 10 47 | 6 35 | at 10 20.] | |
| 77 | Swindon | *arr.* | 11 15 | 7 5 | 1 12 | 4 27 |
| — | Ditto | *dep.* | 11 25 | 7 15 | 1 22 | 4 37 |
| 93¾ | Chippenham | | 11 47 | 7 35 | — | — |
| 106¾ | Bath . | | 12 7 | 7 53 | 1 58 | 5 15 |
| 118¼ | Bristol . | *arr.* | 12 25 | 8 12 | 2 21 | 5 36 |
| — | Ditto | *dep.* | 12 30 | 8 15 | 2 26 | 5 41 |
| 136¾ | Weston Junction | | — | — | — | — |
| 145¼ | Highbridge Junction | | — | — | — | — |
| 151¼ | Bridgewater | | 1 10 | 8 55 | — | — |
| 163 | Taunton . . | | 1 35 | 9 15 | 3 21 | 6 35 |
| 179 | Tiverton Junction | | — | — | — | — |
| 193¾ | Exeter | *arr.* | 2 15 | 10 0 | 4 0 | 7 14 |

| | 1848. | 1884. |
|---|---|---|
| Number of trains from Paddington to Exeter | 9 | 9 |
| | H. M. | H. M. |
| Average time of journey . . | 6 56 | 6 21 |
| Fastest train | 4 25 | 4 14 |
| Slowest train | 11 55 | 10 0 |

### UP TRAINS.

| Miles. | | | October, 1848. | | July, 1884. | |
|---|---|---|---|---|---|---|
| | | | A.M. | P.M. | A.M. | P.M. |
| — | Exeter | *dep.* | 6 30 | 12 0 | 10 30 | 3 55 |
| 14¾ | Tiverton Junction | | — | — | — | — |
| 30¾ | Taunton . . | | 7 8 | 12 40 | 11 12 | 4 37 |
| 42½ | Bridgewater . | | 7 26 | 12 58 | — | — |
| 48½ | Highbridge Junction . | | — | — | — | — |
| 58½ | Weston Junction | | — | — | | |
| 60 | Banwell . | | — | — | [4 55 p.m. | |
| 63½ | Yatton . | | — | — | Exeter reaches | |
| 67½ | Nailsea | | — | — | Paddington at | |
| — | Bedminster | | — | — | 10 20.] | |
| 75½ | Bristol | *arr.* | 8 8 | 1 40 | 12 4 | 5 29 |
| — | Ditto | *dep.* | 8 10 | 1 44 | 12 9 | 5 34 |
| 87 | Bath . | | 8 26 | 2 0 | 12 23 | 5 50 |
| 100 | Chippenham | *arr.* | — | — | — | — |
| — | Ditto . | *dep.* | 8 48 | 2 20 | — | — |
| 116¾ | Swindon . | *arr.* | 9 15 | 2 50 | 1 8 | 6 32 |
| — | Ditto . | *dep.* | 9 25 | 3 0 | 1 18 | 6 42 |
| 140¾ | Didcot | *arr.* | — | — | — | — |
| — | Ditto . . | *dep.* | 9 53 | 3 30 | — | — |
| 158 | Reading . | *arr.* | — | — | — | — |
| — | Ditto . . | *dep.* | 10 13 | — | — | — |
| — | Westbourne Park . . | | — | — | — | — |
| 193¾ | Paddington | *arr.* | 11 0 | 4 30 | 2 45 | 8 0 |

| | 1848. | 1884. |
|---|---|---|
| Number of trains from Exeter to Paddington | 8 | 7* |
| | H. M. | H. M. |
| Average time of journey | 6 54 | 5 30 |
| Fastest train | 4 30 | 4 15 (2) |
| Slowest train | 11 38 | 7 30 |

* Not counting auxiliary trains.

The second route is that to South Wales, and, unfortunately for the inhabitants of the southern half of the Principality, it is their only means of access to London. For a long time they were even more neglected than now, and it was not until the opening of the Severn Tunnel that the Great Western thought fit to give these rich mineral districts an express service at all. Undoubtedly, very much greater facilities might be granted, but, there being no competition from London, it seems unlikely that the Paddington management, which is in many respects most conservative, will bestir itself just at present. A glance at our summary will show how much Gloucester, Newport, Cardiff, Swansea, and Milford stand in need of better express facilities. The last two are particularly badly off, not only as regards the services from London, but from Birmingham district, Manchester, and Liverpool, as well. Merthyr, also, is in a very melancholy position. As regards the others, they are scarcely any better, and the connections all round need re-arrangement and improvement to bring them up to modern standards. One encouraging feature is the service arranged with the North-Western between Bristol (with connections from the West) and Manchester, Liverpool, and the north *viâ* the Severn Tunnel, Hereford, and Shrewsbury. In this case we find, notwithstanding stiff gradients, most excellent performances, there being several expresses each way with an inclusive speed of about 40 miles an hour, thus providing .a better cross-country service than the rival route of the Midland Company.

Things are a good deal less sluggish on the third main line—that to Birmingham and the North. Since 1890 several really creditable trains have been added, and it is only the most northern points, such as Chester and Birkenhead, which are left out of consideration. Cheltenham, however, which is reached *viâ* Chipping Norton Junction, is very badly treated indeed.

Looked at as a whole, the Great Western has a higher reputation

for speed with most travellers than it is actually entitled to. Its great faults are the bad treatment accorded to South Wales, and its generally indifferent arrangements for cross-country traffic. In punctuality the line occupies a fairly good place, though the pressure of exceptional traffic throws the company's discipline out of gear, and there is an absence of that strenuous striving after punctuality which characterises the Great Northern and the North Western. We now give the table referred to above showing the company's train services :—

| Between London and | Miles. | Number of trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 miles per hour. | | 40 miles per hour. | | 45 miles per hour. | | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. | Min. | |
| Reading | 36 | 15 | 11 | 8 | 6 | 2 | 3 | 0 | 45 | |
| Bath | 107 | 10 | 11 | 8 | 8 | 5 | 4 | 2 | 15 | |
| Bristol | 118¼ | 11 | 12 | 7 | 9 | 2 | 4 | 2 | 30 | |
| Weymouth | 168¾ | 1 | 2 | None. | None. | None. | None. | 4 | 30 | |
| Taunton | 163¼ | 7 | 8 | 5 | 4 | 3 | 3 | 3 | 35 | |
| Exeter | 194 | 8 | 9 | 6 | 7 | 1 | 3 | 4 | 5 | |
| Plymouth | 246¾ | 4 | 5 | 2 | 2 | None. | None. | 5 | 38 | |
| Gloucester | 114 | 4 | 7 | 1 | None. | None. | None. | 2 | 48 | The distances given are *viâ* Stapleton Road, (Bristol) and Severn Tunnel, which is the route taken by the fastest trains. Connections are, however, given *viâ* Bristol (Temple Meads) and *viâ* Gloucester, the distances by these routes being 1½ and 15 miles further respectively. Trains by all three routes are included in the table. |
| Newport | 143¼ | 5 | 7 | 1 | None. | None. | None. | 3 | 24 | |
| Cardiff | 155 | 5 | 7 | 1 | None. | None. | None. | 3 | 44 | |
| Swansea | 200¾ | 3 | 1 | None. | None. | None. | None. | 5 | 15 | |
| Milford | 270 | 2 | 1 | None. | None. | None. | None. | 7 | 35 | |
| Oxford | 63¼ | 9 | 9 | 4 | 7 | 4 | 7 | 1 | 18 | |
| Worcester | 120½ | 3 | 3 | 1 | 1 | None. | None. | 2 | 58 | |
| Leamington | 106 | 8 | 8 | 4 | 6 | 4 | 2 | 2 | 14 | |
| Warwick | 108 | 8 | 8 | 3 | 2 | None. | None. | 2 | 35 | |
| Birmingham | 129½ | 8 | 8 | 4 | 6 | 2 | 1 | 2 | 43 | |
| Wolverhampton | 141¾ | 5 | 8 | 4 | 6 | 1 | None. | 3 | 7 | |
| Shrewsbury | 171½ | 3 | 5 | 3 | 4 | None. | None. | 3 | 53 | |
| Chester | 213¾ | 3 | 3 | 1 | 1 | None. | None. | 5 | 5 | |
| Birkenhead | 229 | 2 | 3 | 1 | None. | None. | None. | 5 | 31 | |

Like most other railways, the Great Western follows a beaten path with its local services. There is no very heavy suburban traffic near London—what there is runs punctually and frequently enough. On the numerous lines in the company's extensive district fair

punctuality is observed, and doubtless local interests (the importance of which or otherwise we have not attempted to estimate) are duly attended to. The services on some are, perhaps, more or less cramped by single-line working—a large portion of the Great Western system being single line.

(*b*) *Rolling Stock and General Accommodation.*—As regards passenger rolling stock, the Great Western takes rank with the best of English railways. On the main routes, in the London suburban district, and on the principal branches, the carriages are most comfortable, being well cushioned and roomy, and it is only on the less important of the company's lines that we find any really bad coaches. The stock running in the fastest trains compares well with the finest owned by any other railway—even the third-class compartments being frequently decorated with photographs of the "beauty spots" on the system. A "Corridor" train has recently been built to run on the Birmingham and Birkenhead line, providing excellent accommodation for all three classes. Most of the main-line stock on the Great Western is mounted on eight-wheel bogie trucks, and many of the carriages have the clerestory roof, which, although not favourably regarded by some carriage designers, certainly increases the internal dimensions of the compartment, and gives it a more airy appearance. Gas is being rapidly introduced for the lighting of the carriages.

In other departments also the company merit considerable praise. The line is well signalled throughout, and the brake used is the Automatic Vacuum. The station accommodation on the line is good, and some of the roadside stations near London are models of their kind, many of them being tastefully laid out and decorated with flower-beds.

### (3) Locomotive Work.

(*a*) *Speed.*—The greater proportion of the very considerable and highly creditable booked train speeds on the Great Western is concentrated on a comparatively small section of this vast system—namely, from London to Exeter, and from Didcot to Birmingham. Elsewhere, on such lines as the South Wales sections, the connections between Bristol and the North *viâ* the Severn Tunnel, the line to

Chester from Birmingham northwards, the Weymouth section, and on many other parts of the system where an express service is demanded to a greater or less extent, the speed is not by any means high, being generally nearer 40 miles an hour than 45, and the runs are short. We can, therefore, dismiss these sections, and forthwith discuss the higher speeds which are so frequent within the limits named above.

Between Paddington and Swindon the work is admirable. Only 87 minutes is allowed for the 77¼ miles with several of the West Country trains; and some of the others, together with the best South Wales trains, are timed to cover the distance in 90 minutes. Another South Wales express (10.45 a.m. down) is allowed only 62 minutes from Paddington to Didcot (53¼ miles). Beside these frequent excellent trains, the Birmingham expresses use this line as far as Didcot, making their first stop after leaving London at Oxford, ten miles north thereof, and being allowed 78 to 80 minutes. West of Swindon the speed is considerably lower on the average as far as Bristol, owing probably to the rather steeper gradients. The best performance is, perhaps, one from Bristol to Swindon (41½ miles) in 53 minutes. Most of the expresses stop at Bath.

Between Bristol and Exeter the speed is again very high. Most of the trains stop at Taunton, but those which go through are only allowed 86 to 88 minutes for the 75½ miles. There are five trains from Bristol to Taunton (44¾ miles) in 51 minutes, and the other way in 52; and between Exeter and Taunton (30¾ miles) there are several in 38 and 39 minutes. All this is most creditable, and the average is really higher than between London and Swindon, as there are not so many slow trains run as on that section. Beyond Exeter only 85 minutes is allowed for the best train thence to Plymouth (North Road)—a distance of 52 miles. The other way 89 minutes is best. The gradients here are remarkable for their steepness.

North of Oxford the speed is well maintained to Birmingham. The trains generally stop at Leamington, but the 4.45 p.m. down goes through in 79 minutes (65¾ miles). The average time from Oxford to Leamington (42½ miles) is 51 minutes down and 53 up, and from Leamington to Birmingham (23¼ miles) from 29 to 33 minutes, the up trains being slightly faster than the down. This is good work, considering that the gradients to be surmounted are heavier than on the main line to Exeter.

(*b*) *Gradients.*—The Great Western has on the whole an easy track. From Paddington to Bristol the line is nearly level, there being an almost imperceptible rise from London to Swindon, and beyond the worst gradients being 1 in 660 west of Reading, and 1 in 1,320 east of it. After Swindon we have two short but steep descents, 1 in 100, of two miles length each, from Wootton Bassett to Dauntsey, and through the Box Tunnel. From Bristol to Exeter the line is again almost level, the only exceptions being a rise and fall between Bristol and Nailsea, and between Wellington and Tiverton Junction. Below Exeter the character of the road changes altogether, curves and gradients are very severe, there being several miles of 1 in 40; while between Plymouth and Penzance matters are still worse. These two last-mentioned sections, however, do not much concern us, as there is but little express work thereon and the same may be said of that portion of the Great Western second main line which lies west of Cardiff, which has some very severe short stretches. The third main line is almost level to Birmingham, with the exception of the Hatton bank (four miles of 1 in 107). North of the hardware centre there are frequent but very short stretches of 1 in 100, and near Wrexham there are four miles of 1 in 82. This, therefore, is a moderately hard section to work.

Among other important parts of the system may be mentioned the Severn Tunnel line and the route to South Wales *viâ* Stroud and Gloucester. On the first of these there are several stiff grades (1 in 80), and the Bristol–North expresses have some hard ground to run over. The Gloucester line is rendered difficult by the well-known Brimscombe bank, which ascends steeply on each side of the tunnel near Stroud.

(*c*) *Locomotives.*—Until May, 1892, the Great Western locomotives were naturally classed as broad- and narrow-gauge. For the broad-gauge expresses the company used the well-known "Lord of the Isles" type, introduced so far back as 1846. There were about 30 of these in use, and the principal dimensions are given below in parallel columns, together with those of some of the latest varieties for use on the narrow gauge, including the new 7-ft. 8-in. singles, which have supplanted the broad-gauge type in express work. These broad-gauge singles were, of course, not used on the severe routes in the south-west, saddle-tank bogie engines with 5 ft. 9 in. wheels and 17 in. by 24 in. cylinders taking their place.

| Dimensions. | 8-ft. Singles, Broad Gauge. | New Narrow-Gauge Express, 7-ft. 8-in. Singles. | 3,206 Class, 6 ft. 4-Coupled. | 3,232 Class, 6 ft. 6 in. 4-Coupled. |
|---|---|---|---|---|
| Cylinders . in. | 18 by 24 | 20 by 24 | 18 by 24 | 17½ by 24 |
| Diameter of driving wheels ft. in. | 8 | 7 8 | 6 | 6 6 |
| Tubes . number | 332 | 245 | 262 | 245 |
| Diameter of tubes . in. | 1⅝ | 1¾ | 1¾ | 1¾ |
| Heating surface, tubes sq. ft. | 1,598 | 1,321·04 | 1,352·70 | 1,264·92 |
| ,, ,, Fire-box sq. ft. | 153 | 123·88 | 116·12 | 102·70 |
| ,, ,, Total sq. ft. | 1,751 | 1,444·92 | 1,468·82 | 1,367·62 |
| Area of fire-grate . sq. ft. | 24 | 20·8 | 19·01 | 15·5 |
| Working pressure . . lbs. | 140 | 160 | — | — |
| Weight available for adhesion . . tons cwts. | 16 0 | 19 0 | 29 2 | 26 4 |
| Weight of engine tons cwts. | 41 14 | 44 4 | 42 10 | 38 4 |
| ,, ,, tender tons cwts. | 30 0 | 32 0 | 32 10 | 32 10 |
| Capacity of tender . galls. | 3,000 | 3,000 | 3,000 | 3,000 |

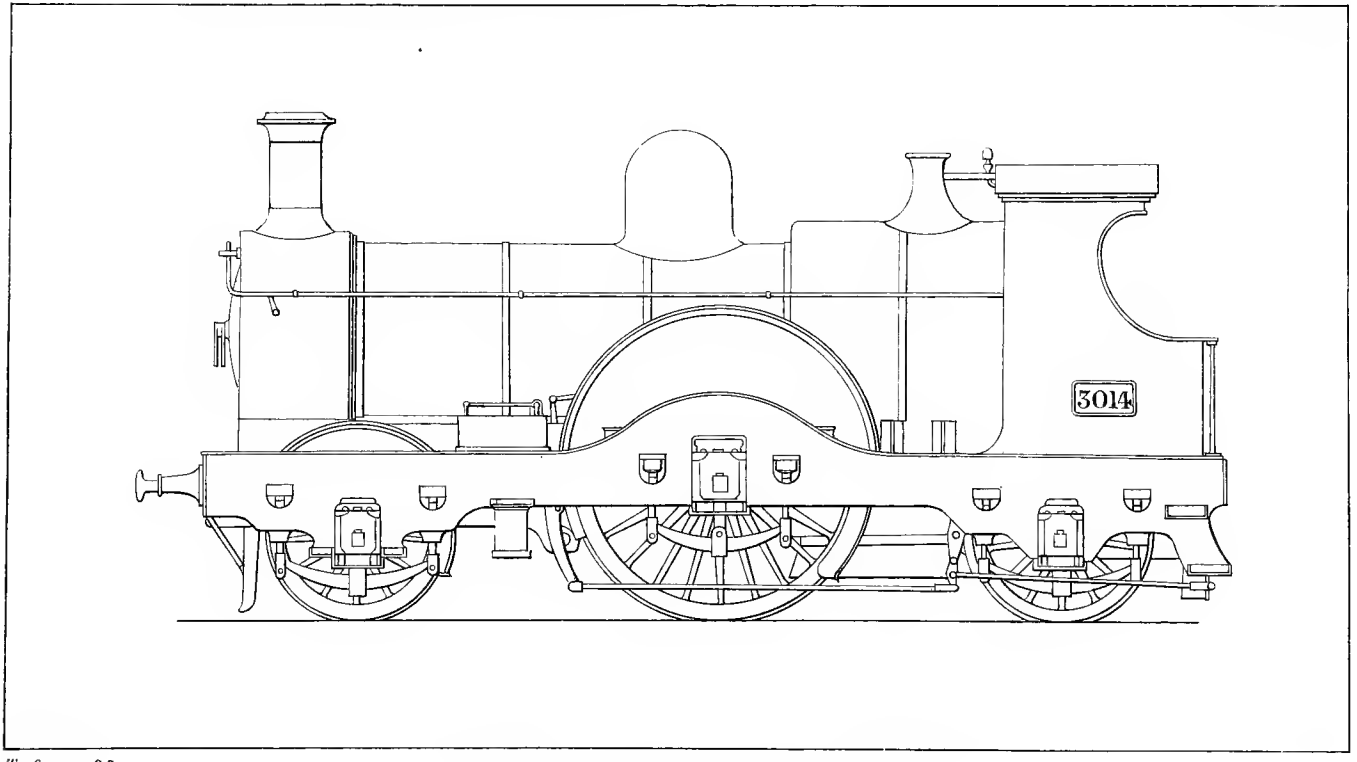
Before the abolition of the broad gauge the narrow-gauge expresses were chiefly worked by 7-ft. "singles," with cylinders 18 in. by 24 in., and this class is still extensively used, and gives the very best results. Some of the finest work in England, generally with heavy trains, has been done by them, and a few performances of this class will be found in the "Actual Performances" section below.

Of the more recent Great Western locomotives it may be said that they are, in general design, of very striking appearance. There is at present no other company so lavish in the display of the brighter metals in the exterior fittings of boiler, framework, etc., to which we were accustomed on almost every line in bygone days, but which in these times does not seem to find favour on other railways. As in the case of the Great Northern, with its slightly more difficult main-line gradients, the single type of engine is that in general use for the fastest trains, and the new 3,000 class in several respects bears a resemblance to the 7-ft. 6-in. singles of recent Doncaster build. Following the old broad-gauge practice, the newer engines seem likely to be more widely known by their name-plate than their number. Their colours are a dark shade of green above and on wheels, with chocolate-brown for wheel-casing and framing. The brake in use is the Automatic Vacuum.

(*d*) *ACTUAL PERFORMANCES.*—Leaving out of account the new 7-ft. 8-in. singles, which have scarcely been running for a sufficiently long period to enable us to say anything definite about their work, but which appear to perform well on the fastest trains, we find that the

# GREAT WESTERN.

Plate VIII.




To face p. 96.

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR W. DEAN.)

7 ft. single is the only narrow-gauge type that has established for itself any great reputation for excellent work on the Great Western. This class is seen to best advantage on the 4.45 p.m. and other expresses from Paddington to Birmingham and Birkenhead. Many of the trains hauled by them are extremely heavy, and the writer knows of a case in which Oxford was reached in 72½ minutes after leaving London (63½ miles), with a load of 16 coaches. Mr. Rous-Marten mentions an instance, as showing the work done on rising grades by an engine of this type, of ascending the Hatton bank (four miles of 1 in 107) with 145 tons in 5½ minutes. A noteworthy performance from Swindon to London with a more than usually heavy load is given in some detail below :—

SWINDON TO LONDON.

ENGINE 1131 (7 FT. SINGLE) AND 22 COACHES.

| Stations. | | Mls. Chns. | Time Due. | Time Actual. | Remarks. |
|---|---|---|---|---|---|
| | | | P.M. | H. M. S. | |
| **Swindon** | *dep.* | — | **3 55** | **4 1 45** | |
| Shrivenham | | 5 58 | — | 4 11 58 | |
| Uffington . | | 5 2 | — | 4 17 54 | |
| Challow | | 2 51 | — | 4 20 58 | |
| Wantage | | 3 39 | — | 4 24 51 | |
| Steventon . | | 3 70 | — | 4 29 3 | |
| **Didcot** . | *arr.* | — | **4 28** | **4 33 38*** | * Swindon to Didcot (24¼ miles) in 31 mins. 53 secs. |
| ,, | *dep.* | 3 33 | **4 32** | **4 37 16** | |
| Moulsford | | 4 52 | — | 4 46 51 | |
| Goring | | 3 51 | — | 4 50 31 | |
| Pangbourne | | 3 22 | — | 4 54 37 | |
| Tilehurst | | 2 71 | — | 4 57 57 | |
| Reading | | 2 53 | — | 5 0 50 | |
| Twyford | | 4 77 | — | 5 6 31 | |
| Maidenhead | | 6 62 | — | 5 14 0 | |
| Slough | | 5 65 | — | 5 20 25 | |
| Langley | | 2 18 | — | 5 22 57 | * Didcot to Westbourne Park (51¾ miles) in 64¾ mins. |
| **Westbourne Park** | *arr.* | 14 76 | **5 37** | **5 42 0*** | |

On the old broad gauge the work done was creditable, though not remarkably brilliant. Time was frequently lost on the fast run from London to Swindon (87 minutes), this being due to the comparatively low tractive force of the broad-gauge "singles." On the return journey, with the road in favour of the train, the booked speed was almost always improved upon, even with the heaviest loads. In fact, the distance has frequently been done in 77 minutes, and once in 76, and it was an everyday occurrence to cover it in 82 to 85

minutes, even with loads equal to 15 or 16 coaches. On up grades, however, the 8 ft. singles were rather at a discount, though the work done, considering the dimensions of the class, cannot be called bad by any means. An average performance from Swindon to London by one of these now extinct engines may prove of interest.

SWINDON TO LONDON.

ENGINE "ALMA" (8 FT. B.G. SINGLE) AND 18 COACHES.

| Station or Milepost. | Time Due. | Time Actual. | Time in Seconds for Intermediate Miles. | Remarks. |
|---|---|---|---|---|
| | P.M. | H. M. S. | | |
| **Swindon** . *dep.* | **1 18** | **1 31 30** | — | |
| 73rd milepost | — | 1 38 54 | — | |
| 70th ,, | — | 1 42 14 | 68, 67, 65 | |
| 65th ,, | — | 1 47 32 | 64, 64, 63, 65, 62 | |
| 60th ,, | — | 1 52 29 | 60, 60, 59, 59, 59 | |
| 55th ,, | — | 1 57 27 | 59, 59, 60, 59, 61 | |
| 50th ,, | — | 2 3 18 | 60, then slowly through Didcot. | |
| 45th ,, | — | 2 8 34 | 64, 63, 62, 65, 62 | |
| 40th ,, | — | 2 13 35 | 61, 60, 60, 61, 59 | |
| 35th ,, | — | 2 18 37 | 61, 60, 61, 58, 62 | |
| 30th ,, | — | 2 23 42 | 63, 62, 61, 60, 59 | |
| 25th ,, | — | 2 28 39 | 60, 59, 58, 60, 60 | |
| 20th ,, | — | 2 33 42 | 59, 61, 61, 61, 61 | Swindon to Paddington ($77\frac{1}{4}$ miles) in 84 mins. 8 secs. |
| 2nd ,, | — | 2 52 40 | — | |
| **Paddington** *arr.* | **2 45** | **2 55 38** | — | |

The Great Western has, in its time, made many record performances. In the palmy days of the broad gauge, when the "Dutchman" was timed to leave Didcot 57 minutes after setting out from Paddington, there used to be some fine running. On one occasion the distance of $53\frac{1}{4}$ miles was covered in 47 minutes. This is probably the fastest start-to-stop run ever recorded, but, considering that the load of the train was extremely light, careful observers will rank it below many recent well-attested performances on other lines.

## IV.

## SOME COUNTRY LINES.

We now leave London for the provinces, to make acquaintance with some of the outside lines. Those we have selected for the present section are :—

(1) *The North-Eastern.*

(2) *The Lancashire and Yorkshire.*

(3) *The North British.*

Between these three lines there are, practically, no points of similarity, and our reason for grouping them together must be that, as they were unclassifiable with any other systems, we resolved to discuss them together on account of their mutual similarity in that one respect.

# I.

## THE NORTH-EASTERN.

### (1) General Description of the Line.

This great system extends in all directions over the north-eastern district of England, and is about 1,550 miles in length. It is almost absolutely without competition, and is, consequently, able to pay high dividends. Over its main line, however, run the East-Coast expresses from London to Scotland, in fierce rivalry with the West-Coast route.

Starting from Shaftholme Junction, near Askern (north of Doncaster), the main route runs through York, Thirsk, Darlington, Durham, and Newcastle to Berwick. The company's expresses in connection with the Great Northern do not start from Askern, but are brought into York by the Great Northern Company. From this point all the way to Edinburgh the North-Eastern takes charge of the running, the last 57½ miles being over North British property. Many branches radiate from this trunk, and are of varying importance—from the little mineral line on which passenger trains are only run as a convenience, to the important section which requires its two or three expresses each way per day. Some of the latter we shall here describe. They are as follows: from Leeds *viâ* Milford Junction and Selby to Hull; from Hull by the somewhat circuitous Yorkshire coast-line through Driffield, Bridlington, Scarborough and Whitby to Saltburn; from York *viâ* Malton to Scarborough—a most important line in the season, with a branch to Whitby from Malton; from Leeds to York; the very important branch (almost a main line in itself) from Leeds through Harrogate, Thirsk or Northallerton and Stockton to Hartlepool; from Newcastle through Sunderland and Wellfield Junction to Hartlepool in the east, and to Stockton and Middlesborough in the south; from Newcastle to Carlisle; from Newcastle to Tynemouth; and from Bilton Junction *viâ* Alnwick to Coldstream. Besides these, there are numerous others, not important as serving large populations, but interesting as opening out

many beautiful localities. Such are those from Harrogate to Pateley Bridge; Northallerton to Hawes; Dalton Junction to Richmond; Darlington to Kirkby Stephen, dividing there into lines for Penrith to the north, and for Tebay to the west; Haltwhistle to Alston; and Berwick to Kelso. The scenery on these sections, together with the beautiful coast-line seen south of Berwick from the through expresses, entitles the North-Eastern to a high position as a picturesque route. To conclude, there are the little mineral lines all over Durham, and a number of agricultural branches in the east and north-east of Yorkshire, which look almost like main routes on Bradshaw's map, but are, in reality, as often single lines as not.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—From what has been stated above, it will be seen that the North-Eastern, although cumbered with numerous lines of merely local interest, possesses an excellent field in which to display its capabilities in the matter of train service. The company, however, do not take advantage of all the opportunities in their hands, and some of the important sections are rather hardly treated. The main-line service is good, if we consider it merely as a means of serving the towns on the North-Eastern system only; but looked at as an integral part of the East-Coast service from London to Edinburgh and Scotland, one must confess that the North-Eastern does less in the way of fast running than either the Great Northern, Midland, London and North-Western, or Caledonian Companies, which are also engaged in the through Scotch traffic. We give below a table showing how, taking York as a centre, other towns are served from this point. It will be noticed that the communications might be improved in many ways, especially from York to the important coast towns.

We have always considered that Leeds was badly treated by the North-Eastern. Owing to their lack of energy, the rival Midland route is able to secure a great part of the traffic from this important town to Scotland. Leeds is also very badly connected with Newcastle, Sunderland, Hartlepool, and the Durham, north-east Yorkshire, and Tyneside populations generally, the fastest connection between it and Newcastle taking over two and a half hours *viâ* York ($105\frac{3}{4}$ miles), and between it and Stockton 95 minutes for $64\frac{3}{4}$ miles. The others are much slower. The average is rather under than over an inclusive speed of 35 miles an hour between these points. The

connections between Leeds and Hull and Leeds and Scarborough are somewhat better, but are capable of improvement.

Newcastle, of course, is well connected with the towns on the main route, but greater facilities are needed to east and south Yorkshire than at present exist. Stockton, Sunderland, Hartlepool and Middlesborough, all having the misfortune to be on branches, are badly, or at best moderately, served from nearly all places on the system. Indeed, the North-Eastern services may be summed up when we say that on the main line a good and fast supply of trains is provided, but on the branches, however important, the services are much poorer and not up to requirements. For instance, on the Newcastle and Carlisle section, the fastest train takes 110 minutes to cover 60 miles, and many of the others are much slower.

We now present a tabular statement showing the services between York and the chief points on the system.

| Between York and | Miles. | No. of Trains at or over | | | | | | Fastest. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hr. | | 40 mls. per hr. | | 45 mls. per hr. | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. Min. | |
| Leeds | 25½ | 8 | 5 | None. | None | None. | None. | 0 40 | |
| Normanton | 24½ | 9 | 4 | 1 | 1 | None. | None. | 0 35 | |
| Hull (*viâ* Market Weighton) | 42 | None. | None. | None. | None. | None. | None. | 1 30 | |
| Scarborough | 42¾ | 6 | 6 | 2 | None. | None. | None. | 1 0 | |
| Whitby | 56¾ | None. | None. | None. | None. | None. | None. | 1 45 | |
| Darlington | 44 | 11 | 10 | 10 | 7 | 7 | 3 | 0 51 | These places are on direct route to the north, and are consequently much better served than the other points mentioned, which are on branch lines. |
| Durham | 66 | 6 | 7 | 2 | 2 | 1 | None. | 1 28 | |
| Newcastle | 80¼ | 13 | 11 | 8 | 6 | 5 | 4 | 1 37 | |
| Berwick | 147 | 8 | 6 | 5 | 4 | 2 | 4 | 3 3 | |
| Middlesborough | 50¾ | 1 | 1 | None. | None. | None. | None. | 1 17 | |
| North Stockton | 47¾ | 1 | 1 | None. | None. | None. | None. | 1 12 | |
| West Hartlepool | 59 | 1 | None. | None. | None. | None. | None. | 1 38 | |
| Sunderland (*viâ* Durham). | 81 | 4 | 1 | 1 | None. | None. | None. | 2 1 | |

Punctuality is not a strong point with the North-Eastern. There seems to be a sort of happy-go-lucky discipline in force on their local and branch lines. Trains are regularly five to ten minutes late. This is certainly not much—but at the same time it shows that there is no right discipline in these matters, and without attention to these little

details railway management is not a success. Then we find the same thing happening to the very important through expresses. They are handed to the North-Eastern at York, for conveyance northwards, with great punctuality. This is not retained long, and at Edinburgh their lateness is simply astonishing. The writer happened to be in that city during the summer of 1890, and was surprised to notice that the arrival of the south trains from 20 to 50 minutes late was of daily occurrence. The trains for London were in an even worse plight. That marvellous railway, the North British, which at that time, apparently, never felt at home unless its trains were an hour or so late, did not hand the trains to the North-Eastern with the slightest approach to punctuality. Once away from Edinburgh the North-Eastern frequently lost time in running, and on the arrival at York the trains were late beyond retrievement. This method of dallying with important expresses, so unlike what one sees on the high-pressure North-Western and Caledonian systems, has told greatly on the East-Coast traffic since that time. The crisis was reached in September, 1890, when no fewer than 68 per cent. of the trains arriving at King's Cross from Scotland were over 30 minutes late. Many of them, doubtless, were over 130 minutes late.

The North-Eastern local services are generally more remarkable for frequency than for punctuality. Many of the branches are exceedingly well served with trains, and no one can accuse the company of treating their district badly because it is in their power to do so. At Newcastle there is a very large local service to be dealt with.

(*b*) *ROLLING STOCK AND GENERAL ACCOMMODATION.*—The North-Eastern passenger rolling stock usually affords excellent accommodation. We shall make a few remarks on the deservedly-admired stock jointly owned by the three East-Coast companies later on. On the small branches certainly many of the old coaches are not so roomy as they might be, but, generally speaking, the stock is extremely comfortable. Few modern improvements have yet been introduced, however, and, at the time of writing, coaches fitted with lavatories are rarely seen, and it is only lately that the directors have come to the conclusion that gas is superior to oil as an illuminant. In another important point, however, the company fully satisfy requirements. There are few safer lines in the kingdom, every carriage has the Westinghouse brake, and the permanent way is well maintained. The line is also carefully signalled, and a noteworthy feature is the liberal accommodation provided at the principal stations. York in particular is universally admired, and generally

allowed to be the finest station in England. Durham, Darlington, Hull, Sunderland, Tynemouth, and Newcastle are also well up to modern requirements.

### (3) Locomotive Work.

(*a*) *Speed.*—On the main line of the North-Eastern Railway there is a very creditable amount of booked speed at high rates, although the line in this respect does not come up to the standard of the other English companies engaged in the through traffic to Scotland. Quite a number of instances of booked speed over 45 miles an hour could be given, and there are several over 48, including one or two which touch 50. Considering the generally heavy loads on the system, this must be considered creditable. Among the best runs are those of the down day Scotch express from York to Newcastle (80¼ miles) in 97 minutes, and the down night express in 99 minutes; another down Scotch express from York to Darlington (44 miles) in 53 minutes, and two up in 51 and 52 minutes, and Newcastle to Darlington (36¼ miles) by one train in 44 minutes.

North of Newcastle the average speed is lower, but the best runs between that point and Berwick are creditable, taking generally about 80 minutes (66¾ miles). One down train, however, has the short allowance of 77 minutes only. Between Berwick and Edinburgh the average booked speed is only poor, the best trains being allowed 75 to 80 minutes (57½ miles), and many of the others much more.

There is no remarkable speed for us to chronicle on the other parts of the North-Eastern system. Booked speeds rarely get above 40 miles an hour, and there is too little even at that rate.

(*b*) *Gradients.*—From York the main line rises gradually for 55 miles to near Ferryhill on gradients averaging 1 in 600. In this stretch there are several short drops on very easy inclines. After Ferryhill the line descends for six or seven miles more steeply, then rises five miles averaging 1 in 150, and after this follows a drop of eight miles of 1 in 150, and easier into Newcastle.

Leaving Newcastle the line mounts gradually for about 10 miles, followed by undulations of 1 in 250, 1 in 228, and easier for 25 miles, with a general downward tendency, then mounts steeply five miles of 1 in 170, drops three of 1 in 150, and is then level, or nearly so, for about 10 miles. The next 13 miles to Berwick consists of a descent and ascent of equal lengths, averaging 1 in 200. Then we have nearly five miles of 1 in 190 up, and about four miles level, followed by eight miles a good deal of which is of 1 in 200 up to

Grant's House, the highest point on the main line. Five miles, nearly all at 1 in 96 down, followed by one and a half miles at 1 in 210 down, succeed this. The rest to Edinburgh, except a short piece of 1 in 78 entering that city, is composed of easy undulations.

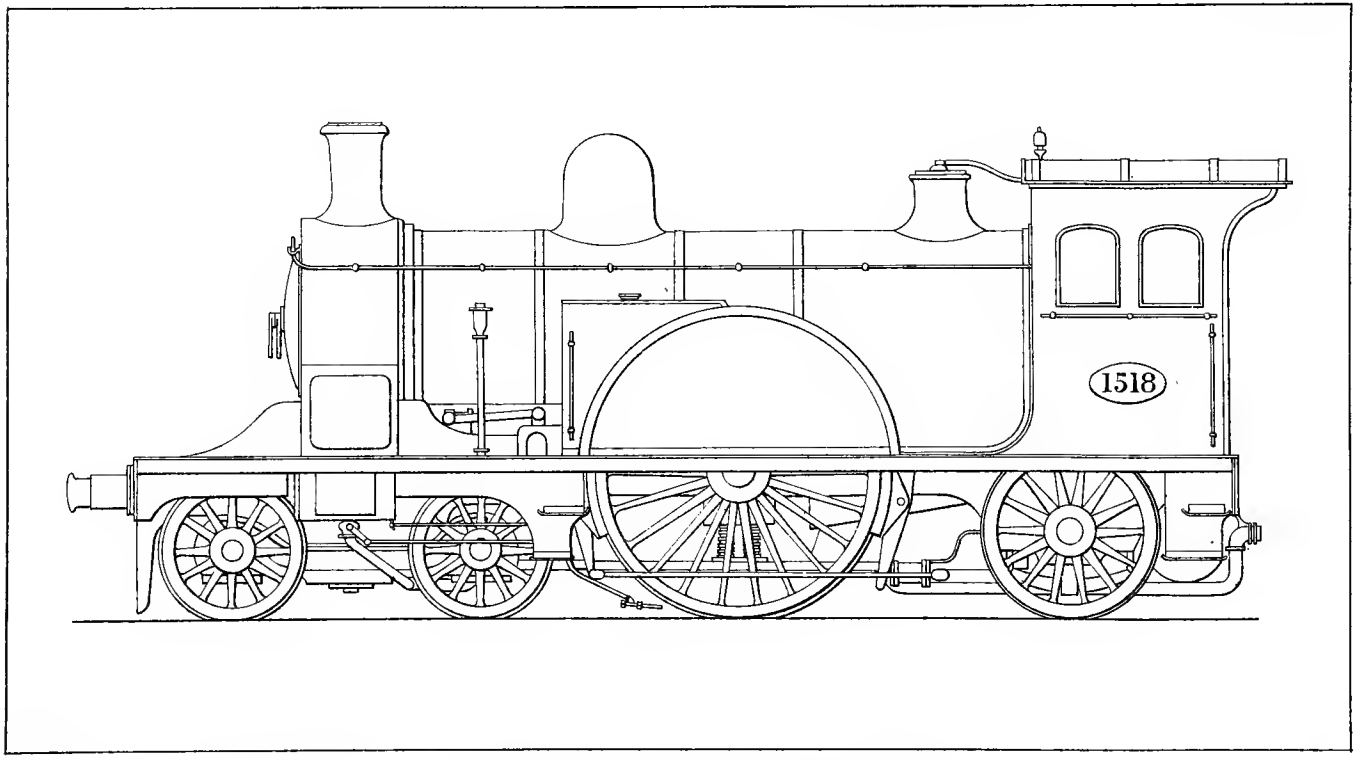
It will thus be seen that the North-Eastern main line is tolerably easy as far as Berwick, but after that point it becomes harder, though not by any means a severe route. The branch lines are in general much steeper than the main route, and one of them in particular—the line from Darlington to Tebay—reaches, by gradients of 1 in 50, the highest point touched by any English railway. This is on Stainmore, no less than 1,365 feet above sea.

(*c*) *LOCOMOTIVES.*—Since the accession of Mr. T. W. Worsdell to office as Locomotive Superintendent of this line, the power and weight of the North-Eastern locomotives have greatly increased. Before his time there was a number of types in use, the best-known of which were Fletcher's seven-feet coupled expresses, with cylinders 17 by 24 inches. But these dimensions look insignificant when compared to Mr. Worsdell's locomotives, which are mostly of the compound type, and are divisible into three classes. They are as follows :—

| Dimensions. | Mr. Worsdell's 1520 class of singles. | Mr. Worsdell's 7-ft. singles. | Mr. Worsdell's coupled express. |
|---|---|---|---|
| Cylinders, High Pressure . . in. | 20 by 24 | 18 by 24 | 18 by 24 |
| ,, Low ,, . . . in. | 28 by 24 | 26 by 24 | 26 by 24 |
| Diameter of drivers . . ft. in. | 7 7¼ | 7 1¼ | 6 8 |
| Number of Tubes . . . . . | 203 | 203 | 242 |
| Diameter ,, . . . . . in. | 1¾ | 1¾ | 1¾ |
| Heating Surface, Tubes . sq. ft. | 1,016 | 1016·12 | 1,211 |
| ,, Fire-box . sq. ft. | 123 | 110 | 112 |
| ,, Total . . sq. ft. | 1,139 | 1126·12 | 1,323 |
| Grate Area . . . . sq. ft. | 20·7 | 17·23 | 17·3 |
| Weight on Drivers . . . tons, &c. | 17 15 0 | 17 10 0 | 17 5 0 |
| | — | — | 13 12 0 |
| Boiler Pressure . . . . . lbs. | 175 | 175 | 160 |
| Total Weight of Engine . tons, &c. | 46 13 2 | 43 0 0 | 46 9 0 |
| ,, Tender tons, &c. | 40 1 0 | 34 8 0 | 34 8 0 |
| Coal Capacity . . . . tons | 5 | 4½ | 4½ |
| Tank and Well Capacity . . gallons | 3,940 | 3,038 | 3,038 |
| Height . . . . . ft. in. | 13 | 13 | 13 1 |
| Length over all . . . . . ft. in. | 53 9¼ | 52 0⅜ | 52 11⅜ |
| Diameter of Bogie Wheels . ft. in. | 3 7¼ | 3 7¼ | 3 7¼ |
| ,, Tender ,, . ft. in. | 3 9¼ | 3 9¼ | 3 9¼ |
| Notes . . . . . | — | — | No. 777 is a non-compound loco. with 18 by 24 cylinders, and other dimensions varying slightly. |

# NORTH EASTERN.

Plate IX.




To face p. 106.

TWO-CYLINDER COMPOUND EXPRESS.

(DESIGNED BY MR T. W. WORSDELL.)

It will be noticed that the dimensions are well-nigh colossal, especially in the case of the 1520 class of singles, which are almost the heaviest passenger engines in the country, and much superior to any work they have to do on the North-Eastern.

But besides these heavy passenger types, Mr. Worsdell has built nearly 200 goods engines on the compound principle and many tank engines suitable for either short passenger journeys or for shunting purposes. All of them are unusually symmetrical in design, and are painted a bright green. The Westinghouse brake is used.

(*d*) *Actual Performances.*—In everyday work nothing out of the common occurs on the North-Eastern. Mr. Rous-Marten gives an excellent example, however, of the work done by the old seven-feet coupled class with 17-inch cylinders. It appears that one of these ran from Newcastle to York (80¼ miles) in 92 minutes, with a load of 180 tons, the last 44 miles taking 48 minutes of this, although generally on a falling grade. The writer has not had the good fortune to record anything so creditable as this: his best performances with this class are from York to Newcastle in 107 minutes with 19 coaches, and from Newcastle to Edinburgh with two engines and 21 coaches in 158 minutes (124 miles).

To get the North-Eastern at its best one must turn to the records of the famous race to Edinburgh in August, 1888. Some doughty deeds were then done, although the semi official statements in the *Engineer* of November 23rd, 1888, are a trifle exaggerated. We are in possession of complete information regarding the running throughout the month, but, as it is of a private nature, must content ourselves with giving the details contained in the following table:—

| Between | Distance. Miles. | Details of the three best runs, excluding delays. | | | | |
|---|---|---|---|---|---|---|
| York and Newcastle . | 80¼ | 80 mins. | on Aug. | 25 & 31 | | With engine 1475, one of a small class with 7-ft. coupled wheels and cylinders 18 by 24, and 100 tons load. |
| | | 81 | ,, | ,, | 29 | |
| | | 82 | ,, | ,, | 30 | |
| Newcastle and Edinburgh | 124 | 124 | ,, | ,, | 14 | Engines 117 (coupled compound) and 1476 and 140 tons load. |
| | | 126 | ,, | ,, | 31 | Engine 117 and 100 tons load. |
| | | 127 | ,, | ,, | 28 | Engine 1505 and 100 tons load. |

From this it will be seen that, when called upon, the North-Eastern locomotives can give a very good account of themselves. The average time from York to Newcastle during the month was

88 minutes, and from Newcastle to Edinburgh 142 minutes, with an average load of 115 tons.

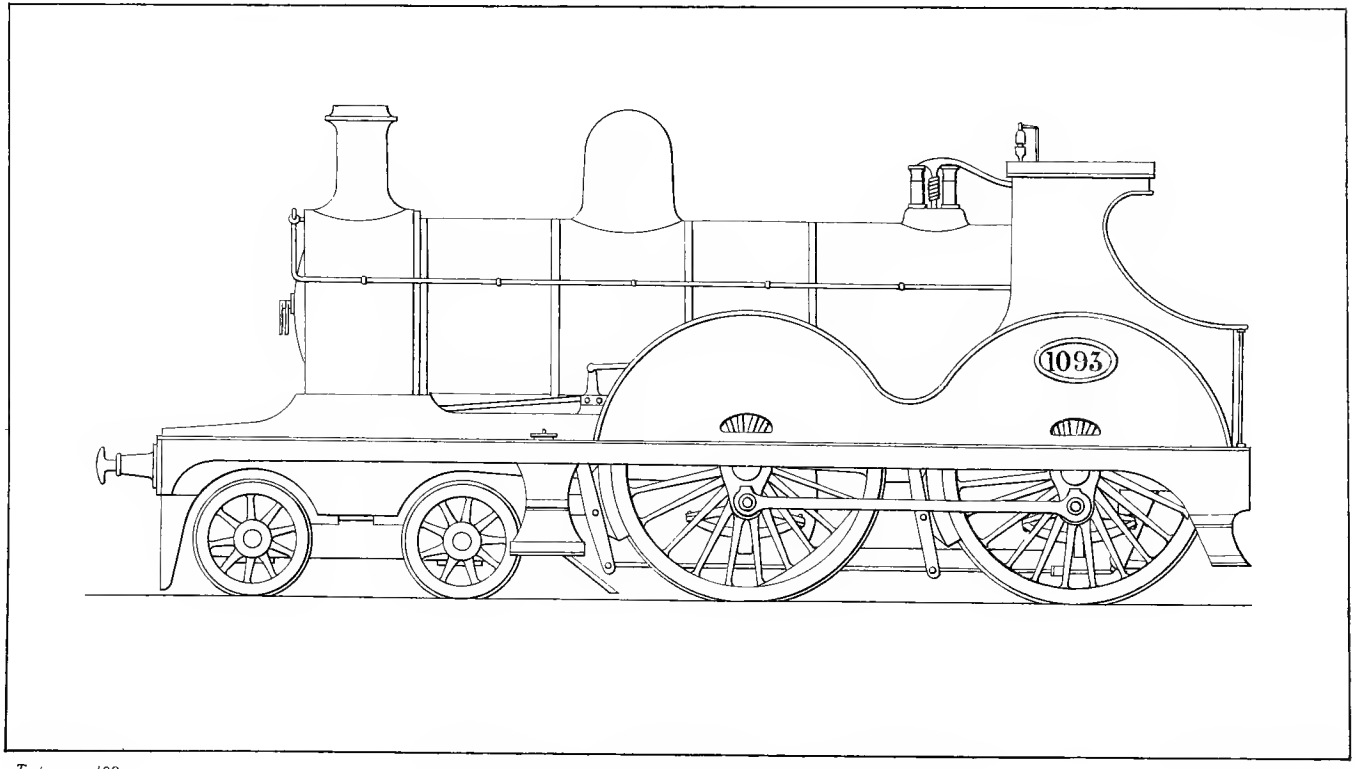
These average times, though excellent, are nothing very remarkable, and fall short of the average times for the month on the Great Northern, and on the two systems forming the West-Coast route, as will be seen when we come to treat of those lines. But as a locomotive's maximum powers are indicated, not by its average, but by its best performance, we must confine ourselves to the actual best work as mentioned above, and for this we have only unqualified praise. To run from Newcastle to Edinburgh in 126 minutes is marvellous, but from York to Newcastle on four occasions in under 82 minutes is still better, and worthy to rank with the phenomenal performances accomplished by the three other lines taking part in that famous race.

Details of two average performances are given below :—

NEWCASTLE TO YORK, 80¾ MILES IN 99½ MINUTES.
YORK TO NORTHALLERTON, 30 MILES IN 35½ MINUTES.

| Engine 269 and 15½ Coaches. | | | | Engine 1479 and 13 Coaches. | | | |
|---|---|---|---|---|---|---|---|
| Stations. | Mls. Chs. | Time Due. | Time Actual. | Stations. | Mls. Chs. | Time Due. | Time Actual. |
| | | A. M. | H. M. S. | | | A. M. | H. M. S. |
| **Newcastle** . *dep.* | — | **12 35** | **1 30 37** | **York** . *dep.* | — | **10 0** | **10 3 51** |
| Chester-le-Street | 8 53 | — | 1 45 53 | Shipton . | 5 45 | — | 10 11 50 |
| Durham . | 5 62 | — | 1 52 6 | Tollerton . | 4 13 | — | 10 16 33 |
| Croxdale . . | 4 18 | — | 1 58 27 | Alne . . | 1 40 | — | 10 18 13 |
| Bradbury . | 7 53 | — | 2 9 0 | Raskelf. | 2 14 | — | 10 20 37 |
| Aycliffe . | 4 53 | — | 2 14 8 | Pilmoor . | 2 59 | — | 10 23 43 |
| Darlington . | 5 32 | — | 2 20 8 | Sessay . . | 1 73 | — | 10 25 53 |
| Dalton . . . | 5 24 | — | 2 2[illegible] 3 | Thirsk . . | 4 12 | — | 10 30 35 |
| Cowton . | 1 58 | — | 2 28 12 | Otterington. | 4 31 | — | 10 35 28 |
| Northallerton . | 7 17 | — | 2 36 27 | **Northallerton** | | | |
| **York** . . *arr.* | 30 1 | **2 15** | **3 10 5** | *arr.* | 3 34 | **10 37** | **10 39 25** |
| Slowly through Durham. | | | | | | | |

Plate X.




To face p. 109.

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR J. A. F. ASPINALL.)

Description p. 115.

## II.

## THE LANCASHIRE AND YORKSHIRE.

### (1) General Description of the Line.

One of the most complex systems in the kingdom is the Lancashire and Yorkshire. Few people outside these two counties know much concerning it, the ordinary public only looking upon the railways which run North and South as being of any account. On these grounds, apparently, Mr. Acworth, in his popular work on railways, omits all mention of this line, though he has since described, in one of the railway papers, a subsequent visit to the comparatively new locomotive works of the company at Horwich. The system reaches a total length of more than 500 miles, and forms an intricate network over the southern portions of Lancashire and Yorkshire, and is the means of inter-communication between most of the large towns of the manufacturing districts. As nearly all its ramifications are important, one can hardly say, strictly speaking, that there is any *main* line. The nearest approach to a main route is the line running from Liverpool to Manchester *viâ* Wigan, and on through Rochdale, Todmorden, and Sowerby Bridge, to Halifax, and thence over the Great Northern to Leeds, with a short section leaving the main route at Low Moor for Bradford. This is the route taken by the through expresses from Liverpool and Manchester to Bradford and Leeds. The York trains from Liverpool deflect from this main route a little beyond Wigan, run *viâ* Bolton and Bury, joining the main route again at Castleton, and connect with the Manchester to York trains at Rochdale. Further on they again leave the trunk line at Sowerby Bridge, and proceed *viâ* Wakefield to Normanton, and then over the North Eastern Railway to York. Leaving this line there are several branches; among others, one from Brighouse to Huddersfield, running for a short distance over the North Western Company's metals, with an extension to Sheffield; another

from Horbury Junction to Barnsley; and a third, from Wakefield through Pontefract and Knottingley to Goole on the eastern coast. There are, besides, several other smaller lines in Yorkshire connecting the large towns together, and the company have extensive running powers over the lines of other companies.

But perhaps the lines in Lancashire are more important than those in Yorkshire. There is, for instance, the very profitable line from Liverpool to Southport; that from Manchester *viâ* Atherton to Southport, which, as far as Wigan, is also used by the Liverpool to Manchester expresses; two lines from Manchester to Bury, continued in one from that point through Ramsbottom (with a branch eastward to Bacup), Accrington and Burnley to Colne, where a connection is formed with the Midland system; from Manchester through Ashton to Stalybridge, and from Manchester through Oldham to Rochdale, with a line thence to Bacup. These lines are all important, but there are others equally so. Such are the routes to Blackpool and Fleetwood in the North-West, and the connection with the Midland system at Hellifield for the North. These three routes run on a common rail as far as Bolton, at which point the two former diverge through Chorley (where there is a branch jointly owned with the London and North Western Company to Blackburn on the right) and Preston, dividing again at Kirkham for Blackpool and Fleetwood, from which latter point there is a cross-Channel service to Belfast and the Isle of Man. The connection with the Midland keeps to the North through Darwen, Blackburn, and Clitheroe to Hellifield. At Blackburn this route is joined by the connection from Liverpool to the Midland line, which passes through Ormskirk and Preston Junction on the way. There is also the cross-country route between Blackburn and Todmorden *viâ* Accrington and Burnley, besides several other lines of comparatively small account.

### (2) Travelling Facilities.

(*a*) *SERVICES BETWEEN CHIEF TOWNS.*—Manchester may be regarded as the great central point of the Lancashire and Yorkshire, and we give below a summary of the services from that city to various other important centres on the system. A glance at this will show that those between Manchester and Liverpool, and Manchester and Southport are most creditable, while those to the Yorkshire towns compare less favourably. But there is no lack of justification for this seeming neglect. On the Lancashire and Yorkshire it is impossible to run—as on the greater number of other

English lines—any considerable distance without stop. The routes are so thickly studded with populous manufacturing towns that the train has barely time to get into speed after leaving one station before another stopping-station is in sight. This it is which restricts the Lancashire and Yorkshire services to a moderate pace, and makes them appear worse than they are in reality. We think, however, that on the principal routes the company do nearly all that could be expected of them; and the comparatively recent opening of the direct route between Manchester and Liverpool with consequent accelerations, added to the conspicuous increase in the briskness of tone on the system in general, fairly entitles the Lancashire and Yorkshire to no inconsiderable amount of praise. The through services from Manchester and Liverpool to Hellifield (for the North and Scotland) are worked by the Midland Company, and will be noticed under that head.

The services between Liverpool and the Yorkshire towns are similar in character to those from Manchester, the best train from Liverpool (*viâ* Manchester) to Leeds or *vice versâ* taking 2 hours 5 minutes for the $85\frac{1}{4}$ miles, and to York (*viâ* Bolton) 2 hours 55 minutes for the $106\frac{1}{2}$ miles.

Besides these services connecting the two great cities of the system with other points of importance, those between the smaller manufacturing centres as among themselves are, when we take into account the heavy gradients, the intricate and frequently-recurring junctions, and the generally complicated nature of the Lancashire and Yorkshire system, very creditable. The inclusive speeds are, as a rule, no higher than 35 miles an hour; but with such obstacles to fast running as we have mentioned, no more can reasonably be desired. The seaside resorts also are by no means neglected. Fleetwood is in direct through communication with Leeds; Scarborough with Liverpool; and Blackpool with almost all places of importance on the system. All this is very admirable, and most of it has been developed in the last few years.

The Lancashire and Yorkshire has, until lately, had no great reputation for punctuality. But of late years there has been a determination to wipe out the record of the past, and substitute another of a more praiseworthy kind. The result is that at present the Lancashire and Yorkshire services are conducted with credit to the company and general satisfaction to the public. It is, in fact, one of those lines, like the London and South-Western, which, after earning the bad opinion of all, seems suddenly to have determined

that there shall not only be no further ground for complaint in the future, but that the commendation of the public shall take its place. We are, therefore, very glad to state that the punctuality of the Lancashire and Yorkshire can now be fairly described as good, and this in spite of a system perhaps the most difficult in England to work.

In the neighbourhood of Liverpool and Manchester the Lancashire and Yorkshire local traffic is heavy, and there are numerous season-ticket holders. The carriages used for this traffic—formerly very bad—still need improvement; and when the company get rid of their too plentiful antiquated passenger stock, their short-distance travellers will have small reason to complain of insufficient accommodation.

The table alluded to above is now given :—

| Between Manchester and | Miles. | Number of trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 miles per hour. | | 40 miles per hour. | | 45 miles per hour. | | | | |
| | | From Manchester. | To Manchester. | From Manchester. | To Manchester. | From Manchester. | To Manchester. | Hr. | Min. | |
| Wigan (*viâ* new line) | 17½ | 6 | 7 | 5 | 4 | None. | None. | 0 | 24 | One up train *viâ* Bolton exceeds 35 miles per hour. |
| Preston . . | 30¾ | 7 | 1 | None. | None. | None. | None. | 0 | 50 | Good service each way at 30 to 35 miles per hour. |
| Southport (direct) | 35 | 7 | 8 | 6 | 5 | None. | 1 | 0 | 45 | One up train *viâ* Bolton exceeds 35 miles per hour. |
| Blackpool (Talbot Road *viâ* Atherton) | 47½ | 2 | 5 | 1 | 2 | None. | None | 1 | 10 | Various routes are taken. Some of the trains run only on certain days of the week. |
| Fleetwood (*viâ* Bolton and Chorley) | 51 | 2 | 2 | 1 | None. | None. | None. | 1 | 15 | Best train runs *viâ* Bolton and Chorley; several others *viâ* Atherton, 50 miles. |
| Liverpool (*viâ* new line) | 36½ | 16 | 15 | 16 | 15 | 16 | 15 | 0 | 45 | Five trains run on certain days of the week only. |
| Blackburn | 24½ | None. | None | None. | None. | None. | None. | 0 | 43 | The best trains between Manchester and Blackburn are worked by the Midland Company. |
| Accrington | 23 | None. | None. | None. | None. | None. | None. | 0 | 38 | |
| Burnley | 29 | None | None. | None. | None. | None. | None. | 0 | 53 | Can also be reached *viâ* Todmorden in from 60 to 70 mins. by best trains. |
| Halifax . | 32¼ | 7 | 8 | None. | 1 | None. | 1 | 0 | 41 | |
| Bradford . | 40½ | None. | 1 | None. | None. | None. | None. | 1 | 8 | Several at from 30 to 35 miles per hour. |
| Leeds . . | 48¾ | 6 | 6 | None. | 1 | None. | None. | 1 | 13 | |
| Huddersfield | 39¼ | None. | None. | None. | None. | None. | None. | 1 | 10 | |
| York. | 75½ | 2 | 1 | None. | None. | None. | None. | 2 | 0 | |

(*b*) *Rolling Stock and General Accommodation.*—As noticed above in our remarks on the local services, the Lancashire and Yorkshire accommodation is very rapidly improving. The old stock —some of the worst in England—is now disappearing, and the new coaches, of which at present the through trains and many others are exclusively made up, are some of the best in England. Exceedingly roomy and comfortable, they are at the same time lighted by gas and provided with the Vacuum brake. The line also is protected by excellent signalling; stations, in many places inadequate, are being rapidly bettered, and the new structures at Liverpool, Bradford, and Blackburn, are evident signs of a long-deferred, but still welcome, increase of enterprise on the Lancashire and Yorkshire.

Another interesting and encouraging feature is the liberal provision of through carriages. No one more truly appreciates the convenience of a through carriage than the traveller who finds he has to change at frequent junctions. So complex a system as the Lancashire and Yorkshire might readily have been excused in this particular; but there is no need of excuse. Nearly all the towns of importance are connected by through carriages with one another, and many of them with points off the system, such as Scarborough, Sheffield, London, and Scotland.

### (3) Locomotive Work.

(*a*) *Speed.*—Few lines during recent years have increased their booked speeds so much as the Lancashire and Yorkshire. Not so long ago this railway possessed no direct route between Liverpool and Manchester, but had to make a detour *viâ* Bolton. By the construction of the new loop from Pendleton to Hindley, trains are enabled to avoid the crowded lines near Bolton, and quicker timings have been put into operation. Thus we now find that trains run hourly each way between Liverpool and Manchester in 45 minutes ($36\frac{1}{2}$ miles) over a road by no means free from gradients. These are very creditable performances, although the trains are light. Over this new line are also run some very fast expresses to and from Southport, the best of which attain speeds well over 45 miles an hour, and in one case 50 is exceeded—St. Luke's, Southport, to Salford ($34\frac{1}{4}$ miles) in 39 minutes. To Blackpool and Fleetwood the service has also been quickened, although the speed here is generally under 45 miles an hour. The fastest trains to Blackburn and Hellifield from Manchester and Liverpool are worked by the Midland Company, and will be referred to later.

East of Manchester the speeds seem considerably lower. This is owing to the number of stops made by the trains, which rarely get a clear run of any length. Many of these short runs are, however, exceedingly smart, and it may always be assumed that they are much better in actual work than their modest 35 to 45 miles an hour speed on paper would lead us to imagine. Exceptions occur now and then, as, for instance, in the case of the 9.42 a.m. from Halifax, which is timed to reach Manchester ($32\frac{1}{4}$ miles) only 41 minutes later.

(*b*) *GRADIENTS.*—As we have previously remarked, the Lancashire and Yorkshire system serves so many large towns at small distances from one another that stops, even with the best trains, are frequent. This being so, it will be unnecessary to refer to the gradients at any great length. Over a considerable extent of the line they are severe, especially in those parts where the system intersects the Pennine range. For the most important section of the line, that from Liverpool to Manchester, we give a gradient profile, furnishing the requisite information, and describe the rather heavy route from Manchester to Leeds below.

From Victoria the line rises for three miles to Newton Heath on 1 in 77, 150, 102, 63, and 135, and thence more gradually (about 1 in 150, with a short piece of level near Middleton Junction) for seven miles to Castleton. An easy ascent of eight miles at about 1 in 330, with short stretches of level, brings us to Walsden, whence to Sowerby Bridge the line falls six miles of 1 in 183 past Mytholmroyd, and six at about 1 in 350. This is followed by three miles rising at 1 in 120 and three of 1 in 200 and 236 past Halifax. The ascent then becomes gradual for four miles, after which the line is more severe, rising at 1 in 150 and 1 in 100 for two miles past Bowling. A descent of seven miles, consisting of four miles of 1 in 100, two of 1 in 150, and nearly a mile of 1 in 50, brings us to Leeds. The route therefore is trying, as the gradients are massed together in tolerably long stretches.

(*c*) *LOCOMOTIVES.*—The number of locomotives necessary to work so complicated a system is largely in excess of that required for a line such as the Great Northern, much of which runs through agricultural districts. They are under the superintendence of Mr. Aspinall, and have recently much increased in size and power. For most of the trains the company use a powerful class with 18 in. by 26 in. cylinders, and fitted with Joy's motion, but just lately a very fine locomotive has been turned out by Mr. Aspinall

# MANCHESTER TO LIVERPOOL.

GRADIENT PROFILE & SPEED RECORDER DIAGRAMS.

L&Y.R.

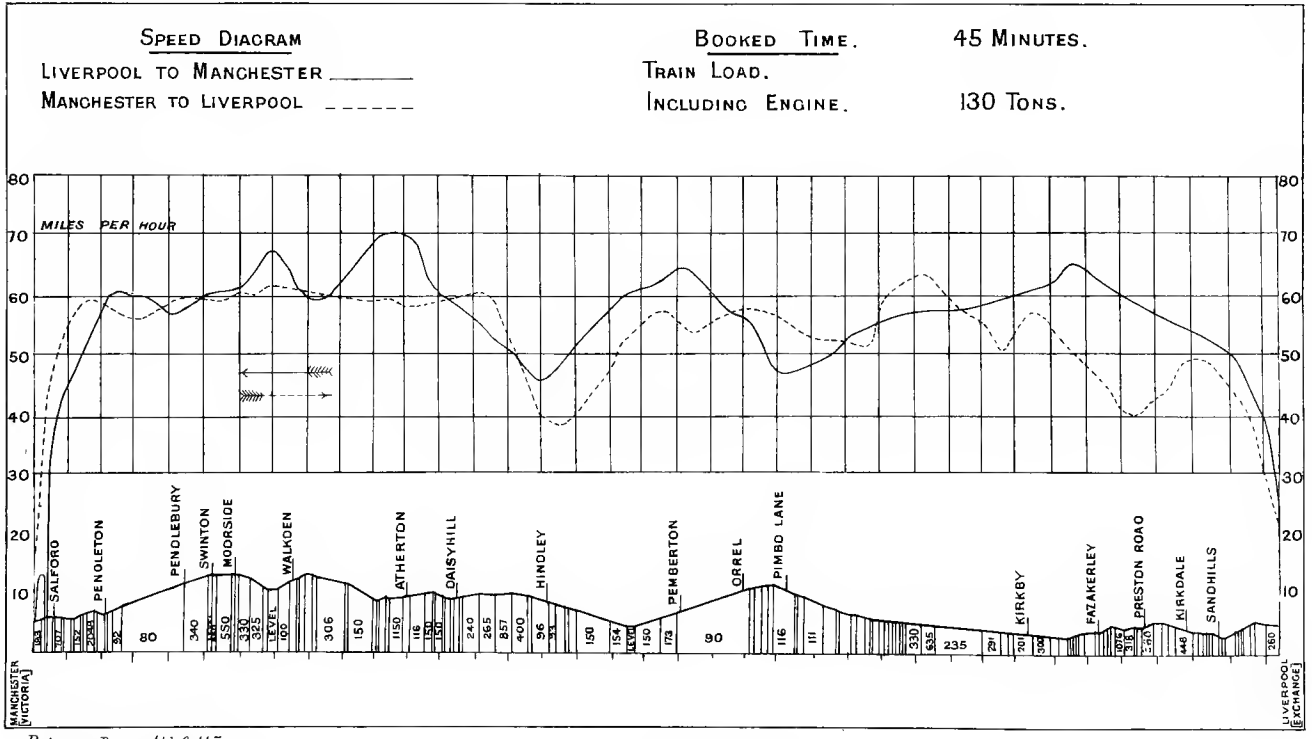



Plate XI.

Between Pages 111 & 115.

for fast express traffic. Dimensions of both these classes are given below :—

| Dimensions. | | 7 ft. 3 in. Coupled. | 6 ft. Coupled. |
|---|---|---|---|
| Cylinders | in. | 19 by 26 | 18 by 26 |
| Driving wheels | ft., in. | 7 3 | 6 0 |
| Heating surface— | | | |
| Tubes | sq. ft. | 1108·73 | 1121·32 |
| Box | sq. ft. | 107·68 | 107·68 |
| Total | sq. ft. | 1216·41 | 1,229 |
| Number of tubes | | 220 | 220 |
| Diameter of tubes | in. | 1¾ | 1¾ |
| Grate area | sq. ft. | 18¾ | 18¾ |
| Boiler pressure | lbs. | 160 | 160 |
| Weight in working order— | | | |
| Bogie | tons, cwts. | 13 16 | 13 16 |
| Driving | tons, cwts. | 16 10 | 15 0 |
| Trailing | tons, cwts. | 14 10 | 14 10 |
| Weight of tender (full) | tons, cwts., qrs. | 26 2 2 | 27 9 0 |
| Water capacity | galls. | 1,800 | 2,000 |

A good deal of the local and short-distance passenger work is performed by a very useful class of tank engine with leading and driving wheels coupled 5 ft. 8 in. in diameter, and with 17½ in. by 26 in. cylinders. Another class has recently been built for the heaviest suburban work with cylinders 18 in. by 26 in., wheels 5 ft. 7 in. in diameter, and front and hind radial axles.

The company's locomotive works are at Horwich. The brake used is the Automatic Vacuum.

(*d*) *Actual Performances.*—Many of the Lancashire and Yorkshire performances do not look so good on paper as they really are. This is because the runs are so short. It is obvious that to run 10 miles in 13 minutes is harder than to run 60 miles in 78 minutes; because, although the speed is actually the same in each case, the loss of time starting and stopping is felt on the short run much more than on the long one. Some of the Manchester to Liverpool and Manchester to Southport expresses, however, furnish us with excellent examples of what the Lancashire and Yorkshire can do when unfettered by continual stoppages. We have two instances where the run from Manchester to Liverpool was done in just over 43 minutes (36½ miles). This, although the load was only about five coaches, is very good, considering the course run over. Elsewhere on the system the loads are heavier, but never extremely so—the average not being over 12 to 13 coaches. As an example

of a fast stopping train we give below a few details of observations made in December, 1889.

| Stations. | | Time Due. | Time Actual. | Mls. | Yds. | Remarks. |
|---|---|---|---|---|---|---|
| | | P.M. | H. M. S. | | | |
| **Todmorden** | *dep.* | **4 0** | **4 4 38** | — | | Engine 880; |
| Eastwood | *pass* | — | 4 6 57 | 2 | 380 | load 12 coaches; |
| Hebden Bridge | *pass* | — | 4 10 35 | 2 | 469 | weather greasy. |
| Mytholmroyd | *pass* | — | 4 11 53 | 1 | 392 | |
| Luddendenfoot | *pass* | — | 4 13 21 | 1 | 1,132 | |
| **Sowerby Bridge** | *arr.* | **4 12** | **4 16 6** | 1 | 1,297 | |
| ,, ,, | *dep.* | **4 15** | **4 20 17** | — | | |
| **Halifax** | *arr.* | **4 22** | **4 26 18** | 4 | 4 | |
| ,, | *dep.* | **4 24** | **4 29 10** | — | | |
| **Low Moor** . | *arr.* | **4 32** | **4 37 59** | 5 | 312 | |

It will be seen from the above that the 9 miles 150 yards from Todmorden to Sowerby Bridge was covered in 11 minutes 28 seconds, and from passing Mytholmroyd to passing Luddendenfoot (1 mile 1,132 yards) only took 1 minute 28 seconds, which equals a speed of 67½ miles an hour. Both these are indeed excellent.

Through the kindness of the Locomotive Superintendent, Mr. Aspinall, we are enabled to give, together with the gradient profile of the line between Manchester and Liverpool, two diagrams showing the running between these points taken by means of a speed recorder. We have also been furnished with similar diagrams of two performances on the section between Manchester and Leeds, but as these simply corroborate our own figures given above from Todmorden to Low Moor, we do not include them here.

# III.

## THE NORTH BRITISH.

### (1) General Description of the Line.

This railway, extending over a length of about 1,000 miles, is the largest in Scotland. It is, however, scarcely the leading system in the northern half of our island—that position being still held by the Caledonian; but of late years the North British has begun to seriously menace the position held by its rival; and, with proper development, its system should in time become the more important of the two. Its lines radiate in all directions from Edinburgh. To Berwick, in the east, is an integral part of the East-Coast system; to Carlisle in the south, through Galashiels and Hawick, is an equally important part of the through Midland route from England to Scotland. The traffic from these two systems is broken up and marshalled at the famous (or infamous) Waverley Station, Edinburgh, and forwarded thence to Glasgow and Helensburgh (for the coast) *viâ* Linlithgow and Falkirk; to Perth (where the Highland Railway gives a connection to the most remote parts of Scotland) *viâ* the Forth Bridge, Dunfermline, and Kinross; and to Dundee and Aberdeen *viâ* the Forth and Tay Bridges. Previous to 1890 the N.B. Company had by no means such direct routes. They were at a serious disadvantage when competing with the Caledonian for the traffic from England, Edinburgh and Glasgow to Perth, Dundee and Aberdeen. This traffic now travels mainly over the Forth Bridge, whereas it formerly went by the Caledonian system *viâ* Larbert and Stirling. The disadvantages, therefore, under which the company

laboured are now no longer felt, and the Forth Bridge, despite its enormous cost, should prove, with good management, an excellent speculation for them.

There are also many other important lines owned by this company. Among these are: from Edinburgh to Glasgow *viâ* Bathgate, Airdrie and Coatbridge; from Glasgow *viâ* Dumbarton to Balloch for Loch Lomond; from Glasgow to Aberfoyle for the Trossachs; from Edinburgh to Galashiels *viâ* Peebles; from Thornton Junction to St. Andrews; from Dunfermline to Stirling; from Stirling to Balloch; and from Carlisle to Silloth. Besides these there are several minor lines in Fife, and quite a number of suburban lines near Edinburgh. Then we have the very important West Highland line, which is to open out the west coast of Scotland, and which will, if extended far enough, compete to some purpose with the present Highland Railway. This new line will not be owned by the North British, but simply controlled and worked by them. Already the works have made great progress, and it will, therefore, not be long before the North British have established themselves in this district also. Quite recently, also, an amicable arrangement with the Caledonian, by which an interchange of working powers will be effected, has been arrived at, and will, no doubt, prove highly beneficial to both systems.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—Taking Edinburgh as our centre, we find that the North British services are fairly good, but at some points stand in need of improvement. Below we give a list showing how quickly and how often the other large Scottish towns can be reached from the metropolis. To Glasgow, Perth, and Dundee the services might be slightly improved, but as they now stand there is no great ground for complaint. To Aberdeen some improvement could be effected, while to Carlisle (for the Midland route to London) the service is an excellent one, but considering that the Caledonian route is three miles longer, and their day express takes half an hour less on the journey, some improvement is necessitated by the competition here. The company's line to Berwick is not used by them for express trains, the North Eastern Company running them over this section.

| Between Edinburgh and | Miles. | No. of Trains at or over | | | | | | Fastest. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hour. | | 40 mls. per hour. | | 45 mls. per hour. | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr Min. | |
| Galashiels | 33½ | 5 | 4 | 2 | 1 | None. | None. | 0 49 | Over heavy gradients. |
| Hawick | 52¾ | 3 | 4 | None. | None. | None. | None. | 1 24 | |
| Carlisle | 98¼ | 4 | 4 | 1 | None. | None | None. | 2 19 | |
| Airdrie | 33¼ | None. | None. | None. | None. | None. | None. | 1 0 | |
| Glasgow | 47¼ | 10 | 8 | 3 | 4 | None. | None. | 1 10 | |
| Helensburgh | 67¾ | 2 | 2 | 1 | None. | None. | None. | 1 35 | |
| Dunfermline (Lower) | 19¼ | 11 | 1 | 1 | None. | None. | None. | 0 28 | Over heavy gradients. |
| Perth | 47¾ | 9 | 4 | 3 | 1 | None. | None. | 1 7 | |
| Dundee | 59¼ | 4 | 2 | 2 | None. | 2 | None. | 1 15 | |
| St. Andrews | 56 | None. | None | None. | None. | None. | None. | 1 40 | |
| Aberdeen | 130½ | 4 | 3 | 2 | None. | None. | None. | 3 13 | |

Looking now to the services from Glasgow to Perth, Dundee, and Aberdeen, we find that the company do not seriously compete with the Caledonian to Perth. They should, however, set about doing so at once, as undoubtedly a great accession of traffic would accrue to them thereby. The best Caledonian trains to Perth, Dundee, and Aberdeen, from Glasgow take 1 hour 32 minutes, 2 hours 5 minutes, and 3¾ hours, respectively; while the North British Company, with only a slightly longer route, can do no better than 1 hour 55 minutes, 2 hours 15 minutes, and 4 hours 20 minutes, respectively. The North British Company thus lag much behind their rivals in the service between Glasgow and the north, as well as between Edinburgh and Carlisle. Perth is reached from Glasgow *viâ* Alloa and Kinross; Dundee and Aberdeen *viâ* the Forth and Tay Bridges

But it is little use commenting on train services when these prove to be only paper services, and when there is no apparent intention of carrying them out in actual practice. There is probably no more unpunctual railway in the British Islands than the North British. What the Great Northern and Midland companies think of the mismanagement in working the through express services we should hardly like to say! Many of the delays are, undoubtedly, due to want of space at the Waverley station. During the summer of 1890 this was daily a scene of the wildest confusion, and we think it is within the mark to say that few trains were ever under half an hour late, and many were frequently from one to two hours

behind time. This state of things continued from June right through the season, and, as most of the trains delayed were through expresses, the block at the Waverley disorganised traffic throughout the kingdom, and its effects were felt equally at Penzance and Wick. So great was the disorganisation that efforts are now being made to enlarge the station, but it will be of little use to do this unless the management wake up to the idea that trains must be run punctually. At present, a journey on the North British is very seldom accomplished without losing time on the road and at stations. The latter are much under-manned, and duties—there being little discipline worth mentioning—are performed in the most listless manner. The author of this work has performed nearly seventy journeys on the Waverley route with the through expresses from the south, and on about sixty has lost time either in running or at stations. In winter things are much better, but directly a press of traffic taxes its energies the North British ignominiously succumbs. The management should realise that it is a great company they control, and not treat its concerns in the haphazard manner indicated. The new General Manager, Mr. Conacher, seems already to have taken some steps in the right direction.

There is no great amount of local traffic on the North British except in the neighbourhood of Edinburgh, where a large passenger. traffic is dealt with. The system mainly consists of through routes, which have been discussed above. Generally speaking, the local services of the company are fairly good, but might be more frequent in many cases. Punctuality in summer is poor, and in 1890 the runnings on the Edinburgh suburban line were so irregular as to be quite a curiosity.

(*b*) *ROLLING STOCK AND GENERAL ACCOMMODATION.*—There is still room for extensive improvement in the North British carriage stock. Spasmodic efforts have done a little in this direction, but the normal state of the coaches is below the average, many on the branch lines unpleasantly recalling the South Eastern and London, Chatham and Dover Railways. Even the new stock turned out by the company is not quite up to modern standards. But great progress has been made in lighting the carriages by gas, and most of the stock has been fitted with the Westinghouse brake. The through stock running to England by the Midland and East Coast routes, however, is excellent, the latter being remarkably so. In other respects one cannot greatly admire the North British. The permanent way might in places be improved, and, until some

few years back, the block system was not provided on many important sections. This, of course, is now much better. The company's stations are often deficient in accommodation, many of the wayside stations on the Waverley route being conspicuously so. But in this respect the Waverley Station itself is "the head and front of the offending." Progress doubtless is being made, but not fast enough, and in many points the North British is greatly inferior to its rival, the Caledonian.

### (3) Locomotive Work.

(*a*) *Speed.*—High-booked speeds on the North British Railway are infrequent, on account of the prevalence of heavy gradients (for which see below). On the Waverley route speed between stations is rarely above forty miles an hour, and this is, perhaps, all that could reasonably be expected. We think the best instance on this section is that of the down Scotch express, which runs from Carlisle to Edinburgh (98¼ miles) in 139 minutes, including a stop at Portobello. Train loads are often heavy, and pilot engines are almost always used for the most severe banks.

North of Edinburgh, the best work on the North British is on the routes to Perth and to Dundee and Aberdeen. On both of these sections there is a fair amount of speed at from forty to forty-five miles per hour. The best instances are the down expresses from Edinburgh to Perth (47¾ miles) in 67, 70 (with one stop), and 72 minutes (with two stops), and the up express in 70 minutes (with one stop); and the two down morning expresses to Dundee (59¼ miles) in 75 minutes (a very creditable performance. Between Dundee and Aberdeen (71¼ miles) the best work is done by two up trains in 105 minutes (each with three stops). It must, however, be mentioned that the up trains from Perth and Dundee to Edinburgh very often fail to maintain these booked times, especially if heavily laden.

On the Edinburgh and Glasgow line there is a fair amount of speed just over forty-five miles per hour between Haymarket and Cowlairs. This is throughout a level course, and the trains are only moderately heavy. On the other parts of the North British system speeds are only poor and might be improved,

especially between such important centres as Edinburgh and Stirling, and Glasgow and Perth.

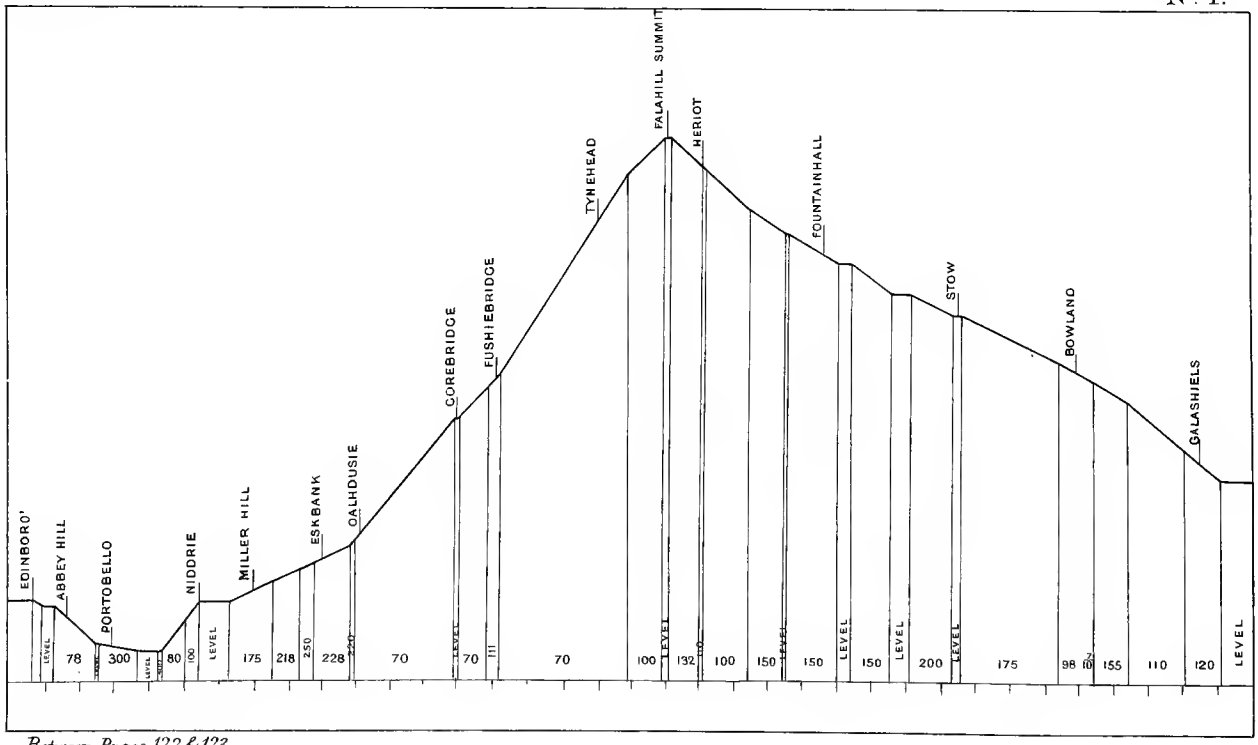
(*b*) *Gradients.*—There is, without doubt, no line in the kingdom over which express trains run so very steep as the North British. The line from Berwick to Edinburgh has been already described under the North-Eastern, as belonging more properly to that company, since their locomotives do all the express work over it. The section between Edinburgh and Glasgow is an exception, being almost a dead level throughout, and greatly contrasting with the rival Caledonian line. But from Carlisle to Edinburgh, as may be seen from the accompanying gradient profile, is a very arduous route. The lines running north to Perth, Dundee, and Aberdeen, can hardly be described as much easier. In fact, the Perth route is, perhaps, harder than the Waverley. From Edinburgh to the Forth Bridge is partly composed of steep undulations, which, after crossing the bridge become worse, and culminate in a three-miles rise of 1 in 80 into Dunfermline. From this point to Kinross there are ups and downs (generally short) of 1 in 78, 85, 88, 132 and 160, after which comes a long rise to Glenfarg, of which much is 1 in 94 and 1 in 110. Thence to Perth is a steep descent, six miles of it being 1 in 74. The Aberdeen route is not so hard as this, but is, nevertheless, sufficiently bad, and has, moreover, the disadvantage of crossing both the Forth and the Tay bridges.

(*c*) *Locomotives.*—These are of a very powerful type, and well fitted to grapple with the difficulties of the North British road. The present superintendent, Mr. Holmes, has more or less adhered to the types of his predecessor, Mr. Drummond, and justly so, we think, considering the numerous classes already on the North British. As mentioned in the article on the London, Brighton and South Coast Railway, there is much similarity between the locomotives of the two companies—Mr. Drummond having at one time assisted Mr. Stroudley. Among the multiform types of passenger locomotives owned by the company those with cylinders 18 inches by 26 and 6-feet 6-inch drivers, with bogies are generally selected for the heaviest work. These were built by Mr. Drummond, and much resemble the bogies built by him for the Caledonian Company. His successor, Mr. Holmes, has built two classes described below, retaining the same cylinder dimensions. Each of these types has about 30 tons available for adhesion, and weighs about 45 tons in working order. Between them these three classes work most of the North British express and heavy fast traffic, although

# EDINBURGH TO CARLISLE.

## GRADIENT PROFILE.

N.B.R. No. 1.




Between Pages 122 & 123.

Plate XII.

# EDINBURGH TO CARLISLE.

## GRADIENT PROFILE.

N.B.R. No 2.

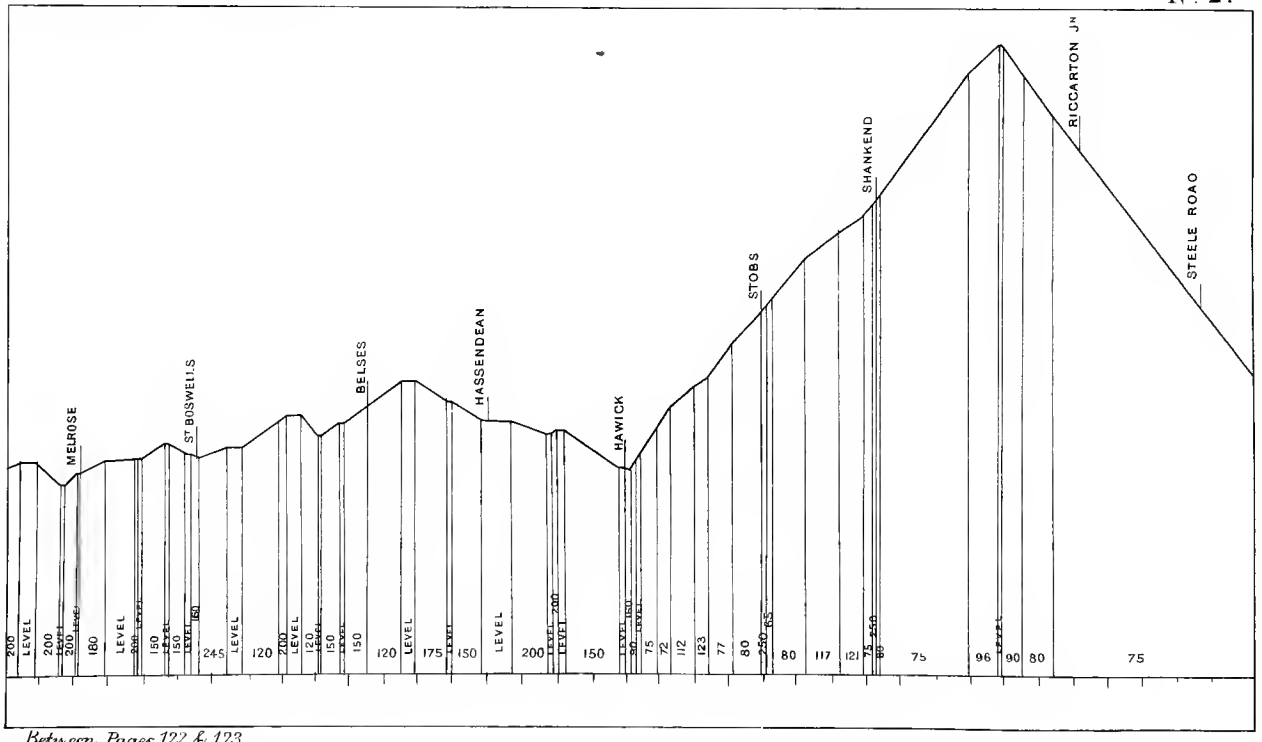



Plate XIII.

Between Pages 122 & 123.

# EDINBURGH TO CARLISLE.

## GRADIENT PROFILE.

N. B. R. Nº 3.

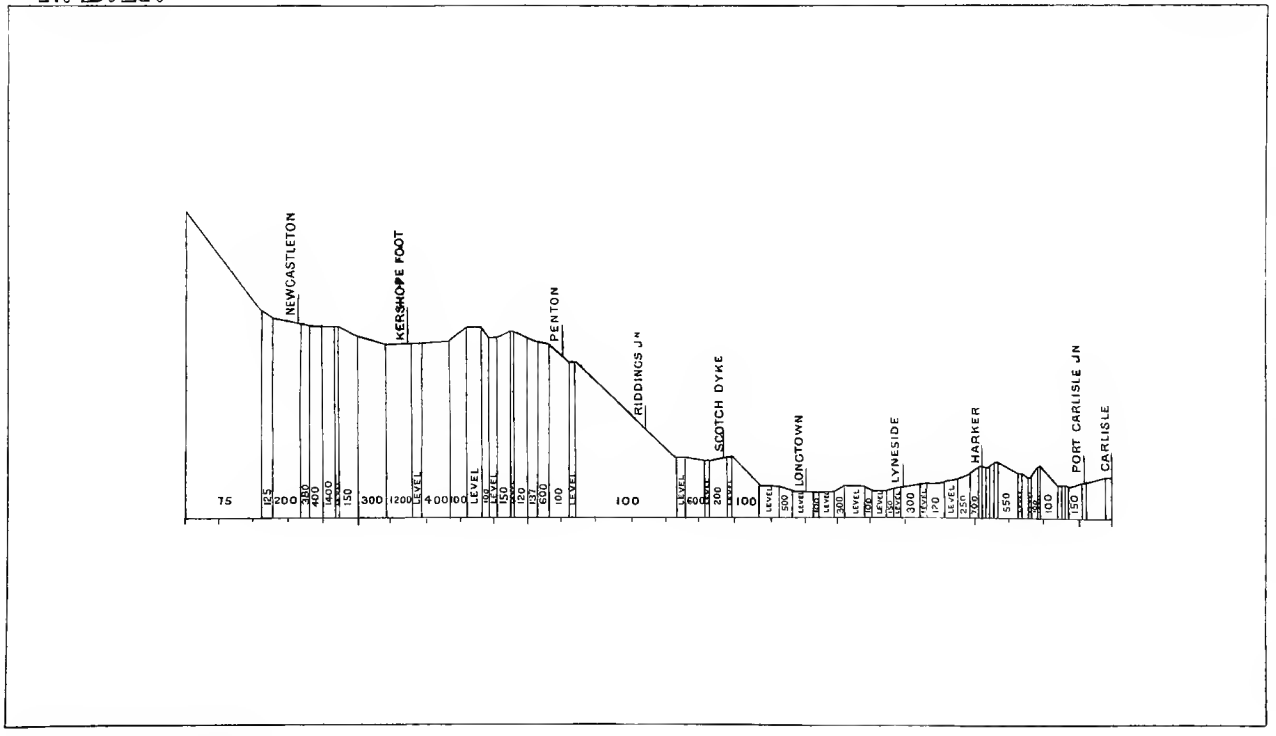



Plate XIV.

*Between Pages 122 & 123.*

there are occasionally seen some of the older types, of which this company has such a variety. The local and short-distance passenger traffic is worked by some suitable descriptions of tank engines; and a very powerful six-coupled class of goods engines performs well on the steep grades so often met with on this system. A few further particulars of the express types are given below:—

| Designer of Class. | Cylinders. | Diameter of Driving Wheels. | No. of Tubes. | Diameter of Tubes. | Boiler Pressure. | Heating Surface. | |
|---|---|---|---|---|---|---|---|
| | | | | | | Tubes. | Fire-box. |
| | | | | | | Sq. Ft. | Sq. Ft. |
| Mr. Drummond . | 18 in. by 26 | 6 ft. 6 in. | 238 | $1\frac{3}{4}$ in. | 140 lbs. | 1,148 | 118 |
| Mr. Holmes . | 18 in. by 26 | 7 ft. | 206 | $1\frac{3}{4}$ in. | 140 lbs. | 1,007 | 119 |
| Ditto . . . | 18 in. by 26 | 6 ft. 6 in. | — | — | 140 lbs. | 1266 | |

(*d*) *Actual Performances.*—It has frequently been remarked that the bogie engines built by Mr. Drummond for the Caledonian Railway seem capable of much better work than the almost similar type also built by him for the North British. The difference, we believe, is more apparent than real, and probably arises from the fact that on the Caledonian every ounce of work is got out of the engine, whereas the more easy-going North British is content to run its trains more slowly and to arrive less punctually. The writer has gone up Beattock Bank (ten miles, averaging 1 in 80) with one Caledonian engine and 17 coaches in 23 minutes, and in 20 minutes with 1 engine and 15 coaches. But the North British trains always stop at Newcastleton for an assisting engine or pilot for the ten miles of 1 in 70, even when the load is only nine or ten coaches. And yet both Caledonian and North British locomotives are almost identical. Occasionally, however, the North British gives us a sample of its real quality. This generally happens about once out of ten or a dozen journeys. Some of these rather rare feats we now give. They are all from personal experience, and it must be remembered that for each of the good performances stated below, we can put against it several bad ones.

On the Edinburgh and Glasgow line the writer's best observations show only moderate work. He has gone from Queen Street to Haymarket, $45\frac{7}{8}$ miles, with 1 engine and 15 coaches, in $60\frac{1}{4}$ minutes, this time including a loss of two minutes by signals. Coming now to the Waverley route, the steep piece from Edinburgh to Falahill

(18 miles) was done in 27 minutes with 2 engines and 15 coaches. This is not so good as the work noted in the other direction, namely, from Galashiels to Edinburgh. This was done with 2 engines and 15 in 47 minutes 22 seconds, of which the $15\frac{1}{2}$ miles up to Falahill, where the pilot detaches, occupied $24\frac{3}{4}$ minutes. With 1 engine and 12 coaches, $46\frac{1}{4}$ minutes was taken, $26\frac{1}{2}$ of them being the time to Falahill; and with 17 coaches and 1 engine, $50\frac{3}{4}$ minutes, $29\frac{1}{2}$ of them to Falahill. Better again is Newcastleton up to Whitrope Tunnel (see profile). These 10 miles took 19 minutes with 2 engines and 15 on, and $17\frac{1}{2}$ minutes with 2 engines and 12 on, in both cases starting from Newcastleton. Up the other side the 10 miles from Hawick was done in 18 minutes 32 seconds, with 2 engines and 20 coaches, the train starting from Hawick and passing Stobs (4 miles) in $7\frac{3}{4}$ minutes, and Shankend (7 miles) in $13\frac{1}{4}$. This is one of the best performances the writer ever accomplished on the North British. The very same train, but with 1 engine and 20 coaches, started from a conditional stop at Steele Road and stopped at Riddings 17 minutes 32 seconds later, a distance of $14\frac{3}{4}$ miles. This might rank with the best performances on other lines. On another occasion, with 17 coaches and 1 engine, we started from Hawick and stopped in Melrose, $15\frac{3}{4}$ miles away, in 18 minutes 23 seconds. A run like this redeems ten or a dozen of the usual North British performances.

With a light load ($7\frac{1}{2}$ coaches) Perth to Dunfermline was covered in $37\frac{1}{2}$ minutes ($28\frac{1}{2}$ miles), the last mile into Dunfermline taking three minutes, and the steep 1 in 74 of Glenfarg being mounted at the steady pace of 34 miles an hour. Lastly, with 16 on, Corstorphine was passed in 18 minutes 50 seconds after leaving Dunfermline, a distance of $15\frac{3}{4}$ miles.

An excellent performance from Edinburgh to Carlisle is given below in some detail. It illustrates North British locomotives at their best, and is further instructive as showing how slowly the station work on this system is generally performed.

## EDINBURGH TO CARLISLE.

| Stations. | | Mls. Chns. | Time Due. | Time Actual. | Remarks. |
|---|---|---|---|---|---|
| | | | P.M. | H. M. S. | |
| **Edinburgh (Wav.)** | *dep.* | — | **2 35** | **2 59 18** | Engines 343 and 488 and 15 coaches. Weather: Fair. |
| Portobello | | 3 0 | — | 3 3 43 | |
| Millerhill | | 3 19 | — | 3 7 55 | |
| Eskbank | | 1 57 | — | 3 10 14 | |
| Dalhousie | | 1 3 | — | 3 11 21 | |
| Gorebridge | | 3 2 | — | 3 16 6 | |
| Fushiebridge | | 0 60 | — | 3 17 15 | |
| Tynehead | | 3 20 | — | 3 23 4 | |
| Falahill | | 1 75 | — | 3 26 30 | Engine 343 detached. Train nearly stopped dead. |
| Heriot | | 1 13 | — | 3 30 12 | |
| Fountainhall | | 3 36 | — | 3 34 0 | |
| Stow | | 4 7 | — | 3 38 26 | |
| Bowland | | 3 10 | — | 3 41 52 | |
| **Galashiels** | *arr.* | 3 61 | **3 26** | **3 45 53** | |
| | *dep.* | | **3 28** | **3 51 38** | |
| **Melrose** | *arr.* | 3 54 | — | **3 57 13** | Engine 488 and 17½ coaches hence. |
| | *dep.* | | **3 35** | **4 7 8** | |
| **St. Boswells** | *arr.* | 3 28 | **3 42** | **4 13 30** | |
| | *dep.* | | **3 44** | **4 18 36** | |
| Belses | | 4 48 | — | 4 26 18 | |
| Hassendean | | 3 30 | — | 4 30 52 | |
| **Hawick** | *arr.* | 4 24 | — | **4 35 27** | Engines 243 and 488 and 19 coaches. |
| | *dep.* | | **4 4** | **4 42 28** | |
| Stobs | | 3 69 | — | 4 50 1 | |
| Shankend | | 3 11 | — | 4 55 35 | |
| Riccarton | | 6 1 | — | 5 5 46 | Slowly through. Engine 243 (in rear) left train at south end of Summit Tunnel. |
| **Steele Road** | *arr.* | 3 44 | — | **5 10 18** | |
| | *dep.* | | — | **5 13 42** | |
| Newcastleton | | 4 45 | — | 5 19 47 | |
| Kershope Foot | | 3 7 | — | 5 23 7 | |
| Penton | | 4 42 | — | 5 28 8 | |
| **Riddings Jctn.** | *arr.* | 2 46 | — | **5 31 14** | |
| | *dep.* | | **4 53** | **5 35 7** | |
| Scotch Dyke | | 2 15 | — | 5 38 57 | |
| **Longtown** | *arr.* | 2 22 | — | **5 41 59** | |
| | *dep.* | | **5 2** | **5 45 55** | |
| Lyneside | | 2 77 | — | 5 51 0 | |
| Harker | | 2 18 | — | 5 53 55 | Twice slacked by signals after Harker. |
| **Carlisle** | *arr.* | 4 31 | **5 20** | **6 1 57** | |

## V.

## THE EXPRESS LINES.

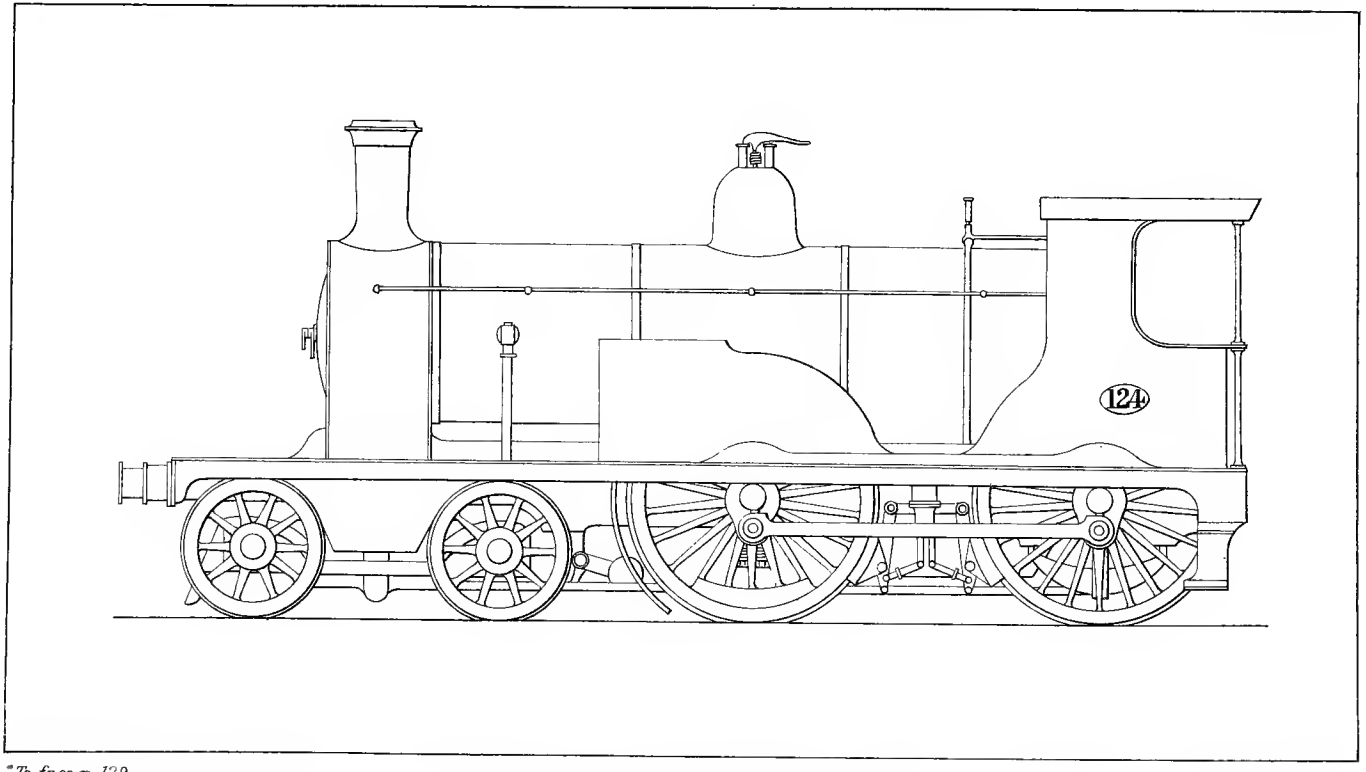
THERE are six railways in Great Britain which stand out so prominently from the rest in express speed that we have here classified them together, in order the more conveniently to compare and test their respective merits. These lines are :—

(1) *THE CALEDONIAN.*
(2) *THE GLASGOW AND SOUTH-WESTERN.*
(3) *THE MANCHESTER, SHEFFIELD AND LINCOLNSHIRE.*
(4) *THE GREAT NORTHERN.*
(5) *THE MIDLAND.*
(6) *THE LONDON AND NORTH-WESTERN.*

Each of these lines has its own special and peculiar speed qualities. The Caledonian train services are good, and its steep gradients afford probably more scope for the highest class locomotive work than any other of the lines mentioned. The Glasgow and South-Western service is, perhaps, the best in the kingdom, considering the comparatively small population areas on its route. Its locomotive work is excellent. With certain modifications the same may be said of the Manchester, Sheffield and Lincolnshire. The Great Northern ranks high for good all-round excellence. The Midland also occupies a good position, but of late has fallen behind a little. The London and North-Western owns, generally speaking, the easiest routes, consequently its competitive trains are not, at times, so fast as they might be, but, on the whole, its locomotive work and train services are of the highest standard and eminently creditable to the premier position held by the company.

# CALEDONIAN.

Plate XV




*To face p 129.*

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR D. DRUMMOND)

*Description p. 135*

# I.

## THE CALEDONIAN.

### (1) General Description of the Line.

This is the leading Scotch system, and extends over more than 700 miles of line. It comprises a main line from Carlisle to Aberdeen, *viâ* Carstairs, Stirling, and Perth. From this the main routes to Edinburgh and Glasgow branch off at Carstairs and Law Junction (or Holytown) respectively. From Glasgow and Edinburgh similar lines join the trunk at Glenboig and Larbert. The other important lines leaving the main route are those from Lockerbie to Dumfries; from Carstairs to Peebles; from Stirling to Oban *viâ* Dunblane, Callander, and Loch Awe; from Crieff Junction to Crieff, and thence to Perth; from Perth to Dundee, and round by Forfar. Not directly connected with the main route are the important sections from Edinburgh to Glasgow *viâ* Midcalder and Holytown Junction; from Glasgow through Paisley to Greenock and Gourock, with a branch to Wemyss Bay; and from Glasgow over the joint line to Kilmarnock, with working powers over the Lanarkshire and Ayrshire from Lugton to Ardrossan. Then there are some minor lines in Forfarshire, and many short pieces in Lanark used chiefly as mineral lines. The company are also owners jointly with the London and North-Western, Midland, and Glasgow and South-Western of the Portpatrick and Wigtownshire Railways, remarks on which will be found under the Glasgow and South-Western Railway.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—To give a proper idea of the express services furnished on the Caledonian system, it will be necessary to furnish two tables—one showing the communications

between Glasgow, as the centre, and the other towns on the system, and the other, those between Carlisle and the North, thus giving an idea of the company's participation in the working of the West-Coast traffic.

From an inspection of the first table it will be noticed that the towns of Edinburgh, Greenock, Ardrossan, Perth, Dundee, and Aberdeen are all fairly well served from Glasgow. This is the more praiseworthy when the extremely heavy gradients are considered. Particularly is praise due as regards the best trains between Glasgow, Perth, Dundee, and Aberdeen. Here the North British, the rivals of the Caledonian Railway, are completely beaten out of the field, and although 3¾ hours may seem none too speedy between Glasgow and Aberdeen (a distance of over 150 miles) it should be remembered that we are not in wealthy England, with populous towns springing up every few miles. To Greenock and Ardrossan the trains are also very smart, considering the shortness of their course. To Edinburgh the company's services are as quick as the North British, although their route is as hilly as the North British is flat.

Looking now to the services northwards from Carlisle in continuation of the London and North-Western trains, we again find ground for praise. To Edinburgh the North British cut a sorry figure when compared with the magnificent two hours trains of the Caledonian (101 miles), as they also do if the times taken from Carlisle to Perth and Aberdeen by the two companies be compared. The Caledonian Railway is in each case the longer route, yet the journey is performed in quicker time. In the following table we make a more detailed comparison between the rival lines. To Glasgow and Greenock, however, the Caledonian Railway have an opponent of different mettle to deal with, and although in this case the company have a route 13½ miles shorter to Glasgow than the Glasgow and South-Western, their service is perhaps scarcely so good.

Punctuality on the Caledonian Railway is often very good, and often absent. The fastest trains are generally those which keep time best, and in general it is only the slow trains and those with connections off the Highland Railway which run late. Nevertheless, there is scarcely that machine-like discipline which one meets with on the London and North-Western ; and the occasional want of this, coupled with poor station arrangements at one or two junctions, has much to do with what unpunctuality does exist.

We here give the tables referred to above :—

| Between Glasgow and | Miles. | Number of Trains at or over 35 miles per hour. From Glasgow. | 35 miles per hour. To Glasgow. | 40 miles per hour. From Glasgow. | 40 miles per hour. To Glasgow. | 45 miles per hour. From Glasgow. | 45 miles per hour. To Glasgow. | Fastest. Hr. Min | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| Greenock (Cathcart Street) . | 23 | 7* | 3* | None | None | None | None | 0 36 | One each way on one day of the week only. |
| Wemyss Bay . | 31 | 1 | 2 | None | None | None | None | 0 50 | |
| Ardrossan . . | 30 | 4 | 6 | 3 | 5 | 1 | 2 | 0 40 | One train to Ardrossan and four from that place run on one day of the week only. |
| Edinburgh . . | 46¼ | 6 | 8 | 2 | 4 | None | None | 1 5 | |
| Perth . . | 63¼ | 4 | 3 | 1 | None | None | None | 1 32 | Service not quite so good as in previous years. |
| Dundee . . | 86¾ | 4 | 3 | 1 | 1 | None | None | 2 5 | |
| Aberdeen . | 153 | 5 | 3 | 1 | None | None | None | 3 45 | |

TABLE SHOWING SERVICES FROM CARLISLE TO THE NORTH *VIÂ* CALEDONIAN AND OTHER ROUTES.

| Between Carlisle and | Distance by C. R. Miles. | Distance by rival route. Miles. | No. of Trains at or over 40 miles per hour by C. R. route. Down. | Up. | No. of Trains at or over 40 miles per hour by rival route. Down. | Up. | Fastest by C. R. Hr. Min. | Fastest by rival route. Hr. Min. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| Glasgow. | 102¼ | 115¾ | 4 | 4 | 5 | 6 | 2 13 | 2 27 | Greenock can be reached *viâ* Glasgow (141½ miles) by express trains *viâ* G. & S.-W. route. |
| Greenock. | 125¼ | 129¼ | 1 | None. | 1 | 1 | 3 6 | 3 3 | |
| Edinburgh | 100¾ | 98¼ | 4 | 4 | 1 | None. | 2 0 | 2 19 | |
| Perth . | 150¾ | 146 | 3 | 1 | 1 | None. | 3 17 | 3 39 | |
| Dundee . | 174¼ | 157½ | 1 | 1 | 1 | None. | 4 8 | 3 54 | |
| Aberdeen. | 240½ | 228¾ | 2 | 1 | None. | None. | 5 30 | 5 54 | |

The local train services of the Caledonian can only be described as moderate, although the elements of a good service, speed and frequency, are not wanting. Punctuality, however, is not sufficiently regarded, and much of the carriage stock is completely out of date.

In the suburbs of Glasgow this has been remedied, and punctuality is observed, the services there now being excellent.

(*b*) *Rolling Stock and General Accommodation.*—The general accommodation provided by the company is fairly good and improving. Most of the branch-line trains, and indeed some of the slow main-line ones, are still composed of very poor rolling stock. But elsewhere, and in those cases where new coaching stock has been provided, things are much better, though perhaps not up to the latest standards. The carriages on the through expresses are, however, excellent specimens, and almost unequalled in the kingdom, as may be supposed when it is mentioned that they are built by the London and North-Western Company. All over the system the carriages are fairly well lighted, gas being commonly used. In some few instances the stock is heated by the waste steam from the engine. Great progress has been made in fitting the Westinghouse brake, and the line is well signalled throughout. Despite these precautions, the Caledonian has had its serious accidents. The permanent way is probably unsurpassed in the kingdom, and the greatest care is bestowed upon its maintenance. The stations are too frequently below requirements, obviously so at important points such as Stirling and Larbert. The same cannot now be said of Perth, Dundee, Glasgow, and Carlisle, where the pressure up to comparatively recent times used to cause much inconvenience. At many of the roadside stations there is still plenty of room for improvement.

### (3) Locomotive Work.

(*a*) *Speed.*—The Caledonian, in common with most of the railways concerned in working the Scotch through traffic, has of late years materially advanced its booked rates of speed. The best the company can show us is found on the main-line trains running from Carlisle northwards. These are generally composed of the Glasgow and Edinburgh through carriages, and although the trains are split up at Carstairs, still the hardest and steepest part of the journey has been accomplished before reaching that point. Hence it is that the north-going main-line trains are much harder to work than those coming south, which perform the hardest part of their journey with light loads before reaching Carstairs, where the trains are united, and after which point the road to Carlisle is tolerably easy. Among the best of these performances may be mentioned the 2.35

a.m., which runs from Carlisle to Stirling ($117\frac{3}{4}$ miles) in just over $2\frac{1}{2}$ hours; the 5.45 and 8.40 p.m. from Carlisle, which run from Beattock to Carstairs ($33\frac{3}{4}$ miles), in 42 minutes (including 10 miles of 1 in 80); and the 5 p.m., which is allowed only 114 minutes from Carlisle to Coatbridge ($94\frac{1}{4}$ miles)—a superb piece of running, and equal to any work done on the line. Another excellent performance is that of the 4.30 p.m., running from Carlisle to Edinburgh in two hours, of which two minutes is taken up outside Carstairs in detaching the Glasgow portion—the time allowed to that junction being (for the $73\frac{1}{4}$ miles) only 86 minutes. This gives considerably over 50 miles an hour on a mountainous route. On the return journey, as above stated, the work is not so striking. The trains from Glasgow and Edinburgh to Carstairs, although performing good work on the up grades, are comparatively light. After Carstairs they become very heavy, and the journey to Carlisle occupies 86 minutes (12.28 p.m. at Carlisle); 91 minutes (4.23 p.m.); and 92 minutes (with two stops) in the case of the 11.55 a.m. These are the best times, with the exception of the 10.15 a.m. from Edinburgh, which arrives at Carlisle at 12.18 p.m. after stopping outside Carstairs to attach the Glasgow portion.

It is only natural to suppose that further northward the speeds are not so good. But even here little falling-off is apparent. From Stirling to Perth, over a very steep route, is done by several trains at about 45 miles an hour; while between Perth and Forfar ($32\frac{1}{2}$ miles) the speeds are considerably higher, ranging up to $51\frac{1}{2}$ miles an hour in the case of one or two of the up trains. Some creditable booked timing is also found north of Forfar, at rates of from 45 to 48. From Perth to Dundee the booked running is extremely fast for so short a stretch, and numerous trains attain speeds over 45 miles an hour, while one or two closely border on 50. On the Coast sections many brilliant short runs may be found. Those between Ardrossan and Eglinton Street ($28\frac{3}{4}$ miles) in 36 and 43 minutes, over very steep grades, may be specially mentioned. The Greenock and Gourock sections also show some good work at rates appreciably above 45 miles an hour, chiefly between Paisley and Greenock. This is very creditable, considering the shortness of the run. An excellent performance is that of the 5.20 p.m. from Glasgow, which reaches Gourock in 35 minutes ($26\frac{1}{4}$ miles). To conclude, there is some very fine work between Edinburgh and Glasgow. The gradients are very severe, but the loads are light. Most of the trains run through from Princes Street or Merchiston to Eglinton Street,

Glasgow, though occasionally intermediate stops are made. The booked speeds are in general about 45 miles per hour. In the opposite direction the performances, though still excellent, are perhaps scarcely so good.

(*b*) *GRADIENTS.*—These are excessively severe all over the Caledonian. From Carlisle the main line descends gradually to almost sea-level for 7 miles, and then mounts 8 miles of 1 in 200, followed by one mile of 1 in 200 down, and two miles level to post 18. Then come four miles of 1 in 200 up, two miles of 1 in 200 down, and five miles of 1 in 528 down, after which the line rises gradually for four miles on grades of 1 in 880 and 330. Then for two miles there is a slight fall and level stretch, followed by two miles of 1 in 206, one mile of 1 in 200, and one mile of 1 in 165 and 1 in 263 rising, bringing us to the foot of Beattock bank. From this point to Edinburgh the gradients are given in the accompanying diagram. It was over this trying route that the writer took part in the record performance during the celebrated race of August, 1888, covering the distance in 102½ minutes, full particulars of which are given on a subsequent page.

From Carstairs northwards to Glasgow and Perth the line continues severe. For five miles from Carstairs it rises at an average of 1 in 150, followed by eleven miles averaging 1 in 100 down to Lesmahagow Junction, 89½ miles. At this point the Perth line leaves that to Glasgow, which latter at once drops four miles more, averaging 1 in 125 to Uddingston, only 92 feet above sea; then rises slightly one mile, is level one mile, and drops again three miles of about 1 in 120, after which it is nearly level into Glasgow.

The Perth line, after leaving Lesmahagow, rises 12 miles very gently, followed by 11 miles of undulations and descents of 1 in 100 to 1 in 150 to two miles past Larbert. Then we have two miles rise of 1 in 126, and two miles fall of 1 in 100, and 3½ miles of gentle descent to the 120th mile, 27 feet above sea. Then there is a steep ascent of 1 in 90 for six miles to Kinbuck (328 feet), followed by nine miles of a gentle rise to Crieff Junction (422 feet). From this point the descent is continuous, and consists of six miles of 1 in 110 to Dunning (90 feet), and ten miles gentle fall to Perth (30 feet above sea).

The other sections of the Caledonian are nearly all steep, and very trying to the locomotive. From Edinburgh to Glasgow the route is, as far as Midcalder, the same as the Carlisle line, and, after leaving it, becomes even worse than the trunk line, rising in wild

# BEATTOCK TO EDINBURGH.

## GRADIENT PROFILE.

C.R. No. 1.

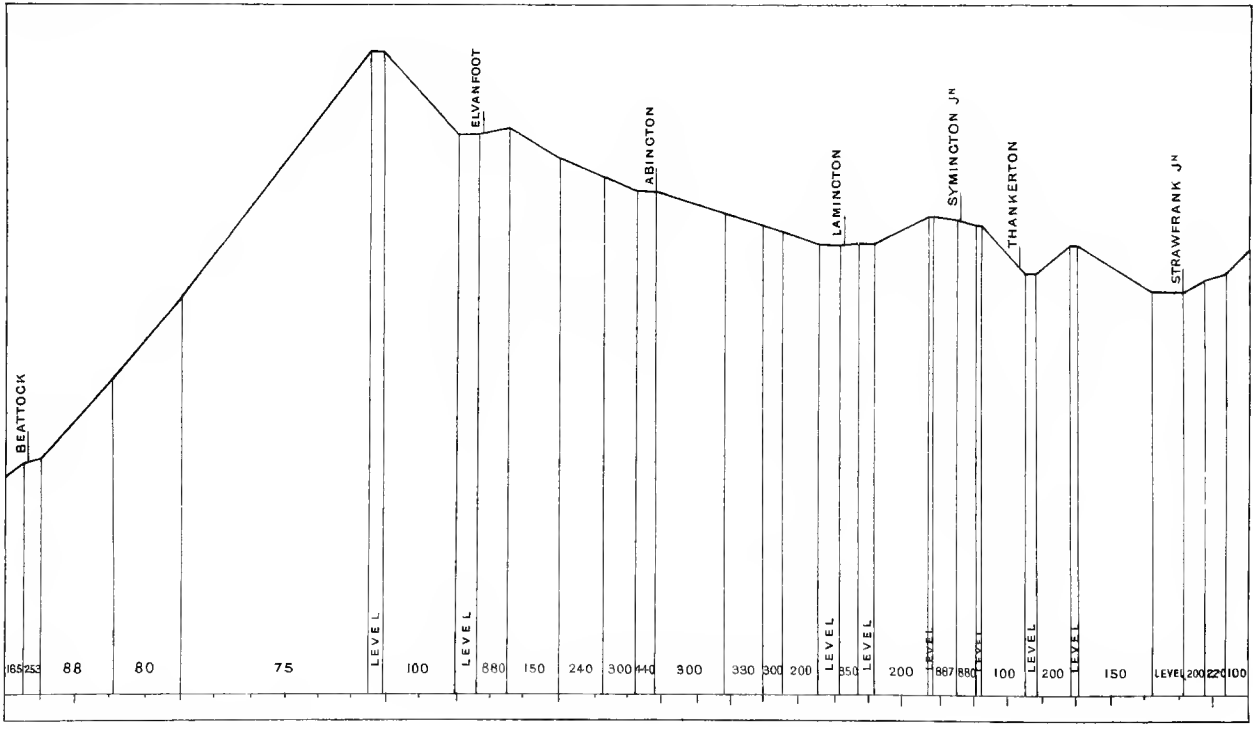



Plate XVI.

*Between Pages 134 & 135*

# BEATTOCK TO EDINBURGH.

## GRADIENT PROFILE.

C.R. No. 2.

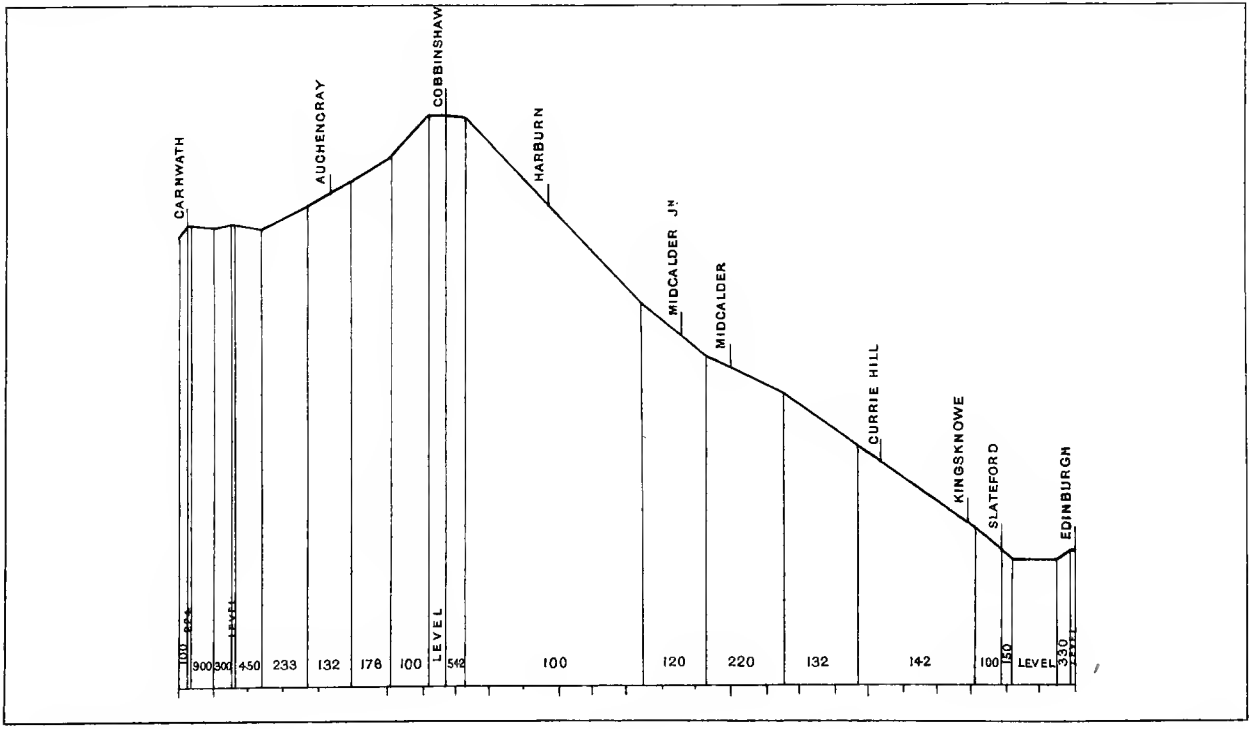



Plate XVII.

*Between Pages 134 & 135.*

alternations of 1 in 80 and 1 in 100 over the moorlands—dropping with similar abruptness on the other side. The Ardrossan trains travel over the Glasgow, Barrhead and Kilmarnock Joint Railway (for description of which, see Glasgow and South-Western Railway). Almost alone of the company's express routes, the Greenock line is level.

(*c*) *LOCOMOTIVES.*—Probably on no other line, except perhaps the Preston to Carlisle section of its ally, the London and North-Western, do speed, gradients, and heavy loads combine to offer a harder task to the locomotive than on the Caledonian Railway. Before the late locomotive superintendent, Mr. Drummond, assumed the reins of management, the company suffered from a multiplicity of types, many of them good, but not good enough for the arduous tasks they had to perform. The labours required have since become still more herculean, but Mr. Drummond has proved fully equal to all demands. His well-known bogie engines have achieved a wide reputation; and even the most thorough-going adherents of the Midland and Great Northern types have at last begun timidly to compare the performances of their favourites with the engines of the Scotch company. Particularly famous—we might justly say the most famous engine in the kingdom—is C.R. No. 123, which twice every day during the race to Edinburgh in August, 1888, ran the "West Coast Flyer," and never lost a minute during the month. This locomotive, as well as a very fine coupled type, were built at the same time, and exhibited in the first Edinburgh exhibition. Each forms a class by itself, and the dimensions are as under:—

| Dimensions. | | No. 123. | | No. 124. | |
|---|---|---|---|---|---|
| Diameter of driving wheels | ft. in. | 7 0 single | | 6 6 coupled | |
| Cylinders (inside) | in. | 18 by 26 | | 19 by 26 | |
| Heating surface—tubes | sq. ft. | 950·36 | | 1088 | |
| ,, ,, box | sq. ft. | 102·98 | | 122 | |
| ,, ,, total | sq. ft. | 1053·34 | | 1210 | |
| Number of tubes | | 196 | | 216 | |
| Diameter of tubes | in. | $1\frac{3}{4}$ | | $1\frac{3}{4}$ | |
| Boiler pressure | lbs. | 150 | | 150 | |
| Grate area | sq. ft. | $17\frac{1}{4}$ | | $19\frac{1}{2}$ | |
| Water capacity | gals. | 2850 | | 2840 | |
| Weight in working order— | | Tons. | Cwts. | Tons. | Cwts. |
| On bogie | | 13 | 5 | 14 | 12 |
| On drivers | | 17 | 0 | 15 | 5 |
| On trailers | | 11 | 4 | 15 | 3 |
| Of tender (full) | | 33 | 5 | 35 | 0 |
| Total weight (engine and tender) | | 74 | 14 | 80 | 0 |

The bulk of the very fine express work on the Caledonian is, however, done by the well-known 6 feet 6 inch coupled bogies, with cylinders 18 inches by 26, and 1,208 square feet of heating surface. This class, which is almost similar to the 6 feet 6 inch type built by Mr. Drummond for the North British Railway, has given exceptionally good results ever since it was introduced about ten years ago. Another type built by Mr. Drummond for use on the Greenock and Oban sections is of similar general appearance, but has smaller dimensions, and only 5 feet 6 inch wheels. Besides these four varieties just described, Mr. Drummond has built two or three types of tank engines (strongly recalling London, Brighton and South Coast practice) for shunting purposes and short-distance passenger journeys.

Before closing this section it would be unjust to pass over unmentioned two old classes which in their time have worked the fast trains of this company. These are Mr. Connor's 8 feet 2 inch singles, and the 125-129 class, 7 feet 1 inch coupled. The former had 17¼ by 24 inch outside cylinders, 1,172 square feet of heating surface, and weighed 30 tons 13 cwts. in working order, with 14 tons 11 cwts. on the driving wheels. One of this class was shown at the Exhibition of 1862, and fully described and illustrated in Colburn's *Locomotive Engineering*. Considering their low tractive force, they did their work well. The latter class, built by Neilson in 1877, had 18 by 24 inch cylinders, and weighed 41 tons 12 cwts., of which 28¾ tons was on the coupled wheels. Some of them have been renewed, and work on the northern section of the company's system. The locomotives are painted blue with white stripe. The brake used is the Westinghouse automatic.

(*d*) *ACTUAL PERFORMANCES.*—About the older class of locomotives we can say but little. Perhaps the best authenticated performance of the 8-feet singles was a run from Lockerbie (starting) to Beattock (stopping), 14 miles, in 19¾ minutes, with a load of 20 coaches. This run, though good, is, we believe, exceptional. We may as well, before coming to modern types, mention one or two instances of work done by two classes not mentioned in the "Locomotives" section above: the 7-feet singles, and a modified type of goods engine (427 class) with 6-feet 4-coupled wheels. The single took six coaches from Edinburgh to Auchengray (stopping there), 21¾ miles, in 32 minutes; and the coupled gave us one of the best performances ever recorded in a run from Carlisle to Beattock Summit with 17 coaches in 64 minutes (passing Beattock, 39¾ miles,

in 40 minutes, and taking only 24 minutes for the ten miles up the bank, without pilot assistance, and including a stop at the summit). Another performance by this excellent class is one from Merchiston to Eglinton Street, Glasgow (44 miles), with seven coaches in $54\frac{1}{4}$ minutes, including three signal-checks.

By far the greater number, however, of our examples are illustrations of the work of the 6 feet 6 inch coupled bogie class. From Glasgow to Motherwell ($13\frac{1}{4}$ miles) in 19 minutes with $9\frac{1}{2}$ coaches, and in $18\frac{1}{2}$ minutes with 2 engines and 21 coaches, are good, as is Motherwell to Carstairs with 2 engines and 21 coaches in 20 minutes ($15\frac{3}{4}$ miles). Other noteworthy short runs are from Beattock (starting) to Lockerbie (stopping) in 18 minutes 41 seconds (14 miles) with $17\frac{1}{2}$ coaches; and from Stirling to Perth (33 miles) in 43 minutes, with 11 on. It is, however, on the main line to Carstairs and Edinburgh from Carlisle that the best Caledonian Railway work has been performed. We may cite as instances Carlisle to Beattock (stopping), $39\frac{3}{4}$ miles, in 52 minutes, with 1 engine and 23 coaches, passing Lockerbie in $35\frac{1}{4}$ minutes ($25\frac{3}{4}$ miles); Edinburgh to Carstairs (stopping there), $27\frac{1}{2}$ miles, in 31 minutes 17 seconds, with 9 coaches, passing Cobbinshaw in $22\frac{3}{4}$ minutes, and never dropping below 46 miles an hour on the long stretch of 1 in 100; Carstairs to Carlisle ($73\frac{1}{2}$ miles) in 84 minutes, with a load of 19 coaches, passing Summit ($23\frac{3}{4}$) in 34 minutes, Beattock ($33\frac{3}{4}$) in $43\frac{1}{2}$, and Lockerbie ($47\frac{3}{4}$) in $57\frac{1}{4}$ minutes, the last 50 miles from Summit to Carlisle being done with this heavy load in $50\frac{1}{4}$ minutes; Carlisle to Carstairs with 16 on, and only one engine even up Beattock bank, in $96\frac{1}{2}$ minutes; with 17 on, in $97\frac{1}{2}$ minutes; and with 18 on, in $94\frac{1}{2}$ minutes. Still better than any of these was a run with engine 124 between these points in 86 minutes 38 seconds with a load of 15 coaches, passing Lockerbie in 28 minutes 51 seconds, Beattock in 43 minutes 13 seconds, and Summit in 63 minutes 19 seconds. This is a grand performance, and we doubt if it has ever been beaten. Further details appear below. As an instance of fine work with a heavy train, we may give two runs. These are from Carstairs to Beattock Summit (stopping), $23\frac{3}{4}$ miles, in 38 minutes, with $23\frac{1}{2}$ coaches; and from Carstairs to Carlisle in 92 minutes with 24 coaches, passing Lockerbie with this extraordinary load in $14\frac{1}{2}$ minutes after running through Beattock. With light loads the company's locomotives have equally distinguished themselves. To pass Cobbinshaw with $7\frac{1}{2}$ coaches in $11\frac{1}{2}$ minutes after starting from Strawfrank loop is excellent, and appears more so when we know that the speed,

except for the 3 miles after starting, never fell below 60, even on grades of 1 in 132 and 1 in 100 up. The final instance we shall give is of course the superb record run in the August, 1888, race to Edinburgh. Here the 7-feet single ran the whole distance in 102 minutes 33 seconds, passing Lockerbie ($25\frac{3}{4}$) in 25 minutes 56 seconds, Beattock ($39\frac{3}{4}$) in 38 minutes 45 seconds, Summit ($49\frac{3}{4}$) in 52 minutes 28 seconds, and Strawfrank loop (73) in 74 minutes 24 seconds. Comment on these figures is unnecessary; but, for purposes of comparison with other companies, we may refer to them later on. Further details of the run appear below. They were first published some time back in the *Engineer*, and illustrated by a full-page diagram.

CARLISLE TO EDINBURGH IN 102 MINUTES 33 SECONDS.
CARLISLE TO CARSTAIRS IN 86 MINUTES 38 SECONDS.

| | Engine 123 (7-ft. single) and 77 tons. Record Racing Performance. | | | Engine 124 (6 ft. 6 in. four-coupled) and 15 coaches. | | |
|---|---|---|---|---|---|---|
| Station or mile-post. | Time Due. | Time Actual. | Time taken for intermediate miles. | Time Due. | Time Actual. | Time taken for intermediate miles. |
| | P.M. | H. M. S. | Seconds. | P.M. | H. M. S. | Seconds. |
| **Carlisle** . *dep.* | **4 8** | **4 52 16** | | **4 30** | **4 40 33** | |
| 5th mile-post . | | 4 57 57 | 91, 73, 63, 60, 54. | | 4 46 36 | 90, 79, 69, 63, 62. |
| 10th ,, ,, . | | 5 2 27 | 54, 53, 51, 53, 59. | | 4 51 38 | 59, 57, 57, 62, 67. |
| 15th ,, ,, . | | 5 7 40 | 58, 64, 63, 62, 66. | | 4 57 48 | 72, 72, 74, 76, 76. |
| 20th ,, ,, | | 5 12 30 | 58, 56, 55, 59, 62. | | 5 3 12 | 68, 62, 61, 65, 68. |
| 25th ,, ,, | | 5 17 28 | 63, 63, 62, 54, 56. | | 5 8 38 | 70, 73, 68, 57, 58. |
| 30th ,, ,, | | 5 21 59 | 56, 57, 55, 53, 50. | | 5 13 18 | 57, 56, 56, 55, 56. |
| 35th ,, ,, | | 5 26 31 | 56, 53, 55, 56, 52. | | 5 18 25 | 57, 60, 64, 64, 62. |
| 40th ,, ,, | | 5 31 18 | 53, 54, 60, 59, 61. | | 5 24 8 | 62, 64, 70, 72, 75. |
| 45th ,, ,, | | 5 37 28 | 65, 67, 73, 81, 84. | | 5 33 17 | 85, 102, 113, 120, 129. |
| 50th ,, ,, . | | 5 45 21 | 92, 94, 94, 95, 98. | | 5 44 19 | 133, 133, 134, 135, 127. |
| 55th ,, ,, . | | 5 50 7 | 66, 56, 52, 58, 54. | | | |
| 60th ,, ,, . | | 5 54 45 | 53, 58, 58, 54, 55. | | | |
| 65th ,, ,, . | | 5 59 20 | 52, 52, 58, 56, 57. | | | |
| 70th ,, ,, . | | 6 3 53 (slacked round loop). | 59, 57, 55, 50, 52. | | NOTE.—**Carstairs (Strawfrank Loop)** ($73\frac{3}{4}$ miles) was reached at **6 7 11**, the train stopping to detach the Glasgow carriages. | |
| 75th ,, ,, . | | 6 9 22 | 54, 55, 58, 61, 101. | | | |
| 80th ,, ,, . | | 6 14 41 | 76, 63, 57, 59, 64. | | | |
| 85th ,, ,, . | | 6 19 48 | 63, 66, 64, 61, 53. | | | |
| 90th ,, ,, . | | 6 24 13 | 52, 49, 51, 54, 59. | | | |
| 95th ,, ,, . | | 6 28 39 | 57, 52, 52, 52, 53. | | | |
| Edinbro' (**100¾ miles**) . *arr.* | **6 0** | **6 34 49** | 54, 56, 56, 56, 57. | | | |
| | NOTE.—Brakes were applied slightly near mile-posts 66, 88, and 90. | | | | | |

It may not be out of place here to remark upon the distinguished part played by the Caledonian in the race to Edinburgh. Its best performance we have just alluded to. Perhaps with the exception of the run on the North-Western from Preston to Carlisle in 89 minutes, it has rarely been equalled. But the average

performances were equally noteworthy. From the 6th to the 31st August, 1888, the average time from Carlisle to Edinburgh was only $107\frac{3}{4}$ minutes. This beats the average work on both the East-Coast lines, and also on the Euston to Crewe section of the North-Western. But the remarkable feature which renders this average unique is that while the North-Eastern, London and North-Western, and Great Northern used several engines during the month for the racing train, the Caledonian used No. 123 throughout. Could a greater triumph be desired by the most ardent advocate of the "single" engine? We think not.

## II.

## THE GLASGOW AND SOUTH-WESTERN.

### (1) General Description of the Line.

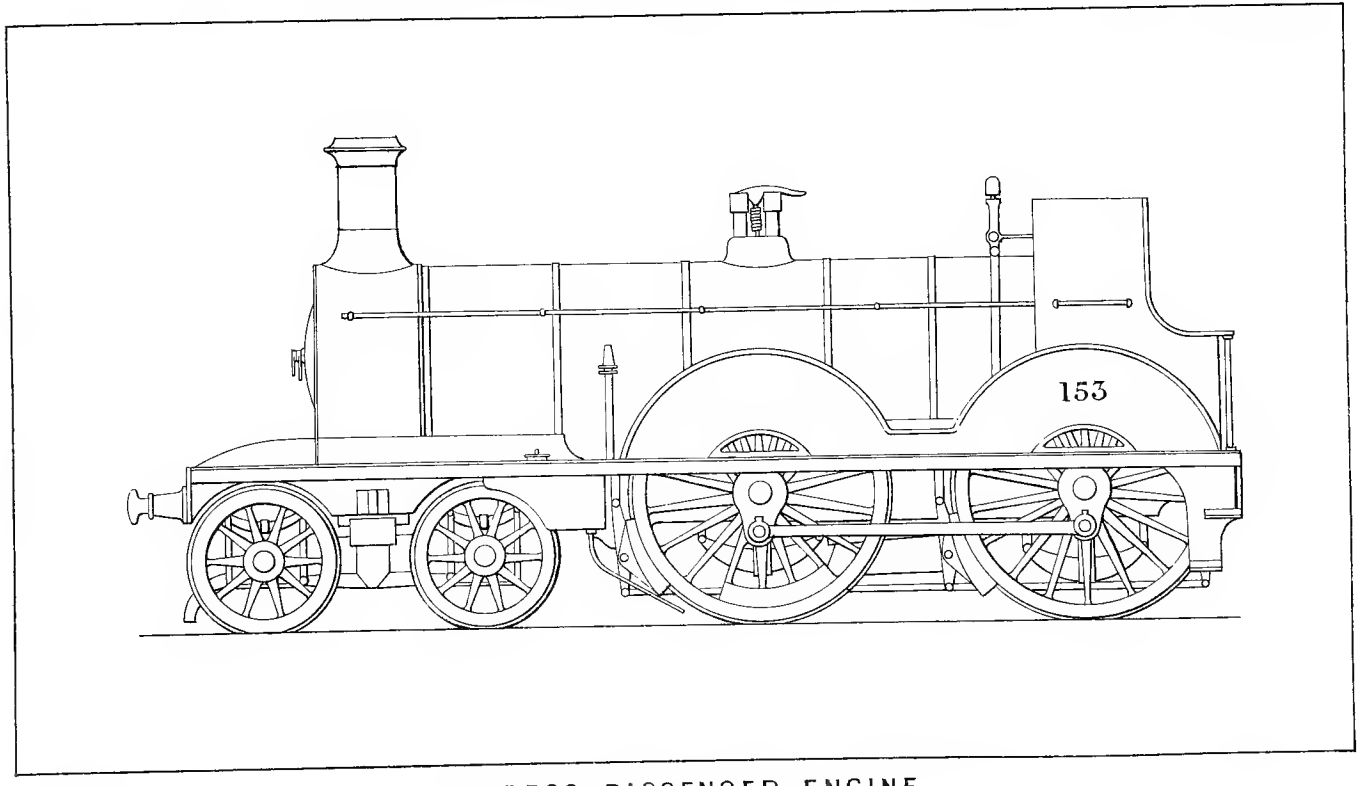
This comparatively small system is only about 325 miles in length. Its main line, over which are conveyed the expresses brought from London, etc., by the Midland, runs from Carlisle to Glasgow through Dumfries and Kilmarnock. At the last-mentioned town another line seeks Glasgow by way of Dalry and Paisley. Besides this main route, there are the lines between Glasgow and Greenock, and between Glasgow and Girvan, which latter on its way south serves, either on its own route or by short branches therefrom, the seaside resorts and coast towns of Fairlie, Largs, Irvine, Ardrossan, and Ayr. The company are also joint owners with the London and North-Western, Midland, and Caledonian, of the Portpatrick and Wigtownshire Joint Railways, which, connecting at Castle Douglas with the Glasgow and South-Western branch from Dumfries, run west through Newton Stewart to Stranraer, with a branch to Wigtown. From Stranraer an excellent service of fast paddle boats crosses the channel to Larne, the passage of nearly 40 miles being accomplished in two hours by the *Princess Victoria* and *Princess May*. The other lines owned by the company are for the most part short connections from Kilmarnock and the coal districts to the coast towns. The direct route from Kilmarnock to Glasgow is jointly owned with the Caledonian Railway.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—There is probably no railway in the British Islands which serves its district so well as the Glasgow and South-Western. Taking Glasgow as a centre, we see, in the table presented below, how admirably the various points

# GLASGOW & SOUTH WESTERN.

Plate XVIII.




To face p 140

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR H. SMELLIE)

of importance on the system are served. Especially is this the case with Kilmarnock, Dumfries, and Carlisle, which towns get the benefit of the through expresses to and from the Midland line—some of the smartest trains to be found north of the Border. Then there are trains to Greenock and Ardrossan for the watering-places down the Clyde, and to Ayr, which though, with few exceptions, not quite up to a 40 miles an hour standard, are yet really excellent, considering their short course and the comparatively small populations served. From Stranraer to Carlisle (106¾ miles) over a very heavy course in 3 hours 2 minutes is a fine piece of work, considering that the Portpatrick Joint Railway is at present only a single line.

The table below shows the company's train services between Glasgow and the principal points on the system :—

| Between Glasgow and | Miles. | Number of Trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 Miles an hour. | | 40 Miles an hour. | | 45 Miles an hour. | | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. | Min. | |
| Kilmarnock | 24¾ | 5 | 6 | 5 | 6 | 3 | 5 | 0 | 31 | Nine other trains at from 35 to 40 m.p.h. *viâ* Paisley. |
| Dumfries . | 82¾ | 5 | 6 | 4 | 6 | 3 | 5 | 1 | 44 | Two others ditto. |
| Carlisle . | 115¾ | 5 | 6 | 5 | 6 | 3 | 5 | 2 | 27 | Two others ditto. |
| Greenock . | 25½ | 5 | 3 | None | None | None | None | 0 | 40 | One of the up trains runs on Mondays only. |
| Ardrossan . | 32 | 4 | 9 | 2 | 4 | 1 | None | 0 | 40 | Several of these trains run on Sat. or Mon. only. |
| Ayr . . | 41½ | 2 | 4 | 1 | 3 | None | None | 1 | 0 | Numerous trains about 30 m.p.h. |

What has been said of the through expresses on this line will apply equally well to the local trains. They are fast above the average, and run with frequency and great punctuality. For instance, the stopping trains are allowed only just over the hour to run from Carlisle to Dumfries—a distance of over 33 miles. This is certainly not surpassed on any other railway. As regards punctuality, the writer travelled over 1,000 miles a week on this system for some time during the summer of 1889, and found the local trains running with almost absolute punctuality—not five per cent. being over 3 minutes late.

(*b*) *Rolling Stock and General Accommodation.*—The accommodation offered is good, as a rule, throughout the system.

On very few branches is any old stock to be seen, and in general the coaches supplied by the company are some of the best in the kingdom. Pullman Day Cars (at first class fares) and Sleeping Cars run in connection with the Midland trains. The third class is frequently supplied with lavatory conveniences. Most of the coaches are lighted by gas, and some are warmed by hot-water pipes in winter; both of which improvements, we believe, originated with this company. The Automatic Vacuum brake is used, the signalling is excellent, and the permanent way in particularly good condition. The line has a very high character for safety, and it is not within the writer's memory that anyone has lost his life from causes beyond his own control while travelling on the system. In other ways, too, the company sustain their all-round first-class reputation. The stations are equal to all traffic requirements, which is not the case, as a rule, on the other Scotch lines. St. Enoch (Glasgow), both stations at Paisley, Kilmarnock, Ardrossan, Dumfries, etc., are all fine structures, and we very much doubt if there is a town of the same importance in the kingdom with so handsome a station as Ayr. The company are also the owners of three hotels.

### (3) Locomotive Work.

(*a*) *SPEED.*—The booked speeds on the Glasgow and South-Western main line are generally high. Between Carlisle and Dumfries the timing is just under 50 miles an hour for the trains which do not stop (39 minutes is the best), while those which stop at Annan are invariably allowed 43 minutes, including stop, for the 33 miles. The best trains get only 70 minutes between Dumfries and Kilmarnock (58 miles), which is just short of 50 miles an hour; and from Kilmarnock to Glasgow ($24\frac{3}{4}$ miles), a most difficult piece, only 31 to 33 minutes is usually allowed.

The coast lines present us with nothing quite so good as the main line, although lately some very smart short runs have been inserted in the time table. The best of these are well above 45 miles an hour, and in some few cases exceed 48. Ardrossan to Paisley (Canal) in 28 minutes ($23\frac{3}{4}$ miles) and Paisley (Gilmour Street) to Prestwick in 41 minutes ($30\frac{1}{2}$ miles) are excellent.

(*b*) *GRADIENTS.*—Perhaps on no line in Great Britain can the effect of gradients be so well studied as on the Glasgow and South-

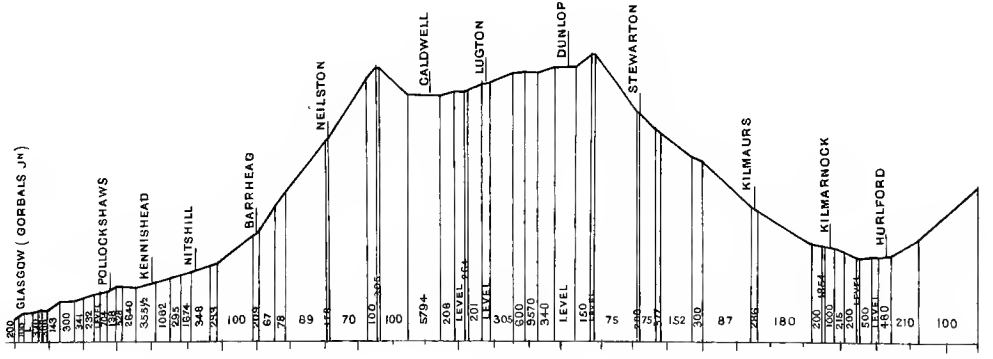
# GLASGOW TO DUMFRIES.

## GRADIENT PROFILE.

G. & S. W. R.

No 1.

Plate XIX.




Between Pages 142 & 143.

# GLASGOW TO DUMFRIES.

## GRADIENT PROFILE.

G. & S.W.R. No 2.

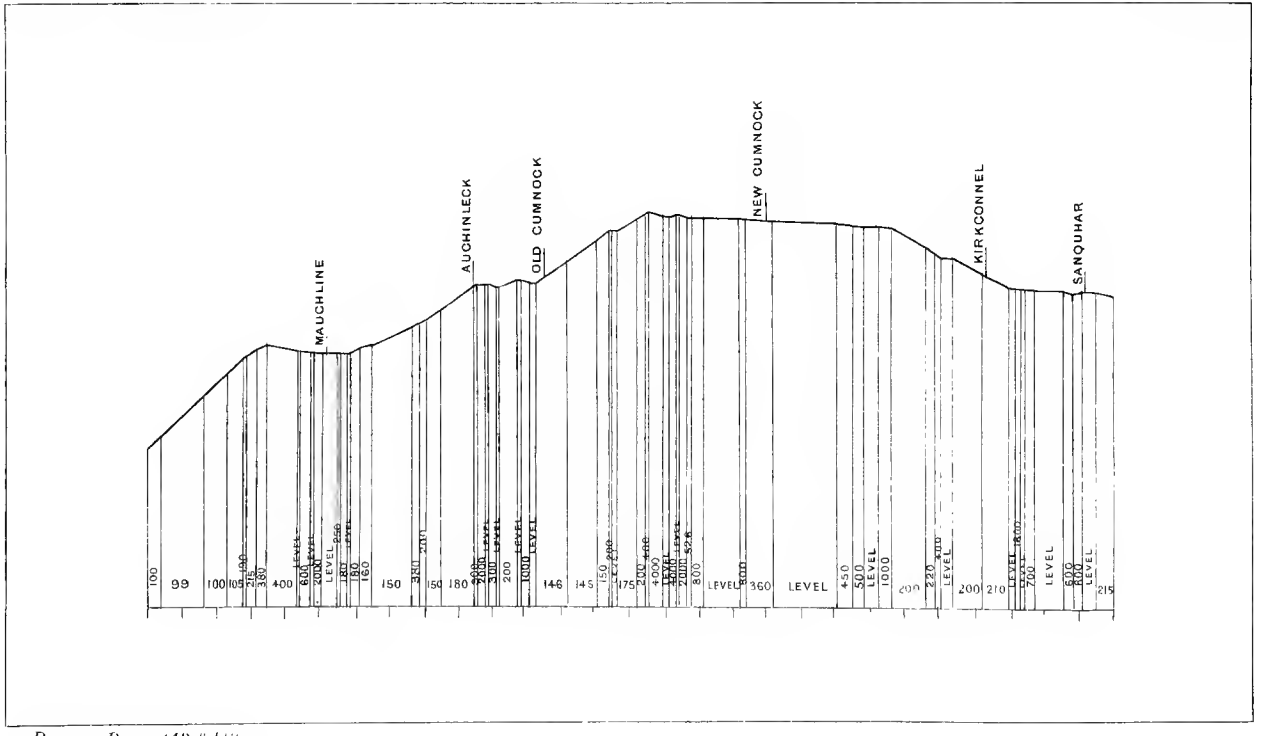



Plate XX.

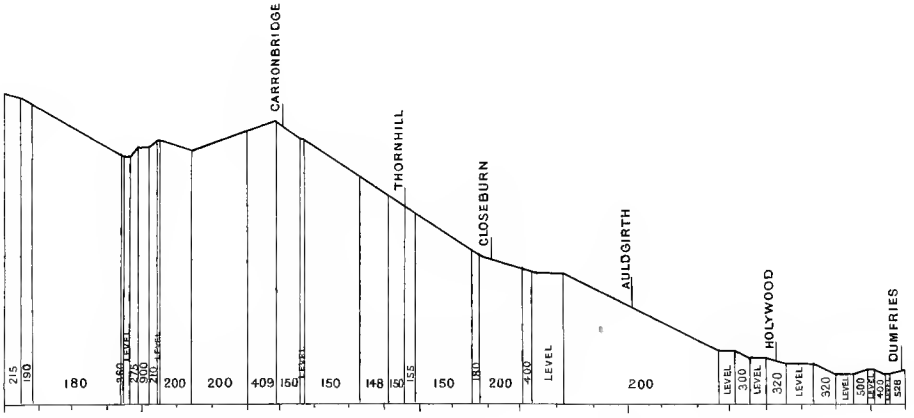
*Between Pages 142 & 143.*

# GLASGOW TO DUMFRIES.

## GRADIENT PROFILE.

G. & S. W. R. No. 3.

Plate XXI.




Between Pages 142 & 143.

Western. Here in a short course of 115 miles we have 33 miles of level, 58 miles of moderately steep road, with one or two banks quite long enough to enable us to test their effect on speed, and 24 miles of some of the steepest main-line gradients in the kingdom. It becomes, therefore, a matter of importance to give these gradients with more detail than usual, and this we shall now proceed to do. In the "Actual Performances" section will be found some noteworthy examples of the work done on these stretches of line.

From Carlisle to Gretna Junction the South-Western trains run over the Caledonian Railway (described elsewhere). Thence the line rises $\frac{3}{4}$ mile at 170 to $115\frac{1}{2}$ mile-post, followed by $1\frac{1}{4}$ miles level, and then $5\frac{1}{4}$ miles of level and easy descent, varying from level to 1 in 750, but most of it 1 in 300. It then ascends 1 mile at 1 in 240, and descends nearly a mile at 1 in 300 to the 107th post. To post 105 is an easy rise for $1\frac{1}{4}$ miles, followed by $\frac{3}{4}$ mile up at 1 in 200, after which is a short rise at the same inclination and level. Thence to $99\frac{1}{2}$ post is 1 in 200 rising, after which the line undulates for $\frac{3}{4}$ mile, and then falls 2 miles at 1 in 150. Thence to Dumfries is almost level throughout.

From Dumfries to Glasgow the accompanying gradient profile gives full information as to the rise and fall of the line. The section from Dumfries to Kilmarnock, especially for trains coming from Dumfries, is a very difficult one to work. For nearly 40 miles after leaving Dumfries there is no chance for high speed. The locomotive is kept pounding away at a long, though not very steep bank. The run mentioned hereafter in 65 minutes from Dumfries to Kilmarnock may, therefore, be adjudged one of the best in the writer's experience. Between Kilmarnock and Glasgow is very severe. The worst gradients are against the south-going trains, but the train *going to* Glasgow has a disadvantage to set off against this, in that it cannot run over the last few miles of descending grades at any great speed, on account of the line traversing the suburbs of Glasgow, where careful running is necessary. Reference to the "Actual Performances" section will show that some magnificent work is done on this piece.

(*c*) *Locomotives.*—The working of such fast trains over such a trying road demands high-class locomotives. These the Glasgow and South-Western have in plenty. Indeed, we may say that no railway company in the kingdom have such an averagely powerful stock of engines. Every one can perform what is known as the

15-coach test, and no one other line can say this of *all* its locomotives. Particulars are given below. We will therefore content ourselves here with saying that the design (that of Mr. Smellie) of all the types is unusually neat and symmetrical. The colour adopted is a dark green. Several of the latest class are fitted with a smoke-box extension; all the recent passenger locomotives have a leading bogie, and no engines on the system have domes. There are scarcely any tank engines on the line. The company's experience with brakes has been singular. Starting with, perhaps, the best possible brake—the Westinghouse—they discarded it in favour of the Automatic Vacuum. This action was probably due to Midland influence. The present Locomotive Superintendent is Mr. Manson (late of the Great North of Scotland Railway). Dimensions of the various classes are as under:—

| Class. | Description. | Diameter of Driving Wheels. | Cylinders. | Number of Engines in Class. | Remarks. |
|---|---|---|---|---|---|
| | | Ft. in. | Inches. | | |
| Passenger . | Four-coupled | 7 0 | 18 by 26 | About 20 | Bogie. |
| Do. . . | Do. | 6 9 | 18 by 26 | 12 | |
| Do. . . | Do. | 6 0 | 18¼ by 26 | 24 | Bogie. |
| Do. . . | Do. | 6 8 | 18¼ by 26 | About 20 | Bogie. |

As the 6 feet 8 inch class at present performs nearly all the fastest express work of the line, we give the following additional dimensions:—

Heating surface, 1,206 square feet (1,105 tubes, 101 box); grate area, 16 square feet; boiler pressure, 150 lbs.; weight on coupled wheels, 29 tons 2 cwts.; total weight, 43 tons 11 cwts.; weight of tender, 27 tons 12 cwts.

(*d*) *ACTUAL PERFORMANCES.*—Though the G. & S. W. locomotives had not the opportunity of engaging in the Railway Race of 1888, they have, notwithstanding, done such excellent work that one feels sure they would have given a good account of themselves if the necessity for doing so had then arisen. As it is, we have so many praiseworthy performances on this line that, for the sake of convenience, we will divide them into three sets. In the first place we shall take Carlisle to Dumfries as showing the work done on a level road. Two of the writer's best performances on this railway were from Carlisle to Annan, stopping at the latter station, 17½ miles, in 20 minutes 9 seconds, with 13 coaches, and from Annan to

Dumfries, $15\frac{1}{2}$ miles, in 17 minutes 57 seconds, also with 13. Not so good, but still excellent, was Carlisle to Annan (stopping) in $21\frac{3}{4}$ minutes, with 17 coaches, and with 15 coaches in $20\frac{1}{3}$ minutes; as also, Annan to Dumfries in 19 minutes 11 seconds with 18 coaches. All the above are really remarkable performances, and the same may be said of Carlisle to Dumfries in $36\frac{3}{4}$ minutes (33 miles) with 12 coaches (passing Annan in $19\frac{3}{4}$ minutes). More recently, Carlisle to Annan (stopping) was done in 19 minutes 33 seconds; and Annan to Carlisle in 19 minutes 34 seconds, both with light loads, and from Carlisle to Dumfries with $12\frac{1}{2}$ coaches in 36 minutes 7 seconds (passing Annan in $19\frac{3}{4}$ minutes).

From Dumfries to Kilmarnock the line is a comparatively steep section, as may be seen by reference to the gradient profile. Yet on this route some fine work was noticed—and, in fact, is demanded, from the timing of the express trains, 70 minutes only being allowed to get over the distance of 58 miles between these points. The following results of journeys made by these trains show how the booked time was improved on, even with heavy loads behind the locomotive. Dumfries to Kilmarnock was covered, with 14 coaches, in $68\frac{3}{4}$ minutes (58 miles); with 12 coaches in $66\frac{3}{4}$ minutes (passing New Cumnock at the top of the incline, 37 miles, in $44\frac{3}{4}$ minutes); and a magnificent performance with $13\frac{1}{2}$ coaches in 65 minutes 7 seconds—thus gaining 5 minutes on booked time—passing New Cumnock in 44 minutes 28 seconds, must not pass unrecorded. From Kilmarnock to Dumfries was frequently covered in 65 to 68 minutes, but the loads were generally lighter, consisting of about 10 coaches.

Kilmarnock to Glasgow, $24\frac{3}{4}$ miles, is exceedingly severe, and some creditable performances were done over this section, which has also the disadvantage of running through the suburbs of Glasgow for the last few miles. Curiously enough, pilot engines are not used here to anything like the extent that prevails on the Dumfries to Kilmarnock piece. St. Enoch to Kilmarnock was done in just over 32 minutes by engine 56 and 8 coaches; and Kilmarnock to St. Enoch by engine 57 and 14 coaches in $33\frac{2}{3}$ minutes, including two slight slacks after passing Dunlop ($7\frac{3}{4}$ miles), which was got through in $14\frac{2}{3}$ minutes after leaving Kilmarnock; by engine 66 and $12\frac{1}{2}$ coaches in 32 minutes, passing Dunlop in 14 minutes; by engine 70 and 14 coaches in 31 minutes 12 seconds, including a slack near Glasgow. But superior to any of these, and fit to rank with the very best performances furnished by other lines, are the runs

from Kilmarnock to Dunlop (passing) in $12\frac{3}{4}$ minutes ($7\frac{3}{4}$ miles of the steepest grades) by engine 68 and $12\frac{1}{2}$ coaches; and by engine 89 and $17\frac{1}{2}$ coaches (no pilot assistance) from Kilmarnock to Glasgow in $32\frac{2}{3}$ minutes, passing Dunlop in $14\frac{1}{4}$ minutes. On this last occasion the speed up the grades of 1 in 70, etc., scarcely at all fell below 30 miles an hour. Few of our uphill performances have equalled this—none have surpassed it. Among the "express" lines the Glasgow and South-Western attains a very honourable place.

Details of three performances on this company's main line are given below. They illustrate the working of their express trains perhaps at its best.

(1) CARLISLE TO DUMFRIES, 33 MILES, IN 36 MINUTES.

| Stations. | | Mls. Chns. | Time due. | Time Actual. | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | P.M. | H. | M. | S. | |
| **Carlisle** | *dep.* | — | **6 13** | **6** | **34** | **53** | Engine 68, |
| Rockliffe | | 4 7 | — | 6 | 40 | 26 | $6\frac{3}{4}$ ft. bogie. |
| Floriston | | 2 0 | — | 6 | 42 | 33 | Load, $12\frac{1}{2}$ coaches. |
| Gretna | | 2 39 | — | 6 | 45 | 10 | Strong side wind. |
| Gretna Green | | 0 78 | — | 6 | 46 | 19 | |
| Dornock | | 5 5 | — | 6 | 51 | 42 | |
| Annan | | 2 79 | — | 6 | 54 | 40 | |
| Ruthwell | | 3 32 | — | 7 | 1 | 46 | |
| Racks | | 3 46 | — | 7 | 6 | 32 | |
| **Dumfries** | *arr.* | 3 72 | **6 52** | **7** | **11** | **0** | |

(2) DUMFRIES TO KILMARNOCK, 58 MILES, IN 65 MINUTES.

| Stations. | | Mls. Chns. | Time due. | Time Actual. | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | P.M. | H. | M. | S. | |
| **Dumfries** | *dep.* | — | **2 15** | **2** | **21** | **32** | Engine 53, |
| Holywood | | 3 32 | — | 2 | 26 | 40 | $6\frac{3}{4}$ ft. bogie. |
| Auldgirth | | 4 16 | — | 2 | 31 | 25 | Load, $13\frac{1}{2}$ coaches. |
| Closeburn | | 3 69 | — | 2 | 36 | 4 | Rails wet. |
| Thornhill | | 2 58 | — | 2 | 39 | 30 | |
| Carronbridge | | 3 26 | — | 2 | 44 | 5 | |
| Sanquhar | | 8 49 | — | 2 | 53 | 50 | |
| Kirkconnel | | 3 27 | — | 2 | 57 | 33 | |
| New Cumnock | | 7 36 | — | 3 | 6 | 0 | |
| Old Cumnock | | 5 27 | — | 3 | 11 | 19 | |
| Auchinleck | | 2 2 | — | 3 | 13 | 20 | |
| Mauchline | | 4 32 | — | 3 | 17 | 15 | |
| Hurlford | | 7 51 | — | 3 | 24 | 30 | |
| **Kilmarnock** | *arr.* | 1 61 | **3 25** | **3** | **26** | **39** | |

(3) KILMARNOCK TO GLASGOW, $24\frac{3}{4}$ MILES, IN $32\frac{3}{4}$ MINUTES.

| Stations. | | Mls. | Chns. | Time due. P. | M. | Time Actual. H. | M. | S. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| **Kilmarnock** . | *dep.* | — | | **3** | **29** | **4** | **4** | **45** | Engine 19, |
| Kilmaurs . | | 2 | 18 | — | | 4 | 8 | 57 | $6\frac{3}{4}$ ft. bogie. |
| Stewarton . | | 3 | 20 | — | | 4 | 14 | 48 | Load, $17\frac{1}{2}$ coaches. |
| Dunlop . . | | 2 | 15 | — | | 4 | 19 | 0 | Strong side wind. |
| Lugton . . | | 2 | 25 | — | | 4 | 21 | 53 | |
| Caldwell . . . | | 1 | 51 | — | | 4 | 23 | 46 | |
| Nitshill | | 6 | 67 | — | | 4 | 30 | 51 | |
| Kennishead . | | 1 | 25 | — | | 4 | 32 | 12 | |
| **St. Enoch** | *arr.* | 4 | 47 | **4** | **2** | **4** | **37** | **27** | |

## III.

## THE MANCHESTER, SHEFFIELD AND LINCOLNSHIRE.

### (1) General Description of the Line.

This system at present has rather more than 300 miles of railway, and is also one of the largest canal-owning companies in the kingdom. Like the Lancashire and Yorkshire, it acts in great measure as a feeder of the main trunk lines. Starting from Manchester, it runs in an eastwardly direction to Penistone, from which point one line diverges through Barnsley and Ulceby to Great Grimsby and New Holland (for Hull), while another, which is in reality the main route, bends southwards to Sheffield, and further on joins the Great Northern main line at Retford, for Peterborough and London. Two unimportant agricultural lines owned by the company are those from Lincoln and Retford *viâ* Gainsborough to Barnetby. But perhaps the most important part of the system is the joint line owned by the company with the Midland and Great Northern. This section is known as the Cheshire Lines, and comprises a through route from Manchester to Liverpool, and from Manchester *viâ* Chester to Wrexham, over the new Dee bridge. Among its offshoots are the routes from Manchester to Wigan, and from Liverpool and Manchester to Southport. The Manchester, Sheffield and Lincolnshire Company work this joint piece.

At present, as stated above, the Manchester, Sheffield and Lincolnshire is only a feeder for more important companies. But the directorate is extremely ambitious, and new projects are being launched in all directions. Northwards a connection is sought

with Blackpool and Preston; westwards it is intended to fuse many of the smaller Welsh railways in the interests of the Manchester, Sheffield and Lincolnshire Company, while southwards most important schemes are in hand. The company have already obtained Parliamentary sanction to extend their system to Annesley, and it is sought in the present session to continue this line through Nottingham and Leicester to Quainton, near Aylesbury, at which point the Metropolitan Railway (the London ally of the Manchester, Sheffield and Lincolnshire, having the same chairman) is already established. This far-reaching scheme, which has passed through the ordeal of the House of Commons, will seriously affect the Midland and Great Northern companies. A new and effective competition for Leicester, Nottingham, and Sheffield, will threaten the Midland, while the Great Northern Company, although preserving their present access to both Sheffield and Manchester by running powers which, by agreement, the Manchester, Sheffield and Lincolnshire engage to afford them, will doubtless lose a good deal of valuable traffic.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—Regarding Manchester as the centre of the system, we see from the table below that with few exceptions the towns on the company's lines are well served. Barnsley, Chester, and Grimsby are, however, not treated so well as they should be. But these deficiencies are fully atoned for by the superb services between Manchester and Liverpool in competition with the North-Western and the Lancashire and Yorkshire companies.

The towns to the east of Manchester are by no means well served from Liverpool. To take rather more than two hours as the fastest time to Sheffield (76¼ miles), and the rest of the trains generally much longer, is the reverse of creditable; and Barnsley, Hull, Grimsby, etc., are of course much worse off even than this. Liverpool is also only moderately connected with the towns on the Great Northern system and London, owing doubtless to the recognised futility of competing with the London and North-Western for the traffic to the Metropolis. Manchester, however, in this respect comes out well, and we may perhaps refer at a later stage to the state of the competition on each of the three routes.

Punctuality on the Manchester, Sheffield and Lincolnshire line proper is very good, except for the slower expresses, which stop more frequently. On the Cheshire Lines section between Manchester and Liverpool we possess at once perhaps the fastest, most frequent, and most punctual services in the kingdom. The table referred to above showing the train services is here given :—

| Between Manchester and | Miles. | Number of Trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 miles per hour. | | 40 miles per hour. | | 45 miles per hour. | | | | |
| | | From Manchester. | To Manchester. | From Manchester. | To Manchester. | From Manchester. | To Manchester. | Hr. | Min. | |
| Warrington | 15¾ | 20 | 21 | 20 | 18 | 17 | 15 | 0 | 18 | Three trains run on certain days of the week only. |
| Southport . | 49½ | 7 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | One up and two down trains run on certain days of the week only. |
| Liverpool . | 34 | 17 | 17 | 16 | 17 | 16 | 17 | 0 | 40 | Three trains run on certain days of the week only. The trains in 40 minutes run *viâ* the straight line at Warrington, and thus slightly reduce the distance. |
| Chester . | 38¾ | 1 | 1 | None | None | None | None | 1 | 0 | Poor Service. |
| Barnsley . | 35½ | None | None | None | None | None | None | 1 | 18 | Poor Service. |
| Grimsby . (*viâ* Retford) | 109½ | 2 | 1 | None | None | None | None | 2 | 50 | |
| Sheffield . | 41¼ | 5 | 5 | 2 | None | None | None | 1 | 0 | |

Except in the neighbourhood of Manchester and Liverpool, the company have very little local traffic, and what they have is conducted in much the same way and at similar speeds to those which prevail on other English railways.

(*b*) *ROLLING STOCK AND GENERAL ACCOMMODATION.*— The passenger rolling stock of the Manchester, Sheffield and Lincolnshire Railway is fairly good throughout. The carriages in the through trains are exceedingly well equipped, the thirds being well cushioned and roomy, with a larger amount of window space than usual, and the seconds and firsts being almost up to the best specimens running on other lines. The latter class is generally ornamented in fancy woods, and is frequently provided with lavatory accommodation. Almost alone of the lines north of the Thames, the Manchester, Sheffield and Lincolnshire Company have adopted an electrical means of communication between the passengers and the officials of the train. Dining saloons, owned jointly with the

Great Northern, are run twice daily each way between Manchester and London. The only shabby rolling stock on the line is seen occasionally in the slower trains, and even here matters have much improved of late. The coaching stock used on the Cheshire Lines railways is of similar character to that on the Manchester, Sheffield and Lincolnshire line proper, and is mostly of the twelve-wheel bogie type.

In other respects the accommodation given by the company is tolerably good. The Automatic Vacuum brake, after some years' use of the simple variety, has been adopted. The termini at Manchester and Liverpool are well adapted to traffic demands, and most of the roadside stations on the main line are superior to the English average. The company have been rather unfortunate as regards accidents, two of the most disastrous of recent years—Penistone and Hexthorpe—having occurred on their line.

### (3) Locomotive Work.

(*a*) *Speed.*—The Manchester, Sheffield and Lincolnshire possesses some very smartly-booked trains, and also some which might be levelled up a little. The best and quickest timing they are supposed to do is the series of runs from Manchester to Warrington in 18 minutes, a little under 16 miles. This, however, is rarely done in daily work. Also, the best trains between Manchester and Southport, and the best between Sheffield and Retford and Grantham, are timed at decidedly high rates. Warrington to Liverpool is generally run over by the fast Manchester service at a booked rate of about 45 miles an hour, and this is nothing to boast of. The section over the Pennine, between Manchester and Sheffield, with light loads, is usually done at a booked speed of 40 or under. This is scarcely brilliant. It is, however, worthy of note that this line claims the fastest start-to-stop run but one in England. This is from Grantham to Retford ($33\frac{1}{4}$ miles) in 36 minutes, with the Great Northern Company's 4.15 p.m. express from King's Cross, which, north of Grantham, is worked by Manchester, Sheffield and Lincolnshire locomotives.

(*b*) *Gradients.*—The Manchester, Sheffield and Lincolnshire main line from Retford, the point where it diverges from the Great Northern, to Manchester is very steep. This is particularly so on

the latter part of the journey, that is, from Sheffield westwards, which is extremely arduous. We give the gradients below in some detail. Before doing so, it may, however, be stated that one or two of the fastest London to Manchester expresses are run north of Grantham, on the Great Northern Railway, by the Manchester, Sheffield and Lincolnshire locomotives. For description of gradients on this section, reference must be made to the article on the Great Northern.

Starting from Retford the line is level for about $\frac{1}{2}$ mile, then rises $\frac{3}{4}$ mile at 1 in 146, undulates and is level for $1\frac{1}{4}$ miles, rises $1\frac{1}{4}$ miles at 1 in 175, undulates with a slight downward tendency for 2 miles, rises 1 mile at 1 in 150, and is almost level into Worksop. It then mounts 1 mile at 1 in 150, descends $1\frac{1}{4}$ miles gently, and rises 3 miles at 1 in 132 and 140, and after $\frac{1}{4}$ mile level mounts another mile at 1 in 179. This is followed by a very short level stretch and $3\frac{1}{2}$ miles of descent at 1 in 115. This descent is responded to by a 3-mile ascent at 1 in 137 and 1 in 150, followed by $2\frac{1}{2}$ miles of 1 in 144 and 155 down ($\frac{1}{2}$ mile easy) into Sheffield. The section is, therefore, a moderately hard one, and would be harder if the gradients were massed together, as they are west of Sheffield. Here the ascents and descents are steep but not long, and the impetus from the descents aids a great deal in mounting the short ascents. Still, the express speed is distinctly good on this section, and would be still more creditable if the trains were heavier.

The accompanying diagram gives full details of the severe gradients between Sheffield and Manchester. The express trains running over this section do some good work. Their loads, however, are not heavy, and their booked times are not nearly so difficult to follow in practice as the work accomplished on the Preston to Carlisle section of the North-Western or on the Caledonian main line.

Beyond Manchester, on the Cheshire Lines route there is nothing worth speaking of. To Warrington is practically level, and thence to Liverpool is only a trifle harder, part of the distance being composed of undulations of 1 in 200, or thereabouts.

(*c*) *LOCOMOTIVES.*—The locomotives on the Manchester, Sheffield and Lincolnshire are painted green, and are generally of rather unprepossessing appearance. The latest type, however, cannot, in fairness, be thus described, as they are of very handsome design.

# MANCHESTER TO SHEFFIELD.

## GRADIENT PROFILE.

M.S.&L.R.

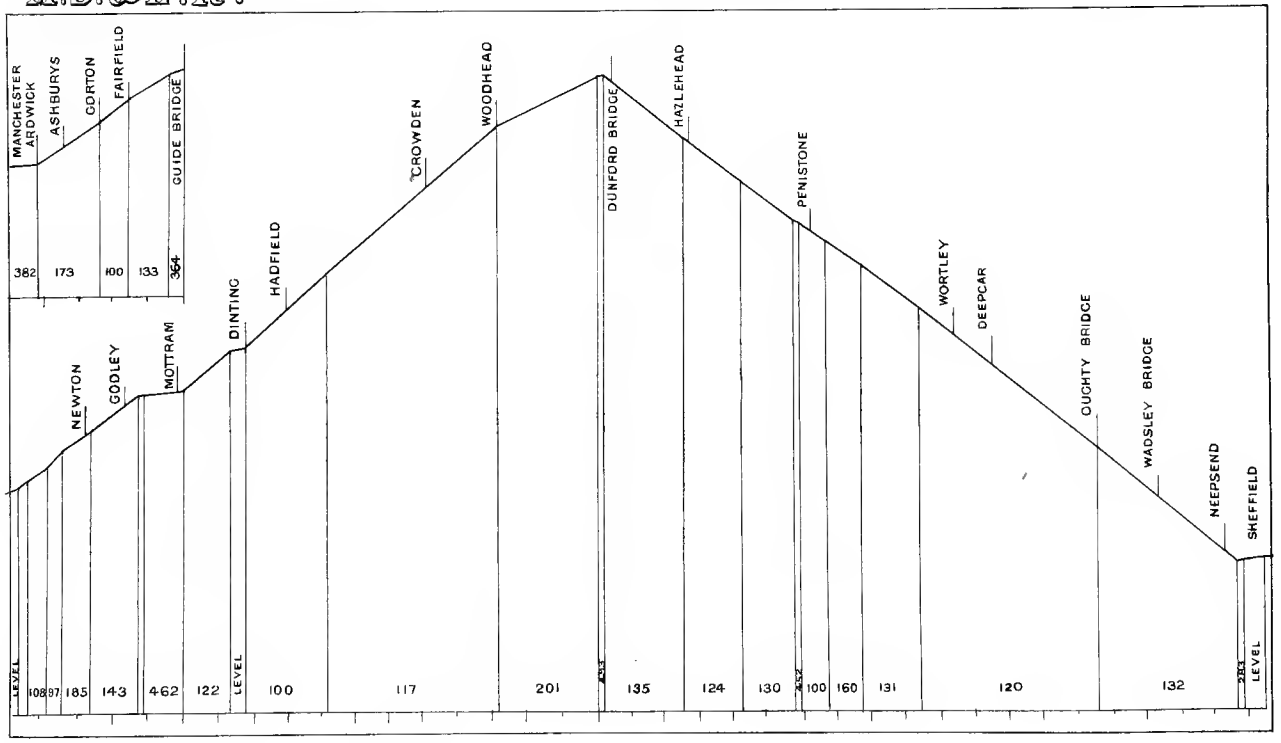



Plate XXII.

*Between Pages 152 & 153.*

They are also capable of excellent work, as will be seen below. It is very singular that in their dimensions this most recent type adopted by the company should be so different from the standard express engines with single driving wheels of only a few years back, built by Mr. Sacré. Details of the principal dimensions are as under :—

| Dimensions. | | Single. | Coupled. |
|---|---|---|---|
| Diameter of drivers . . . . | ft., in. | 7 6 | 6 9 |
| Cylinders . . . . . | in. | 17½ by 26 | 18 by 26 |
| Heating surface (tubes) . | sq. ft. | 1,057 | 1,179 |
| Ditto (fire-box) . . | sq. ft. | 87 | 99 |
| Ditto (total) . . . . . | sq. ft. | 1,144 | 1,278 |
| Grate area . . . . . | sq. ft. | 17 | 18·85 |
| Weight on drivers or coupled wheels . | tons, cwts. | 17 11 | 32 1 |
| Total weight, working order . . | tons, cwts. | 40 12 | 46 0 |

(*d*) *Actual Performances.*—Some splendid work has been done on this line. Most of it is claimed by the 7 feet 6 inch single class, although it is stated that one of the new coupled engines has taken a light special from Manchester to Aintree (35¼ miles) in 34 minutes, while an engine of the same type has gone from Grantham to Retford in 33¾ minutes with 10 coaches, and climbed the steep bank out of Sheffield with 7 coaches, performing the first 17 miles in the good time of 26 minutes. The singles have run from Grantham to Sheffield in 62 minutes (56¾ miles) with 7 coaches, slacking to 10 miles an hour over the Retford curve; and from Manchester to Sheffield, also with 7 coaches, 41¼ miles, in 48 minutes, thus showing how easy it is to observe the booked time of 59 minutes. But their best chances are on the fast 18 minutes run from Manchester to Warrington (15¾ miles). As stated elsewhere, this run is rarely done in the booked time, but exceptions are far from wanting to this statement. On one occasion the distance was covered, with 11 coaches, in 17 minutes 43 seconds, and we believe it has been done in 15 minutes 44 seconds. If this be so, we can fairly credit the Manchester, Sheffield and Lincolnshire with the finest short run from start to stop ever performed. The 40 minutes trains, which run through between Liverpool and Manchester by the straight line at Warrington, very often perform the journey in 37 and 38 minutes, and it was done on one occasion in 35 minutes. The loads, however, are very light.

A few extra details of the run from Manchester to Warrington in 17 minutes 43 seconds, with 11 coaches, are given below:—

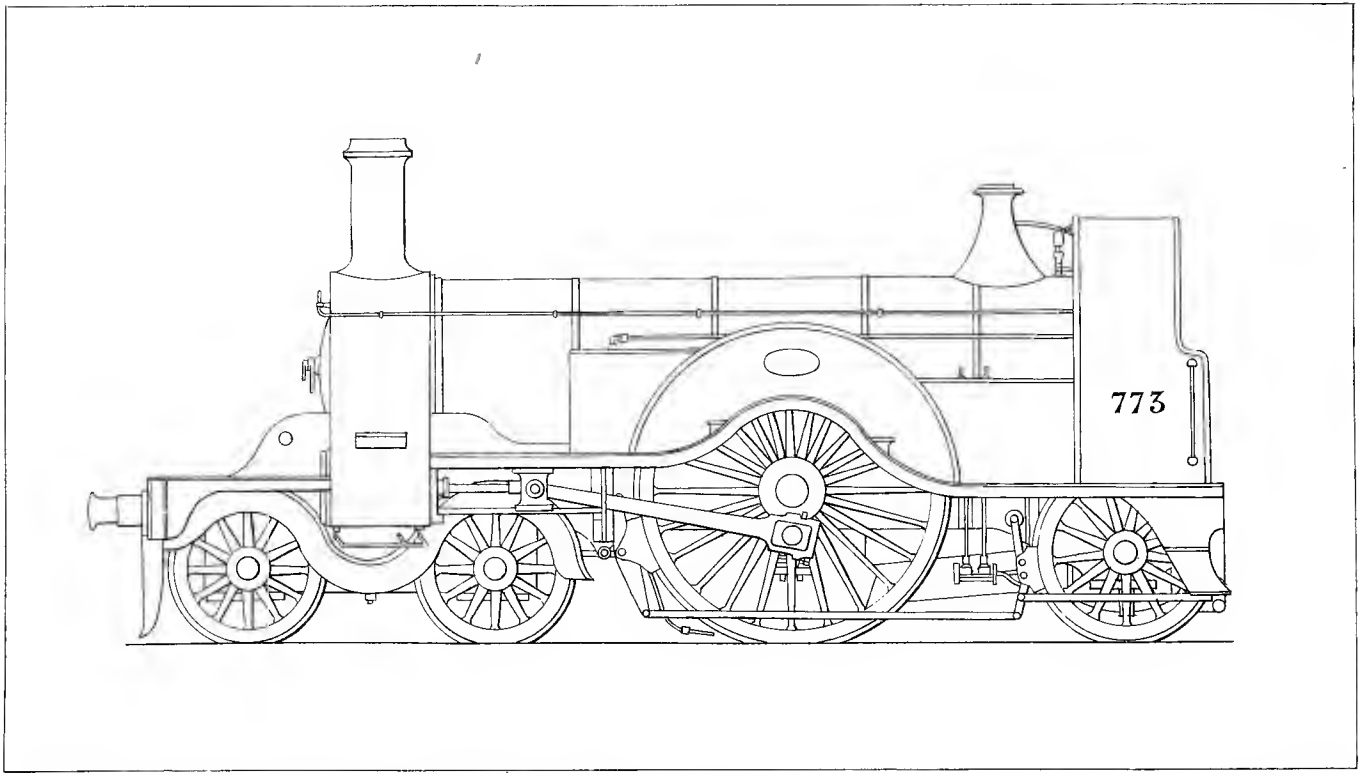
ENGINE 501, 7 FT. 6 IN. SINGLE.

| Stations. | Mls. Chns. | Time Due. | Time Actual. |
|---|---|---|---|
| | | P.M. | H. M. S. |
| **Manchester** . . . . *dep.* | — | **7 30** | **7 30 33** |
| Urmston . . . . | 4 79 | — | 7 37 11 |
| Flixton . . . . | 1 21 | — | 7 38 24 |
| Irlam . . . . | 2 10 | — | 7 40 30 |
| Glazebrook . . . | 1 18 | — | 7 41 45 |
| Padgate . . . . . | 4 24 | — | 7 46 6 |
| **Warrington** . . . . *arr.* | 1 63 | **7 48** | **7 48 16** |

We also subjoin further details of the run referred to above from Grantham to Retford in $33\frac{3}{4}$ minutes, with 10 coaches:—

ENGINE 561, 6 FT. 9 IN. COUPLED.

| Stations. | Mls. Chns. | Time Due. | Time Actual. |
|---|---|---|---|
| | | P.M. | H. M. S. |
| **Grantham** . . . . *dep.* | — | **4 4** | **4 6 30** |
| Barkstone . . . . | 4 20 | — | 4 11 55 |
| Hougham . . . . . | 1 68 | — | 4 13 32 |
| Claypole . . . . | 3 68 | — | 4 16 54 |
| Newark . . . . . | 4 62 | — | 4 21 7 |
| Carlton . . . . . | 6 20 | — | 4 26 54 |
| Crowpark . . . | 1 0 | — | 4 27 52 |
| Tuxford . . . . | 4 41 | — | 4 32 54 |
| **Retford** . . . . . | 6 56 | **4 40** | **4 40 18** |
| (Dead slow through station) | | (to pass) | |




To face p. 155.

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR PATRICK STIRLING.)

Description p. 163.

# IV.

## THE GREAT NORTHERN.

### (1) General Description of the Line.

This system is about 650 miles in length, and owns as its proportion of joint lines about 120 miles more. It forms one of the three great competing routes from London to the North. The main line runs very directly from King's Cross to Shaftholme, about four miles north of Doncaster, where it connects with the North-Eastern system. From this trunk numerous lines branch off to east and west, of which the most important are:—From Hatfield to St. Albans, Dunstable, and Luton; from Hitchin to Cambridge; from Peterborough through Spalding, Boston, and Louth, to Grimsby, with branches to Lynn, Spilsby, Skegness, and Mablethorpe; from Grantham to Nottingham, with a continuation to Derby, Uttoxeter, and Stafford; from Grantham to Lincoln; and from Doncaster *viâ* Wakefield to Leeds. Dissociated from the main line are the company's small but important branches in South Yorkshire. The chief of these are:—From Ardsley to Bradford; from Wakefield *viâ* Dewsbury and Batley to Bradford, with extensions to Halifax, and *viâ* Thornton to Keighley; and from Leeds to Bradford. Leicester and Nottingham are reached from Newark over this company's line, and lines owned jointly with the London and North-Western Company. Then the company are joint owners of the Great Northern and Great Eastern Joint Line, which is of small importance to the Great Northern, but is the means of giving the Great Eastern a northern outlet. Besides these, there are numerous suburban lines serving the outskirts of London. Recently the Great Northern have arranged to become joint owners with the Midland Company of the Eastern and Midlands Railway. This line we shall again refer to when we come to discuss the Midland Railway.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—One would indeed be very hard to please did one find fault with the Great Northern

train service. By many it is looked upon as the very best in the kingdom; and there is no doubt that, with one or two others, it deserves this distinction. The table given on p. 158, showing the connections between London and the chief towns on the system, renders further remarks almost superfluous. Peterborough, Cambridge, Grantham, Nottingham, Lincoln, Doncaster, York, Leeds, Bradford, Wakefield, and many other towns, are in full enjoyment of most admirable services; and by the aid of the North-Eastern, North British, and Manchester, Sheffield and Lincolnshire companies, the important points off the company's own line are abundantly provided for. In the table below we do not mention those towns outside the Great Northern system to which other lines compete, as we think it will be more convenient to make our comparisons at a later stage, so as to show how the great lines leading from London to the North compete to the many points of importance served by them in common. These comparisons are made in tabular form, under the heading of *Competitive Traffic*, in the concluding section of this work. There is, however, no competition worth speaking of to some of the important towns in the North-East of England served by the Great Northern and North-Eastern, or by the Great Northern and Manchester, Sheffield and Lincolnshire companies. Such towns are, for instance, Hull, Sunderland, and Newcastle. The services to the two former towns are fairly good, and indeed, so far as the Great Northern controls the running of the trains, excellent. Sunderland can be reached either *viâ* Durham (269 miles), *viâ* Newcastle and Shields (286¾ miles), or *viâ* Newcastle and Pelaw (280¼ miles). The best trains are by the last-mentioned route, and take about 6½ hours on the journey. Hull is reached either *viâ* Selby (205), *viâ* Doncaster (196¾), or *viâ* the ferry at New Holland (179½ miles). The Selby and Doncaster routes give the quickest connections, in rather over 4½ hours. To Newcastle (268¼ miles) the services are all that can be desired. Ten trains each way daily exceed 35 miles an hour, and there are six down and seven up over 40. The fastest takes just over 5½ hours.

Admirable services have also been established, with through carriages, to the smaller towns of Yorkshire and East Lancashire. Huddersfield (188½ miles) has good connections, the best train being allowed only just over four hours. This service is conducted *viâ* Sheffield by the aid of the Manchester, Sheffield and Lincolnshire and Lancashire and Yorkshire companies. Burnley, Accrington, and Rochdale, all just over 200 miles from London, are treated

almost equally well, the best trains exceeding an inclusive speed of 40 miles an hour; while to Halifax (about 195 miles) the service is fast and frequent, and almost as good as that accorded to such large towns as Leeds and Bradford.

It is not alone, however, on the main line of the Great Northern that we find such splendidly developed express services. Most of the branches have their own express trains at creditable speeds, connecting at the various junctions with those of the main line. Such branches are those from Hitchin to Cambridge; Grantham to Nottingham; Grantham to Lincoln; and Newark to Nottingham.

The punctuality of these splendid services is still good, though not what it used to be several years ago. There is no doubt that during the summer season the arrivals at King's Cross are distinguished by great want of punctuality; and it is only in the winter that the up trains are strictly punctual. In a pamphlet published two or three years ago, entitled *Great Northern Speeds*, it was sought to prove that the Great Northern was at the time still a punctual line, even in summer. We are, however, fortunately in a position to disprove this too comprehensive statement. The Return of Punctuality supplied to the House of Commons for the year 1890 shows, in the case of this company, the express and Scotch traffic separately. We give an abstract of this return below for three representative months, showing the punctuality at various seasons of the year:—

Punctuality of Great Northern Railway Long-distance and Scotch Trains.

| Months. | Description of Train. | Under 3 mins. late. | From 3 to 5 late. | From 5 to 10 late. | From 10 to 15 late. | From 15 to 20 late. | From 20 to 25 late. | From 25 to 30 late. | Over 30 mins. late. |
|---|---|---|---|---|---|---|---|---|---|
| | | Per cent to total. | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent to total. |
| May, 1890 | Scotch | 29 | 6 | 18 | 9 | 17 | 8 | 5 | 8 |
| | Long-distance | 39 | 12 | 22 | 10 | 8 | 3 | 3 | 2 |
| July, 1890 | Scotch | 8 | 1 | 8 | 7 | 10 | 8 | 10 | 48 |
| | Long-distance | 32 | 11 | 24 | 14 | 8 | 4 | 4 | 3 |
| November, 1890 | Scotch | 8 | 6 | 7 | 13 | 7 | 12 | 8 | 39 |
| | Long-distance | 35 | 13 | 24 | 13 | 2 | 8 | 2 | 2 |

As, however, it may be alleged that most of this lateness may be ascribed to the trains having been handed unpunctually to the Great Northern by the North-Eastern or the Manchester, Sheffield and Lincolnshire, we may state in disproof that the return gives

further down a statement of the precise amount of unpunctuality due to the Great Northern Company alone. Here it is :—

Punctuality of Long-distance and Scotch Trains after Deducting Detentions from Fog, Storm, or Waiting Connections.

| Months. | Description of Train. | Under 3 mins. late. | From 3 to 5 late. | From 5 to 10 late. | From 10 to 15 late. | From 15 to 20 late. | From 20 to 25 late. | From 25 to 30 late. | Over 30 mins. late. |
|---|---|---|---|---|---|---|---|---|---|
| | | Per cent to total. | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent to total. |
| May, 1890 | Scotch | 66 | 6 | 14 | 8 | 3 | 2 | 0 | 0 |
| | Long-distance | 56 | 12 | 16 | 7 | 4 | 2 | 2 | 1 |
| July, 1890 | Scotch | 56 | 12 | 15 | 6 | 4 | 3 | 1 | 2 |
| | Long-distance | 45 | 12 | 21 | 11 | 5 | 2 | 3 | 1 |
| November, 1890 | Scotch | 61 | 7 | 16 | 9 | 3 | 1 | 1 | 2 |
| | Long-distance | 53 | 13 | 20 | 9 | 3 | 1 | 1 | 1 |

Our statement, therefore, is proved exactly by figures supplied by the company. But the return does not deal with down trains from King's Cross, which are much more punctual than the up, as may be seen from a return for 1892 including down as well as up trains, nor does it touch the branch-line fast services, which are exceedingly punctual. Hence our remarks above to the effect that the "punctuality is still good, though not what it used to be several years ago."

The table referred to above showing the services between London and the chief towns on the system is here given :—

| Between London and | Miles. | Number of Trains at or over 35 miles per hour. Down. | Up. | 40 miles per hour. Down. | Up. | 45 miles per hour. Down. | Up. | Fastest. Hr. | Min. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| Cambridge | 58 | 6 | 6 | 5 | 6 | 1 | 1 | 1 | 17 | |
| Huntingdon | 58¾ | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 11 | |
| Peterborough | 76¼ | 17 | 21 | 16 | 20 | 14 | 19 | 1 | 25 | Fastest train connects by slip carriage. |
| Grantham | 105⅓ | 20 | 23 | 19 | 22 | 16 | 17 | 1 | 57 | |
| Nottingham | 127¾ | 11 | 10 | 10 | 8 | 6 | 3 | 2 | 32 | |
| Lincoln | 130 | 8 | 8 | 5 | 2 | 1 | None | 2 | 45 | |
| Retford | 138½ | 14 | 12 | 12 | 11 | 8 | 6 | 2 | 40 | |
| Doncaster | 156 | 15 | 15 | 14 | 14 | 10 | 7 | 3 | 2 | |
| York | 188 | 15 | 11 | 12 | 10 | 5 | 4 | 3 | 45 | |
| Wakefield | 175 | 10 | 11 | 10 | 6 | 6 | 4 | 3 | 30 | |
| Leeds | 185½ | 10 | 11 | 8 | 6 | 4 | 4 | 3 | 50 | |
| Bradford | 192 | 10 | 8 | 7 | 4 | 3 | 3 | 4 | 3 | |
| Dewsbury | 181½ | 7 | 9 | 7 | 4 | 1 | 1 | 3 | 59 | |

The local services of the Great Northern are, with those of the London and North-Western, as certainly the best in England as the Glasgow and South-Western Company's are in Scotland. Great frequency of trains, great speed, and great punctuality might well describe this company's local arrangements. Other lines are content to run their local trains at an inclusive speed of but little over 20 miles an hour. The three companies we have named think nothing of running up to 30. As instances look at the Great Northern Company's 7.50 a.m. from Peterborough, which stops at every station down to Retford, getting there in two hours, a distance of 62¼ miles; the Glasgow and South-Western Company's 2 p.m. from Carlisle, which makes Kilmarnock (91¼ miles of hilly road) in 3 hours 18 minutes, stopping everywhere; and, most wonderful of any local train in the world, the London and North-Western Company's 6.50 a.m. from Carlisle, which stops at every station to Oxenholme, and yet does the 50 miles of mountain road in 90 minutes. Not less admirable than the speed and punctuality of the Great Northern local trains is the rolling stock, which is well lighted (except on the London suburban trains, where electricity is slowly coming in) and upholstered in tasteful style.

(*b*) *Rolling Stock and General Accommodation.*—The rolling stock and general accommodation of the Great Northern is of the very highest class. We have previously spoken of the carriages on the branch lines in terms of great praise. The main-line stock, consisting principally of 6-wheeled vehicles, is almost equally worthy of praise. The company are now busy fitting the third-class carriages with lavatory accommodation, and this is already supplied on the East Coast Joint Stock in rather a novel way. A corridor runs down one side of the vehicle, and provides means of access to two lavatories—one at each end. The upholstering and fittings could hardly be improved upon, being executed in the best materials and in the best taste. The first class is not quite so good, and must be considerably improved before equalling the London and North-Western types. Some new firsts, however, lately built for the East Coast Joint Stock, are most pleasingly decorated and provided with comfortable lavatory accommodation; the second-class coaches employed in that traffic are also of a very fine description. Two 12-wheeled dining-cars run each way between London and Leeds and Manchester. Those running to Manchester are jointly owned by the Manchester, Sheffield and Lincolnshire Company, and are probably the finest cars running in this country.

In other respects the Great Northern Company serve the public very well. The line is one of the best north of the Thames for its signalling arrangements, and although the simple vacuum brake was long used, the automatic variety has at last made its appearance. The permanent way is in first-class condition, and few fatal accidents have occurred for some years. The station accommodation is generally adequate, but might be improved at one or two of the larger towns and junctions on the company's system.

### (3) Locomotive Work.

(*a*) *Speed.*—Before glancing at the results achieved in actual working we will consider for a brief space and in a general manner the booked speeds which the Great Northern engages on paper to perform in practice. It may at once be stated that the general level of this company's performances stands higher than that of any other, but perhaps not so much so as is generally imagined. It gives us, on its short system of about 800 miles, a bewildering profusion of fast runs, and presents us with almost as many examples of express speed as the much more extensive systems of the Midland and North-Western Companies. This to a certain extent explains the high and well-merited reputation of the Great Northern as an express line. Its advocates are never weary of pointing out how much more express mileage it has in proportion to its length than any other line. But this indiscriminate praise needs great qualification. The Great Northern has a main line nearly 200 miles long, and over it is conveyed a fair share of the traffic to Scotland, Leeds, Bradford, Sheffield, Manchester, Nottingham, Hull, and all the Newcastle district passengers. The North-Western over its main line carries the Scotch traffic for 300 miles; the Irish for about 250; Liverpool and part of Manchester, about 200: and a fair share of the Birmingham district for a little more than 100 miles. *The opportunities and obligations of each line to run express traffic do not thus seem greatly dissimilar, and are at any rate far from being so disproportionate as the difference in the total lengths of the respective systems.* The fact is, the North-Western's long system is composed in great part of suburban and branch lines, to run express trains over which would be absurd and anomalous, while the Great Northern consists mostly of through or important routes, over which not to run express trains would be a reproach. Of course, we are far from saying there is anything of this sort in the case of the Great

# LONDON TO GRANTHAM.

## GRADIENT PROFILE.

G.N.R. No. 1.

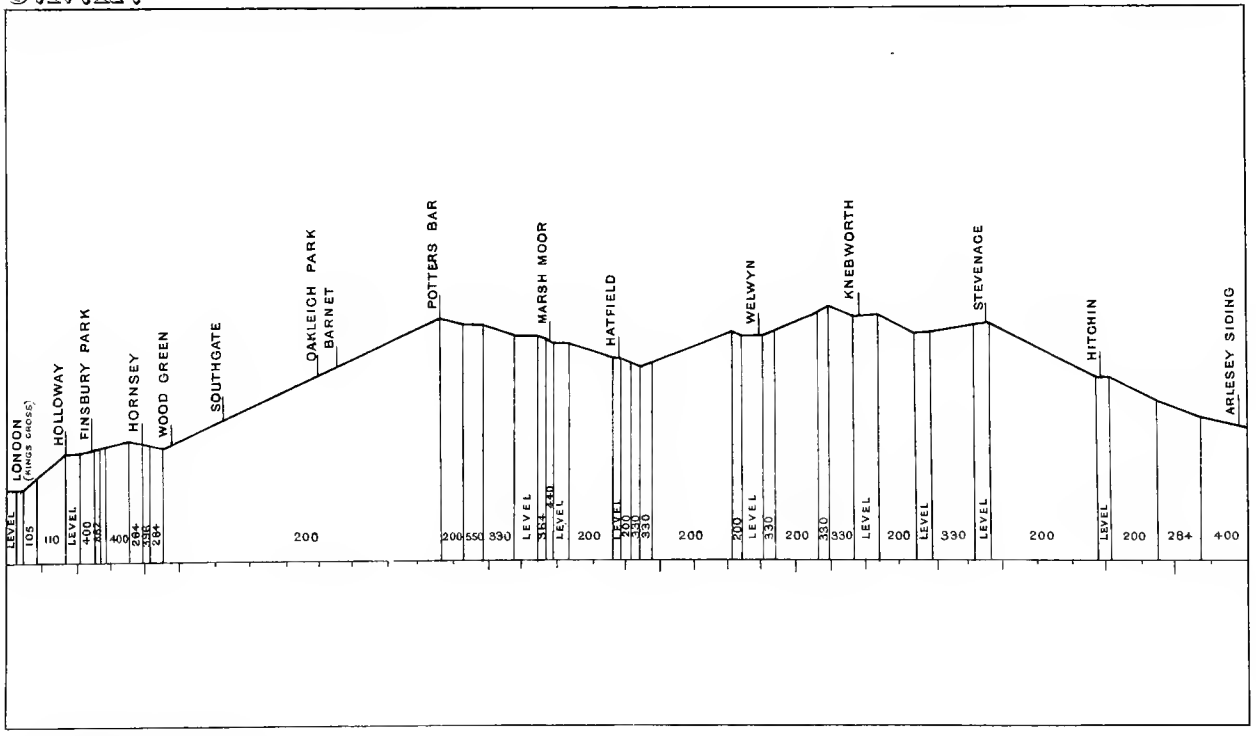



Plate XXIV.

*Between Pages 160 & 161.*

# LONDON TO GRANTHAM.

## GRADIENT PROFILE.

G.N.R. No. 2.

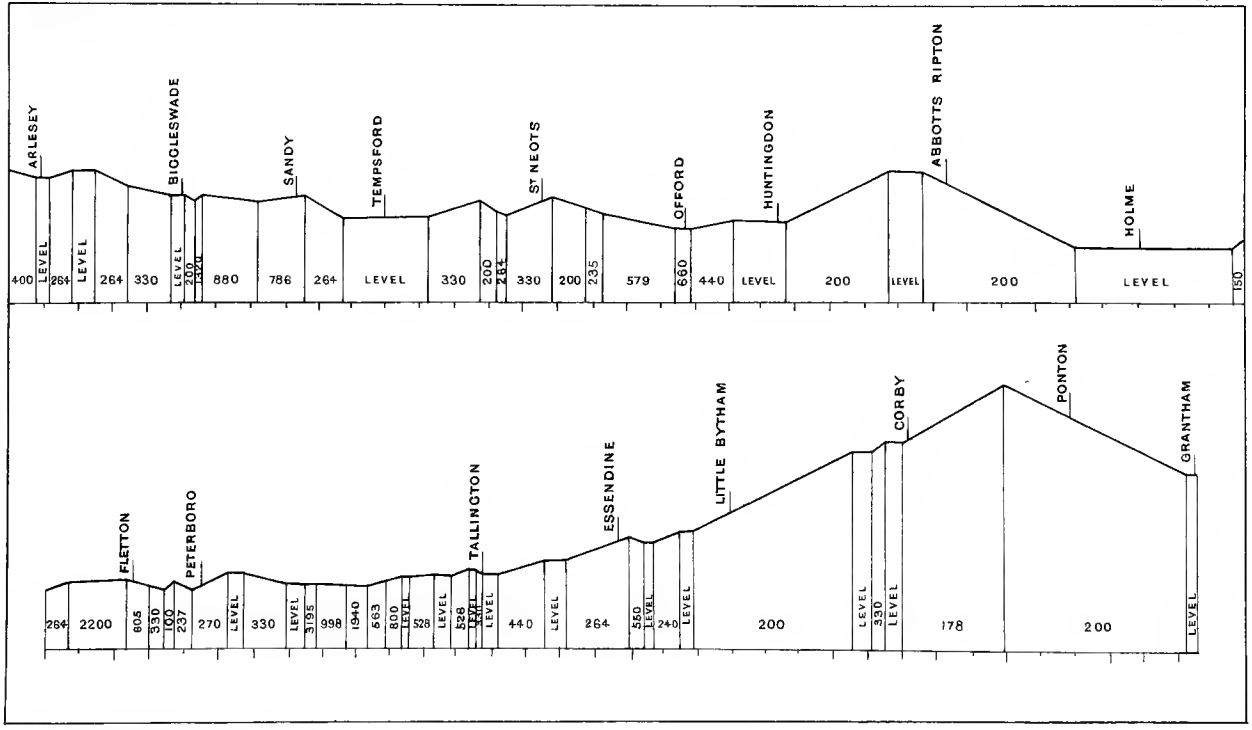



Plate XXV

*Between Pages 160 & 161.*

Northern Company. Exactly the reverse. The extraordinary number of express journeys run daily on their system fully satisfies all demands.

Looking, then, in a general way at the booked speeds, we find that there is a very large number of trains which easily tops the 50-miles-an-hour mark between London (King's Cross or Finsbury Park) and Peterborough or Grantham. The best to Peterborough takes 87 minutes (down) and 86 minutes (up) for 76¼ miles; but on Mondays only there is an extraordinary train which is timed to run from Peterborough to Finsbury Park (73¾ miles) in 80 minutes. To Grantham the best down train gets 119 minutes; the best up 117 only. Between Peterborough and Grantham the down trains are not very quickly timed on account of gradients, but several up trains are only allowed 33 minutes for the 29 miles.

North of Grantham the same high pressure is maintained. In fact here, as further south, trains with a booked speed of under 50 miles an hour seem less numerous than those over that figure. On the shorter runs, such as Grantham to Newark, Grantham to Retford, Doncaster to Wakefield, the speed rules very high, just as it does south of Grantham on such stretches as Hitchin to Peterborough, etc. The longer runs are also superb. Examples are easily found. Grantham to Doncaster (50¾ miles) in 56 minutes down and 58 up; and to York (83 miles) several times under 100 minutes, give evidence of the characteristic energy of the line. On the branches also, such as from Grantham to Nottingham and Lincoln, and Hitchin to Cambridge, the work is most spirited, and falls little short of a booked speed of 50 miles an hour.

The loads taken by these quickly-timed trains vary considerably. Few of them, however, are really lightly loaded, and quite 80 per cent. of the main-line expresses average 13 carriages or more. Thus not only are the Great Northern expresses very quickly timed but they are also heavily loaded. In spite of this, however, the use of pilot or assistant engines is forbidden even on the heaviest trains. We believe the Great Northern is the only line in England which never uses two engines on a train. In this respect it offers a striking contrast to its rival and neighbour, the Midland, which seems to seize with alacrity every opportunity for tacking on an assistant locomotive.

(*b*) *Gradients.*—The Great Northern main line gradients are moderately hard, as may be seen by reference to the accompanying gradient profile of the line from London to Grantham. From

this point the line descends gradually for 11 miles, and is almost level for 11 more, then rising for 6 miles mostly at 1 in 200. This brings us to post 133, and thence to Retford (138½ miles) is chiefly 1 in 200 and 1 in 178 falling. From here to York (with the exception of 1½ miles up and one mile down of 1 in 198, between posts 147 and 151), the line is one of the most level stretches in the kingdom.

It is customary in describing the gradients of the Great Northern main line to exaggerate their importance. The line is moderately hard and nothing more. The gradients, we think, are disposed more to aid the down than the up trains, and it will be noticed that the best runs on the Great Northern, in actual daily practice, are performed by the down expresses.

The route leaving the main line at Doncaster for Leeds and Bradford is of a different character altogether. Between Doncaster and Wakefield there are two steep bits, a seven-miles rise and a four-miles fall averaging 1 in 150, and after Wakefield we rise five miles to Ardsley, falling thence four miles of 1 in 100 into Leeds. From Ardsley the Bradford line is almost mountainous, rising for eight miles on gradients of 1 in 70 to 1 in 132 to 750 feet above sea, and dropping four very steep miles (two of which are 1 in 50 to 1 in 60) into Bradford. From Doncaster to Bradford, therefore, is a very difficult piece to work over.

(*c*) *Locomotives.*—On looking at the speeds demanded and the gradients to be overcome, one would imagine that what the Great Northern wanted would be a locomotive of considerable power combined with excellent speed qualities. This is exactly what the company possess. The 8 feet singles, the dimensions of which we give below, are splendid engines, and have for more than twenty years worked the Great Northern traffic to admiration. Recently, however, it has been deemed advisable to supplement these by a more powerful class, having inside cylinders 18½ by 26 inches, 7 feet 6 inch single driving wheels, and without bogie. Of course, neither of these types possesses the great hauling capabilities of, say, the Caledonian four-coupled bogies, or the large North-Western compounds. Still, their adaptability to pull extremely fast and heavy trains over easy grades is unquestioned, and many of the best performances recorded have been done on the Great Northern Railway.

Among the other classes of passenger locomotives on the system may be mentioned the 6 feet 6 inch coupled types, with 17½ by 26 cylinders. These do excellent work, but are not often employed on the very fastest trains. Then we have the old 7 feet singles with

17½ by 24 cylinders, which in their day have done performances worthy of much more powerful types. Frequently the minor expresses are worked by a 5 feet 6 inch front-coupled class with 17½ by 24 cylinders. In the London suburban district, the local traffic is worked by tank engines, which, with some of the faster local trains, running for some distance without stop, have attained to 60 miles an hour between stations—a very high speed for a tank engine. All the engines on the line are painted a grass green; and those employed for the fastest traffic are, we think, in general compactness of design, more striking than those of any other company. The brake in use is the Automatic Vacuum.

The Great Northern locomotive stock is maintained in first-rate condition under the careful superintendence of Mr. Patrick Stirling of Doncaster. This gentleman has adhered to the "single" type of passenger locomotive through evil and good report, and has been well rewarded. His locomotives are to-day, perhaps, more economical in coal consumption, and more favourably known for their general performances than any others. Further dimensions of most of the types mentioned above are given in the subjoined table:—

| Dimensions. | 8 ft. Singles. | 7½ ft. Singles. | 6½ ft. Coupled. | 5½ ft. Coupled. |
|---|---|---|---|---|
| Cylinders . . . in. | 18 by 28 | 18½ by 26 | 17½ by 26 | 17½ by 24 |
| Diameter of driving wheels ft., in. | 8 ft. | 7 ft. 6 in. | 6 ft. 6 in. | 5 ft. 6 in. |
| Heating surface Tubes sq ft. | 936 | 936 | 836·9 | 823·6 |
| ,, ,, Box . ,, | 109 | 109 | 92·4 | 92·4 |
| ,, ,, Total . ,, | 1,045 | 1,045 | 929·3 | 916 |
| Grate area . ,, | 17¾ | 18·4 | 16¼ | 16¼ |
| Weight available for adhesion . . tons. | 17 | Tons. Cwts. 17 8 | 27½ | Tons. Cwts. 26 16 |
| Total weight of engine . tons. | 45 | Tons. Cwts. 40 13 | 39 | Tons. Cwts. 35 2 |

(*d*) *Actual Performances.*—We will now give a few instances of actual daily work on the Great Northern system, and at the outset have some difficulty in treating the great mass of material before us, scarcely knowing what to accept and what to reject. It may somewhat simplify matters if we give the outlines of some of our best performances on this line, passing over at present the details of uphill running, which are referred to more at length at a later stage.

The majority of the Great Northern performances have, of course, been done by the 8 feet singles. This class is responsible for the following fine work: Grantham to London in 117¾ minutes, with 8½ coaches; London to Grantham (105¼) in 116 minutes 58 seconds, with 12 coaches (including a signal check near Peterborough which delayed the train 2½ minutes), further particulars of which are given below; the same run, but with 17½ coaches and only 1 engine, in 126½ minutes, passing Potter's Bar in 19 minutes 38 seconds, Hatfield in 25 minutes 5 seconds, Hitchin in 39 minutes 51 seconds, Huntingdon in 66 minutes 8 seconds, and (after a signal check), Peterborough in 88 minutes 4 seconds; Peterborough to Finsbury Park (73¾ miles) in 75½ minutes, with 10 coaches, on the up 10.40 a.m. (Mondays only); Hitchin to King's Cross, with 9½ on, in 35 minutes (passing Hatfield in 16 minutes 41 seconds after passing Hitchin); Wakefield to Doncaster, with 13 coaches, in 22 minutes 24 seconds (19 miles), starting and stopping; Doncaster to Grantham (50¾) in 62 minutes with 14 coaches, passing Retford in 20 minutes 53 seconds and Newark in 41 minutes 34 seconds after starting, and then being badly checked three times by signal; Peterborough to Grantham with 13 on, in 31¾ minutes (29 miles).

The 7 feet 6 inch and 7 feet singles have also done very noteworthy performances. To run from Peterborough to King's Cross in 83 minutes 13 seconds with a 7 feet 6 inch single and 13 coaches is brilliant work. Further particulars of this excellent run are given below. With the smaller singles, some of the best records are those of Mr. Rous-Marten, given in his *Notes on the Railways of Great Britain.* He states that on one occasion the 76¼ miles between London and Peterborough was run in 88 minutes, with a load of 159 tons, and on another that Huntingdon to Finsbury Park (56¼ miles) was done in 66 minutes with no fewer than 16 coaches.

All the above, highly creditable as they are, are simply everyday Great Northern performances. But, as explained in our remarks on the North-Eastern Railway, a locomotive should be judged by its best, and not by its average, performances. Now the best work the Great Northern has ever given us was in the race to Edinburgh in August, 1888. Here some extremely fine work was done; and the best performances, especially between London and Grantham, were quite on a par with the records of the three other companies concerned. Grantham to York was not quite so good as London to Grantham, although sufficiently fine work was done on that piece. We reproduce below a complete statement of the running during the

month. Attention is particularly directed to the run of August 25th, in which London to Grantham ($105\frac{1}{4}$) was covered in 105 minutes. We believe the figures should be 106 minutes; but in any case it is a hard matter to decide whether this or the North-Eastern run from York to Newcastle in 80 minutes is the better, or whether either of them quite comes up to the West-Coast records described elsewhere. The average daily performances on the Great Northern are, without doubt, superior to the North-Eastern, whatever may be the opinion as to the relative merits of the best performance on either line. We now give the statement referred to above. It has previously appeared in the columns of the *Engineer*.

Running of down Special Express 10 A.M. from King's Cross during August, 1888.

I.—London to Grantham, 105 miles 26 chains.

| Date. | No. of Engine. | No. of Vehicles. | Left King's Cross. Due 1st to 31st incl., 10 a.m. | Arr. at Grantham. Due 1st to 4th incl., 11 59. 6th to 18th, 11 57. 20th to 31st, 11 55. | Delays, &c. | Miles per hour. Actual. Running, excluding delays. | Miles per hour. Actual. Including stops, &c. |
|---|---|---|---|---|---|---|---|
| | | | A M. | A.M. | MIN. | | |
| 1st . . | 671 | 8 | 10 | 11 59 | — | 53·1 | — |
| 2nd . . | 233 | 9 | 10 | 11 58 | — | 53·6 | — |
| 3rd . . | 776 | 9 | 10 | 11 56 | — | 54·5 | — |
| 4th . . | 233 | 9 | 10 | 11 58 | — | 53·6 | — |
| 6th . . | 98 | 8 | 10 | 12 0 | 7 | 55·9 | 52·7 |
| 7th . . | 69 | 9 | 9 58 | 11 54 | — | 54·5 | — |
| 8th . | 48 | 8 | 9 59 | 11 56 | — | 54·0 | — |
| 9th . | 776 | 9 | 9 58 | 11 55 | — | 54·0 | — |
| 10th . . | 234 | 10 | 10 | 11 57 | — | 54·0 | — |
| 11th . | 776 | 8 | 10 | 11 55 | — | 55·0 | — |
| 13th . . | 237 | 8 | 10 | 11 55 | — | 55·0 | — |
| 14th . | 7 | 8 | 10 | 11 55 | — | 55·0 | — |
| 15th . . | 98 | 8 | 10 | 11 55 | 2 | 55·9 | 55·0 |
| 16th . . | 22 | 9 | 10 | 11 51 | — | 56·9 | — |
| 17th . | 22 | 8 | 10 | 11 55 | 2 | 55·9 | 55·0 |
| 18th . | 7 | 8 | 10 | 11 56 | — | 54·5 | — |
| 20th . . | 233 | 7 | 10 | 11 50 | — | 57·5 | — |
| 21st . | 237 | 7 | 10 | 11 49 | — | 58·0 | — |
| 22nd . | 98 | 7 | 10 | 11 53 | — | 55·9 | — |
| 23rd . . | 233 | 7 | 10 | 11 48 | — | 58·5 | — |
| 24th . . | 98 | 7 | 10 | 11 53 | — | 55·9 | — |
| 25th . . | 233 | 7 | 10 | 11 45 | — | 60·2 | — |
| 27th . . | 22 | 7 | 10 | 11 51 | — | 56·9 | — |
| 28th . . | 98 | 7 | 10 | 11 52 | — | 56·4 | — |
| 29th . . | 22 | 7 | 10 | 11 49 | — | 58·0 | — |
| 30th . . | 69 | 8 | 10 | 11 54 | — | 55·4 | — |
| 31st . | 98 | 7 | 10 | 11 50 | — | 57·5 | — |
| | | | Average . | | . | 55·7 | 55·5 |

II.—GRANTHAM TO YORK, 82 MILES 55 CHAINS.

| Date. | No. of Engine. | No. of Vehicles. | Left Grantham. Due, 1st to 4th incl., 12 4. 6th to 18th, 12 2. 20th to 31st, 12 0. | Arrival at York. Due, 1st to 4th, 1 35. 6th to 11th, 1 32. 13th to 31st, 1 30. | Delays, &c. | Miles per hour. Actual. Running excluding delays. | Miles per hour. Actual. Including stops, &c. |
|---|---|---|---|---|---|---|---|
| | | | | P.M. | MIN. | | |
| 1st | 3 | 8 | 12 2 | 1 33 | — | 54·5 | — |
| 2nd | 3 | 9 | 12 2 | 1 33 | — | 54·5 | — |
| 3rd | 3 | 9 | 12 0 | 1 31 | — | 54·5 | — |
| 4th | 3 | 9 | 12 3 | 1 36 | 3 | 55·1 | 53·3 |
| 6th | 777 | 8 | 12 4 | 1 36 | 2 | 55·1 | 53·9 |
| 7th | 777 | 9 | 11 59 | 1 31 | 2 | 55·1 | 53·9 |
| 8th | 777 | 8 | 11 59 | 1 29 | — | 55·1 | — |
| 9th | 777 | 9 | 12 0 | 1 30 | — | 55·1 | — |
| 10th | 777 | 9 | 12 2 | 1 32 | — | 55·1 | — |
| 11th | 777 | 8 | 11 59 | 1 30 | — | 54·5 | — |
| 13th | 775 | 8 | 12 0 | 1 30 | 6 | 59·1 | 55·1 |
| 14th | 775 | 8 | 12 0 | 1 30 | 2 | 56·4 | 55·1 |
| 15th | 775 | 8 | 11 59 | 1 28 | — | 55·7 | — |
| 16th | 775 | 8 | 11 59 | 1 27 | — | 55·1 | — |
| 17th | 775 | 8 | 12 0 | 1 29 | — | 55·7 | — |
| 18th | 775 | 8 | 12 0 | 1 30 | — | 55·1 | — |
| 20th | 775 | 7 | 11 54 | 1 24 | — | 55·1 | — |
| 21st | 775 | 7 | 11 53 | 1 22 | — | 55·7 | — |
| 22nd | 775 | 7 | 11 56 | 1 26 | — | 55·1 | — |
| 23rd | 775 | 7 | 11 53 | 1 22 | — | 55·7 | — |
| 24th | 775 | 7 | 11 58 | 1 26 | — | 56·4 | — |
| 25th | 775 | 7 | 11 51 | 1 30 | 9 | 55·1 | 50·1 |
| 27th | 95 | 7 | 11 56 | 1 28 | 3 | 55·7 | 53·9 |
| 28th | 95 | 7 | 11 58 | 1 29 | 2 | 55·7 | 54·5 |
| 29th | 95 | 7 | 12 0 | 1 30 | 4 | 57·7 | 55·1 |
| 30th | 95 | 8 | 11 58 | 1 27 | — | 55·7 | — |
| 31st | 95 | 7 | 11 54 | 1 23 | — | 55·7 | — |
| | | | Average | | | 55·5 | 54·8 |

In addition to the statement showing the running of the down special Scotch express for August 1888, we append below a few extra details of two runs from daily practice referred to briefly above. It will be observed that the second run reads from the bottom upwards.

LONDON AND PETERBOROUGH { 76¼ MILES IN 83¾ MINUTES.
76¼ MILES IN 83¾ MINUTES.

| Stations. | Mls. Chns. | Engine 544 & 12 coaches. Time Due. | Time Actual. | Engine 234 & 13 coaches. Time Due. | Time Actual. |
|---|---|---|---|---|---|
| | | P.M. | H. M. S. | P.M. | H. M. S. |
| **King's Cross** | — | **2 0** | **2 2 0** | **9 20** | **9 27 23** |
| Holloway | 1 50 | — | 2 5 31 | — | 9 24 47 |
| Finsbury Park | 0 72 | — | 2 7 7 | — | 9 23 36 |
| Harringay | 0 51 | — | 2 8 21 | — | 9 22 39 |
| Hornsey | 0 71 | — | 2 9 10 | — | 9 21 56 |
| Wood Green | 0 76 | — | 2 10 11 | — | 9 20 56 |
| New Southgate | 1 30 | — | 2 11 47 | — | 9 19 20 |
| Oakleigh Park | 2 3 | — | 2 14 26 | — | 9 17 27 |
| New Barnet | 0 64 | — | 2 15 28 | — | 9 16 46 |
| Hadley Wood | 1 30 | — | 2 17 22 | — | 9 15 24 |
| Potter's Bar | 2 11 | — | 2 20 26 | — | 9 13 6 |
| Hatfield | 4 79 | — | 2 25 31 | — | 9 7 40 |
| Welwyn | 4 22 | — | 2 29 34 | — | 9 3 40 |
| Knebworth | 3 4 | — | 2 32 51 | — | 9 0 27 |
| Stevenage | 3 43 | — | 2 36 13 | — | 8 56 22 |
| Hitchin | 3 30 | — | 2 39 4 | — | 8 52 1 |
| Three Counties | — | — | 2 42 13 | — | 8 47 56 |
| Arlesey | 5 6 | — | 2 43 26 | — | 8 46 30 |
| Biggleswade | 4 4 | — | 2 47 11 | — | 8 42 18 |
| Sandy | 2 79 | — | 2 50 1 | — | 8 39 11 |
| Tempsford | 3 32 | — | 2 53 19 | — | 8 35 53 |
| St. Neot's | 4 13 | — | 2 58 3 | — | 8 31 43 |
| Offord | 4 21 | — | 3 2 35 | — | 8 27 38 |
| Huntingdon | 2 74 | — | 3 5 49 | — | 8 25 0 |
| Abbott's Ripton | 4 43 | — | 3 11 48 | — | 8 19 49 |
| Holme | 5 74 | — | 3 17 0 (Lost 1 min. by slack) | — | 8 13 31 |
| **Peterborough** (76¼ miles) | 6 78 | **3 25** (to pass) | **3 25 47** (Passed at 5 miles an hr.) | **7 56** | **8 4 10** |

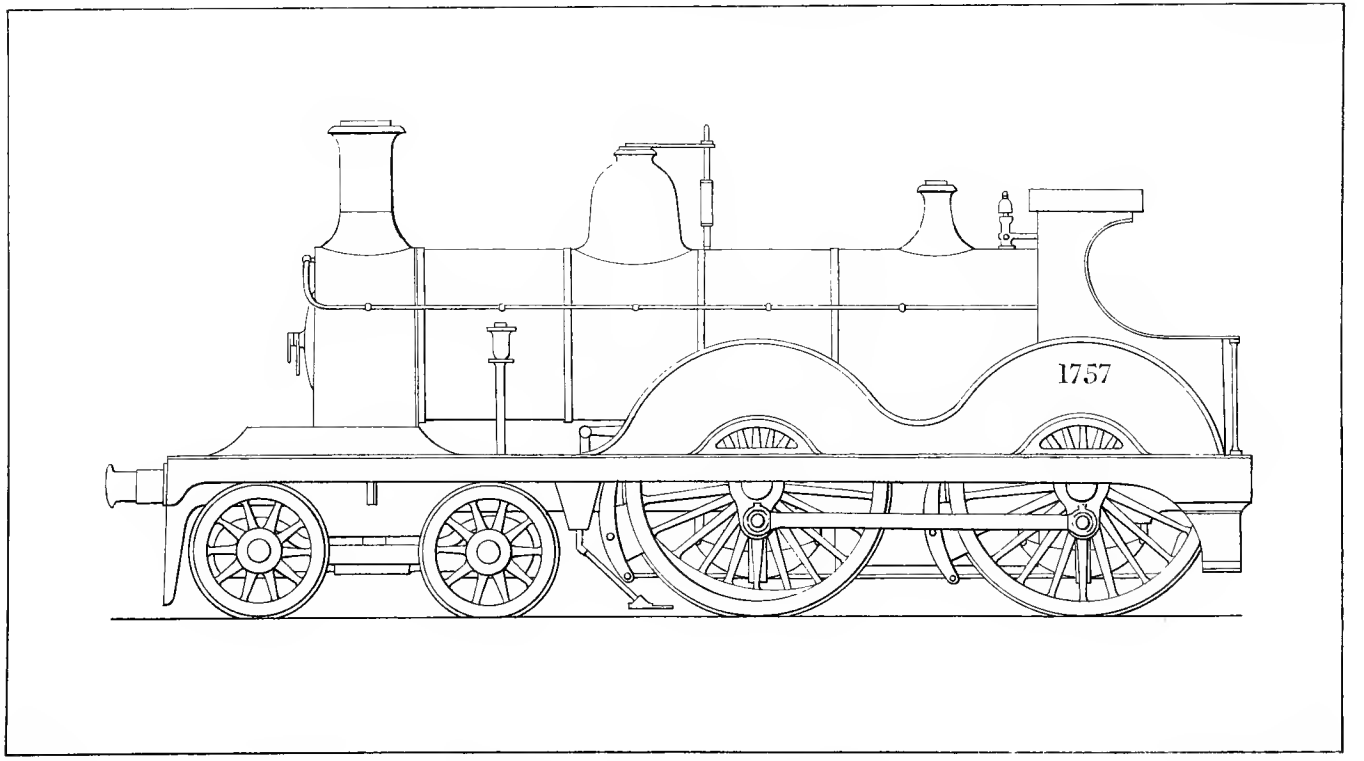
# V.

## THE MIDLAND.

### (1) General Description of the Line.

The Midland Railway, extending over some 1,300 miles, ranks second in importance to the North-Western. It is the most ubiquitous of our lines, stretching its arms in all directions—the greater part of its far-reaching system consisting rather of valuable branches than of lines of merely suburban importance. Almost alone of the English lines the Midland Railway has been fortunate in finding an historian to chronicle its marvellous record of enterprising development. The late F. S. Williams, in his *Midland Railway: its Rise and Progress*, has, in a picturesque and romantic manner, told the history of the line's fortunes. From the London terminus at St. Pancras the main line extends through St. Albans, Luton, Bedford, Wellingborough, Leicester, Chesterfield, Sheffield, Normanton, Leeds, Keighley, Skipton, and Appleby to Carlisle. Alternative routes to the North leave this trunk at Kettering, going round through Melton and Nottingham and joining the main line again north of Trent Junction; and at Chesterfield, running through Staveley and rejoining at Masboro'. At frequent intervals along this stretch there are most important branches on both the right and left. They are as under, taking those leaving on the right first:—

From Bedford to Hitchin (this line gave the Midland access over the Great Northern to King's Cross before the Bedford to London section was built); from Kettering to Cambridge *viâ* Huntingdon; from Leicester through Melton and Stamford to Peterboro', and thence over a piece of line jointly owned with the Great Northern to




To face p. 168.

EXPRESS PASSENGER ENGINE.

(DESIGNED BY Mr S W JOHNSON.)

Description p 184.

Wisbech and Lynn; from Trent to Nottingham and on to Newark and Lincoln in the North-East, and Mansfield in the North; and branches from two or three points to Otley and Ilkley. In addition to the above, the company run into York station over the North-Eastern metals.

Many of the above branches are very important, but those leaving the main line on the left side are much more so, and in several cases form main routes in themselves. Such is the line leaving Trent for Derby, the Peak district, and Manchester, with a branch at Miller's Dale to Buxton, and connections to the Cheshire Lines at Stockport for Warrington and Liverpool, and to the Lancashire and Yorkshire by a loop in Manchester, thus uniting the Midland system with the great towns of Lancashire, and giving it an alternative route to the North, joining the direct main line at Hellifield. The Midland expresses between London and Manchester and Liverpool take this route *viâ* Derby, but it has not yet been thought expedient to put on an express for Scotland *viâ* the Peak, Manchester, and the Lancashire and Yorkshire line. Under existing arrangements, the Midland contents itself with running its own engines and trains from Manchester and Liverpool to Carlisle, there connecting with its Scotch allies.

Another important section is that leading southwards from Derby through Burton, Birmingham, Worcester, Cheltenham, and Gloucester to Bristol, with a branch at Mangotsfield for Bath and the Somerset and Dorset Joint Line, which is described below. This is practically a main line in itself, as it affords a means of placing North-East and North-West England in touch with the South-West. Many small branches leave this line. Among these are the lines from Burton to Leicester; from Birmingham to Leicester *viâ* Nuneaton; from Water Orton to Wolverhampton; from Barnt Green to Ashchurch *viâ* Evesham; from Ashchurch to Malvern *viâ* Tewkesbury; and several smaller branches. There is also the isolated line from Hereford to Swansea *viâ* Brecon.

These are the leading offshoots of the Midland on the west side of the trunk line to the North. But, in addition, there are many other lines of less importance. Such are those from Bedford to Northampton; from Leicester to Rugby; from Clay Cross to Derby; from Shipley to Bradford; from Skipton to Colne; and from Settle Junction to Lancaster and Morecambe, with a line (jointly owned with the Furness Company) diverging from this at Wennington for Carnforth. There is, in addition, a multitude of lines covering

Derbyshire and Nottinghamshire with a network, but many of these are more valuable as mineral lines than as routes for passenger travel, for which reason we do not further allude to them here.

The Somerset and Dorset line referred to above is jointly owned with the London and South Western Company, and continues the Midland connections from Bath southwards through Shepton Mallet and Wimborne to Poole and Bournemouth. At Evercreech a line branches off for Bridgwater *viâ* Glastonbury, at which point another line leaves for Wells. The Ashby and Nuneaton Joint Railway is owned with the London and North Western Company, and the Cheshire Lines are jointly held with the Great Northern and Manchester, Sheffield and Lincolnshire. Arrangements are also being made with the Great Northern for acquiring jointly with that company the Eastern and Midlands Railway, extending from Lynn to Yarmouth, with branches at Melton Constable to Cromer and to Norwich.

It will thus be seen that the Midland is essentially a line of through routes, affording connections from London to Leicester, Nottingham, Sheffield, Leeds, Bradford, Manchester, Liverpool, and Scotland; from Liverpool and Manchester to Scotland, Leicester, Nottingham, Birmingham, and Bristol; and from Birmingham to nearly every town of importance in England and Scotland. No other line connects so many populous centres so directly one with another. This is partly the result of having (unlike the Great Northern and London and North Western) all the large towns on the main line, and partly in consequence of the company's excellent services, which we now proceed to discuss.

### (2) Travelling Facilities.

(*a*) *SERVICES BETWEEN CHIEF TOWNS.*—No line in England surpasses the Midland in the quality of its express services. This, as previously stated, is greatly due to the fact that many of the largest towns in England are on its main line. If this were not the case, we certainly should prefer both the Great Northern and North Western services to the Midland, both as being more frequent, and, where competition occurs, faster. The company's Scotch expresses in their journey North can pass *en route* Nottingham, Leicester, Sheffield, and Leeds, thus placing these four towns not only in connection with London, but at the same time giving them

an excellent service as among themselves. This the Great Northern and London and North Western cannot do, as all along their main lines no towns half the size of any of these four occur.

Perhaps the best way to give an idea of the Midland services will be in the form of tabular statements, showing those (1) from London to Luton, Bedford, Leicester, Nottingham, Sheffield, Leeds, Bradford, Carlisle, Derby, Manchester, Blackburn, Bolton, Warrington, Liverpool, Burton, and Birmingham; (2) from Manchester to Carlisle, Derby, Nottingham, Leicester, Birmingham, and Bristol; (3) from Liverpool to the same places; (4) from Leeds to Sheffield, Nottingham, Leicester, Birmingham, Bristol, and Carlisle; and (5) from Sheffield to Birmingham, Bristol, Nottingham, Leicester, York, and Carlisle. These five tables will give a general, and at the same time accurate, idea of the Midland services between the chief towns on the company's system. Attention is specially directed to the excellent services between London and Nottingham, Sheffield, Leeds, and Bradford. These could hardly be improved. Those from London to Manchester and London to Carlisle (for Scotland) are also very fine, although scarcely up to the mark demanded by Great Northern and North Western competition. The same may be said of the London to Liverpool services, which are in themselves good, but only poor when compared with the North Western Company's. From Liverpool and Manchester to Bristol a good service is rendered, but here again the shorter route taken by the Great Western and London and North Western trains gives them nearly all the traffic. Liverpool and Manchester to Edinburgh is good as far as Carlisle, but the slowness of the North British Company from that point renders competition with the London and North Western and Caledonian futile. Thus at several points the Midland is beaten, and this not so frequently because its trains are slower than those of its rivals, but because it competes over longer routes and under less advantageous conditions. Few instances of really bad services occur on this railway. Perhaps those between Leeds and Leicester and between Sheffield and Leicester are the worst cases.

In one direction the Midland Railway deserves great praise. It was the first company to introduce express cross-country travelling, and the convenient services from Scotland, the North-East of England, Liverpool and Manchester to Birmingham, Bristol, and the South-West of England are now very popular with the public. For some time the Midland was the only line which laid itself out for this

kind of traffic, but several of our leading lines, particularly the North Western, have since done much for the public in this respect.

We now give the tabular statements referred to above :—

SERVICES FROM AND TO LONDON.

| Between London and | Miles. | Number of trains at or over 35 miles per hour. Down. | Up. | 40 miles per hour. Down. | Up. | 45 miles per hour. Down. | Up. | Fastest. Hr. | Min. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| Luton | 30¼ | 4 | 5 | 2 | 2 | 1 | 1 | 0 | 38 | Fastest train serves Luton by slip carriage. |
| Bedford | 49¾ | 9 | 11 | 6 | 8 | 5 | 5 | 0 | 58 | |
| Leicester . | 99 | 15 | 14 | 13 | 13 | 8 | 5 | 1 | 55 | |
| Nottingham | 124 | 14 | 12 | 12 | 9 | 9 | 8 | 2 | 25 | Fastest trains are *viâ* Kettering (124 miles); but several nearly as good run *viâ* Trent (126¾ miles), and these have been included in table. |
| Sheffield | 164½ | 10 | 12 | 9 | 9 | 6 | 6 | 3 | 25 | Fastest trains are *viâ* Nottingham (164½ miles); but several good ones run *viâ* Trent (158¼ miles), and one or two *viâ* Trent and Derby (165½ miles). All such reaching the standard of speed adopted have been included in table. |
| Leeds | 196 | 9 | 11 | 7 | 8 | 5 | 6 | 4 | 5 | Best train is *viâ* Trent and Staveley (196 miles), but trains run *viâ* Sheffield (197¾), *viâ* Nottingham and Staveley (202¼), *viâ* Nottingham and Sheffield (204), and *viâ* Trent and Derby (205). These are included in table. |
| Bradford . | 209½ | 8 | 7 | 5 | 6 | None. | 1 | 4 | 30 | Distances vary as in case of Leeds. Best train runs *viâ* Trent and Staveley (209½ miles). |
| Carlisle | 307¾ | 6 | 6 | 5 | 5 | 3 | 1 | 6 | 40 | Distances vary as in case of Leeds. Best train runs *viâ* Trent, Staveley, and Holbeck (307¾ miles). |
| Derby | 129¼ | 15 | 14 | 12 | 10 | 3 | 2 | 2 | 40 | Derby can be reached by travelling *viâ* Nottingham and changing there. Several trains cover this 140-mile run in just over 3 hours. They are included in table. |

SERVICES FROM AND TO LONDON (*continued*).

| Between London and | Miles. | Number of trains at or over. | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 miles per hour. | | 40 miles per hour. | | 45 miles per hour. | | | | |
| | | Down. | Up. | Down. | Up. | Down. | Up. | Hr. | Min. | |
| Manchester | 191½ | 10 | 7 | 8 | 6 | 1 | 1 | 4 | 15 | Fastest train runs *viâ* Chaddesden (191½ miles). Others *viâ* Derby (192). The best train, though not the fastest, runs *viâ* Nottingham and Chaddesden in 4 hours 25 minutes (202¼ miles). |
| Liverpool . | 220¼ | 8 | 8 | 4 | 5 | 1 | None. | 5 | 0 | See notes as for Manchester. Two or three of the trains in table go *viâ* Manchester (226 miles), passengers changing there into Manchester, Sheffield and Lincolnshire trains to Liverpool. The service, if these were excluded, would only be moderate. |
| Blackburn | 224½ | 6 | 4 | 2 | None. | None. | None. | 5 | 20 | These trains are worked by the Midland Company throughout. See under Manchester for notes as to routes. Distances given (224½ and 210¾ miles) are by route taken by fastest train, *viâ* Nottingham, Chaddesden and Manchester (Victoria). |
| Bolton . | 210¾ | 7 | 5 | 3 | 1 | None. | None. | 4 | 51 | |
| Warrington . | 202 | 8 | 8 | 4 | 5 | 1 | None. | 4 | 36 | See notes as for Manchester and Liverpool. Distance given (202 miles) is by route taken by fastest train, *viâ* Chaddesden and Stockport. |
| Burton (*viâ* Ashby) | 130 | 4 | 2 | 1 | None. | None. | None. | 3 | 10 | |
| Burton (*viâ* Derby) | 140 | 8 | 9 | 1 | 1 | None. | None. | 3 | 13 | Poor service. Trains *viâ* Nottingham, by which all passengers have to change carriages, are included in table. |
| Birmingham . | 139 | 3 | 1 | None. | None. | None. | None. | 3 | 20 | Best train is *viâ* Wigston. The Midland does not compete from London. |

## SERVICES FROM AND TO MANCHESTER.

| Between Manchester and | Miles. | Number of trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 miles per hour. | | 40 miles per hour. | | 45 miles per hour. | | | | |
| | | From Manchester. | To Manchester. | From Manchester. | To Manchester. | From Manchester. | To Manchester. | Hr. | Min. | |
| Carlisle | 125¼ | 6 | 4 | None. | 1 | None. | None. | 3 | 7 | |
| Derby . | 62¾ | 7 | 7 | 4 | 2 | None. | None. | 1 | 25 | |
| Nottingham | 78¾ | 2 | 2 | None. | 1 | None. | None. | 1 | 52 | Two or three others each way rather under 35 miles an hour. The fastest train runs *viâ* Chaddesden. The others *viâ* Derby (78¾ miles). |
| Leicester . | 92¼ | 9 | 8 | 6 | 4 | 2 | None. | 2 | 2[illegible] | Fastest trains run *viâ* Chaddesden; others *viâ* Derby, about ½-a-mile longer. |
| Birmingham | 105 | 3 | 3 | None. | None. | None. | None. | 2 | 50 | |
| Bristol . . | 196¾ | 3 | 4 | None. | None. | None. | None. | 5 | 5 | |

## SERVICES FROM AND TO LIVERPOOL.

| Between Liverpool and | Miles. | Number of trains at or over | | | | | | Fastest. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 35 miles per hour. | | 40 miles per hour. | | 45 miles per hour. | | | | |
| | | From Liverpool. | To Liverpool. | From Liverpool. | To Liverpool. | From Liverpool. | To Liverpool. | Hr. | Min. | |
| Carlisle | 136 | 6 | 5 | 4 | 3 | None. | None. | 3 | 2 | |
| Derby | 91½ | 4 | 5 | 2 | 1 | None. | None. | 2 | 15 | All these towns can be reached by one or two trains each way daily *viâ* Cheshire Lines and Manchester, changing there into Midland trains. Some of the times are good, but the trains are not included here, as they are not worked by the Midland throughout. |
| Nottingham (*viâ* Derby and Trent) | 107½ | 2 | 1 | None. | None. | None. | None. | 3 | 0 | |
| Leicester | 121½ | 5 | 5 | 3 | 1 | None. | None. | 2 | 48 | |
| Birmingham . | 133¾ | 2 | 1 | None. | None. | None. | None. | 3 | 30 | |
| Bristol | 225½ | 2 | 3 | None. | None. | None. | None. | 6 | 5 | |

## SERVICES FROM AND TO LEEDS.

| Between Leeds and | Miles. | Number of trains at or over: 35 miles per hour. From Leeds. | 35 miles per hour. To Leeds. | 40 miles per hour. From Leeds. | 40 miles per hour. To Leeds. | 45 miles per hour. From Leeds. | 45 miles per hour. To Leeds. | Fastest. Hr. | Fastest. Min. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| Sheffield . | 39½ | 10 | 11 | 7 | 5 | 6 | 4 | 0 | 50 | |
| Nottingham . | 80 | 6 | 5 | 6 | 4 | None. | None. | 1 | 50 | Two trains *viâ* Trent (84¾ miles) in 134 and 140 mins. are not included in the table. |
| Leicester | 97 | 2 | 3 | 2 | 2 | 1 | None. | 2 | 5 | Distance given is *viâ* Staveley, route taken by fastest train. Other trains are *viâ* Sheffield or (in 3 to 3¼ hours) *viâ* Derby. Poor service. |
| Birmingham | 118 | 4 | 3 | 1 | None. | None. | None. | 2 | 50 | |
| Bristol | 209¾ | 4 | 2 | 1 | None. | None. | None. | 5 | 0 | |
| Carlisle | 112¾ | 6 | 8 | 3 | 3 | 2 | None. | 2 | 27 | |

## SERVICES FROM AND TO SHEFFIELD.

| Between Sheffield and | Miles. | Number of trains at or over: 35 miles per hour. From Sheffield. | 35 miles per hour. To Sheffield. | 40 miles per hour. From Sheffield. | 40 miles per hour. To Sheffield. | 45 miles per hour. From Sheffield. | 45 miles per hour. To Sheffield. | Fastest. Hr. | Fastest. Min. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| Birmingham . | 78½ | 5 | 4 | 1 | None. | None. | None. | 1 | 50 | |
| Bristol | 170¼ | 4 | 4 | 1 | None. | None. | None. | 4 | 0 | |
| Nottingham | 40½ | 8 | 6 | 8 | 6 | 1 | 1 | 0 | 50 | Fast connections (chiefly down) *viâ* Trent in from 75 to 80 minutes. |
| Leicester (*viâ* Trent) | 59¼ | 1 | 4 | 1 | 1 | None. | None. | 1 | 24 | The other up trains take 2 to 2¼ hours (*viâ* Derby); the down are similar, but two run *viâ* Nottingham in 108 and 120 mins., and one *viâ* Derby in 112 mins. |
| York . | 46½ | 3 | 2 | 2 | 1 | None. | None. | 1 | 5 | |
| Carlisle . | 152¼ | 6 | 6 | 5 | 3 | None. | None. | 3 | 25 | One up and two down trains run *viâ* Holbeck (about half-mile shorter). |

We regret to state that want of punctuality, especially in summer, mars these fine services. In winter, and when there is

no press of traffic, the Midland manages pretty well. Discipline, however, seems to fall to pieces directly the summer tourist traffic commences, and the present writer has on several occasions noticed the 25 to 30 express trains daily entering St. Pancras aggregate from 600 to 700 minutes late in arriving at that station. The year just ended has been much better than some of those preceding it, when Midland punctuality sank to a very low ebb. The line, of course, has to encounter many difficulties, and has, besides, the misfortune to work its Scotch traffic in connection with the North British. But the London and North Western, which is a much more punctual line than the Midland, has many more obstacles to overcome. It also works in connection with other companies; it runs expresses in connection with boats from Ireland; and its trains are not "solid" ones, like those on the Midland, but are composed of through carriages for its chief towns, which nearly all lie off the main line, thus necessitating much shunting at junctions, which is altogether avoided on the Midland—most of whose trains, like the Leeds and Bradford expresses, run right through without attaching or detaching a single carriage *en route.* The Midland management should, therefore, persist in endeavouring to enforce punctuality. On the railways south of the Thames, where punctuality is much below par on all the lines, it matters less than on a system which has to strain every nerve in the struggle with its rivals on either side, as in the present case. We have known the Midland actually delay its Scotch express about 15 minutes to attach a horse-box. What would they say to this on the North Western? They would not think of doing such a thing, and in fact the express trains on the London and North Western are not allowed to convey this class of traffic. This should be the same on the Midland.

If we look simply to the carriage accommodation provided, the Midland local services are probably as good as any in the kingdom. But there are other things to consider, and one does not find on this line the frequency and speed of the local trains to which the Great Northern and North Western accustom us. One noticeable point is the small amount of suburban travelling for so large a system. At Birmingham, Sheffield, Manchester, etc., the company have very little short-distance traffic, and even in the Metropolis the amount is only moderate.

(*b*) *Rolling Stock and General Accommodation.*—The accommodation provided on the Midland Railway is excellent. All

the carriages used for branch-line or local traffic are very roomy and comfortable; and if the stock were somewhat better lighted, it would take rank with the very best in the kingdom. The suburban carriages in the London district are brilliantly lighted by gas, and are very comfortable vehicles.

The carriages used for the express traffic are upholstered in similar fashion to those on the local trains, except that some of the first- and third-class compartments are supplied with lavatory conveniences. The lavatory for third-class travellers was originated by the Midland, and the practice has since been adopted by the Great Northern, North Western, Great Western, and Glasgow and South Western companies. As an alternative to the first-class compartment the company run a large number of Pullman cars out of St. Pancras daily, including occasional dining-saloons, in which refreshments of various kinds are served at a reasonable figure. These, however, are not much patronised—Englishmen so far not having become accustomed to American habits. The accommodation is, in general, comfortable for both classes, but casual examination will show that the through coaches of both the London and North Western and the Great Western—at any rate, for first-class passengers—are superior in upholstery and finish to those of the Midland. Many of the latter company's firsts are without lavatory, and the decoration (and in many cases the lighting) is poor. In this last particular we are glad to find that the Midland, which so long persisted in lighting its trains with oil, while the North Western used gas, is now trying the latter as an illuminant. Several improvements introduced by the company, such as the bogie truck and the "clerestory" or "monitor" roof, have found more or less favour with the public.

For many years the Midland Company have run no second-class carriages on any of their trains. In the last few years their policy in this respect has been followed, either partially or wholly, by several other English and Scotch railways. Public feeling seems inclined to favour the total abolition of the intermediate class; but if this be done without a simultaneous reduction of first-class fares, no benefit, but rather inconvenience, results. As regards the saving to the company obtained by hauling lighter trains, this is regarded by good authorities as being of small account. The Midland Company, in abolishing the second-class, succeeded in slightly reducing the dead weight of their trains, but their subsequent policy in introducing Pullman cars (which have a very large proportion of dead to paying weight), and charging an extra fare beyond first-class for the

accommodation—thus practically re-introducing the three classes again—is rather puzzling and hard to be understood.

The Midland has a high reputation as a safe line, and its permanent way is among the best in the kingdom. The continuous Automatic Vacuum brake is used on all trains. No company provides better station accommodation for its travellers—the erections at St. Pancras, Bradford, Manchester, and Liverpool being especially fine. The smaller stations are absolutely the best in the country, and anyone wishing to see how far in excess of requirements such accommodation can be carried should visit the Settle and Carlisle section, and admire the structures there. Many of these small roadside stations are beautifully decorated with flowers and shrubs, for the careful cultivation of which the company award prizes to the amount of £100 per annum.

### (3) Locomotive Work.

(*a*) *Speed.*—In the case of the Midland, although we find a surprisingly large proportion of most meritorious booked runs, we miss that extremely high level which is so characteristic of the Great Northern services, and find in its place very fine work indeed in some parts of the system, and at other points services which are nothing out of the common. It is, however, a singular anomaly that wherever the Midland gradients are hardest, the speed is best; and, on the other hand, where the route is easy, the speed is markedly below what it is on some of the hillier sections. It should likewise be stated that the use of pilot engines on the steeper grades of the Midland Railway is excessive, even when the load is scarcely sufficiently heavy to warrant their use. We have also to bear in mind, in order to avoid the erroneous conclusions of some writers on this company's locomotive work, that the very fastest trains on the Midland Railway (*e.g.*, the Leeds and Bradford and Scotch day expresses) are seldom heavily laden. One rarely finds the highest speed, severe gradients, and heavy loads concurrently on this system. When these do occur, two engines, as stated above, seem indispensable.

From London to Leicester and Nottingham the Midland is perhaps at its best. The up and down Scotch day trains do the 99 miles 9 chains to Leicester in 115 minutes, and the Leeds expresses run to Kettering from Kentish Town (70½ miles) in 80 and 81

minutes, etc., continuing from Kettering to Nottingham ($51\frac{3}{4}$ miles) in the even hour. The down day express to Edinburgh gets to Bedford ($49\frac{3}{4}$ miles) in 57 minutes, and thence to Nottingham ($74\frac{1}{4}$ miles) in 85 minutes. The down night Highland and Edinburgh expresses also maintain about 50 miles an hour as far as Nottingham. All these are, however, as a rule, light trains, except at certain seasons of the year. The Manchester expresses are heavier, and sometimes run to 15 or 16 coaches. The pace of these trains is generally about 48 miles an hour as far as Leicester. Summarising the section, we may remark in a general way that the Leeds and Bradford expresses, and most of the Scotch, are not, generally speaking, heavy trains, and are booked to run at from 50 to 52 miles an hour; while the Manchester and Liverpool expresses, and one or two of the Scotch night trains, are heavy and maintain about 48. The work done, therefore, is excellent all round. Many of our best actual performances mentioned below are on this piece.

Northwards of Leicester the Midland booked times are, it must be confessed, disappointing. As far as Skipton we find few speeds at over 48 miles an hour. The average is certainly under that figure, even on the easy grades of this part of the system. The same remarks hold good of the Leeds and Bradford expresses, the speed of which is much poorer north than south of Nottingham.

After Skipton, however, the Scotch train-running is exceedingly good. Over the Settle and Carlisle section the speed of the best seems to average about 47 to 48 miles an hour, either going through to Carlisle without stop, or with one or two stops included. At Hellifield the Liverpool and Manchester through coaches to Scotland increase the weight of the main-line train, and necessitate the use of pilot engines. The speed, nevertheless, on this section is very praiseworthy, and would receive more attention than it does were it not that the North Western Preston to Carlisle piece, with its really phenomenal speed, is almost parallel. The trains from Liverpool and Manchester to Hellifield are now worked by the Midland over the Lancashire and Yorkshire metals. These trains are always extremely light. Between Liverpool and Blackburn some booked speeds of 50 miles an hour, or over, occur.

The Manchester and Liverpool services run *viâ* the severe gradients of the Peak District of Derbyshire. Some of the trains run direct from Leicester without stopping at Trent and Derby; but with these exceptions, which are timed at 46 or 47 miles an hour, and are light, the others are, as a rule, timed at under 45 miles an hour.

This may not be bad over such a trying course, but compared with what the Midland does elsewhere, and what is accomplished by the North Western and Caledonian companies over their steep sections, it scarcely shows up well. From Marple and Stockport the Liverpool carriages go forward alone. The trains are light, and the gradients easy. Occasionally booked speeds of 50 miles an hour are met with.

The Bristol to Derby line is chiefly of use to the Midland in its cross-country services. The trains on this section, which it would be wearisome to treat in detail, are seldom timed at a higher booked rate than 45 miles an hour. The course is a level one, with the exception of the Lickey Incline. Stops are also frequent, and there are few long runs. For a cross-country line the speed cannot be considered bad, but it might be improved somewhat in order to compete with the North Western and Great Western routes to Manchester, Liverpool, and the North, from Bristol *viâ* the Severn Tunnel.

(*b*) *GRADIENTS.*—The Midland route is almost throughout characterised by steep gradients. Although these are generally exaggerated when discussed, still there can be no doubt that they are much stiffer than are generally found on the lines of its rivals. Some of the sections are, however, tolerably easy. Such are—(1) the line from Stockport to Liverpool, already described under the Manchester, Sheffield and Lincolnshire Railway as a part of the Cheshire Lines system. (2) Leicester to Skipton, which forms the only fairly level portion of the main line. From Leicester the line descends gradually with a few undulations to Trent, from which point to Clay Cross is an almost continuous ascent, which, with the exception of a few miles of 1 in 150 and 1 in 230, is comparatively easy. Then for six or seven miles there is a descent of 1 in 160 and easier, followed by six miles rise and six miles fall of 1 in 100 into Sheffield. The loop line *viâ* Staveley is more or less level. From Sheffield to Normanton consists of an easy fall, followed by a slightly harder rise, both extending about equal distances; and from the last-mentioned point to Leeds is easy undulating line. Thence to Skipton, except for a short piece north of Keighley, is an almost continuous ascent, of which the greater portion averages 1 in 200 to 1 in 250. It will thus be seen that, with the exception of the Sheffield loop and the Leeds to Skipton piece, the section is tolerably easy. (3) Derby to Bristol, which is a gentle ascent from Burton to Birmingham, followed by an ascent to King's Norton of 1 in 300 or

steeper. Then comes the Lickey Incline, which is over two miles of 1 in 37 down. This, followed by a short piece of 1 in 283 down and a level bit, brings us to Worcester. From this point the line descends with undulations for about 15 miles of 1 in 300 or easier, then ascends for eight miles on similar grades, and descends past Gloucester at 1 in 300 for about the same distance. The line now undulates for about twenty miles on very easy grades, finally rising for several miles before Mangotsfield on 1 in 220 or easier. There is then a short piece of level, and a descent of 1 in 70 for a short distance into Bristol. This section therefore, with the exception of the Lickey Incline, is a comparatively easy one to work. In marked contrast to this last-mentioned level piece, however, is its very severe continuation the Somerset and Dorset Joint Line, which, although not worked by either of the owning companies (Midland and London and South Western), has engines much like those of the former company. The gradients are exceedingly steep, and we briefly describe them below.

From Bournemouth the line mounts for a mile on grades of 1 in 100 and 1 in 198, and then descends three miles on varying grades averaging 1 in 250, but which in parts are 1 in 50 and 1 in 60. Then there is a gentle rise for 1½ miles, followed by two miles at 1 in 75, a mile level, and 1¼ miles at 1 in 100 down, bringing us to Wimborne. Then for 3½ miles we have undulations, mostly steep, followed by 4½ miles of steep ascent, varying from easy grades to 1 in 160 and 1 in 100 up. This brings us to Spettisbury, after which, for a distance of 31 miles, right away to Evercreech, it is impossible to classify the gradients, as the grade changes no fewer than 119 times in this distance, *i.e.*, no less than about once every quarter of a mile. All we can say is that a slight upward tendency is preserved throughout amidst all the varying alternations of ups and downs, and that the gradients are extremely severe—1 in 80 being met with very frequently. These extreme rises and falls are, however, not so difficult to run over as they would appear to be on paper, as the ups and downs are very short, and are never massed together. Just after Evercreech the line rises about 2½ miles at 1 in 50, and then descends into Shepton steeply (one mile) on 1 in 55, 60, 70, 103, and 157. After Shepton we meet with 3½ miles averaging 1 in 64 up (part of it is 1 in 50), followed by about 7½ miles of descent averaging 1 in 75, and composed of all sorts of heavy gradients, with an occasional rest in the shape of a short level piece. This brings us to Radstock, whence to Bath the line consists of

about five miles steep undulations, $1\frac{1}{2}$ miles of descent at 1 in 120, 1 in 100, and 1 in 60, two miles of ascent varying from 1 in 55 to 1 in 330, and two miles of descent at 1 in 55 to 1 in 60 into Bath. The line, it will be seen, follows the contour of the country pretty closely, and is a difficult section to work over, the banks near Shepton being the most difficult part of the road.

There now remain to be discussed the three important sections over which express trains run. These are :—

(1) *Derby to Manchester.*
(2) *Skipton to Carlisle.*
(3) *London to Leicester and Nottingham.*

Each of these sections is extremely hard, and some of the running done over them is excellent.

(1) The Derby to Manchester line, of which full particulars are given in the accompanying gradient profile, is extremely difficult to work. The trains, however, are generally light. If at all heavy, they invariably have the assistance of a pilot engine.

(2) The Skipton and Carlisle line may be fitly compared with the Preston to Carlisle section of the North Western. Mr. Foxwell says that the North-Western is easier than the Midland for down trains, but harder for up. It appears to us, however, that this conclusion is erroneous. In order of difficulty, the sections should stand as under :—

(1) *Carlisle to Skipton.*
(2) *Preston to Carlisle.*
(3) *Skipton to Carlisle.*
(4) *Carlisle to Preston.*

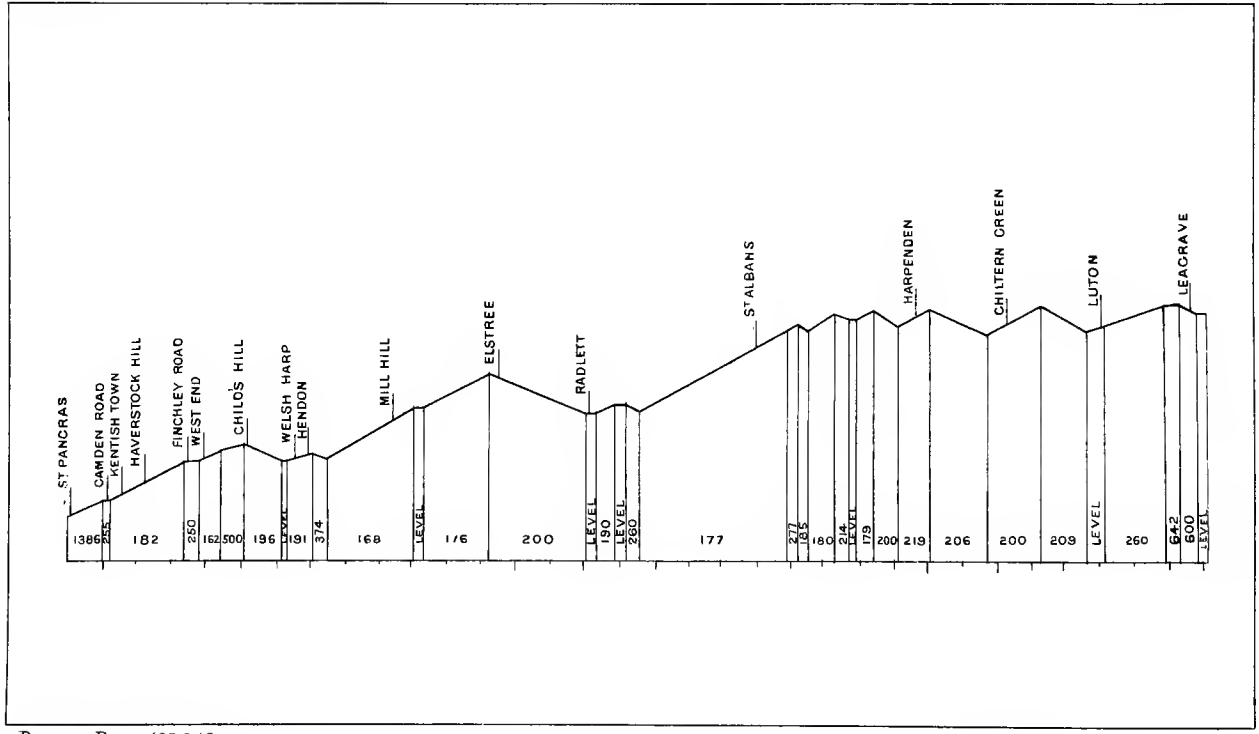
That this is so will appear when it is remembered that in (1) $48\frac{1}{4}$ miles of uphill have to be surmounted, in which the train ascends from Carlisle (70 feet) to Ais Gill (1,170 ft.) = 1,100 ft. ; (2) about 37 miles of uphill have to be surmounted, in which the train ascends from sea-level to Shap Summit (915 ft.) = 915 ft. ; (3) only $38\frac{1}{2}$ miles, mostly uphill, occur before the train gets a clear run of $48\frac{1}{4}$ miles downhill into Carlisle, and the ascent is only 850 ft., being from Skipton (about 300 ft.) to Ais Gill (1,170 ft.) ; (4) only $31\frac{1}{2}$ miles of uphill, then a clear descent or level almost all the way to Preston ($58\frac{1}{2}$ miles), the train also only rising 845 ft. from Carlisle (70 ft.) to Shap Summit (915 ft.). The gradients from Hellifield to Carlisle are clearly shown in the accompanying profile. Between Skipton and Hellifield the line rises eight miles on gradients of 1 in 130 and 150

# LONDON TO LEICESTER

## GRADIENT PROFILE.

M. R. No 1.

Plate XXVII.




*Between Pages 182 & 183.*

# LONDON TO LEICESTER.

## GRADIENT PROFILE.

M. R. No 2.

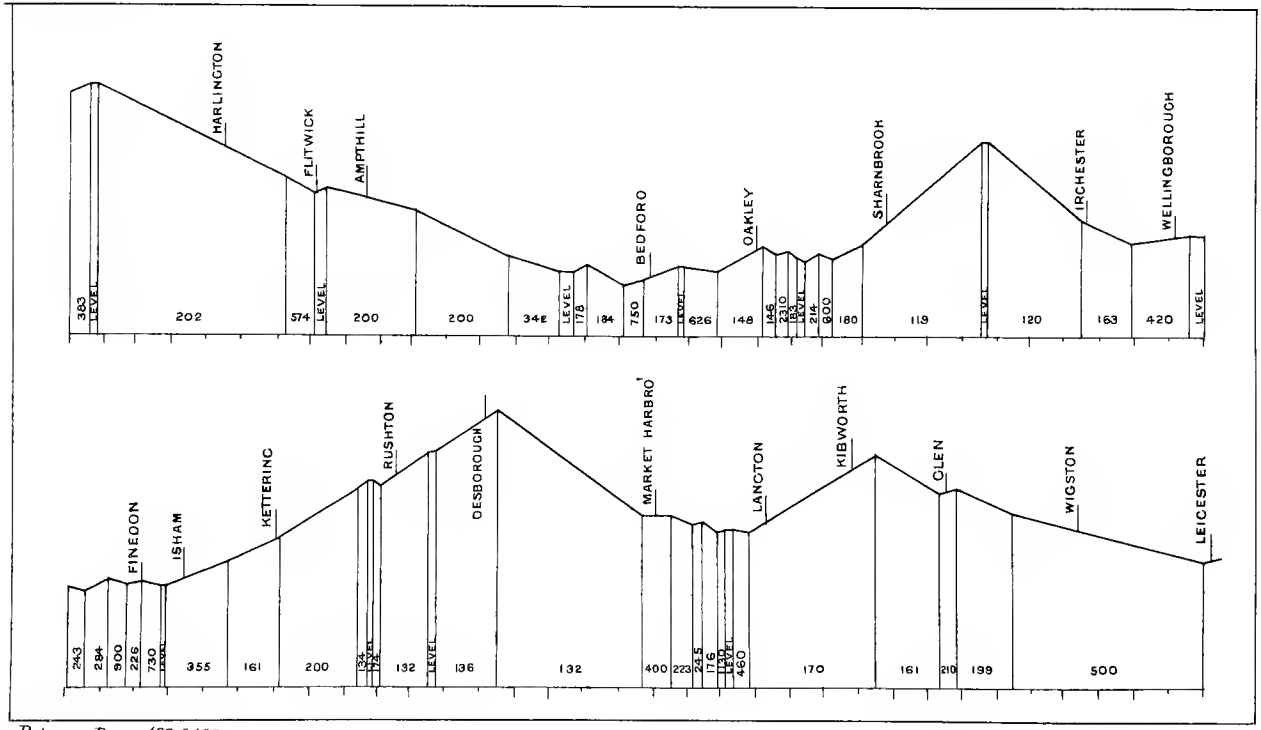



Plate XXVIII.

Between Pages 182 & 183.

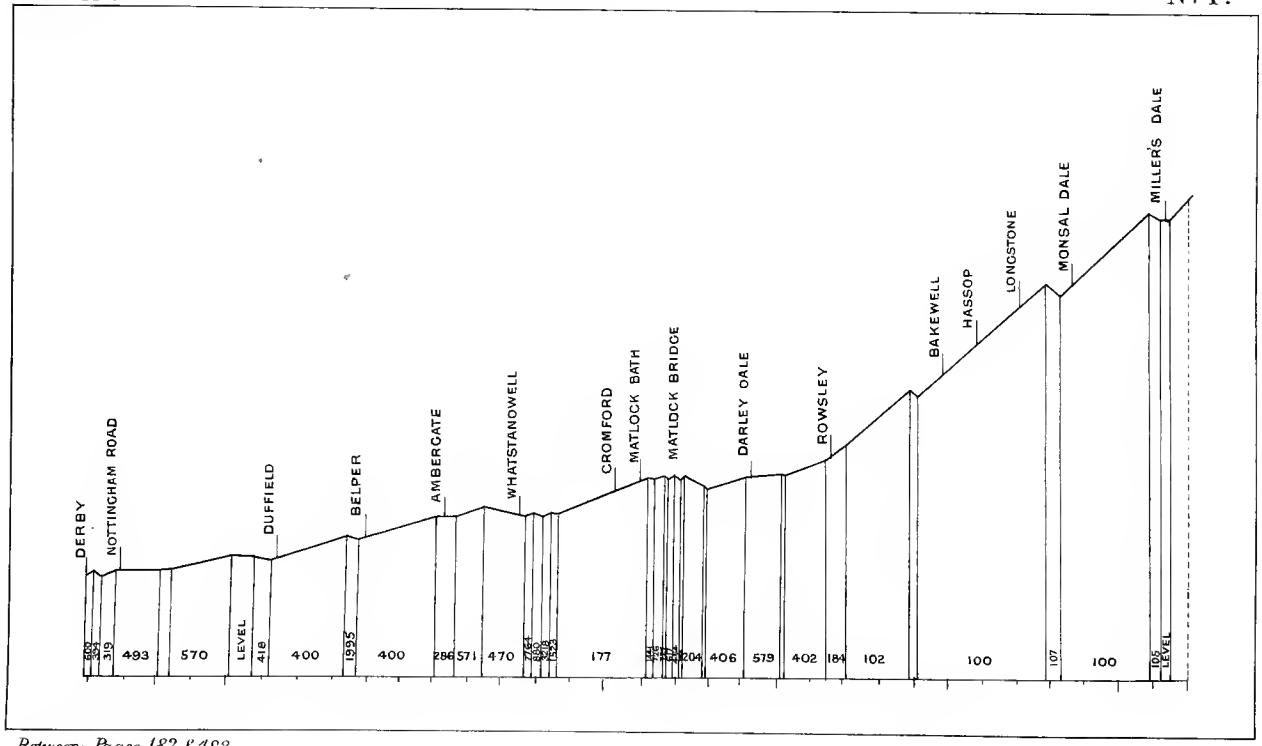
# DERBY TO MANCHESTER.

## GRADIENT PROFILE.

M.R.

No 1.

Plate XXIX.



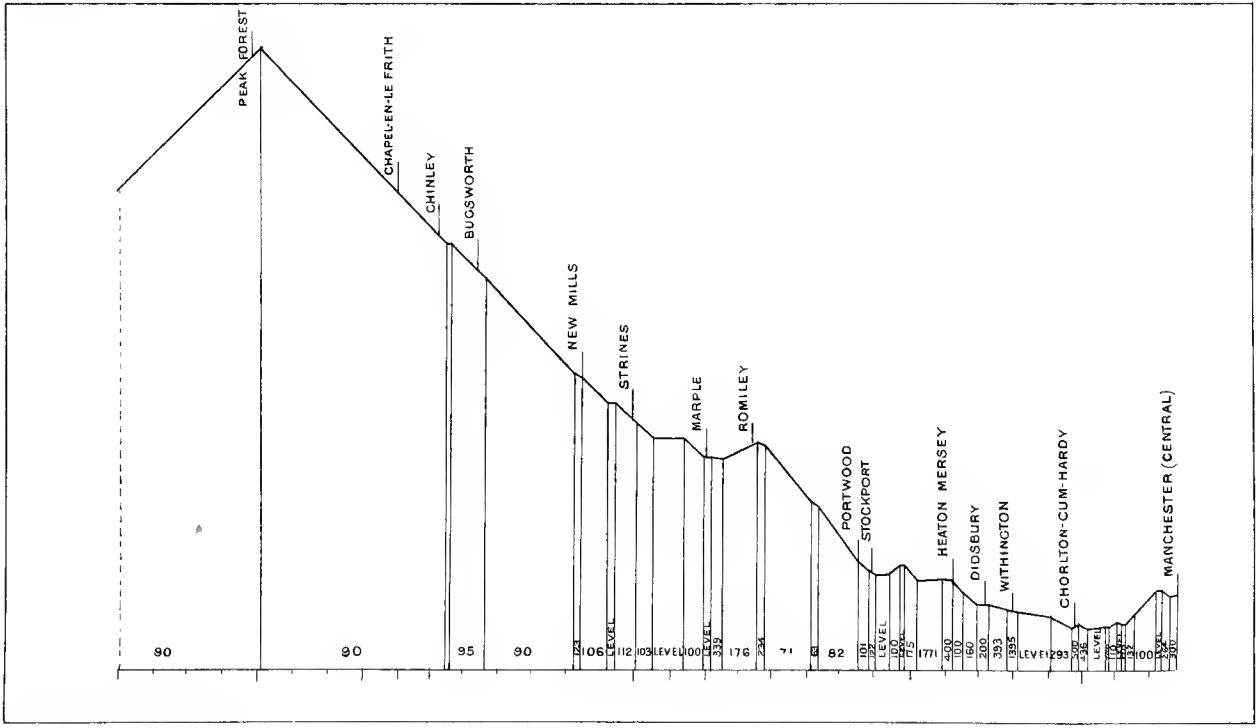

Between Pages 182 & 183.

# DERBY TO MANCHESTER.

## GRADIENT PROFILE.

M. R. No 2.

Plate XXX.



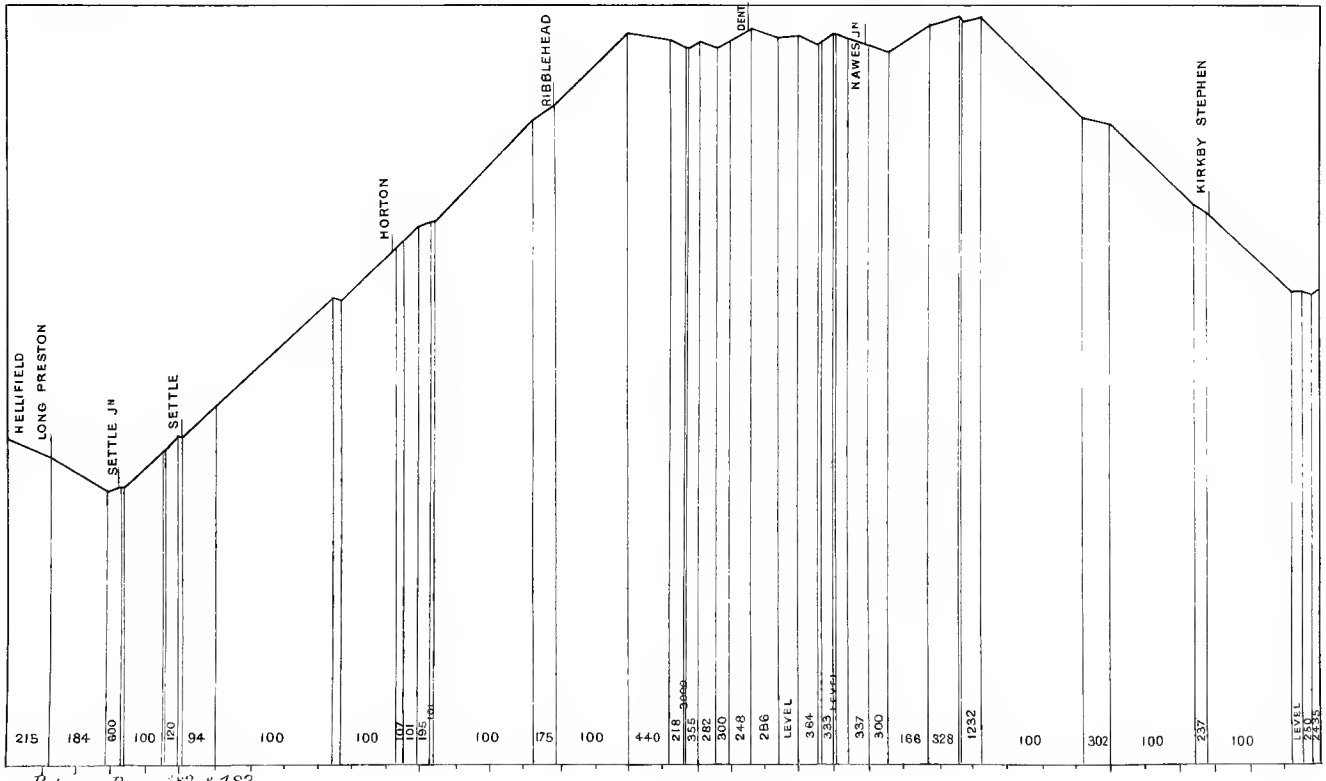

*Between Pages 182 & 183.*

# HELLIFIELD TO CARLISLE.

## GRADIENT PROFILE.

M.R. No. 1.

Plate XXXI.



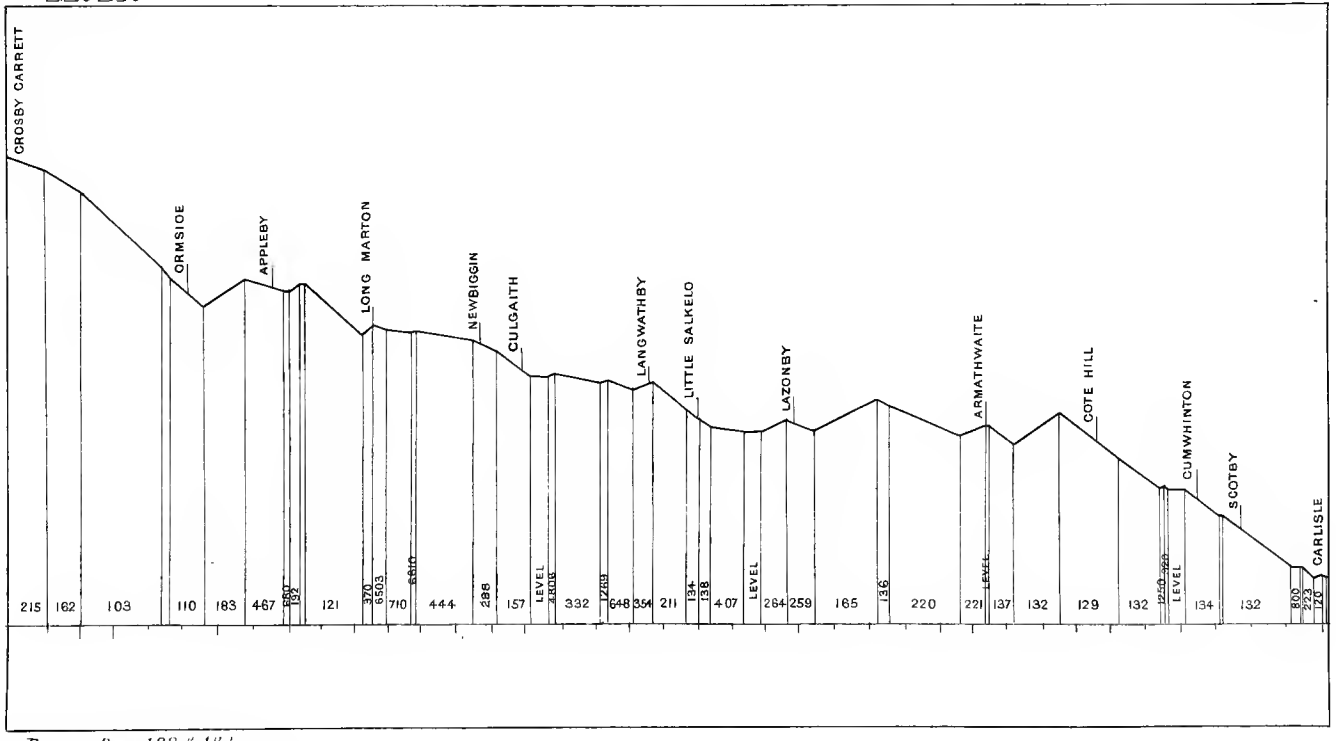

Between Pages 182 & 183

# HELLIFIELD TO CARLISLE.

## GRADIENT PROFILE.

M. R. No 2.

Plate XXII.




*Between Pages 182 & 183.*

and easier, followed by a drop of two miles of 1 in 215. The section throughout equals in severity the Derby to Manchester line, referred to above.

(3) The London to Leicester section, of which we also give the gradient profile, is not so steep as either of the foregoing. The ascents are never very long at a time, but are in places sufficiently trying to demand good work.

The fast expresses to Leeds and Bradford *viâ* Nottingham diverge from the main route at Kettering, thus just avoiding the severe Desborough bank. From Kettering the route to Nottingham is, however, by no means easy, and starts with a seven-mile ascent, chiefly at 1 in 167. This is followed by about eight miles down, mostly at 1 in 200. Then seven miles ascent, on gradients of 1 in 143 and easier, brings us to Oakham, after which there is a short level stretch. Thence about 10 miles of falling gradients, averaging 1 in 290, take us past Melton. From here to Old Dalby is an ascent, and thence to Nottingham, with a slight rest, the line falls at 1 in 200, 1 in 330 and easier. It will thus be seen that the section is by no means easy, and the gradients are massed together in a manner sufficiently awkward for heavy trains. The loads, however, on this section (Leeds and Bradford expresses) are light, although the run referred to in detail later on (from Kettering to Nottingham in 56½ minutes with 15 coaches) shows how well Midland locomotives can tackle a fast and heavily-loaded train.

(*c*) *Locomotives.*—The Midland Company's Chief Locomotive Superintendent is Mr. S. W. Johnson, of Derby. That gentleman has built several of the finest varieties of locomotives running on any of our English lines. Until lately he exclusively adopted the coupled type, but during the last two or three years numerous "singles" have been turned out at the Derby works. As we give the principal dimensions in the form of a tabular statement below, we will only remark here that all the types are doing work of a satisfactory nature. They present an imposing appearance, and in the Paris Exhibition of 1889 many comparisons were instituted between the neat-looking English locomotives (among which Midland Railway No. 1853 was conspicuous) and the clumsy home-produced article of France. Some years ago the Midland engines were painted green, but on economical grounds that colour has now been superseded by a dark shade of red. The suburban-passenger and goods-shunting work is done by a variety of well-designed tank engines of considerable power.

The older classes are now rapidly disappearing from the Midland, having either been sent summarily to the scrap-heap or renewed with larger dimensions. Thus to-day we see apparently only modern engines on the company's metals.

We now present in tabular form the dimensions of the most recent types :—

| Name of Class. | Diameter of Driving Wheels. | | Cylinders. | Heating Surface. Sq. ft. | | Boiler Pressure. | Grate Area. | Weight available for adhesion. | | Weight in Working Order. | | Weight of Tender loaded. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Tubes. | Box. | | | | | | | | |
| | Ft. | Ins. | Inches. | | | lbs. per Sq. In. | Sq. Ft. | Tons. | Cwts. | Tons. | Cwts. | Tons. | Cwts. |
| 1868 "singles" | 7 | 6 | 18½ by 26 | 1123·6 | 117 | 160 | 19·68 | 17 | 10 | 43 | 4 | 36 | 1 |
| 1808 "coupled" | 6 | 6 | 18 by 26 | 1151·0 | 110·16 | 160 | 17·67 | 27 | 5 | 41 | 9 | 36 | 1 |
| 1754 "coupled" | 7 | 0 | 18 by 26 | 1151·0 | 110·16 | 160 | 17·67 | 28 | 3 | 42 | 15 | 36 | 1 |
| 1669 "coupled" | 7 | 0 | 19 by 26 | 1011·46 | 110·16 | — | 17·5 | 27 | 19 | 42 | 16 | — | |

Besides the above classes, which are the latest built on this system—with the exception of a type just constructed with 7 ft. four-coupled driving wheels, and cylinders 18½ in. by 26 in.—the following brief particulars of other passenger types built by Mr. Johnson for the Midland may be of interest :—

| Engine. | Diameter of Driving Wheels. | Cylinders. | Date Built. | Remarks. |
|---|---|---|---|---|
| | | Inches. | | |
| 50–54 | 6 ft. 6 in. | 17½ by 26 | 1876 | |
| 55–59 | 6 ft. 8 in. | 17½ by 26 | 1876 | |
| 101–110 | 7 ft. 0 in. | 18 by 26 | 1877 | Formerly 1347–1356. |
| 111–115 | 6 ft. 6 in. | 18 by 26 | 1880 | |
| 1282–1311 | 6 ft. 6 in. | 17½ by 26 | 1876 | |
| 1312–1321 | 6 ft. 6 in. | 17½ by 26 | 1876 | Bogies. |
| 1327–1346 | 7 ft. 0 in. | 18 by 26 | 1877 | ,, |
| 1400–1409 | 6 ft. 8 in. | 18 by 26 | 1879 | |
| 1472–1487 | 6 ft. 8 in. | 18 by 26 | 1880 | |
| 1488–1491 | 6 ft. 8 in. | 18 by 26 | 1880 | |
| 1492–1501 | 7 ft. 0 in. | 18 by 26 | 1881 | |
| 1502 and 1503 | 6 ft. 9 in. | 18 by 26 | 1880 | |
| 1504–1531 | 6 ft. 9 in. | 18 by 26 | 1881 | |
| 1562–1581 | 6 ft. 9 in. | 18 by 26 | 1882 | Bogies. |
| 1657–1666 | 6 ft. 9 in. | 18 by 26 | 1883 | ,, |

From an examination of the above table it will be seen that, with some slight variation in the diameter of the driving wheel, Mr. Johnson has of late mainly adhered to a cylinder 18 in. by 26 in. He has also rebuilt a well-known type (the 800 class) originated by Mr. Kirtley with 17 in. by 24 in. cylinders. To these he has given, in some cases, a cylinder 18 in. by 26 in., and in others 18 in. by 24 in.

The Midland locomotives are fitted with the Automatic Vacuum brake, and the "1868" class of singles have an improved sanding apparatus to increase adhesion.

(*d*) *Actual Performances.*—Although not directly concerned in the race to Edinburgh, few lines have yielded so many excellent performances as the Midland. For convenience sake we divide the line into four sections, and illustrate each separately.

(1) *Leicester to Manchester and Liverpool.*—The work here, although not so good as is found on the other mountainous section (Skipton to Carlisle), has still afforded us some good performances. One of our best is from Trent Junction to Marple ($57\frac{1}{2}$ miles) in 70 minutes 55 seconds. On this occasion, with engine 1332 and load eight coaches, Derby was passed in 12 minutes (the train running through Chaddesden sidings), Rowsley in $35\frac{1}{2}$ minutes, Monsal Dale in 46 minutes, and (after several signal-checks) Peak Forest in $57\frac{3}{4}$ minutes. From Stockport to Liverpool some capital work has been done. Formerly the Midland used to run their Liverpool trains into Manchester instead of splitting at Stockport. It is on record that one of the company's coupled locomotives took the light Liverpool portion of the train from Manchester to the other city in 35 minutes. The distance is $33\frac{3}{4}$ miles, *viâ* the straight line at Warrington.

(2) *Skipton to Carlisle.*—On this section of the Midland excellent performances are daily accomplished, though perhaps falling behind the superb work done by the North Western and Caledonian companies over their mountain sections. We give some sample runs. From Carlisle to Appleby, with engines 1578 and 1302, in $36\frac{1}{4}$ minutes ($30\frac{1}{4}$ miles) with 19 coaches; Appleby to Hawes, with the same engines and load (21 miles), in 28 minutes; Carlisle to Hawes in $66\frac{3}{4}$ minutes with 19 coaches and engines 1572 and 1309, passing Appleby in $39\frac{3}{4}$ minutes from Carlisle; Carlisle to Appleby (stopping, as in the previous cases), with engines 1580 and 1341 and 14 coaches, in 36 minutes 7 seconds; Appleby to Hawes, with same engines and load, in $28\frac{5}{6}$ minutes, passing Kirkby Stephen in 15 minutes 5 seconds; Carlisle to Keighley ($95\frac{1}{2}$ miles) in $121\frac{1}{2}$ minutes with engine 1574 and $14\frac{1}{2}$ coaches, passing Appleby in 41 minutes, Hawes Junction in $73\frac{5}{6}$ minutes, and Hellifield in $99\frac{1}{2}$ minutes; Hawes Junction (starting) to Skipton ($35\frac{1}{2}$ miles) in $36\frac{1}{2}$ minutes, with engine 1302 and 19 coaches; Hellifield to Carlisle in 93 minutes 48 seconds with engine 1748 and 15 coaches, passing Dent (including a signal-check), in $34\frac{1}{2}$ minutes and Appleby in $59\frac{1}{2}$ minutes; and Keighley to Carlisle in 119 minutes 23 seconds

with engine 1522 and 13 coaches, passing Skipton in $12\frac{1}{4}$ minutes, Dent in $60\frac{1}{2}$ minutes, and Appleby in $84\frac{1}{4}$ minutes.

All the above are high-class performances, but do not equal those recorded for the two West Coast companies. Such, however, is not the case with a run made from Carlisle to Skipton in $102\frac{1}{4}$ minutes with engines 1748 and 803 and 16 coaches, passing Appleby in $36\frac{1}{4}$ minutes, Hawes Junction in $64\frac{1}{4}$ minutes, and Hellifield in 90 minutes. Another noteworthy performance was accomplished by engine 1309, which ran through Settle 4 minutes 43 seconds after passing Horton. This is a distance of 6 miles 22 yards, and the speed therefore for that distance averaged nearly 77 miles per hour. The load was 19 coaches.

The best run noticed on this section by the writer was, however, one from Carlisle to Skipton in 97 minutes 59 seconds with two engines and 14 coaches. On this occasion Appleby was passed in $36\frac{1}{4}$ minutes, Hawes Junction in $62\frac{1}{2}$ minutes, and Hellifield in $87\frac{1}{2}$ minutes. It is within the writer's knowledge that with a slightly reduced load and only one engine the run in the opposite direction has been performed in the same time, but, unfortunately, no details are available. It is to be regretted that on this section so many assistant engines are employed on the express trains. To see two engines hauling a comparatively light train, naturally diminishes our respect for locomotive work otherwise admirable. The practice, unfortunately, prevails all over those sections of the Midland which are at all of a hilly character, and might, we think, be abolished, with a saving to the company, and without results detrimental to punctuality.

(3) *London to Leicester and Nottingham.*—Here we find the fastest work on the Midland, though, looking to the easier grades as compared with the Skipton to Carlisle piece, we should almost think the work inferior in merit to that performed on the mountain road. Some of our best examples are as under:—From St. Pancras to Bedford in 59 minutes 3 seconds, including a check by signals and a dead-stop of $\frac{3}{4}$ minute, with $13\frac{1}{2}$ coaches and engine 1477; from Kentish Town to Bedford in 56 minutes 9 seconds with engine 1499 and 15 coaches, passing St. Albans in 25 minutes and Luton in $37\frac{1}{4}$ minutes; from Kettering to Nottingham ($51\frac{3}{4}$ miles) in 55 minutes 54 seconds with engine 1337 and $8\frac{1}{2}$ coaches; from Kettering to Kentish Town in $78\frac{2}{3}$ minutes with engine 1743 and $8\frac{1}{2}$ coaches, and in 77 minutes 10 seconds with engine 1741 and 10 coaches, passing Bedford respectively in 25 and $24\frac{3}{4}$ minutes, Luton in $49\frac{1}{4}$ and 49 minutes, and St. Albans in 60

and $59\frac{1}{2}$ minutes; from Leicester to Bedford (stopping), two excellent runs with engine 818 and 14 coaches on each occasion, doing the $49\frac{1}{2}$ miles in 57 minutes 22 seconds (with a signal-check), and in 56 minutes 48 seconds respectively, on both occasions passing Market Harborough in $20\frac{1}{2}$ minutes and Kettering in $33\frac{1}{4}$ minutes.

A few of our performances, however, stand out in relief from the rest, and may be described as equalling the best efforts of any other railway company. Such are the runs from St. Pancras to Leicester, with engines 1477 and 818 and 19 coaches, in 113 minutes 55 seconds, passing St. Albans in $27\frac{1}{2}$ minutes, Luton in $38\frac{1}{2}$ minutes, Bedford in $56\frac{11}{12}$ minutes, and Wellingboro' in 76 minutes; from St. Pancras to Bedford (passing), with engine 1740, on the Glasgow morning express, load $7\frac{1}{2}$ coaches ($49\frac{3}{4}$ miles), in 52 minutes 14 seconds, passing St. Albans in 23 minutes 47 seconds and Luton in 34 minutes 18 seconds; from Nottingham to St. Pancras (124 miles) in 138 minutes 26 seconds, including three signal-checks approaching London, with engine 27 (single) and $12\frac{1}{2}$ coaches, passing Melton in $23\frac{5}{6}$ minutes, Manton in 40 minutes, Kettering in $58\frac{1}{2}$ minutes, Bedford in $81\frac{1}{2}$ minutes, Luton in $106\frac{1}{2}$ minutes, and St. Albans in $117\frac{3}{4}$ minutes. Best of all, however, and perhaps equal to anything else in the writer's experience, is the run from Kettering to Nottingham in 56 minutes 30 seconds with engine 34 and 15 coaches, passing Manton in $21\frac{1}{2}$ minutes, Ashwell in $29\frac{2}{5}$ minutes, Melton in $37\frac{2}{5}$ minutes, and Plumtree in $51\frac{1}{3}$ minutes. Further particulars of this performance are given below.

(4) *Other and less hilly parts of the system.*—Here naturally such good work as is accomplished on the main routes of the system is neither expected nor found. There is, however, no lack of praiseworthy examples. Leicester to Trent has been done (starting and stopping) with engine 165 and $12\frac{1}{2}$ coaches in 24 minutes 33 seconds; and with engines 1477 and 818 and 19 coaches in the really wonderful time of 22 minutes 35 seconds. This is very fine for such a short start-to-stop run ($20\frac{3}{4}$ miles). Then engine 63 once took 19 coaches from Normanton to Trent in 82 minutes ($65\frac{1}{2}$ miles). Sheffield to Leeds ($39\frac{1}{2}$ miles) has been done by engine 1507 and $10\frac{1}{2}$ coaches, with two signal-checks, in $47\frac{1}{3}$ minutes; the reverse direction, also with two checks, by engine 1671 and $12\frac{1}{2}$ coaches, in just under 49 minutes. Keighley to Normanton ($27\frac{1}{2}$ miles) was done by engine 1580 and $15\frac{1}{2}$ coaches, with two signal-checks, in 32 minutes 37 seconds; and Normanton to Sheffield ($28\frac{3}{4}$ miles) in 35 minutes 54 seconds, including two signal-checks, by engine 168

and 18 coaches. Thus, if the Midland rarely gives us those dazzling performances occasionally met with on one or two of the other lines, its work is, nevertheless, of an extremely high order. Averagely, perhaps, it is as good as any in the kingdom, but its best efforts have not touched the best on the North Western and Caledonian systems. This inferiority is most marked in running uphill, and is all the more singular as the Midland locomotives are generally of a powerful type, and should mount their banks more quickly than they do. Instead of this, however, there is an appreciable difference on ascending grades between the Midland and the North Western, for instance, in favour of the latter. On many occasions, as previously remarked, the former company find it necessary to employ pilot or assisting engines for banks of moderate grades. Having said this, there is nothing other than praise for the very fine locomotive work on the system, effected, as is seldom the case on other railways, with remarkable economy in the consumption of coal.

We now give details of some of the best of our performances referred to briefly above. These details, considered with the information given under the head of gradients, will enable the student of express speeds to estimate more exactly the work done by the locomotive.

ST. PANCRAS TO BEDFORD.

| Stations. | St. Pancras to Bedford (passing) in 52¼ mins. (49¾ miles) with engine 1740 and 7½ on. | | | | |
|---|---|---|---|---|---|
| | Mls. | Chns. | Time Due. | Time Actual. | |
| | | | A.M. | H. M. | S. |
| **St. Pancras** *dep.* | — | | **10 30** | **10 30** | **50** |
| Camden Road | 1 | 16 | — | 10 33 | 25 |
| Kentish Town | 0 | 36 | — | 10 33 | 59 |
| Haverstock Hill | 0 | 54 | — | 10 35 | 1 |
| Finchley Road | 1 | 14 | — | 10 36 | 37 |
| West End | 0 | 37 | — | 10 37 | 11 |
| Child's Hill | 1 | 17 | — | 10 38 | 48 |
| Hendon . | 1 | 66 | — | 10 40 | 48 |
| Mill Hill | 2 | 30 | — | 10 43 | 32 |
| Elstree . | 3 | 9 | — | 10 47 | 23 |
| St. Albans | 7 | 30 | — | 10 54 | 37 |
| Harpenden | 4 | 67 | — | 10 59 | 53 |
| Chiltern Green | 2 | 49 | — | 11 2 | 21 |
| Luton . | 2 | 79 | — | 11 5 | 8 |
| Leagrave | 2 | 33 | — | 11 7 | 40 |
| Harlington | 4 | 42 | — | 11 12 | 3 |
| Flitwick . | 2 | 76 | — | 11 14 | 32 |
| Ampthill | 1 | 43 | — | 11 15 | 53 |
| **Bedford** . . . *pass.* (passing) | 8 | 2 | **11 27** (to pass) | **11 23** | **4** |

## TRENT TO MARPLE.

| Stations. | | Trent to Marple (*viâ* Chaddesden) in $70\frac{13}{16}$ mins. ($57\frac{1}{2}$ miles) with engine 1332 and 8 coaches. | | | | |
|---|---|---|---|---|---|---|
| | | Mls. | Chns. | Time Actual. | | |
| | | | | H. | M. | S. |
| **Trent** | *dep.* | — | | **5** | **53** | **13** |
| Sawley | | 2 | 23 | 5 | 57 | 4 |
| Draycott | | 0 | 68 | 5 | 58 | 4 |
| Borrowash | | 2 | 25 | 6 | 0 | 41 |
| Spondon | | 1 | 18 | 6 | 1 | 58 |
| Nottingham Road | | 2 | 51 | 6 | 5 | 47 |
| Duffield | | 4 | 50 | 6 | 11 | 3 |
| Belper | | 2 | 32 | 6 | 13 | 41 |
| Ambergate | | 2 | 51 | 6 | 16 | 20 |
| Whatstandwell | | 2 | 12 | 6 | 19 | 7 |
| Cromford | | 2 | 60 | 6 | 22 | 3 |
| Matlock Bath | | 0 | 59 | 6 | 23 | 0 |
| Matlock | | 1 | 14 | 6 | 24 | 13 |
| Darley Dale | | 2 | 8 | 6 | 26 | 25 |
| Rowsley | | 2 | 24 | 6 | 28 | 51 |
| Bakewell | | 3 | 30 | 6 | 33 | 17 |
| Hassop | | 1 | 1 | 6 | 34 | 47 |
| Longstone | | 1 | 25 | 6 | 36 | 55 |
| Monsal Dale | | 1 | 31 | 6 | 39 | 16 |
| Miller's Dale | | 2 | 54 | 6 | 43 | 13 |
| Peak Forest | | 4 | 50 | 6 | 50 | 56 |
| Chapel | | 3 | 54 | 6 | 55 | 3 |
| Chinley | | 1 | 68 | 6 | 56 | 3 |
| Bugsworth | | 1 | 3 | 6 | 57 | 42 |
| New Mills | | 2 | 60 | 7 | 0 | 24 |
| Strines | | 1 | 34 | 7 | 1 | 50 |
| **Marple** | *arr.* | 2 | 5 | **7** | **4** | **8** |

NOTE.—Ran slowly through Chaddesden Sidings, and was checked by signals at Monsal Dale.

## KETTERING AND NOTTINGHAM.

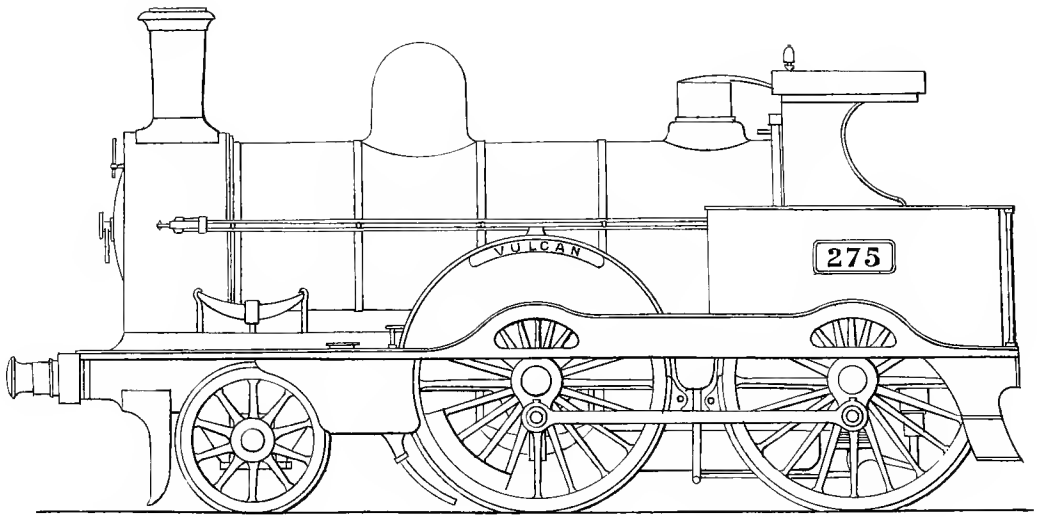
| Stations. | Run No. 1, Kettering to Nottingham, with engine 34 and 15 coaches ($51\frac{3}{4}$ miles), in $56\frac{1}{2}$ mins. (60 mins. allowed). | | | | | | Run No. 2 (to be read upwards), Nottingham to Kettering, in $58\frac{1}{2}$ mins. (60 mins. allowed), with engine 27 and 12 coaches. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mls. | Chns. | Time Actual. | | | | Mls. | Chns. | Time Actual. | | | |
| | | | H. | M. | S. | | | | H. | M. | S. | |
| **Kettering** | — | | **4** | **40** | **8** | | 5 | 3 | **7** | **24** | **37** | (passing) |
| Geddington | 5 | 3 | 4 | 48 | 25 | | 2 | 37 | 7 | 19 | 53 | |
| Weldon | 2 | 37 | 4 | 51 | 15 | | 3 | 43 | 7 | 17 | 1 | |
| Gretton | 3 | 43 | 4 | 54 | 37 | | 1 | 72 | 7 | 12 | 42 | |
| Harringworth | 1 | 72 | 4 | 56 | 18 | | 5 | 16 | 7 | 10 | 49 | |
| Manton | 5 | 16 | 5 | 1 | 38 | | 3 | 47 | 7 | 6 | 16 | |
| Oakham | 3 | 47 | 5 | 6 | 3 | | 3 | 8 | 7 | 2 | 48 | |
| Ashwell | 3 | 8 | 5 | 9 | 32 | | 2 | 24 | 6 | 59 | 32 | |

## KETTERING AND NOTTINGHAM (*continued*).

| Stations. | Run No. 1, Kettering to Nottingham, with engine 34 and 15 coaches (51¾ miles), in 56½ mins. (60 allowed). | | | | Run No. 2 (to be read upwards), Nottingham to Kettering, in 58½ mins. (60 allowed), with engine 27 and 12 coaches. | | | |
|---|---|---|---|---|---|---|---|---|
| | Mls. | Chns. | Time Actual. | | Mls. | Chns. | Time Actual. | |
| | | | H. M. S. | | | | H. M. S. | |
| Whissendine | 2 | 24 | 5 11 | 45 | 2 | 42 | 6 56 | 57 |
| Saxby . | 2 | 42 | 5 14 | 3 | 3 | 60 | 6 54 | 4 |
| Melton | 3 | 60 | 5 17 | 30 | 3 | 79 | 6 50 | 2 |
| Grimston . | 3 | 79 | 5 22 | 3 | 2 | 17 | 6 46 | 14 |
| Old Dalby . | 2 | 17 | 5 24 | 41 | 1 | 18 | 6 43 | 38 |
| Upper Broughton | 1 | 18 | 5 26 | 0 | 2 | 51 | 6 42 | 15 |
| Widmerpool . | 2 | 51 | 5 28 | 42 | 2 | 67 | 6 38 | 53 |
| Plumtree. . | 2 | 67 | 5 31 | 27 | 2 | 44 | 6 34 | 57 |
| Edwalton . | 2 | 44 | 5 33 | 47 | 2 | 66 | 6 31 | 31 |
| **Nottingham** . | 2 | 66 | **5 36** | **38** | — | | **6 26** | **12** |

## CARLISLE AND SKIPTON.

| Stations. | Run No. 1, Carlisle to Skipton, with 2 engines and 14 coaches, in 97 minutes 59 seconds (86¾ miles). | | | | Run No. 2 (to be read upwards), Hellifield to Carlisle with engine 1748 and 15 on, in 93¾ minutes (76½ miles). | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ml. | Ch. | Time Due. | Time Actual. | Ml. | Ch. | Time Due. | Time Actual. | Remarks. |
| | | | A.M. | H. M. S. | | | A.M. | H. M. S. | |
| **Carlisle** | — | | **12 15** | **12 36 37** | 2 | 57 | **4 30** | **4 49 8** | |
| Scotby. | 2 | 57 | — | 12 40 48 | 1 | 16 | — | 4 44 25 | Bad slack near Scotby. |
| Cumwhinton | 1 | 16 | — | 12 42 30 | 2 | 70 | — | 4 43 12 | |
| Cotehill | 2 | 70 | — | 12 46 19 | 3 | 13 | — | 4 40 24 | |
| Armathwaite | 3 | 13 | — | 12 50 5 | 5 | 40 | — | 4 36 42 | |
| Lazonby | 5 | 40 | — | 12 56 11 | 2 | 72 | — | 4 30 13 | |
| Little Salkeld | 2 | 72 | — | 12 59 0 | 1 | 33 | — | 4 27 23 | |
| Langwathby | 1 | 33 | — | 1 0 34 | 3 | 45 | — | 4 25 57 | |
| Culgaith | — | | — | — | 1 | 29 | — | 4 22 26 | |
| New Biggin. | — | | — | — | 3 | 11 | — | 4 21 5 | |
| Long Marton | 8 | 5 | — | 1 9 38 | 2 | 35 | — | 4 17 54 | |
| Appleby | 2 | 35 | — | 1 12 56 | 2 | 76 | — | 4 14 48 | |
| Ormside | 2 | 76 | — | 1 15 40 | 4 | 79 | — | 4 12 8 | |
| Crosby Garrett | 4 | 79 | — | 1 21 40 | 3 | 17 | — | 4 7 2 | |
| Kirkby Stephen | 3 | 17 | — | 1 25 50 | 9 | 70 | — | 4 3 36 | Slight check near Kirkby Stephen. |
| Hawes | 9 | 70 | — | 1 39 0 | 3 | 21 | — | 3 53 14 | |
| Dent . | 3 | 21 | — | 1 43 0 | 6 | 9 | — | 3 49 47 | |
| Ribblehead . | 6 | 9 | — | 1 48 55 | 4 | 56 | — | 3 40 41 | |
| Horton | 4 | 56 | — | 1 53 26 | 6 | 1 | — | 3 31 45 | |
| Settle . | 6 | 1 | — | — | 5 | 17 | — | 3 21 44 | |
| **Hellifield** | 5 | 17 | — | 2 4 12 | — | | **2 48** | **3 15 20** | |
| **Skipton** . | 10 | 15 | **2 9** (to pass) | **2 14 36** | — | | — | — | |




To face p. 191.

EXPRESS PASSENGER ENGINE.

(DESIGNED BY MR F.W. WEBB)

Description p. 206.

# VI.

## THE LONDON AND NORTH WESTERN.

### (1) General Description of the Line.

This is the most important railway in England, and covers nearly 1,700 miles. It is not so extensive a system as the Great Western, nor are its main lines studded with so many large towns as the Midland, but it is the old established line, and where competition exists its route is nearly always the shortest. The London terminus is Euston, and the main line runs *viâ* Watford, Rugby, Nuneaton, Stafford, Crewe, Warrington, Wigan, and Preston to Carlisle. Numerous branches leave this at intervals, but before considering these we will mention some of the principal sections owned by the company, which from their importance, are almost main lines in themselves. Among these are the alternative route from Rugby to Stafford *viâ* Coventry, Birmingham, Dudley, and Wolverhampton; the Crewe to Manchester line with a continuation into Yorkshire, by way of Stalybridge and Huddersfield; Crewe to Liverpool over the Runcorn Bridge, and Crewe to Holyhead *viâ* Chester, Flint, Rhyl, Conway, Bangor, and the Britannia Bridge. These are all sections of the greatest importance, being the direct means of connecting Birmingham, Manchester, Liverpool, and Ireland respectively with London. From each of them many subsidiary lines diverge. Intimately connected with the Birmingham loop are the branches from Rugby to Coventry *viâ* Leamington and Warwick; from Coventry to Nuneaton; from Birmingham *viâ* Sutton Coldfield to Lichfield; from Walsall to Lichfield; from Walsall to Rugeley; and several suburban lines in the Birmingham district. Off the Manchester line the branches are generally small suburban lines of

great importance for short distance passenger traffic, and this remark also extends to the Yorkshire lines in the neighbourhood of Leeds, etc. It may here be stated that a line similar to the one which connects Manchester with the south by way of Crewe also connects it with the north by way of Tildesley and Wigan, there meeting the great trunk line to Carlisle and Scotland. Several branches leave this connecting link to the north and are the means of serving some of the important Lancashire towns. They, however, are nearly all short stretches, and need not further be described. The Crewe to Liverpool line has a few suburban branches in the neighbourhood of Liverpool. From Liverpool, as from Manchester, there is a connection with the main line at Wigan by way of St. Helen's. The Crewe to Holyhead piece differs from the three previous important sections in having no suburban branches. The lines diverging from it are chiefly used by tourists in the season; such are the sections from Chester *viâ* Mold to Denbigh, with branches from that point to Corwen and Rhyl in opposite directions; from Llandudno Junction to Blaenau Festiniog *viâ* Bettws; from Bangor to Bethesda; from Bangor to Afonwen; from Carnarvon to Llanberis; and from Gaerwen to Amlwch.

Leaving these four main sections, the London and North Western possesses besides a very large number of less important branches. Starting from London and proceeding northwards these are as follows:—On the right hand side—Watford to St. Albans; Leighton to Dunstable; Bletchley to Cambridge, *viâ* Bedford; Roade to Rugby, *viâ* Northampton; Northampton to Peterboro'; Northampton to Bottesford (jointly with the Great Northern Company), with running powers over the Great Northern north thereof; Rugby *viâ* Market Harboro' to Peterboro' with an offshoot at Seaton for Stamford; Nuneaton to Leicester, and Nuneaton to the Charnwood Forest district; Lichfield to Derby *viâ* Burton; and Low Gill to Ingleton.

On the left hand side the offshoots are of similar importance. Among them are—Watford to Rickmansworth; Bletchley to Oxford; Weedon to Daventry; Stafford to Shrewsbury; Warrington to Chester; Lancaster to Morecambe; and Oxenholme to Kendal and Windermere.

The company have also a very important section leading from Crewe southwards through Shrewsbury to Craven Arms, at which point one line goes south-west through Knighton and Llandovery to Swansea, and another south through Hereford, enabling connections

to be formed between Lancashire and the South Wales towns and Bristol. Part of this route is owned jointly with the Great Western Company.

Among other joint lines may be mentioned the Chester and Birkenhead (Great Western and London and North Western); the Wigan and Blackburn, which is partly London and North Western and Lancashire and Yorkshire joint; the Preston and Longridge and the Preston and Wyre (this last connecting Preston with Blackpool, etc.), which are also jointly owned with the Lancashire and Yorkshire Company.

Besides these numerous lines the North Western possesses very considerable running powers over the systems of other companies. Thus, by arrangement with the Caledonian, it has power to run over nearly the whole of that company's main line. This power is occasionally exercised in the case of excursion trains running through from one system to the other, which have only one kind of brake hose couplings, and which it would be inconvenient to run with the other company's engine—the two lines having adopted different systems of continuous brakes—the North Western using the Vacuum and the Caledonian the Westinghouse. A like practice is followed by the Caledonian when the stock is fitted only with their brake—the engine of the Scotch company taking the excursion train south over the North Western line.

### (2) Travelling Facilities.

(*a*) *Services between Chief Towns.*—The North Western is not nearly in such a favourable position as the Midland as regards having large towns situated on its main line. This disadvantage, however, is more than counterbalanced by the fact that to most of the large towns in the central and western central parts of England, the North Western route is the quickest and most direct from London. We accordingly find that the services to Birmingham, Wolverhampton, Northampton, Rugby, Stafford, Crewe, Chester, Holyhead, Birkenhead, Liverpool, Warrington, Wigan, Manchester, Blackburn, Oldham, Rochdale, Preston, and Carlisle (for Scotland) from London are excellent, but that the services between some of these towns and others are not so good as we find on the Midland, and this because they are generally situated off the main line, and thus away from the running of the through express services. For instance, Nottingham

is only 1 hour 50 minutes from Leeds (80 miles) by the Midland, both towns being on the main route to the north. But Birmingham is 2 hours 10 minutes distant from Manchester (83½ miles), both being on what are practically branch lines. This inferior position of many of the chief towns on the North Western is, however, minimised to a great extent by the enterprise of the management, which, as will be shown below, has created an excellent train service in whatever part of England the system is found.

Perhaps the best way to give an idea of the services of the London and North Western Company will be to furnish a set of four tabular statements showing respectively the services (1) between London and the chief towns on the system as stated above; (2) from Birmingham to Manchester, Liverpool, Leeds, Carlisle; (3) from Liverpool to Manchester, Leeds, Carlisle, and Bristol; (4) from Manchester to Leeds, Carlisle, and Bristol. These figures will show that few improvements could be effected in any of the company's services. From London to any of the towns on the main line, to Liverpool and to Carlisle, the service is superb. To Manchester the time taken by nearly all the company's trains is 4¼ hours, while the Great Northern and Midland have only one or two trains each in that time. Of course, their routes are both longer and harder, and they do all that can fairly be expected of them. Indeed, many urge that the North Western should reduce to 4 hours, and this of course could be easily done. Considering, however, that the London and North Western has reduced the time on several occasions until it stands at its present figure, we hardly think there is pressing necessity to go further now. To Birmingham the company's trains offer a lower inclusive speed than to any other of their large towns. This is doubtless due to the excessive number of stops made by the expresses thither. To Holyhead (for Ireland) the service stands in need of improvement. The two best up and down trains are limited to first and second classes only at express fares. These trains carry the Irish mails and run at a high speed. But the third-class trains are poor, and the company cannot be complimented on the third-class service to Ireland from London, much less from the principal provincial towns.

Coming now to Tables 2, 3 and 4, we find that our previous remarks are borne out as regards the services between principal towns as among themselves. For this, with one exception, the company can certainly not be blamed. The exception is that of

Leeds. This town is only moderately connected with Manchester, and badly with Birmingham and Liverpool. If the North Western thought fit they could arrange with the North Eastern Company to run through trains from Newcastle *viâ* Leeds to Manchester, Birmingham, and Bristol at express speed and thus establish an effective competition with the Midland north-east to south-west cross-country services. This has already been done between Liverpool, Manchester, and Newcastle, but the services are hardly fast enough. These Liverpool to Newcastle trains form, as between Liverpool and Manchester, part of one of the most remarkable services to be found anywhere. Here, from each end, every hour, starts an express which covers the 31½ miles in 40 to 45 minutes, with one to three or four intermediate stops. The Cheshire Lines and Lancashire and Yorkshire offer similar services in 45 minutes (with several on the Cheshire Lines in 40 minutes). Thus Manchester and Liverpool are connected together by no fewer than about 90 express trains daily.

Besides the cross-country service between Carlisle (for Scotland), Manchester, Liverpool, and Bristol, the North Western have organised another in the shape of through carriages from Birmingham to Harwich in connection there with the Great Eastern Company's boats. These trains connect at Rugby with the up Scotch expresses.

Punctuality is a thing for which the London and North Western is famous. It is, no doubt, meritorious to work a small system with regularity, but to do this with so complex a network as the North Western is a task of a different order. Yet few of the trains are unpunctual—the fastest scarcely ever so. This is in great measure due to the excellent and machine-like discipline maintained on the system. Whenever this company determine to do anything we may feel sure it will be done thoroughly. When it was decided to run the expresses to Edinburgh in the same time as the East Coast companies, it was generally felt that the North Western would fulfil its promise. And the result justified the expectation. During the first two months of the running the up express was only once late at Euston, while the rival companies' trains were frequently behind time at King's Cross.

We now give the tables referred to above:—

## SERVICES FROM AND TO LONDON.

| Between London and | Miles. | No. of trains at or over 35 mls. per hr. Down. | 35 mls. per hr. Up. | 40 mls. per hr. Down. | 40 mls. per hr. Up. | 45 mls. per hr. Down. | 45 mls. per hr. Up. | Fastest. Hr Min | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| Birmingham . | 113 | 13 | 9 | 5 | 7 | None. | 1 | 2 30 | NOTE—Some trains run *viâ* Northampton (2 miles longer), and are included in the table. |
| Wolverhampton | 123¾ | 10 | 8 | 3 | 2 | None. | None. | 3 0 | |
| Northampton | 65¾ | 13 | 13 | 7 | 7 | 2 | 2 | 1 24 | |
| Rugby . | 82¾ | 28 | 23 | 25 | 20 | 14 | 10 | 1 43 | |
| Stafford . | 133¾ | 12 | 14 | 7 | 8 | 1 | 1 | 2 55 | |
| Crewe | 158 | 16 | 19 | 14 | 15 | 6 | 8 | 3 12 | |
| Chester . | 179¼ | 9 | 12 | 7 | 5 | None. | None. | 4 3 | |
| Holyhead | 263¾ | 3 | 3 | None. | None. | None. | None. | 6 37 | The best trains are the Irish Mails, 1st and 2nd only, at express fares. |
| Birkenhead . (Woodside) | 194½ | 8 | 6 | 3 | None. | None | None. | 4 30 | |
| Liverpool . | 193½ | 7 | 10 | 5 | 6 | None. | None. | 4 20 | |
| Warrington . | 182¼ | 8 | 8 | 5 | 5 | None. | 1 | 4 2 | |
| Wigan . . . | 194 | 11 | 8 | 7 | 3 | None. | None. | 4 23 | |
| Manchester . | 188¾ | 12 | 9 | 6 | 8 | None. | None. | 4 15 | The distance given is by the route taken by fastest train, *viâ* Crewe; but three trains each way run *viâ* Colwich or *viâ* Stafford, 183¾ and 187 miles respectively. |
| Blackburn | 220 | 4 | 6 | 2 | 2 | None. | 1 | 4 52 | Best train runs *viâ* Preston (220 miles), but nearly all others *viâ* Wigan (211½ miles). |
| Oldham (Clegg St.) | 193¾ | 8 | 7 | 6 | 4 | None. | None. | 4 32 | See notes as for Manchester. |
| Rochdale . . | 201½ | 6 | 7 | 3 | 1 | None. | None. | 4 52 | |
| Preston . | 209 | 10 | 14 | 6 | 8 | 2 | 3 | 4 17 | |
| Carlisle . . | 299¼ | 10 | 8 | 6 | 6 | 4 | 3 | 6 20 | |

## SERVICES FROM AND TO BIRMINGHAM.

| Between Birmingham and | Miles. | No. of trains at or over 35 mls. per hr. From Birmingham. | 35 mls. per hr. To Birmingham. | 40 mls. per hr. From Birmingham. | 40 mls. per hr. To Birmingham. | 45 mls. per hr. From Birmingham. | 45 mls. per hr. To Birmingham. | Fastest. Hr Min | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| Manchester . | 83½ | 3 | None. | None. | None. | None | None. | 2 10 | Poor service. |
| Liverpool . . | 88¼ | 4 | None. | None. | None. | None. | None. | 2 25 | One down train on Thursdays only. |
| Leeds (*viâ* Stockport) | 126½ | 1 | None. | None. | None. | None. | None. | 3 25 | Poor service. |
| Carlisle . | 194 | 5 | 3 | 1 | 1 | None. | None. | 4 45 | |

SERVICES FROM AND TO LIVERPOOL.

| Between Liverpool and | Miles. | No. of trains at or over | | | | | | Fastest. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hr. | | 40 mls. per hr. | | 45 mls. per hr. | | | |
| | | From Liverpool. | To Liverpool. | From Liverpool. | To Liverpool. | From Liverpool. | To Liverpool. | Hr Min. | |
| Manchester . . | 31½ | 15 | 18 | 12 | 16 | 3 | 3 | 0 40 | One train each way in 40 minutes on Thursdays only. |
| Leeds . . | 74½ | 2 | 4 | None. | None. | None. | None. | 2 0 | |
| Carlisle (from Exchange Station and *viâ* L. & Y. to Preston) | 119 | 6 | 8 | 4 | 4 | None. | 1 | 2 34 | Five trains (2 of them down) run *viâ* Wigan (125 miles). The fastest trains, however, are *viâ* L. & Y. to Preston. |
| Bristol . . . | 187½ | 2 | 4 | None. | None. | None. | None. | 4 45 | Good cross-country service. |

SERVICES FROM AND TO MANCHESTER.

| Between Manchester and | Miles. | No. of trains at or over | | | | | | Fastest. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | 35 mls. per hr. | | 40 mls. per hr | | 45 mls. per hr. | | | |
| | | From Manchester. | To Manchester. | From Manchester. | To Manchester. | From Manchester. | To Manchester. | Hr. Min. | |
| Leeds . | 43 | 1 | 3 | None. | None. | None. | None. | 1 10 | Several others rather below 35 m.p.h. |
| Carlisle— (*Viâ* L.& N.W.) | 123 | 3 | 6 | 2 | 2 | None. | None. | 2 50 | |
| (*Viâ* L. & Y., to Preston from Victoria Station) . | 122 | 3 | 4 | 3 | 2 | None. | None. | 2 47 | |
| Bristol . | 182¾ | 2 | 4 | None. | None. | None | None. | 4 35 | Good cross-country service. |

The local train-services of the North Western may, for speed, frequency, and general convenience be described as among the best in the kingdom. In the matter of carriage accommodation, however, though the stock provided is nearly always comfortable and

well lighted, it is yet scarcely so good as that of the Great Northern Company. We have already referred to the wonderfully fast local train from Carlisle at 6.50 a.m. to Oxenholme Junction. Another striking instance we may cite is that from Bedford to Cambridge, where a stopping train covers in 56 minutes the 29½ miles, part of which is single road. These are scarcely exceptions, as all over the system the very greatest attention is paid to the running of local trains.

The company have a very large suburban service in London, Birmingham, Liverpool, and Manchester. Here we find the coaching stock excellent, and almost invariably well lighted with gas.

(*b*) *Rolling Stock and General Accommodation.*—The carriages provided by the London and North Western Company are among the best in the kingdom. We have already alluded to the stock used in the local and suburban trains as being remarkably good. It is, however, on the main line that we see the best carriages on the system. Most of these are of the eight-wheeled type (42 feet in length) with radial axles, and are perhaps the finest vehicles running on any British railway, and, as regards first-class accommodation at least, they represent simply the best practice of our railway-carriage designers. The first-class compartments are upholstered in the most sumptuous and tasteful manner, and in nearly every case are furnished with lavatory accommodation. There is a considerable difference between these vehicles and those which the Midland and some other companies use in their express trains. For many years they have been excellently lighted by gas, which is used to a large extent on the North Western. On certain trains to Liverpool and Manchester dining-saloons are run, and in these dinner or light refreshments can be obtained at a moderate charge. To Scotland several sleeping-saloons, furnished with every luxury and convenience, are despatched nightly. The company are now providing their comfortable second- and third-class carriages with lavatory accommodation. The summer of 1893 will see not only this company, but the Great Northern and Midland as well, running third-class dining cars on their Scotch express trains.

The coaching stock is now fitted with the Automatic Vacuum brake. This was not always so. The history of the North Western in regard to brakes is not a very creditable one, the company having chopped and changed from one inefficient variety to another more than once. For many years their most important trains were run

under the protection of what is generally known as the "Emergency" Chain-brake—so called from orders having been given that it was not to be used except in cases of emergency. In other respects, however, the company's safety appliances are quite beyond reproach. The signalling of the line is excellent, and the permanent way said to be the best in the world. At certain intervals on the main line water-troughs, for the replenishment of the locomotive tenders while running at speed, are laid between the rails. This practice has also been adopted by, among other railways, the Lancashire and Yorkshire, and the Pennsylvania Railroad of America. The accommodation for passengers at stations is good—especially is this so at the larger towns and junctions, such as Rugby, Preston, Carlisle, Liverpool (Lime Street), Manchester (London Road and Exchange), Leeds, Huddersfield, Chester, Birmingham, and several others. At these points fine structures have been erected at great cost.

Broadly speaking, it may be said that railway management has approached more nearly to perfection on the North Western than on any other line. Its discipline and regular working, considering the size and complexity of the system, are nothing short of marvellous. Much more complete information on these points than we have space to give may be obtained from *The Working and Management of an English Railway*, by the late general manager, Sir George Findlay.

### (3) Locomotive Work.

(*a*) *Speed.*—As in the case of the Midland and Great Northern companies, we propose, before citing examples of actual performances, to give a brief *résumé* of the booked speeds set down in the time-tables to be carried out in daily practice. We intend to make our remarks as general as possible, and avoid going into wearisome details. Many of the speeds we are about to mention may not at first sight seem so high as those of the rival lines running northwards from London. It must in fairness be borne in mind that trains are much more heavily laden as a rule on the North Western than on the Midland, and are appreciably heavier than even on the Great Northern. This very prominent factor in any comparisons that may be made is too frequently ignored. It is also just as well to remember that to competitive points the North Western system is,

as a rule, the shortest route, and consequently there is scarcely any incentive for the company to resort to excessive speeds. As a result, then, we find that although this system possesses perhaps the hardest-timed trains anywhere, its general average is certainly lower than the Great Northern, and a trifle lower perhaps than the Midland. In *amount* of express speed, however, it stands much higher than either of its rivals; and, to sum up, looking at the obligations and opportunities of the line to run express trains, it certainly performs its duty as well as either of its neighbours.

From London to Crewe there is a very large amount of express traffic. All of the fast trains, with scarcely an exception, are very heavy. The average booked time runs approximately to 50 miles an hour, some trains being as high as 53¼, and others averaging about 48 or 49. The pick of the bunch are probably:—the 10 a.m. and 10.30 a.m. down, which run from Rugby to Crewe, 75¼ miles, in 85 minutes; the 6.45 p.m. up, which runs from Rugby to Willesden Junction, 77¼ miles, in 88 minutes; the 4.45 p.m. up express, which runs from Bletchley to Willesden, 41¼ miles, in 48 minutes; and the up Scotch expresses due at Euston at 7 p.m. and 10.50 p.m., which run from Crewe to Nuneaton in 71 and 70 minutes (61¼ miles), and follow this up by doing Nuneaton to Willesden, 91½ miles, in 108 and 105 minutes respectively. Besides these very fast specimens of booked speed, we must not neglect the Birmingham trains, which make some very fast runs for short distances, and such trains as the 3.30 p.m. and 9.45 p.m. up, which are booked from Rugby to Willesden at 50 miles an hour, and always have excessively heavy loads.

Between Crewe and Preston the speed, with the exception of certain of the Scotch trains, falls off, and averages only about 45 miles an hour. The best Scotch expresses get about an hour or just over to cover the 51 miles. As there are one or two hilly pieces in this stretch, the timing is not at all bad. The other Scotch trains are a good deal slower over this length, and have to make up for it between Preston and Carlisle, where the timing is of a most extraordinary description—quite surpassing, in our opinion, anything performed elsewhere on the iron road.

It is usual, when estimating the booked speeds over so hilly a section as the Preston to Carlisle, to expect a rate of somewhere about 45 miles an hour, and, if anything occurs above that figure, to regard it as extremely praiseworthy. How remarkable is the pace on this stretch of line may be judged from the following table, which

gives a list of the trains having an inclusive rate of 45 miles an hour or over between the two extreme points :—

List of Expresses on Preston to Carlisle Section of the London and North Western Railway with a Speed of 45 miles an hour or over.

| Down Expresses from Preston at | Distance. Miles. | Time. Minutes. | Speed. | Up Expresses from Carlisle at | Distance. Miles. | Time. Minutes. | Speed. |
|---|---|---|---|---|---|---|---|
| 12.20 a.m. (from Wigan) | 105 | 130 | 48·5 | 12.5 a.m. | 90 | 117 | 46·2 |
| 2.25 a.m. | 90 | 115 | 47·0 | 12.1 p.m. | 90 | 106 | 50·9 |
| 10.50 a.m. | 90 | 120 (2 stops) | 45·0 | | | | |
| 11.0 a.m. | 90 | 120 (2 stops) | 45·0 | 12.23 p.m. | 90 | 102 | 52·9 |
| 2.40 p.m. | 90 | 105 | 51·4 | 12 34 p.m. | 90 | 105 | 51·4 |
| 3.10 p.m. | 90 | 105 | 51·4 | 4.20 p.m. | 90 | 115 (including stop) | 47·0 |
| 6.42 p.m. | 90 | 113 (including stop) | 47·8 | 4.30 p.m. | 90 | 115 (including stop) | 47·0 |
| 3.38 p.m. | 90 | 122 (2 stops) | — | 8.41 p.m. | 90 | 121 (1 stop) | — |

There is clearly nothing anywhere else so good as this. The Caledonian comes nearest over the hilly piece from Carlisle to Carstairs, but even its best speed is well below the North Western best, and in number of trains it is decidedly inferior; while the position of the Midland, North British, and Manchester, Sheffield and Lincolnshire companies will readily be seen by reference to the following table :—

| Railway. | From | Number of Expresses between the extreme points having an inclusive rate of speed of | | | | | |
|---|---|---|---|---|---|---|---|
| | | Over 40 miles per hour. | Over 45 miles per hour. | Over 48 miles per hour. | Over 50 miles per hour. | Over 51 miles per hour. | Over 52 miles per hour. |
| M. S. and L. . | Manchester to Sheffield | 2 | 0 | 0 | 0 | 0 | 0 |
| Ditto . . | Sheffield to Manchester | 0 | 0 | 0 | 0 | 0 | 0 |
| North British . | Carlisle to Hawick | 3 | 0 | 0 | 0 | 0 | 0 |
| Ditto . . | Hawick to Carlisle | 3 | 0 | 0 | 0 | 0 | 0 |
| Midland . . | Derby to Manchester | 4 | 0 | 0 | 0 | 0 | 0 |
| Ditto . . | Manchester to Derby | 6 | 1 | 0 | 0 | 0 | 0 |
| Ditto . . | Hellifield to Carlisle | 9 | 8 | 2 | 0 | 0 | 0 |
| Ditto . . | Carlisle to Hellifield | 9 | 5 | 0 | 0 | 0 | 0 |
| Caledonian . | Carlisle to Carstairs | 11 | 7 | 3 | 1 | 0 | 0 |
| L. and N.-W. . | Carlisle to Preston | 9 | 6 | 3 | 2 | 2 | 0 |
| Ditto . . | Preston to Carlisle | 10 | 7 | 3 | 3 | 2 | 1 |

Elsewhere on the large North Western system there is not much beyond a very respectable mediocrity for us to chronicle. The Irish Mail trains are run from Chester to Holyhead over a route not altogether free from obstacles of one kind or another. The down trains get 107 and 109 minutes, and the up 110 and 119 minutes, for the 84½ miles. This is for first- and second-class only, at express fares. The traffic is, of course, altogether in the North Western Company's hands. The third-class trains are only moderate over this section. There is, however, besides the Irish Express trains, a large number of other trains running partly over this piece of line. The booked speeds are not very high, but perhaps sufficiently so for the traffic, which is mostly tourist or seaside.

There is a good deal of fast running for short stretches on the line between Liverpool and Manchester. Most of the trains take 45 minutes to run the 31½ miles from one terminus to the other. Two 40 minutes trains (Thursdays only, one each way) do the 30¼ miles between Edge Hill and Manchester, or *vice versâ*, in 36 and 35 minutes. In 1890 nearly all the trains between Liverpool and Manchester had only 40 minutes allowed them, and at that time most of the intermediate runs were timed at 50 miles an hour or over, forming the finest collection of "sprints" anywhere. But it was too good to last.

The Rugby to Stafford (*viâ* Birmingham), and the Manchester to Leeds lines, present no high booked speeds worthy of mention. Junctions and gradients are unquestionably hindrances, but after allowing for them the traffic is important enough to warrant higher speeds than are at present in vogue. Elsewhere, however—as, for instance, on the line from Crewe to Hereford, over which run the West of England expresses from Manchester and Liverpool to Bristol, and on that portion of the North Staffordshire Railway run over by some of the London and North Western expresses to Manchester—the speeds are by no means bad. In concluding our remarks on the booked speeds of this company's fast trains, it is pleasant to find—as in the case of the Great Northern Railway—that the branch lines are fairly well served. The speeds, though not very high, are sufficiently respectable on such branch lines as Nuneaton to Burton, Rugby to Peterborough, Stafford to Shrewsbury, and elsewhere. There is abundant evidence to prove that the London and North Western, while providing well for the through express traffic, does not by any means neglect the local wants of its system.

(*b*) *Gradients.* — In the case of the Midland and Great Northern we find the gradients generally exaggerated in the few books of reference on the subject, whereas the North Western is frequently treated as a level line. Mr. Foxwell tells us that from Carnforth to Euston is very easy except three miles of 1 in 177 into Crewe from the south. We hope here to show that this is not so, and that many of the North Western gradients, though of no great steepness, are of considerable length, and consequently difficult to work. If anyone were asked to compare the section from St. Pancras to Bedford with that from Euston to Bletchley, he would very probably say the former was much harder. Yet the Midland piece is very little harder than the North Western; its gradients, though steeper, come in shorter stretches; it has a fine piece of 20 miles downhill into Bedford (much of it 1 in 200), while the London and North Western has only about six miles descent of 1 in 330 after Tring, and its summit-level is lower than the North Western at Tring. It is, in fact, necessary when considering the profile of the North Western to refer to the section on gradients in the introductory chapters, where some stress is laid on the difficulty of working long, continuous inclines.

The North Western on leaving Euston mounts about a mile on gradients averaging 1 in 75, and is then almost level for six miles. Then follow eight miles of 1 in 330 and 1 in 341 up, followed by a short piece of level and slight drop to the seventeenth milepost, from which the line mounts almost continuously on gradients of 1 in 330, with shorter bits intervening of 1 in 406, 1 in 528, and 1 in 1,056 to Tring ($31\frac{3}{4}$ miles). Six miles drop of 1 in 330 succeeds, followed by about 13 miles of easy descent and three miles of level to post 54. Then for seven miles the line mounts at 1 in 330, only to fall again for two miles at about the same grade. For nine miles it is nearly level, followed by about six miles of 1 in 342, 1 in 406, and 1 in 511 rising, and then falling into Rugby ($82\frac{3}{4}$ miles) on 1 in 364.

From Rugby the line rises very gently, with undulations, for about 10 miles, only to fall again for six miles at 1 in 330 and 1 in 660. Then there is a slight rise for four miles, and a fall for 10 miles on grades of about 1 in 600. This brings us to post 113, from which we rise five miles, mostly of 1 in 330, followed by undulations for about 15 miles to Stafford. Then on grades varying from 1 in 400 to 1 in 600 we ascend for 16 miles continuously to Whitmore, dropping from there 10 miles into Crewe, of which three are

at 1 in 330, four at 1 in 177, and the others at 1 in 250. The whole distance from London (158 miles 8 chains) was run without stop on August 13th, 1888, in 166 minutes by one of Ramsbottom's 7 ft. 6 in. singles with 16 in. by 24 in. cylinders and only 11½ tons on the driving wheel.

The first four miles out of Crewe are on the level, and are followed by an almost continuous descent, broken by two minor ascents, to the 185th milepost—a distance of 23 miles. The descent is, however, very gradual, and is rarely worse than 1 in 600. Then for six miles there is an ascent, averaging 1 in 400, followed by three miles almost level. Then on grades varying from 1 in 120 to 1 in 330 the line rises for six miles, and then drops steeply into Preston, a distance of nearly 10 miles, on gradients of 1 in 110 to 1 in 330. On August 7th, 1888, Mr. Ramsbottom's 275 "Vulcan," with 6 ft. 6 in. drivers and 17 in. by 24 in. cylinders, covered the 51¼ miles from Crewe to Preston in 49 minutes—a performance as good as any recorded during that month.

Before leaving the more level portions of the North Western main line we wish once again to call attention to Mr. Foxwell's statement that the line from Carnforth to Euston is very easy. From Preston to Crewe we have, roughly speaking, 10 miles rising on an average, say, of 1 in 200, 15 falling gradually, and about 26 rising gradually. Now, from Bedford to London by the Midland consists, again speaking roughly, of 16 miles of 1 in 200 rising, 10 about level, and about 24 falling either steeply or gradually. A fair comparison would certainly result in the North Western being adjudged to be the harder section. Mr. Foxwell, however, thinks otherwise; describes the Midland gradients as trying, and passes the North Western with but slight comment.

From Preston to Carlisle the North Western main line is very steep. Rising for four miles of 1 in 500, it then undulates for 16 miles on very easy grades. This is followed by a drop for a mile at 1 in 90 into Lancaster, after which point the accompanying diagram gives the requisite information. Over this stretch was performed, on August 7th, 1888, one of the finest runs ever made on any railway. Engine No. 275 "Vulcan" did the 90 miles of mountain road in 89 minutes. Though the route is scarcely so hard as the Caledonian from Carlisle to Edinburgh, still the speed is faster than in the case of the Caledonian record, and the engine drawing the North Western train was much less powerful than that of the Scotch Company. It is stated that on this occasion the last 31¾ miles, from Shap

# LANCASTER TO CARLISLE.

## GRADIENT PROFILE.

L.& N.W.R. No. 1.

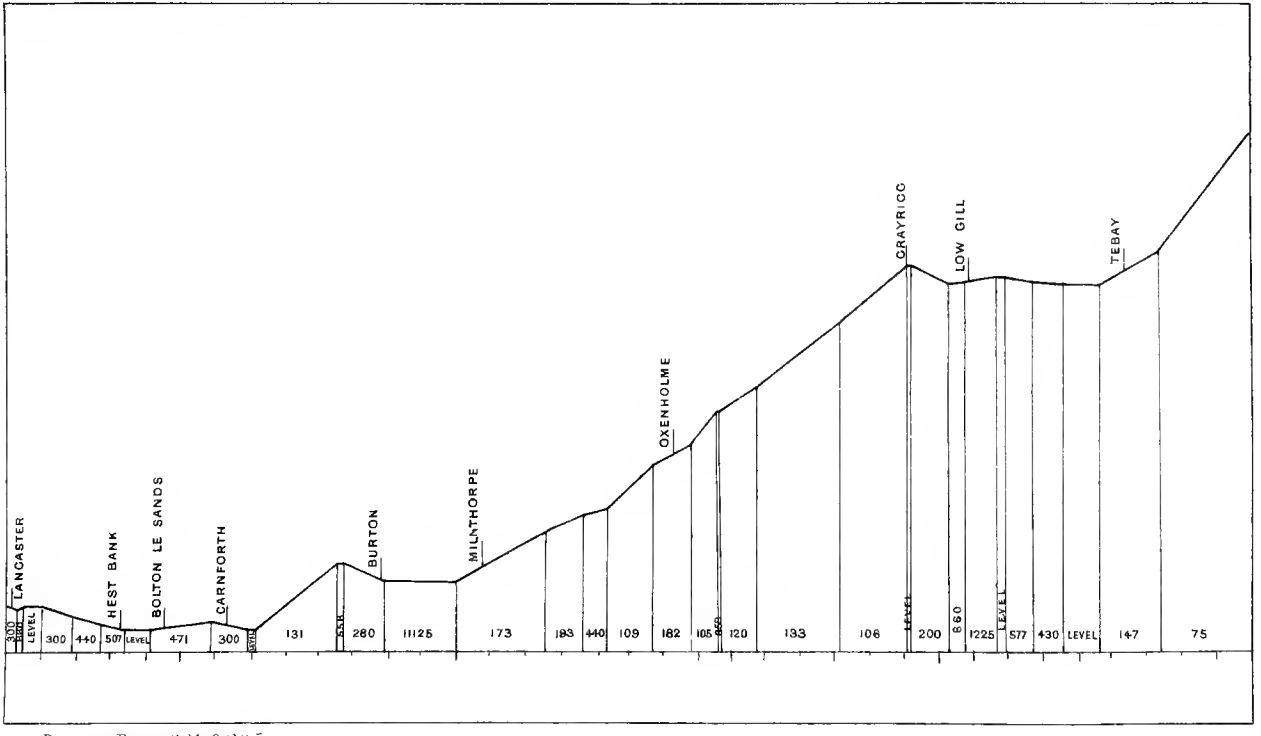



Plate XXXIV.

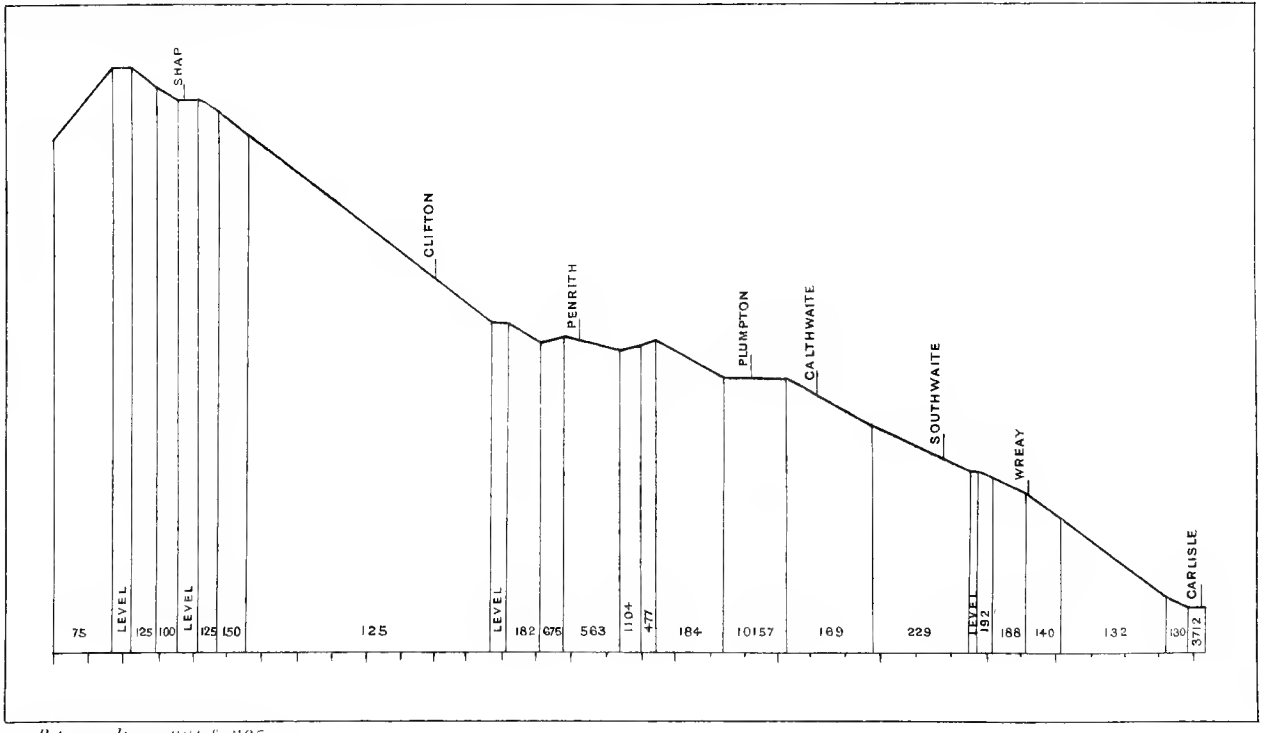
*Between Pages 204 & 205.*

# LANCASTER TO CARLISLE.

## GRADIENT PROFILE.

L.& N.W.R. No 2.

Plate XXXV




*Between Pages 204 & 205.*

Summit into Carlisle, was covered in 26½ minutes. Unfortunately, however, no exact details of the journey were ever taken.

As this main route is used by nearly all the North Western express trains, it will not be necessary to go into much detail over the other parts of the system. The lines from Crewe to Manchester and Liverpool are mostly easy. Between Liverpool and Manchester—a short section over which numerous express trains run—there is nothing difficult, if we except short pieces of 1¼ miles of 1 in 97 up before Edgehill, 1¼ miles of 1 in 97 up before Rainhill, one mile of 1 in 89 down before St. Helen's Junction, and a mile of 1 in 152 up just before entering Manchester. Manchester to Leeds has as yet no express service. It is therefore scarcely worth while detailing the gradients, which are very steep. Liverpool has a good connection with Buxton over a route which mounts to nearly 1,200 ft. above sea, and is very severe.

Coming further south, we find the various lines over which the North Western runs express or semi-express trains to be generally of moderate difficulty, and rarely presenting any very serious impediments to the speedy progression of the locomotive. The company's Central Wales lines are, however, rather formidable sections to work. In North Wales the Chester and Holyhead line—the most important avenue for exchange traffic between England and Ireland—deserves a more extended notice than the preceding smaller sections. Its course is more or less level along the coast-line from Chester to Rhyl, rising afterwards for a short distance past Abergele on 1 in 100. A gentler descent follows from Colwyn to Llandudno Junction, and then the line is again more or less level to Bangor. Between Menai Bridge and Holyhead steep undulations of 1 in 100 to 1 in 150 are most frequently met with. The section is therefore of moderate difficulty throughout. The gradients of that part of the North Staffordshire Railway used by some of the North Western Manchester expresses will be found briefly described in our remarks on the North Staffordshire Railway.

(*c*) *Locomotives.*—The company's chief Locomotive Superintendent is Mr. F. W. Webb—one of the best known of our mechanical engineers. Much of this gentleman's fame is due to his successful introduction of the 3-cylinder compound system of locomotives on the North Western, the "Experiment" of 1881 being the first attempt in this direction. The innovation gave such satisfactory results that it was followed by the enlarged and improved "Marchioness of Stafford" (6 ft. class)—one of the most

prominent features in the Inventions Exhibition of 1885. Further developments have since produced the 7 ft. "Teutonic" class of 1889—grand examples of English design and workmanship as adapted to the requirements of fast and heavy traffic; and the "Greater Britain"—a fine machine, embodying some new ideas in locomotive construction. Probably this last-named type will be represented in the forthcoming World's Fair at Chicago.

Besides these, however, Mr. Webb has achieved equal fame with his "Precedent" class. These, when compared with the engines of other companies, are small; their work, however, has never been surpassed. Mr. Rous-Marten, in his *Notes*, says that they have done heavier work in proportion to their weight than any other English engines. Similar to them is Mr. Ramsbottom's "Newton" class, which at present is being converted into "Precedents" by Mr. Webb. It was one of this class which in August, 1888, ran the Edinburgh express from Preston to Carlisle (90 miles) in 89 minutes —one of the finest runs ever accomplished.

The other classes, among which will be found the "Precursors" (also well known for excellent work), will be found below, with their dimensions, in tabular form :—

| Name of Class. | Diameter of Driving Wheels. | Cylinders. | Heating Surface. | | Grate Area. | Weight in Working Order. | Weight available for adhesion. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Tubes. | Box. | | | | |
| | ins. ft. | inches. | sq. ft. | sq. ft. | sq. ft. | tons. cwts | tons. cwts. | |
| Lady of Lake singles | 7 6 | 16 by 24 | 981 | 87·3 | 15 | 27 5 | 11 10 | Some of the Precedent class have only 960·2 sq. ft. tube surface. The Compounds have a boiler pressure of 175 lbs. per sq. in., and in some cases the H.P. cyl. is 15 by 24 inches. |
| Precursor type | 5 6 | 17 by 24 | 980 | 04·9 | 17·1 | 31 8 | 21 4 | |
| Precedent type | 6 6 | 17 by 24 | 980 | 103 | 17·1 | 32 10 | 22 10 | |
| 6-feet Compounds | 6 0 | L. P. 30 by 24<br>H. P., 14 by 24 | 1220·5 | 159·1 | 20·5 | 44 10 | 30 0 | |
| 6½-feet Compounds | 6 6 | L. P., 26 by 24<br>H. P., 13 by 24 | 980 | 103·5 | 17·1 | 37 15 | 27 7 | |
| 7-feet Compounds | 7 0 | L. P., 30 by 24<br>H. P., 14 by 24 | 1220·5 | 159·1 | 20·5 | 45 10 | 31 0 | |
| New engine Greater Britain (No. 3292). | 7 0 | L. P., 30 by 24<br>H. P., 15 by 24 | Forward 853<br>Rear 493<br>Chamber 39 | 120·6 | 20·5 | 52 2 | 31 0 | The boiler barrel, 18½ ft. long, has two sets of tubes with combustion chamber between. |

All these classes are wonderfully neat in appearance, and are painted black, relieved with white, slate, and red. The tenders are small, there being no great tank capacity provided, owing to the line

being furnished at frequent intervals with Ramsbottom's water troughs, which are placed between the running rails, and from which water can be taken up at speed. No locomotives on the North Western have bogies—many being fitted with radial axles instead. The brake used is a modification of the Automatic Vacuum.

(*d*) *Actual Performances.*—In treating of the Midland Company's actual performances we divided the line into sections, which in regard to gradients were dissimilar. On that railway most of the locomotives are almost equally powerful. On the London and North Western just the opposite is the case. The locomotives vary greatly in power—the "Precedent" class being only of moderate size, whereas the Compounds have, for England, very large dimensions. To show the capacity, therefore, of these types more clearly, we have decided to keep the work done by each separately, without reference to the gradients on which it was performed.

The smallest passenger type in regular use on the North Western is the "Lady of the Lake" class. These engines work the very fast trains between Manchester and Liverpool, and the results are admirable. During August, 1888, they regularly ran the "West Coast Flyer" from Euston to Crewe without stop. We give below a complete statement of their performances for the month, from which it will be seen that for engines of such small dimensions the results were most creditable. The run of August 13th is as good as anything ever done by an engine of similar capacity. On August 8th, "Waverley," one of this class, passed Willesden in 8 minutes 20 seconds, Watford in 21 minutes 37 seconds, Tring in 38 minutes 6 seconds, Bletchley in 53 minutes 13 seconds, Blisworth in 70 minutes 6 seconds, Rugby in 90 minutes 58 seconds, Nuneaton in 106 minutes 58 seconds, Tamworth in 121 minutes 56 seconds (after which we nearly had our long run terminated by a signal-check), and Stafford in 147 minutes 40 seconds, arriving at Crewe in 175 minutes 55 seconds after the start from Euston. But, besides this excellent month's record, these engines have frequently run the lightly-loaded expresses from Manchester to Edgehill in just over the half-hour (a distance of 30¼ miles).

Another class which has done excellent work is the "Precursor" type. These did not take part in the race to Edinburgh except on August 9th, when the "Newton" engine broke down on Shap bank and a "Precursor" took the express into Carlisle. But on less exciting occasions a "Precursor" has taken 10 coaches from Preston to Tebay (stopping) in 68½ minutes (52½ miles), passing Lancaster

in $25\frac{2}{3}$, Carnforth in $32\frac{1}{2}$, and Oxenholme in 49 minutes. Again, to stop in Wigan (15 miles, mostly uphill) in 19 minutes 42 seconds after leaving Preston, with 17 coaches on, is a splendid performance. Lastly, to start from Oxenholme and stop in Carnforth ($12\frac{3}{4}$ miles, mostly downhill and level) in 15 minutes 33 seconds, with 17 coaches, is worthy of great praise. At present this type is not so much employed for the express work of the line—having been displaced by the larger types—but the class was originally constructed to work the expresses over the mountainous Preston to Carlisle road, a task they performed most successfully. The writer has noted a speed of 73 miles an hour downhill with an engine of this class. This is very high for a 5 ft. 6 in. wheel.

With the "Newton" and "Precedent" classes some of the best work noticed was accomplished. In spite of their comparatively small dimensions, these types are set to do work which on other lines is performed by locomotives 10 to 15 tons heavier. The least we can say is that what they do is done admirably. Among many performances, we may cite:—Carlisle to Penrith, with 2 engines (one a "Precursor," the other a "Precedent"), and $16\frac{1}{2}$ coaches, $17\frac{7}{8}$ miles, in 25 minutes; Penrith to Tebay with the same engines and load, $19\frac{3}{4}$ miles, in just over 25 minutes, and in 26 minutes 55 seconds, with $18\frac{1}{2}$ coaches and engines "Boadicea" (Precursor) and "Breadalbane" (Precedent); Oxenholme to Carnforth, $12\frac{3}{4}$ miles, in 14 minutes 52 seconds (start and stop) with "Wheatstone" (Precedent) and $16\frac{1}{2}$ coaches, and in 15 minutes 54 seconds with "Breadalbane" (Precedent) and $18\frac{1}{2}$ coaches; Lancaster to Preston, 21 miles, in 27 minutes 54 seconds, with "Breadalbane" and 19 coaches; Oxenholme (passing) to Preston, 40 miles, in 43 minutes, with 20 coaches and engine "Wheatstone." All the above, except where otherwise stated, are from start to stop. We refrain from detailed comment, as the merit of each is sufficiently apparent without further remark.

Further south most of our observations relate to the Compound classes. Even here, however, the "Precedents" and "Newtons" have made themselves a name. Mr. Rous-Marten records a "Precedent" taking 20 coaches from Rugby to Willesden in 93 minutes; and on one occasion, with a load even slightly heavier than this, we ran from Bletchley to Willesden in just over 49 minutes ($41\frac{1}{4}$ miles), the last $26\frac{1}{4}$ miles, from Tring, being covered in just under 26 minutes—a really splendid piece of work. They have very frequently run the Scotch expresses between Rugby and Willesden as

much as four or five minutes within time; and during the months of June and July, 1888 (previous to the Edinburgh race), they were, with the Compounds, successful in bringing the comparatively heavy Scotch express into Euston only once late (one minute) during those two months. This wonderful record is, however, eclipsed by the marvellous way in which the "Newtons" performed between Crewe and Carlisle in the August race. To them must be awarded the honours in that fine exhibition of train-running. So excellent were the average performances that we might almost dispense with giving ordinary every-day examples. Between Crewe and Preston the best performance was 49 minutes ($51\frac{1}{4}$ miles), and the average was $54\frac{1}{2}$ minutes. Here, therefore, we have a performance equal to the best done on either the Great Northern, North Eastern, or Caledonian lines, and a series of average performances superior to the Great Northern and North Eastern, and quite equal to the Caledonian. Between Preston and Carlisle ($90\frac{1}{4}$ miles) we have a best of 89 minutes and an average of $96\frac{1}{2}$ minutes. Here the average is equal to the Caledonian, and the best is superior to that company's. What prodigies of speed up the banks on this mountainous line, and how often 80 miles an hour was exceeded down the banks between Shap and Carlisle on the 89 minutes day, will never be known, as it appears no one took any careful observations of this unique feat. A full statement of the daily running between Crewe and Carlisle appears below.

Some of the finest examples of uphill work in England are furnished by the North Western Compounds. These types—at any rate, the "Dreadnoughts" and "Teutonics"—have outlived all attempts to injure their reputation, and, although perhaps not economising coal to so great an extent as was anticipated, have yet done all that was expected of them in other directions. Some of the runs we give below are little short of marvellous; and as space forbids us to comment on all, we must simply let them speak for themselves. Engines "Britannic" and "City of Manchester" took $21\frac{1}{2}$ coaches from Willesden to Rugby in $91\frac{1}{4}$ minutes, passing Tring in 34 and Bletchley in 50 minutes, and from Rugby passed Milford and Brocton ($46\frac{1}{2}$ miles) with the same load in 53 minutes 11 seconds, passing Nuneaton in $17\frac{1}{4}$ minutes from starting. Our best down run from Euston was by the 10 a.m. Scotch express, when on one occasion "Teutonic" greatly distinguished itself by running from Willesden to Rugby ($77\frac{1}{4}$ miles) in $88\frac{1}{6}$ minutes, with a load of 19 coaches, following this up by a more remarkable feat in running from

Rugby to Crewe ($75\frac{1}{2}$ miles) in $83\frac{3}{4}$ minutes. Rugby to Willesden ($77\frac{1}{4}$ miles) was done in 91 minutes 56 seconds by "City of Carlisle" and 18 coaches; in 90 minutes 26 seconds (a splendid performance) by "City of Lichfield" and $19\frac{1}{2}$ coaches; and in 86 minutes 51 seconds by "City of London" and 14 coaches, passing Bletchley (36 miles) in 43, 43, and $41\frac{1}{4}$ minutes respectively, Tring (51 miles) in $61\frac{3}{4}$, $62\frac{1}{2}$, and $58\frac{1}{4}$ respectively, and Watford in $78\frac{1}{2}$, $75\frac{3}{4}$, and $73\frac{3}{4}$ respectively. Rugby to Watford ($65\frac{1}{2}$ miles) was covered by "City of Edinburgh" in $82\frac{3}{4}$ minutes with $20\frac{1}{2}$ coaches, passing Tring in $65\frac{3}{4}$ minutes; Rugby to Northampton (19 miles) in $23\frac{5}{6}$ minutes by "Vandal" and 14 coaches; Crewe to Rugby in $98\frac{1}{3}$ minutes ($75\frac{1}{4}$ miles) by "Duke of Albany" and $20\frac{1}{2}$ coaches; in $92\frac{1}{4}$ minutes by "City of Carlisle" and 16 coaches, and in $88\frac{1}{2}$ minutes by "Archimedes" and 17 coaches. In each case the train was slacked near Stafford, and the passing times at Stafford were $33\frac{3}{4}$, $32\frac{1}{2}$, and 30 minutes respectively, and at Nuneaton 80, 75, and $71\frac{1}{4}$ minutes from the start. Best of any of the up performances, however, on this southern section were those of "City of London" and 14 coaches in running from Crewe to Tamworth (stopping), 48 miles, in $52\frac{5}{6}$ minutes, passing Whitmore in 13 minutes 49 seconds, Stafford in 27 minutes 18 seconds, and Lichfield in $46\frac{1}{6}$ minutes from the start; and from Tamworth to Rugby ($27\frac{1}{4}$ miles) in 30 minutes 41 seconds with the same load, passing Nuneaton in 15 minutes 15 seconds.

North of Crewe such performances as follow are found sufficiently seldom on most other lines in England to make us appreciate them the more on the North Western. "Rowland Hill" took 21 coaches from Preston to Warrington (27 miles) in $37\frac{1}{3}$ minutes, including a slack at Bamfurlong; and the same load from Warrington to Crewe (24 miles) in 31 minutes 27 seconds. "Teutonic" with 16 on ran from Preston to Warrington in $32\frac{2}{3}$ minutes—a very fine performance, considering the long bank out of Preston; and "Doric" went from Warrington to Crewe with a load of $19\frac{1}{2}$ coaches in $32\frac{1}{2}$ minutes. "Leviathan" with 16 coaches ran from Crewe to Preston (51 miles) in $59\frac{1}{4}$ minutes, passing Wigan in 19 minutes 41 seconds, and Warrington in 31 minutes 42 seconds. This is superb work, but not so good as a remarkable run from Crewe to Preston in $56\frac{1}{2}$ minutes by engine "Celtic" with no fewer than 19 coaches, particulars of which we append below.

Nor on the Preston to Carlisle section, where we find the hardest-timed trains in the world, considering the gradients, did the Com-

pounds fall off. From Carlisle to Penrith (stopping) was frequently done by a Compound and pilot engine, with loads of 16 to 18 coaches, in 23 to 24 minutes (18 miles). "Himalaya" took 20 coaches from Penrith to Tebay in $31\frac{3}{4}$ minutes, without pilot assistance, passing the Summit in $25\frac{1}{2}$ minutes; and "Teutonic" with 16 on only took $28\frac{1}{2}$ minutes for the same distance. "Leviathan" took 16 coaches from Shap Summit to Preston in $62\frac{1}{6}$ minutes ($58\frac{1}{2}$ miles), and "Dunrobin" took $62\frac{5}{6}$ minutes with $17\frac{1}{2}$ coaches (including a check) for the same distance; Oxenholme being passed in $19\frac{1}{2}$ and $19\frac{1}{4}$ minutes respectively, and Lancaster in $38\frac{1}{2}$ and $37\frac{1}{2}$. Tebay to Oxenholme (starting and stopping) was run in 16 minutes (13 miles) by "Teutonic" with 16 coaches on, and No. 1,045 (non-compound) with $20\frac{1}{2}$ coaches ran from Shap Summit to Oxenholme ($18\frac{1}{2}$ miles) in 20 minutes. "Rowland Hill" took $19\frac{1}{2}$ coaches from Oxenholme to Carnforth in 15 minutes 39 seconds ($12\frac{3}{4}$ miles), and from Lancaster to Preston (21 miles) in $26\frac{11}{12}$ minutes; and on another occasion one engine ran from Oxenholme to Carnforth in 15 minutes with a load of $19\frac{1}{2}$ coaches, and "Teutonic" took 16 coaches from Lancaster to Preston in $26\frac{1}{2}$ minutes, although losing fully a minute outside Preston by signal-checks. "Doric," an engine of the same class, did very well with $17\frac{1}{2}$ coaches from Oxenholme to Carnforth ($12\frac{3}{4}$ miles) in $14\frac{1}{2}$ minutes, and followed this up by a $29\frac{1}{2}$ minutes' run from Lancaster to Preston with the enormous load of $22\frac{1}{2}$ coaches. All the above are start-to-stop runs. "Alchymist" (6 ft. Compound) took $12\frac{1}{2}$ coaches unaided from Carlisle to Preston (90 miles) in 103 minutes 25 seconds, passing Penrith in 24, Shap Summit in 42, Oxenholme in $60\frac{1}{4}$, then was checked twice by signals, and passed Lancaster in $79\frac{1}{2}$ from the start. This performance, fine as it is, scarcely deserves mention here, as it is surpassed daily by at least four trains running over the section. In fact, four or five times daily the North Western furnish on this section runs which for merit of locomotive work are only equalled by other lines now and again. Occasionally, as in the two cases which follow, something more than ordinarily good happens. For instance, "Teutonic" took 15 coaches from Preston to Carlisle unaided in $103\frac{3}{4}$ minutes; mounted the $5\frac{1}{2}$ miles between Tebay and Shap Summit (1 in 75) in 9 minutes 57 seconds, and attained $79\frac{1}{4}$ miles an hour down the other side. Lancaster was passed in $24\frac{1}{3}$, Oxenholme in $46\frac{1}{4}$, Tebay in 65, and Penrith in $87\frac{3}{4}$ minutes from Preston. "Leviathan" and "Cook" —the latter one of the "Newton" class—stopped on Shap Summit 35 minutes 41 seconds after leaving Carlisle ($31\frac{3}{4}$ miles of steep up

grades); the load was 16 coaches. On the steepest grades the speed never fell below 50 miles an hour. Surely this is a sufficient answer to Mr. Webb's antagonists, and a vindication of his Compound system.

Reference will be further made in our concluding remarks on uphill work to the splendid way in which up grades are mastered by these locomotives. We give below the running between London and Carlisle of the August Race expresses :—

| 1888. August. | 7 ft. 6 in. Single Express. | | 6 ft. 6 in. Coupled Class. | | | |
|---|---|---|---|---|---|---|
| | 158 miles. | | 51 miles. | | 90 miles. | |
| | Euston. | Crewe. | Crewe. | Preston. | Preston. | Carlisle. |
| | DEPART. | ARRIVE. | DEPART. | ARRIVE. | DEPART. | ARRIVE. |
| 6th | 10 0 | 12 57 | 1 3 | 1 54 | 2 18 | 3 55 |
| 7th | 10 0 | 12 59 | 1 4 | 1 53 | 2 20 | 3 49 |
| 8th | 10 0 | 12 56 | 1 3 | 1 58 | 2 22 | 3 58 |
| 9th | 10 0 | 12 58 | 1 5 | 1 57 | 2 22 | 4 48 |
| 10th | 10 0 | 12 56 | 1 2 | 1 55 | 2 22 | 3 57 |
| 11th | 10 0 | 12 58 | 1 3 | 1 56 | 2 22 | 4 0 |
| 13th | 10 0 | 12 46 | 12 51 | 1 47 | 2 5 | 3 47 |
| 14th | 10 0 | 12 56 | 1 2 | 1 55 | 2 20 | 3 58 |
| 15th | 10 0 | 12 57 | 1 2 | 1 55 | 2 20 | 3 57 |
| 16th | 10 0 | 12 57 | 1 2 | 1 57 | 2 22 | 4 0 |
| 17th | 10 0 | 12 57 | 1 2 | 1 58 | 2 22 | 4 0 |
| 18th | 10 0 | 12 57 | 1 2 | 1 59 | 2 23 | 4 0 |
| 20th | 10 0 | 12 55 | 1 1 | 1 56 | 2 22 | 3 59 |
| 21st | 10 0 | 12 58 | 1 4 | 2 0 | 2 23 | 4 0 |
| 22nd | 10 0 | 12 56 | 1 2 | 1 58 | 2 23 | 4 0 |
| 23rd | 10 0 | 12 56 | 1 3 | 1 55 | 2 23 | 3 57 |
| 24th | 10 0 | 12 55 | 1 1 | 1 57 | 2 24 | 3 57 |
| 25th | 10 0 | 12 57 | 1 2 | 1 58 | 2 23 | 4 0 |
| 27th | 10 0 | 12 57 | 1 3 | 1 59 | 2 23 | 4 0 |
| 28th | 10 0 | 12 56 | 1 1 | 1 56 | 2 23 | 4 0 |
| 29th | 10 0 | 12 56 | 1 3 | 2 0 | 2 23 | 4 2 |
| 30th | 10 0 | 12 54 | 1 1 | 1 58 | 2 23 | 3 58 |
| 31st | 10 0 | 12 57 | 1 3 | 1 58 | 2 24 | 3 58 |

NOTE.—Except on August 20th the load was four eight-wheeled carriages. On August 20th, five. Average weight, 19¼ tons. On August 9th the engine failed on Shap Bank.

The annexed table give details of some very fine performances we have noted on the London and North Western. They are nearly all briefly referred to above :—

## WILLESDEN AND RUGBY (77¼ MILES).

WILLESDEN TO RUGBY IN 88 MINS. 11 SECS. (94 MINS. ALLOWED).
RUGBY TO WILLESDEN IN 84 MINS. 45 SECS. (88 MINS. ALLOWED).

| Stations. | Mi. Ch. | Engine "Teutonic" and 19 coaches. Actual Time. | Stations. | Mi. Ch. | Engine "Adriatic" (7 ft. Compound) and 16½ coaches. Actual Time. |
|---|---|---|---|---|---|
| | | A.M. | | | P.M. |
| **Willesden** . *dep.* | — | **10 12 30** | **Rugby** *dep.* | — | **5 12 15** |
| Sudbury . . | 2 56 | 10 16 59 | Welton | 7 23 | 5 23 24 |
| Harrow . . | 3 31 | 10 21 40 | Weedon | 5 58 | 5 29 0 |
| Pinner . . | 1 67 | 10 23 58 | Heyford | — | 5 31 16 |
| Bushey . . | 2 52 | 10 27 22 | Blisworth | 6 57 | 5 36 0 |
| Watford . . | 1 41 | 10 29 3 | Roade | 3 8 | 5 39 18 |
| King's Langley . | 3 46 | 10 33 3 | Castlethorpe | 4 75 | 5 44 32 |
| Boxmoor . . | 3 32 | 10 37 8 | Wolverton . | 2 30 | 5 46 54 |
| Berkhampstead . | 3 46 | 10 41 26 | Bletchley . | 5 58 | 5 53 32 |
| Tring. . . | 3 50 | 10 46 10 | Leighton | 6 41 | 6 0 15 |
| Cheddington . | 4 37 | 10 50 38 | Cheddington | 4 9 | 6 4 49 |
| Leighton . . | 4 9 | 10 54 23 | Tring . . | 4 37 | 6 10 29 |
| Bletchley . . | 6 41 | 11 0 45 | Berkhampstead | 3 50 | 6 14 39 |
| Wolverton . . | 5 58 | 11 6 24 | Boxmoor . | 3 46 | 6 17 58 |
| Castlethorpe . | 2 30 | 11 8 50 | King's Langley | 3 32 | 6 21 10 |
| Roade . . | 4 75 | 11 14 55 | Watford | 3 46 | 6 24 25 |
| Blisworth . . | 3 8 | 11 18 17 | Bushey | — | — |
| Heyford . . | — | 11 23 11 | Pinner | 4 13 | 6 28 45 |
| Weedon . . | 6 57 | 11 25 47 | Harrow | 1 67 | 6 30 36 |
| Welton . . | 5 58 | 11 32 20 | Sudbury . | 3 31 | 6 33 48 |
| **Rugby** . . *arr.* | 7 23 | **11 40 41** | **Willesden** . *arr.* | 2 56 | **6 37 0** |

## RUGBY AND CREWE (75½ MILES).

RUGBY TO CREWE IN 83 MINS. 48 SECS. (85 MINS. ALLOWED).
CREWE TO RUGBY IN 83 MINS. 31 SECS. NET } (87 MINS. ALLOWED).
CREWE TO RUGBY IN 88 MINS. 30 SECS. }

| Stations. | Mi. Ch. | Engine "Teutonic" and 19 coaches. Actual Time. | Stations. | Mi. Ch. | Engine "City of London" (6 ft. Compound) and 14 coaches. Actual Time. | Engine "Archimedes" (6 ft. Compound) and 17 coaches. Actual Time. |
|---|---|---|---|---|---|---|
| | | A.M. | | | P.M. | P.M. |
| **Rugby** *dep.* | — | **11 48 52** | **Crewe** *dep.* | — | **3 38 48** | **3 47 3** |
| Brinklow | 5 32 | 11 57 0 | Betley | 4 64 | 3 45 30 | 3 54 22 |
| Shilton . | 3 30 | 12 0 45 | Madeley . | 3 13 | 3 49 35 | 3 59 0 |
| Bulkington | 2 11 | 12 3 22 | Whitmore | 2 42 | 3 52 37 | 4 2 25 |
| Nuneaton | 3 52 | 12 7 0 | Standon Bridge | 4 16 | 3 56 44 | 4 6 55 |
| Atherstone . | 5 12 | 12 12 15 | Norton Bridge | 4 41 | 4 1 5 | 4 11 38 |
| Polesworth . | 4 11 | 12 16 26 | Stafford. | 5 24 | 4 6 6 | 4 17 6 |

RUGBY AND CREWE (*continued*).

| Stations. | Ml. Ch. | Engine "Teutonic" and 19 coaches. Actual Time. | Stations. | Ml. Ch. | Engine "City of London" (6 ft. Compound) and 14 coaches. Actual Time. | Engine "Archimedes" (6 ft. Compound) and 17 coaches. Actual Time. |
|---|---|---|---|---|---|---|
| | | A.M. | | | P.M. | P.M. |
| Tamworth | 3 55 | 12 19 53 | Milford . | 3 78 | 4 11 1 | 4 21 56 |
| Lichfield | 6 14 | 12 26 32 | Colwich . | 2 37 | 4 13 42 | 4 24 30 |
| Armitage | 4 60 | 12 32 7 | Rugeley . | 2 65 | 4 16 33 | 4 27 36 |
| Rugeley | 3 23 | 12 35 13 | Armitage . | 3 23 | 4 19 57 | 4 31 10 |
| Colwich | 2 65 | 12 38 33 | Lichfield . | 4 60 | 4 24 58 | 4 36 37 |
| Milford . | 2 37 | 12 41 5 | **Tamworth** *arr.* | 6 14 | **4 31 38** | pass |
| Stafford | 3 78 | 12 45 48 | ,, *dep.* | | **4 34 16** | 4 43 14 |
| Great Bridgeford | 3 15 | 12 49 50 | Polesworth . | 3 55 | 4 39 22 | 4 47 17 |
| | | | Atherstone | 4 11 | 4 44 4 | 4 52 23 |
| Norton Bridge | 2 9 | 12 52 11 | Nuneaton . | 5 12 | 4 49 31 | 4 58 17 |
| Standon Bridge | 4 41 | 12 57 20 | Bulkington . | 3 52 | 4 53 37 | 5 2 53 |
| Whitmore | 4 16 | 1 2 10 | Shilton . . | 2 11 | 4 55 56 | 5 5 37 |
| Madeley . | 2 42 | 1 5 4 | Brinklow | 3 30 | 4 59 12 | 5 9 21 |
| Betley | 3 13 | 1 8 8 | **Rugby** . *arr.* | 5 32 | **5 4 57** | **5 15 33** |
| **Crewe** . *arr.* | 4 64 | **1 12 40** | | | | |

CREWE AND PRESTON (51 MILES).

CREWE TO PRESTON IN 56 MINS. 32 SECS. (61 MINS. ALLOWED).
PRESTON TO CREWE IN 59 MINS. 19 SECS. (60 MINS. ALLOWED).

| Stations. | Ml. Ch. | Engine "Celtic" (7 ft. Compound) and 19 coaches. Actual Time. | Stations. | Ml. Ch. | Engine "Leviathan" (6 ft. Compound) and 16 coaches. Actual Time. |
|---|---|---|---|---|---|
| | | P.M. | | | P.M. |
| **Crewe** . . *dep.* | — | **1 19 3** | **Preston** . *dep.* | — | **2 33 18** |
| Minshull Vernon . | 4 69 | 1 26 15 | Farington | 2 25 | 2 37 11 |
| Winsford . | 2 48 | 1 28 57 | Leyland | 1 47 | 2 39 35 |
| Hartford . | 4 25 | 1 34 14 | Coppull | 5 43 | 2 46 34 |
| Acton Bridge | 2 54 | 1 35 59 | Standish | 2 31 | 2 49 51 |
| Preston Brook | 4 11 | 1 40 9 | Wigan | 3 24 | 2 52 59 |
| Moore . | 2 53 | 1 42 41 | Warrington | 11 62 | 3 5 0 |
| Warrington | 2 67 | 1 45 21 | Moore . | 2 67 | 3 8 15 |
| Wigan . | 11 62 | 1 58 3 | Preston Brook . | 2 53 | 3 11 8 |
| Standish . | 3 24 | 2 2 30 | Acton Bridge . | 4 11 | 3 16 21 |
| Coppull | 2 31 | 2 6 6 | Hartford . . | 2 54 | 3 19 23 |
| Leyland | 5 43 | 2 11 18 | Winsford . | 4 25 | 3 24 6 |
| Farington | 1 47 | 2 12 53 | Minshull Vernon. | 2 48 | 3 27 3 |
| **Preston** . . *arr.* | 2 25 | **2 15 35** | **Crewe** . . *arr.* | 4 69 | **3 32 37** |

## PRESTON AND CARLISLE (90 Miles).

Preston to Carlisle in 103 mins. 52 secs. (105 mins. allowed).
Carlisle to Preston in 97 mins. 51 secs. net (102 mins. allowed).

| Stations. | Ml. Ch. | Engine "Teutonic" and 15 coaches. Actual Time. | Stations. | Ml. Ch. | Engines "Cook" and "Leviathan" (6ft. Compound) to Shap Summit, and "Leviathan" alone beyond—16 coaches. Actual Time. |
|---|---|---|---|---|---|
| | | P.M. | | | P.M. |
| **Preston** . *dep.* | — | **2 43 14** | **Carlisle** . . *dep.* | — | **12 28 30** |
| Barton . | 4 61 | 2 50 38 | Wreay . | 4 77 | 12 35 8 |
| Brock . | 2 53 | 2 53 27 | Southwaite . | 2 25 | 12 37 51 |
| Garstang | 2 5 | 2 55 30 | Calthwaite . | 3 29 | 12 41 27 |
| Scorton . | 3 17 | 2 58 53 | Plumpton | 2 24 | 12 43 57 |
| Bay Horse . | 2 44 | 3 1 35 | Penrith | 4 75 | 12 48 42 |
| Galgate . . | 1 32 | 3 3 3 | Clifton . | 4 17 | 12 53 0 |
| Lancaster . | 4 27 | 3 7 34 | Shap . . . | 7 22 | 1 1 34 |
| Hest Bank . | 3 6 | 3 10 27 | **Shap Summit** . *arr.* | 2 10 | **1 4 11** |
| Bolton-le-Sands | 1 28 | 3 11 44 | **Shap Summit** . *dep.* | | **1 5 57** |
| Carnforth . | 1 66 | 3 13 39 | Tebay . . | 5 40 | 1 12 38 |
| Burton and Holme | 4 41 | 3 18 53 | Low Gill . | 4 20 | 1 16 43 |
| Milnthorpe . . | 2 58 | 3 21 54 | Grayrigg . . | 1 47 | 1 18 35 |
| Oxenholme . | 5 45 | 3 29 21 | Oxenholme | 7 19 | 1 25 10 |
| Grayrigg . | 7 19 | 3 41 18 | Milnthorpe . . | 5 45 | 1 29 57 |
| Low Gill . | 1 47 | 3 43 41 | Burton and Holme | 2 58 | 1 32 26 |
| Tebay . | 4 20 | 3 48 16 | Carnforth . | 4 41 | 1 36 43 |
| Shap Summit | 5 40 | 3 58 13 | Bolton-le-Sands | 1 66 | 1 38 32 |
| Shap . . | 2 10 | 4 1 22 | Hest Bank . . | 1 28 | 1 40 6 |
| Clifton . | 7 22 | 4 7 35 | Lancaster . | 3 6 | 1 43 31 |
| Penrith | 4 17 | 4 11 1 | Galgate . | 4 27 | 1 48 56 |
| Plumpton | 4 75 | 4 15 27 | Bay Horse . | 1 32 | 1 50 28 |
| Calthwaite . | 2 24 | 4 17 38 | Scorton | 2 44 | 1 53 13 |
| Southwaite . | 3 29 | 4 20 36 | Garstang . | 3 17 | 1 56 35 |
| Wreay . . | 2 25 | 4 22 45 | Brock . . | 2 5 | 1 58 50 |
| **Carlisle** *arr.* | 4 77 | **4 27 6** | Barton . | 2 53 | 2 1 53 |
| | | | **Preston** . . *arr.* | 4 61 | **2 8 7** |

Note.—Ran slowly into Preston Station.

## VI.

## THE MINOR LINES.

The best-known of the smaller British lines are as under :—

(1) *The Highland.*

(2) *The Great North of Scotland.*

(3) *The Furness.*

(4) *The North Staffordshire.*

(5) *The Cambrian.*

(6) *The Metropolitan, Metropolitan District, and North London.*

(7) *The Hull and Barnsley.*

(8) *The London, Tilbury and Southend.*

# VI.

## THE MINOR LINES.

(1) The **HIGHLAND** serves that part of Scotland north and west of Perth. Its main line is over 300 miles long, and its system extends over about 425 miles, being nearly all single line. On an out-of-the-way line like this we cannot reasonably look for express services; nevertheless, excellent connections are afforded between Perth and Inverness (144 miles) in four hours. Many of the slower trains are, or were until recently, mixed, as during the greater part of the year passengers are so few that it would not pay to run separate trains for them. Consequently, the local services are slow. The great unpunctuality which prevails is not the fault of the company, as explained in our remarks on that head in the introductory chapters.

The best locomotive performances are those of the four hours expresses between Perth and Inverness. The loads are very heavy indeed, and Mr. Foxwell gives an instance of the morning mail leaving Perth with 36 coaches. These excessive loads, in conjunction with long grades of 1 in 70 and 1 in 100 over the Grampians (the line touching 1,476 feet above sea on Drumouchter Pass), render this train, although timed at only 36 miles an hour, one of the hardest in the kingdom to work. Two engines almost invariably take it up the banks, and occasionally there are two in front and one behind. One of the best examples of its daily work is given below. Attention is specially directed to the running between Kingussie and Perth on the return journey.

The locomotives performing this admirable work have 6 ft. 4 in. coupled driving wheels, outside cylinders 18 in. by 24 in., and bogie. They are painted a dark green, and present a very fine appearance. Perhaps no locomotives—excepting the London, Brighton and South Coast—are kept in such excellent condition. There is also a class of powerful goods engines similar in appearance to the above. Two or three exceedingly neat tank locomotives are owned by the company. A larger and more powerful type of passenger locomotives has lately been built.

The performances referred to above are here presented :—

| Stations. | | Run No. 1.—Perth to Inverness. | | | |
|---|---|---|---|---|---|
| | | Miles. | Time Due. | Time Actual. | Remarks. |
| | | | A.M. | H. M. S. | |
| **Perth** . | *dep.* | — | **7 50** | **7 51 28*** | * Engines 74 and 79, load 20 coaches. |
| Luncarty | *pass* | 4¼ | — | 7 58 35 | |
| Strathord | ,, | 5¼ | — | 8 0 0 | |
| Stanley | ,, | 7¼ | — | 8 3 23 | |
| Murthly | ,, | 10½ | — | 8 8 20 | |
| Dunkeld | ,, | 15¾ | — | 8 15 20 | |
| Dalguise | ,, | 20¼ | — | 8 20 33 | |
| Ballinluig | ,, | 23¾ | — | 8 24 27 | |
| Pitlochry | ,, | 28½ | — | 8 30 34 | |
| Killiecrankie | ,, | 32¼ | — | 8 36 18 | |
| **Blair Athole** | *arr.* | **35¼** | — | **8 40 40** | |
| | *dep.* | | **8 45** | **8 45 58** | |
| Struan . | *pass* | 40 | — | 8 54 50 | |
| Dalnaspidal . | ,, | 51 | — | 9 19 15 | |
| Dalwhinnie . | ,, | 58¾ | — | 9 30 13 | |
| Newtonmore | ,, | 68¾ | — | 9 40 8 | |
| **Kingussie** . | *arr.* | **71¾** | — | **9 43 16** | |
| | *dep.* | | **9 50** | **9 51 25** | |
| Kincraig | *pass* | 77½ | — | 9 59 41 | |
| Aviemore | ,, | 83½ | — | 10 6 4 | |
| **Boat of Garten** | *arr.* | **88½** | — | **10 12 35** | |
| | *dep.* | | **10 14** | **10 15 12** | |
| Broomhill . | *pass* | 92¼ | — | 10 20 39 | |
| **Grantown** . | *arr.* | **96** | — | **10 24 24** | |
| | *dep.* | | **10 25** | **10 29 55** | |
| Dunphail | *pass* | 110¾ | — | 10 52 5 | |
| **Forres** | *arr.* | **119¼** | **11 0** | **11 1 32** | |
| | *dep.* | | **11 5** | **11 10 8*** | * Engine 79 only and 24 coaches hence. |
| Brodie . | *pass* | 122¾ | — | 11 17 33 | |
| **Nairn** . | *arr.* | **128¾** | — | **11 25 49** | |
| | *dep.* | | **11 23** | **11 29 57** | |
| Dalcross | *pass* | 137¼ | — | 11 42 26 | |
| Culloden | ,, | 140¾ | — | 11 46 50 | |
| **Inverness** . | *arr.* | **144** | **11 50** | **11 50 50** | |

| Stations. | | Run No. 2.—Inverness to Perth. | | |
|---|---|---|---|---|
| | | Time Due. | Time Actual. | Remarks. |
| | | A.M. | H. M. S. | |
| **Inverness** . | *dep.* | 3 0 | 3 21 45* | * Engine 73, load 23½ coaches. |
| Culloden | *pass* | — | 3 28 30 | |
| Dalcross | ,, | — | 3 33 13 | |
| **Nairn** | *arr.* | — | 3 43 25 | |
| | *dep.* | 3 25 | 3 46 45 | |
| Brodie | *pass* | — | 3 57 10 | |
| **Forres** . | *arr.* | 3 40 | 4 1 30 | |
| | *dep.* | 3 45 | 4 7 6* | * Load hence 18 coaches. Two engines hence to Blair Athole. |
| Dunphail | *pass* | — | 4 25 13 | |
| **Grantown** . | *arr.* | — | 4 51 27 | |
| | *dep.* | 4 23 | 4 54 56 | |
| Broomhill | *pass* | — | — | |
| **Boat of Garten** | *arr.* | — | 5 4 48 | |
| | *dep.* | 4 34 | 5 8 10 | |
| Aviemore . | *pass* | — | 5 16 25 | |
| Kincraig . | ,, | — | 5 24 23 | |
| **Kingussie** | *arr.* | — | 5 31 12 | |
| | *dep.* | 5 5 | 5 36 44 | |
| Newtonmore | *pass* | — | 5 41 35 | |
| Dalwhinnie | ,, | — | — | |
| Dalnaspidal | ,, | — | 6 14 34 | |
| Struan . | ,, | — | 6 25 40* | * Signal-check. |
| **Blair Athole** | *arr.* | — | 6 31 23 | |
| | *dep.* | 6 5 | 6 36 12* | * Engine 73 hence and 18 coaches. |
| Killiecrankie | *pass* | — | — | |
| Pitlochry | ,, | — | 6 45 29 | |
| Ballinluig . | ,, | — | 6 50 29 | |
| Dalguise | ,, | — | 6 54 8 | |
| Dunkeld | ,, | — | 6 59 32 | |
| Murthly | ,, | — | 7 7 20 | |
| Stanley | ,, | — | 7 11 50* | * Signals near Stanley. |
| Strathord . | ,, | — | 7 14 19 | |
| Luncarty | ,, | — | 7 15 15 | |
| **Perth** . . . | *arr.* | 7 0 | 7 20 28 | |

(2) The **GREAT NORTH OF SCOTLAND** serves the counties of Aberdeen, Banff, and Elgin; is slightly over 300 miles in length; and consists of a number of unimportant branches, together with lines from Aberdeen to Ballater, Aberdeen to Peterhead, and Aberdeen to Elgin, *viâ* Keith and *viâ* Buckie. As the line is nearly all single road, and abounds in obstructive gradients, we cannot expect very good services; but these are, nevertheless, thoroughly creditable, considering the small populations served. Ballater (43½ miles) is within 75 minutes of Aberdeen; Keith (53¾ miles) is 95 minutes away; and Elgin (87¼ miles) is 155 minutes distant. Thus an average of over 30 miles an hour is maintained under very adverse conditions and inclusive of a multitude of stops.

The locomotives doing this work are worthy to rank with those of any company in the British Islands, and have been mainly built under the able superintendence of Mr. Manson, who has now left the Great North of Scotland to take charge of the Glasgow and South Western Company's Kilmarnock works. Their appearance is very handsome (painted dark-green) and in many ways suggests Glasgow and South Western practice—Mr. Manson having formerly served on that system. The dimensions of some of the principal classes are as follows:—

(*a*) Outside cylinders, 17½ in. by 26 in.; driving wheels, 6 ft. four-coupled (some are 5 ft. 6 in.). Built by Neilson in 1878.

(*b*) Inside cylinders, 18 in. by 26 in.; driving wheels, 6 ft. four-coupled. Built by Kitson in 1888.

(*c*) Inside cylinders, 18 in. by 26 in.; driving wheels, 6 ft. 6 in. four-coupled. Built by Stephenson in 1890.

All the above have leading bogie wheels, and the latest class has the tender mounted on 8 wheels. Kitson also built a class of 4 ft. 6 in. six-coupled tank engines, with cylinders 16 in. by 24 in. The company's locomotives, it will be seen, are exceedingly powerful.

(3) The **FURNESS RAILWAY** is not quite 150 miles in length, and serves the Furness district of Lancashire and the west coast of Cumberland. Of late considerable improvement has taken place in its train services, more intimate relations with the North Western and Midland having been opened up, and the journey from Carnforth to Whitehaven, which is the company's main line, has now been reduced to 2 hours 12 minutes down, and 2 hours 17 minutes up, the distance being 74¼ miles. More, however, might still be done, especially as the gradients are not difficult, and the road is double throughout.

The locomotives of the company have 5 ft. 7½ in. driving wheels; cylinders, 17 in. by 24 in.; heating surface, 1,041 sq. ft.; 150 lbs. boiler pressure; and weigh 36½ tons in working order. The tender weighs 25½ tons loaded, and has capacity for 4 tons of coal and 2,000 gallons of water.

(4) The **NORTH STAFFORDSHIRE RAILWAY** serves the district known as "the Potteries," and is nearly 200 miles in

length. The company also own 119 miles of canals. The principal sections of the line are from Crewe through Stoke to Burton and Derby, and from Colwich to Macclesfield. Over the first of these the best trains do not appreciably exceed an inclusive speed of 30 miles an hour, although the road is double, and the populations to be served are considerable. The second section is used by some of the North Western through expresses between Manchester and London, which provide a very good service.

The gradients on this second section are fairly easy, and may be briefly described as follows:—From Colwich the line rises easily for 6 miles to past Weston, then for about 20 miles to near Harecastle is a gradual ascent, most of it 1 in 330 or thereabouts, but with numerous rests and easy pieces. From Harecastle to a little past Congleton is 7 miles of easy undulations. We have then about 3 miles of 1 in 176 rising, followed by a descent of nearly the same length at 1 in 102 and 146 into Macclesfield.

The company's standard locomotives have 6 ft. four-coupled driving wheels; cylinders, 16½ in. by 24 in.; 140 lbs. boiler pressure; 722 sq. ft. tubes and 99½ sq. ft. firebox, heating surface; and 25½ tons on the coupled wheels, the engines weighing in working order 36 tons 3 cwts.

In the July, 1891, time tables we find a very curious train (the 10.50 p.m. from Stoke) on this line. This wonderful train, which has now ceased to run, went from Stoke to Crewe (15 miles) in 45 minutes, or at the rate of 20 miles an hour, and carried first-class passengers only, and these conditionally on their signing a form absolving the company from all liability in case of accident! Why such restrictions were made we have never been able to ascertain, and fancy this Staffordshire knot would be a very difficult one to unravel.

(5) The **CAMBRIAN** is one of the principal Welsh systems. Its main line runs from Whitchurch through Oswestry, Welshpool, Montgomery, Machynlleth, and Barmouth to Pwllheli; and there are branches from Machynlleth to Aberystwith, and from Moat Lane to Brecon. The line is single road, and the population to be served very scanty. The train service cannot, however, be called bad, as one train runs from Whitchurch to Machynlleth (75¼ miles) in just over 2½ hours; and from Brecon (Talyllyn Junction) to Moat Lane Junction (55¾ miles) takes just about two

hours by the best train in each direction. These trains surmount considerable grades, and have several intermediate stops. In the summer, arrangements are made with the North Western and Great Western companies for the running of through carriages from London to the various points of interest on the system.

The most recent locomotives of the company have bogie wheels 3 ft. 1 in. in diameter, coupled wheels 5 ft. 7 in., and 17 in. by 24 in. cylinders, and weigh 34½ tons in working order. The boiler pressure is 150 lbs. to the square inch, and the engines are being fitted with the Vacuum Automatic brake and Gresham's steam sanding apparatus. The tender carries 1,600 gallons of water.

(6) The **METROPOLITAN, METROPOLITAN DISTRICT, and NORTH LONDON.** These systems all serve the London district, and are in many ways so much alike that we will discuss them together here. The North London is an overhead line, while the other two are underground. Both, therefore, have disadvantages to contend with—the former being exposed to the fogs so common in the Metropolis, and the latter having to run through close and smoky tunnels.

Although none of these lines are of any considerable length, they have—chiefly by means of running powers over other lines—put out feelers in various directions, so as to tap new sources of traffic. The Metropolitan, in particular, has now extended its system as far as Aylesbury, and hopes to enter into close alliance with the Manchester, Sheffield and Lincolnshire Railway when that line builds its new southern extension. The District stretches its arms west and south-west—either by means of its own lines, or by running powers over other railways—to Ealing, Hounslow, Putney Bridge, and Wimbledon; but this railway has no very ambitious projects in view. In common with the Metropolitan, some of this company's trains run to New Cross in the south-east. The North London, not content with its own short piece of line from Broad Street to Chalk Farm, and from Dalston to Poplar, has the most extensive running powers over other lines, some of which are jointly owned by itself with other companies. In the west and south-west it goes to Willesden, Hammersmith, Kew, and Richmond, competing very successfully to the last two points with the Metropolitan and the District, which also run

through trains from the City; and in the north, over the Great Northern, to Potter's Bar, Enfield, and High Barnet. A large part of its system proper is laid with four tracks.

Tank engines suitable for a traffic with many stops are exclusively employed by all three companies. The coaching stock is only moderate—the third class being invariably without cushions. Gas is used for lighting, but is often kept at too low a pressure. All trains on the Metropolitan and the District stop at all stations, but some of the North London trains to Kew and Richmond make rather smart runs of from about three to five miles in length.

More comprehensive information on the subject of London railway and street traffic may be obtained by consulting Gustav Kemmann's *Der Verkehr Londons* (Berlin, 1892). This treatise is a fine example of German skill and patience, and it is to be regretted that no English work approaching that of Kemmann in accuracy and exhaustiveness on this important and interesting subject has yet appeared.

(7) The **HULL AND BARNSLEY** is the newest line of any consequence in England. It connects Hull with Cudworth, and has had, up to the present date, a most unprosperous history. This, however, does not prevent it from giving a fairly good service between its extreme points. Three trains (two up) cover the 52½ miles between Hull and Cudworth in under 90 minutes, the best taking 83. The engines are small and of the 6 ft. four-coupled type. If the larger companies would befriend this small railway, it would doubtless give us some good express work, as one of its extreme points, Cudworth, is on the Midland main line. Hence advantageous connections might be opened up with that highly important system.

(8) The **LONDON, TILBURY AND SOUTHEND** is another small railway of about 75 miles in length. Yet it is in many respects noteworthy. The old line of this company follows the course of the Thames from Fenchurch Street to Shoeburyness *viâ* Tilbury. The new direct line runs from Barking *viâ* Upminster to Pitsea, where it joins the older route. Extensions are in progress from Upminster northwards and southwards respectively to Romford and Grays Thurrock. Considering that it is practically only a

suburban line, its train services are admirable. Southend ($35\frac{3}{4}$ miles from Fenchurch Street) is within 50 minutes run; Tilbury ($22\frac{1}{2}$ miles) is only 42, and Barking ($7\frac{1}{2}$ miles) 17 minutes distant. Results like these are given by scarcely any other line in the neighbourhood of London. But perhaps even more praiseworthy than the excellence of this fast and frequent service is its punctuality. The writer was for some time a season-ticket holder on the line, and can state that absolute punctuality is the rule. If the Tilbury Company had appeared in the Parliamentary Return of Punctuality, they would most probably have shown 100 per cent. of their trains arriving punctually or within three minutes of booked time.

The locomotives used on this line are all tanks of large dimensions and very neat design. They have four-coupled 6 ft. 1 in. driving wheels and leading bogie; cylinders, outside, 17 in. by 26 in.; heating surface (tubes, 923; box, 97), 1,020 sq. ft.; grate area, $17\frac{1}{4}$ sq. ft.; weight in working order, 56 tons 2 cwts. (distributed as under—on bogie, 15 tons 18 cwts.; on drivers, 32 tons 1 cwt.; and on trailers, 8 tons 3 cwts.); water capacity, 1,300 gallons; coal, $2\frac{1}{2}$ tons. Average coal consumption per mile, 26 lbs. They somewhat resemble the tank engines on the London and South Western Railway, and are painted a dark green, and named after the various stations on the line. These engines run in the 50 minutes service to and from Southend ($35\frac{3}{4}$ miles), and have thus probably the distinction of working the fastest passenger trains in the world regularly drawn by tank engines. The feat is well within their powers, although the line runs for some miles over rails crowded with suburban traffic, and afterwards, in the open, the gradients are by no means favourable. In fact, the writer has never known them to lose time. Previous to the opening of the direct Upminster route these expresses ran *viâ* the old riverside line at Tilbury, taking one hour for the 42 miles.

Just recently another type of tank engine has been built, but the variations in dimensions from those given above are of minor importance.

We give below two runs of the 50 minutes express from Fenchurch Street to Southend. It will be seen that in both cases time was gained, signal-checks notwithstanding.

## FENCHURCH STREET TO SOUTHEND *viâ* UPMINSTER.

| Stations. | Run No. 1, with engine 22, "East Horndon," and 11 coaches. | | | Run No. 2, with engine 10, "Grays," and 11 coaches. | Remarks. |
|---|---|---|---|---|---|
| | Miles. | Time Due. | Time Actual. | Time Actual. | |
| | | P.M. | H. M. S. | H. M. S. | |
| **Fenchurch St.** | — | 5 5 | **5 5 48** | **5 7 23** | RUN No. 1. Twice badly checked by signals near Stepney, and ran very slowly for half-mile after Burdett Rd. Slowly through Pitsea. ($35\frac{3}{4}$ miles in 49 minutes 16 seconds.) RUN No. 2. Checked by signals near Stepney, and ran very slowly after Burdett Rd. Slowly through Pitsea. ($35\frac{3}{4}$ miles in 48 minutes 45 seconds.) |
| Leman St. | $\frac{1}{2}$ | — | 5 6 35 | 5 8 22 | |
| Shadwell . | $\frac{1}{2}$ | — | 5 7 37 | — | |
| Stepney . | $\frac{3}{4}$ | — | 5 8 56 | 5 11 1 | |
| Burdett Rd. | $\frac{1}{2}$ | — | 5 10 11 | 5 12 6 | |
| Bromley . | 1 | — | 5 13 18 | 5 14 44 | |
| Plaistow | $1\frac{1}{4}$ | — | 5 14 51 | 5 16 25 | |
| Upton Park | $\frac{3}{4}$ | — | 5 15 50 | 5 17 30 | |
| East Ham | $\frac{3}{4}$ | — | 5 16 51 | 5 18 30 | |
| Barking | $1\frac{1}{2}$ | — | 5 18 40 | 5 20 16 | |
| Dagenham | $3\frac{3}{4}$ | — | 5 23 32 | 5 25 0 | |
| Hornchurch | $2\frac{1}{4}$ | — | 5 26 31 | 5 27 56 | |
| Upminster | $1\frac{1}{2}$ | — | 5 28 32 | 5 29 48 | |
| East Horndon . | 4 | — | 5 32 51 | 5 34 5 | |
| Laindon | $3\frac{1}{2}$ | — | 5 38 5 | 5 39 6 | |
| Pitsea | $3\frac{3}{4}$ | — | 5 42 48 | 5 43 52 | |
| Benfleet | 3 | — | 5 46 28 | 5 47 22 | |
| Leigh | $3\frac{1}{4}$ | — | 5 50 58 | 5 52 10 | |
| **Southend** | $3\frac{1}{4}$ | 5 55 | **5 55 4** | **5 56 8** | |

# PART III.

## CONCLUDING REMARKS.

# CONCLUDING REMARKS.

Before closing our remarks on a subject which has occupied our attention so long, we have decided to discuss one or two points of interest in connection with railway speeds. These points are as under :—

(1) *The Highest Speed ever Recorded.*
(2) *The Fastest Train in the World.*
(3) *The Race to Edinburgh.*
(4) *Competitive Traffic.*
(5) *Uphill Running.*

These points will not detain us long. We will first deal with

(1) *The Highest Speed ever Recorded.*—The Americans claim that the highest speeds ever recorded have been reached in their country. A most circumstantial account of one of these instances of very high velocity appears in the *Railroad Gazette* of September 18th, 1891. A few of the details are here reproduced.

It is stated that engine No. 206 with $18\frac{1}{2}$ in. by 22 in. cylinders, and wheels only 5 ft. 8 in. in diameter, ran from Jenkintown to Langhorne on the Philadelphia and Reading Railroad, with a train weighing about 86 American tons (169 tons, including engine and tender), in 8 mins. $42\frac{1}{5}$ sec., a distance of 12 miles. In detail, the speed for the 12 miles was as under:—80, 84.5, 80.7, 76.2, 77.9, 84.5, 84.9, 85.7, 90, 90.5, 75.3, and 80.7 miles an hour. The two quickest miles were done on grades of 1 in 140 falling, and a level piece at the foot thereof.

Here we have a speed of over 90 miles an hour, got out of a

4-coupled 5 ft. 8 in. engine. We do not like to doubt this well-attested feat; nor do we care to consider at length the still faster run attributed to the Central Railroad of New Jersey, in February, 1892, when nearly 92 miles an hour was attained, nor other instances of 97 and 98 miles an hour since reported from America. We should, however, have felt more satisfied if we had obtained such results from personal observation.

Another claimant for highest recorded speed is the North Eastern Company. It is alleged that one of their largest "singles" attained 86 miles an hour on the level, with a load of 341 tons. This looks improbable; and as the writer has seen no further details, he suspends judgment at present.

But whether the American and North Eastern runs be fact or fiction, we think that a letter which appeared in *Engineering* of August 22nd, 1890, may be taken as accurate. Here a speed of $81\frac{4}{5}$ miles an hour was attained on the London and North Western, Carlisle to Preston section, on a down grade, with a moderate load. We reproduce some of the figures :—

ENGINE WITH 6 FT. 6 IN. DRIVERS; CYLINDERS 17 IN. BY 24 IN.; AND 10 COACHES.

| Mile-post from Lancaster. | Time from Shap Summit. | Speed. | Mile-post from Lancaster. | Time from Shap Summit. | Speed. |
|---|---|---|---|---|---|
| | MINS. SECS. | | | MINS. SECS. | |
| $37\frac{1}{2}$ | — | — | 23 | 14 19 | — |
| 37 | 0 33 | — | 22 | 15 8 | 73·4 |
| 36 | 1 30 | — | 21 | 15 57 | 73·4 |
| 35 | 2 18 | 75 | 20 | 16 45 | 75 |
| 34 | 3 3 | 80 | 18 | 18 17 | 78·26 |
| 33 | 3 47 | 81·8 | 17 | 19 1 | 81·8 |
| 32 | 4 33 | 78·26 | 16 | 19 46 | 80 |
| | | | 15 | 20 32 | 78·26 |
| 31 | 5 21 | 75 | 14 | 21 18 | 78·26 |
| Slack, 1 min. lost | — | — | 13 | 22 4 | 78·26 |
| | | | 12 | 22 52 | 75 |

This, we think, may be safely accepted as the highest speed ever properly recorded. It is, however, stated that in some recent experiments, with complete registering apparatus, on the Paris, Lyons, and Mediterranean Railway, a speed of 90 miles an hour was attained. The French authorities are generally very accurate in any experiments they make, but, no details having yet reached us, we must, as in the case of the North Eastern, again suspend judgment.

While discussing the subject of the fastest speed ever attained, it

may be worth while to touch briefly on the various methods of speed-recording. This is generally done by means of specially designed instruments, or by the aid of a stop-watch. The former is the method ordinarily adopted by the administration of the line to obtain results, while the latter can be used by anyone possessing the requisite knowledge of the route and the position of the mile-posts. For an exhaustive description of most of the instruments specially designed for speed-recording, reference should be made to the article "Fahrgeschwindigkeitsmesser," in the *Encyklopädie des gesamten Eisenbahnwesens* (Carl Gerold's Sohn, Vienna). As regards stop-watch timing, we may say that it, of course, approaches more nearly to accuracy in direct ratio to the ability, care, and knowledge of the observer, and undoubtedly can be made, under suitable conditions, to give results as nearly correct as are necessary for ordinary purposes. It is, however, somewhat difficult to eliminate personal errors, whether arising unconsciously or from incompetency. The task is also rendered more difficult in another way. The mile-posts on some English lines are almost illegible, are numbered in several cases in the most erratic fashion, and, on some lines, cross from the down to the up side, and back again, sufficiently often to perplex the observer. As a slight aid we give in the subjoined table some particulars of the mile-posts on a few of the main lines in England and Scotland :—

| Mile-posts on Down Side of Line. | Mile-posts on Up Side of Line. |
|---|---|
| Euston to Crewe. | Carlisle to Edinburgh, *viâ* N.B. |
| King's Cross to York. | Edinburgh to Glasgow, *viâ* N.B. |
| Carlisle to North, *viâ* C.R. | Manchester to Retford. |
| Carlisle to Kilmarnock. | Glasgow to Kilmarnock, *viâ* Barrhead. |
| Kilmarnock to Greenock. | Bristol to Paddington. |
| Settle to Carlisle. | |
| Manchester to Liverpool (C.L.C.) | |
| Waterloo to Exeter. | |

On the Midland main line from Hendon to nearly 27 miles from London the mile-posts are on up side, thence to Luton on down, and to Bedford on up. Between Bedford and Kettering they are on down side, and are numbered from Hitchin; while from Kettering to Nottingham they change from one side to the other three times, and are numbered from three different points.

(2) *The Fastest Train in the World.*—Until about a year or so ago England was easily first in this respect, but we are now

slightly beaten by an American train, as may be seen from the following details :—

| Fastest Train in America. | | | | Fastest Train in England. | | | |
|---|---|---|---|---|---|---|---|
| Miles. | Stations. | Time. | Speed. | Miles. | Stations. | Time. | Speed. |
| | | A.M. | M. P. H. | | | A.M. | M. P. H. |
| — | New York. | 8 30 | — | — | Euston | 10 0 | — |
| 143 | Albany | 11 15 | 52·0 | $5\frac{1}{2}$ | Willesden | 10 9 | 36·67 |
| | ,, | 11 20 | | | ,, | 10 10 | |
| $94\frac{3}{4}$ | Utica | — | 51·68 | $77\frac{1}{4}$ | Rugby | 11 44 | 49·31 |
| | ,, | 1 10 | | | ,, | 11 49 | |
| $53\frac{1}{4}$ | Syracuse | 2 15 | 49·15 | $75\frac{1}{4}$ | Crewe | 1 14 | 53·12 |
| | ,, | 2 20 | | | ,, | 1 19 | |
| $80\frac{1}{4}$ | Rochester | — | 54·20 | $51\frac{1}{4}$ | Preston | 2 20 | 50·41 |
| | ,, | 3 47 | | | ,, | 2 40 | |
| $68\frac{1}{2}$ | Buffalo | 5 10 | 49·52 | 90 | Carlisle | 4 25 | 51·43 |
| | | | | | ,, | 4 30 | |
| | | | | $73\frac{1}{4}$ | Strawfrank Loop | 5 56 | 51·10 |
| | | | | | | 5 58 | |
| | | | | $27\frac{1}{2}$ | Edinburgh. | 6 30 | 51·56 |
| $439\frac{3}{4}$ | Totals | — | 51·73 | 400 | Totals | — | 50·84 |

This American phenomenon was only decided on after a special run from New York to Buffalo, details of which we extract from the American *Railroad Gazette* of September 18th, 1891 :—

| Miles. | Stations. | Time. | Speed. |
|---|---|---|---|
| | | H. M. S. A.M. | |
| — | New York | 7 30 15 | — |
| 143 | Albany | 9 50 15 | 61·29 |
| | ,, | 9 53 43 | |
| 148 | Syracuse | 12 19 43 | 60·82 |
| | ,, | 12 22 41 | |
| $70\frac{1}{2}$ | Fairport | 1 30 30 | 62·37 |
| | ,, | 1 38 20 | |
| $75\frac{1}{4}$ | East Buffalo | 2 50 15 | 62·78 |

If the figures are correct, the performance quite equals anything achieved in Great Britain. Indeed, the speed maintained for so long a distance is faster than our record, and the load somewhat heavier. This is balanced by the fact that the road is very easy, and free from gradients. The engine, too, was of extremely powerful type—much larger than those used in the race to Edinburgh in 1888; and how much coal per mile it consumed we are afraid to say.

Apart from this special trial trip, we fancy that in ordinary daily working, our English train, as shown in the table above, is the better, even now. Our grades are much harder, and while the American train averages about 130 tons weight only, ours is frequently heavier.

By many it is supposed that the express from Berlin to Hamburg, in 3 hours 24 minutes (177 miles), is the fastest in the world. This, however, is erroneous. Local time differs 15 minutes at Hamburg from Berlin, and thus the train is allowed 3 hours 39 minutes for the journey. That this is so may be seen from the fact that the Hamburg to Berlin trains have all about half an hour longer allowed them than those in the other direction. In their case 15 minutes must be deducted, and this makes one of the Hamburg to Berlin trains actually faster than the 3 hours 24 minutes train just referred to.

(3) *The Race to Edinburgh.*—Perhaps we should apologise for once more bringing forward this well-worn but interesting subject. For a very full, and, in the main, accurate account, we refer those desirous of further acquainting themselves with the great achievements of August, 1888, to Mr. Foxwell's *The Best Trains*, published as a *Pall Mall Gazette* Extra some four years since. Here we find, disregarding the Midland, which never really entered into the racing competition, that in 1887 the best London and North Western express to Edinburgh took 10 hours, and the best Great Northern only 9, though the latter did not carry third-class passengers. In November of that year, however, the G. N. Company added third class to their Scotch express, thus getting them through in 9 hours also. This alteration abstracted much traffic from the London and North Western and Caledonian Companies (forming the West Coast route), and, moreover, gave them a foretaste of what they might expect when the Forth Bridge should be opened for through traffic. They accordingly quietly laid their plans in the spring, and by the 1st of June were fully prepared to send their best day train down to both Glasgow and Edinburgh in 9 hours. This was done in spite of a longer and much hillier route, and, moreover, it was done well, as day after day the trains arrived before time, even when cumbered with very heavy loads. For a month the East Coast Companies (the Great Northern and North Eastern) made no counter-move, owing, it is said, to the dislike of the North Eastern for very high speeds. But then (1st of July) they brought their time down to 8½ hours, thus beating the West Coast by half an

hour. During the whole of the month of July trains ran well, especially on the West Coast, whose 9 hours up express had been only once late in arriving at Euston since it started to run in June. In fact, so well to time did these West Coast trains run, that on the 1st of August they also accelerated to 8½ hours. This greatly surprised everybody, and was, in fact, extremely stiff timing. The distance was just over 400 miles, the road very hilly, and a dining interval at Preston had to be provided for. Nothing daunted, however, by the pertinacity of their opponents, the East Coast immediately replied by reducing to 8 hours (392¼ miles). Railway people and the travelling public thought the game was over after this last move of the Great Northern and North Eastern Companies, but a more dramatic *dénouement* was reserved for the 6th of August, 1888, when the West Coast put on an eight hours express also. This train was booked to do the phenomenal feat of running 400 miles in eight hours over a hilly road, make two ordinary stops, and one of 20 minutes for dining. Its load (exclusive of engine and tender) was just under 80 tons, while the East Coast was rather over 100 tons. The arrivals in Edinburgh—both East and West trains being due at 6 p.m.—were as under, dating from the 6th of August.

| August, 1888. | Time of Arrival. | | August, 1888. | Time of Arrival. | |
|---|---|---|---|---|---|
| | East Coast. | West Coast. | | East Coast. | West Coast. |
| DATE. | P.M. | P.M. | DATE. | P.M. | P.M. |
| 6th | 5 59 | 5 52 | 20th | 5 57 | 5 57 |
| 7th | 6 16 | 5 52 | 21st | 5 50 | 5 57 |
| 8th | 5 55 | 5 53 | 22nd | 5 58 | 5 56 |
| 9th | 5 57 | 6 37 | 23rd | 5 57 | 5 56 |
| 10th | 5 47 | 5 58 | 24th | 5 52 | 5 57 |
| 11th | 6 3 | 5 56 | 25th | 5 52 | 5 56 |
| 13th | 6 6 | 5 38 | 27th | 5 50 | 5 57 |
| 14th | 5 31 | 5 58 | 28th | 5 28 | 5 57 |
| 15th | 5 44 | 5 58 | 29th | 5 37 | 5 56 |
| 16th | 5 57 | 5 56 | 30th | 5 33 | 5 56 |
| 17th | 5 55 | 5 58 | 31st | 5 26¾ | 5 57 |
| 18th | 5 54 | 5 55 | | | |

The best East Coast performance was on the last day of the month, as will be seen above. On that occasion the express reached Edinburgh at 5 26¾, having taken 7 hours 26¾ minutes on the journey, or, deducting stops, 392¼ miles in 404 minutes. August 13th was the best day for the West Coast. They did the 400 miles

in 7 hours 38 minutes, or, deducting stops, in 428 minutes. The best sectional performances were as under :—

WEST COAST ROUTE.

| Date. | Miles. | Between | Minutes. |
|---|---|---|---|
| Aug. 13 | 158 | London and Crewe | 166 |
| ,, 7 | 51¼ | Crewe and Preston | 49 |
| ,, 7 | 90 | Preston and Carlisle | 89 |
| ,, 9 | 100¾ | Carlisle and Edinburgh | 102½ |
| | 400 | Total | 406½ |

EAST COAST ROUTE.

| Date. | Miles. | Between | Minutes. |
|---|---|---|---|
| Aug. 25 | 105¼ | London and Grantham | 105 |
| ,, 13 | 82¾ | Grantham and York | 84 |
| ,, 28 | 80¼ | York and Newcastle | 80 |
| ,, 31 | 124 | Newcastle and Edinburgh | 125 |
| | 392¼ | Total | 394 |

It is hard to say which is the best of the above. Probably the Preston to Carlisle run in 89 minutes takes slight precedence of all the others. Then follow the Carlisle to Edinburgh in 102½; York to Newcastle in 80; King's Cross to Grantham in 105; and Crewe to Preston in 49. These are all about equally good. The East Coast had heavier loads, the West Coast heavier gradients. Perhaps, all things considered, the performances of the latter were, as a whole, superior to those of the former. The North Western Company, indeed, must be distinctly congratulated on their performances. The locomotives used by them were much smaller in dimensions than those of the other lines, and yet quite as good results were obtained. The Caledonian also deserves much praise for running the express throughout the month with engine 123. We have previously given in detail the best day's performance of that well-known locomotive.

(4) *Competitive Traffic.*—Nowhere in the world is competition so severe as in England and Scotland. In many cases, we

fear, trains are run at a loss or a very slight profit. The annexed table shows the competing services from London to the most important towns, and from certain important provincial towns to others. An idea may by this means be gained of the various facilities provided by the different routes.

| Between | Route. | Miles. | No. of trains at or over 35 miles per hour. Down. | 35 miles per hour. Up. | 40 miles per hour. Down. | 40 miles per hour. Up. | Fastest Train. HR. | MIN. |
|---|---|---|---|---|---|---|---|---|
| London and Dover | L. C. & D. | 78 | 3 | None. | None. | None. | 2 | 0 |
| Ditto | S. E. | 75½ | 1 | None. | None. | None. | 2 | 5 |
| London and Portsmouth | L. B. & S. C. | 86¾ | 3 | 2 | 1 | 1 | 2 | 0 |
| Ditto | L. & S.-W. | 73½ | 3 | 1 | None. | None. | 1 | 59 |
| London and Plymouth | L. & S.-W. | 229½ | 4 | 3 | 1 | None. | 5 | 23 |
| Ditto | G. W. | 246¼ | 4 | 5 | 2 | 2 | 5 | 38 |
| London and Birmingham | G. W. | 129¾ | 8 | 8 | 4 | 6 | 2 | 43 |
| Ditto | L. & N.-W. | 113 | 13 | 9 | 5 | 7 | 2 | 30 |
| London and Sheffield | G. N. and M., S. & L. | 162 | 8 | 8 | 8 | 8 | 3 | 10 |
| Ditto | Mid. | 164½ | 10 | 12 | 9 | 9 | 3 | 25 |
| London and Leeds | G. N. | 185½ | 10 | 11 | 8 | 6 | 3 | 50 |
| Ditto | Mid. | 196 | 9 | 11 | 7 | 8 | 4 | 5 |
| London and Bradford | G. N. | 192 | 10 | 8 | 7 | 4 | 4 | 3 |
| Ditto | Mid. | 209½ | 8 | 7 | 5 | 6 | 4 | 30 |
| London and Manchester | L. & N.-W. | 188¾ | 12 | 9 | 6 | 8 | 4 | 15 |
| Ditto | Mid. | 191½ | 10 | 7 | 8 | 6 | 4 | 15 |
| Ditto | G. N. and M., S. & L. | 203 | 8 | 8 | 7 | 7 | 4 | 15 |
| London and Liverpool | L. & N.-W. | 193½ | 7 | 10 | 5 | 6 | 4 | 20 |
| Ditto | Mid. | 220¼ | 8 | 8 | 4 | 5 | 5 | 0 |
| Ditto | G. N. and M., S. & L. | 238¼ | 6 | 6 | 4 | 1 | 5 | 30 |
| London and Edinburgh | L. & N.-W. and Cal. | 400 | 6 | 4 | 4 | 4 | 8 | 30 |
| Ditto | G. N. and N.-E. | 392½ | 8 | 6 | 5 | 4 | 8 | 25 |
| Ditto | Mid. and N. B. | 412¼ | 4 | 3 | 3 | 2 | 9 | 25 |
| London and Glasgow | L. & N.-W. and Cal. | 401½ | 7 | 4 | 4 | 4 | 8 | 45 |
| Ditto | G. N., N.-E. and N. B. | 439¾ | 7 | 5 | 2 | 4 | 9 | 45 |
| Ditto | Mid. and G. & S.-W. | 423½ | 5 | 4 | 4 | 3 | 9 | 15 |
| London and Aberdeen | L. & N.-W. and Cal. | 539¾ | 4 | 4 | 3 | 2 | 12 | 5 |
| Ditto | G. N., N.-E. and N. B. | 523 | 5 | 5 | 2 | 4 | 11 | 45 |
| Ditto | Mid. and N. B. | 545 | 3 | 2 | 1 | None. | 13 | 5 |
| Bristol and Manchester | G. W. and L. & N.-W. | 182¾ | 4 | 2 | None. | None. | 4 | 35 |
| Ditto | Mid. | 196¾ | 4 | 3 | None. | None. | 5 | 5 |
| Bristol and Liverpool | G. W. and L. & N.-W. | 187½ | 4 | 2 | None. | None. | 4 | 45 |
| Ditto | Mid. | 225½ | 3 | 2 | None. | None. | 6 | 5 |
| Manchester and Edinburgh | L. & Y., L. & N.-W. and Cal. | 222¾ | 5 | 5 | 3 | 3 | 4 | 55 |
| Ditto | Mid. and N. B. | 223½ | 3 | 2 | None. | None. | 5 | 48 |
| Manchester and Glasgow | L. & Y., L. & N.-W. and Cal. | 224¼ | 5 | 5 | 4 | 3 | 5 | 10 |
| Ditto | Mid. and G. & S.-W. | 241 | 3 | 5 | 2 | 2 | 5 | 40 |
| Manchester and Aberdeen | L. & N.-W. and Cal. | 363½ | 3 | 3 | 1 | 1 | 8 | 35 |
| Ditto | Mid. and N. B. | 354 | 2 | 1 | None. | None. | 9 | 25 |
| Liverpool and Edinburgh | L. & Y., L. & N.-W. and Cal. | 219¾ | 6 | 5 | 3 | 3 | 4 | 50 |
| Ditto | Mid. and N. B. | 234¼ | 4 | 3 | None. | 1 | 5 | 50 |
| Liverpool and Glasgow | L. & Y., L. & N.-W. and Cal. | 221¼ | 5 | 5 | 3 | 3 | 5 | 2 |
| Ditto | Mid. and G. & S.-W. | 251¼ | 3 | 5 | 2 | 2 | 5 | 35 |
| Liverpool and Aberdeen | L. & Y., L. & N.-W. and Cal. | 359½ | 3 | 3 | None. | 1 | 8 | 30 |
| Ditto | Mid. and N. B. | 364¼ | 2 | 2 | None. | None. | 9 | 30 |
| Birmingham and Edinburgh | L. & N.-W. and Cal. | 294¾ | 4 | 3 | 2 | 1 | 7 | 0 |
| Ditto | Mid. and N. B. | 329 | 3 | 1 | 1 | None. | 8 | 5 |
| Birmingham and Glasgow | L. & N.-W. and Cal. | 296¼ | 4 | 3 | 2 | 1 | 7 | 15 |
| Ditto | Mid. and G. & S.-W. | 346½ | 4 | 2 | 1 | None. | 8 | 0 |
| Birmingham and Aberdeen | L. & N.-W. and Cal. | 434¼ | 3 | 3 | None | None | 11 | 5 |
| Ditto | Mid. and N. B. | 459½ | 3 | None | None | None. | 12 | 5 |

NOTE.—The distances given above are in all cases by the route taken by the fastest train between the points named.

(5) *Uphill Running.*—In the preceding articles on the various railways, we have dealt with the speed of most of our English lines from two standpoints. We have, in the first place, shown by means of numerous tables, giving the services afforded by the various lines between their principal towns, what is generally called the "*Commercial Speed*," or, in other words, the speed which alone interests the great bulk of travellers, who are more concerned about reaching their destination in quick time than about the gradients and various hindrances to fast progress *en route*. A train which takes four hours to reach a certain point 160 miles away is, to the great majority of travellers, much more acceptable than one which reaches the same point in $4\frac{1}{2}$ hours by a circuitous and difficult route 200 miles long.

The other aspect of the subject has not, however, been neglected; and under the sections entitled *Gradients*, *Actual Performances*, *etc.*, we have given very complete particulars concerning speeds viewed from the standard of locomotive performance merit. In the Introductory Remarks, moreover, after discussing the general effect of gradients with some detail, we came to the conclusion that those wishing to study locomotive performances with a view to more closely appreciate their merit, would best satisfy themselves, and obtain the most complete results, by directing their attention to the running of the various types of locomotives on uphill grades. The reasons given for arriving at this conclusion will also be found set forth in the Remarks above referred to. We now give some detailed specimens of uphill work, in order that performances may be more thoroughly appreciated.

It is necessary, however, to state at once that the undermentioned examples must not be taken as by any means exactly representing the capacity of the various locomotives when tried on up grades. Irrespective of the fact that the details below are simply selections from a list of about a thousand express runs made by the writer during recent years, and are by no means test-performances, it must be remembered that we have not all the factors for making an exact comparison; and without all the factors, results will never be absolutely correct. In the subjoined instances we detail the engine, load, gradient, and speed; but many things other than these go to make up a locomotive performance. Not to mention many minor factors, let us simply look at coal consumption. If we compare the performances of two engines, one of which mounts a rising grade in two-thirds of the time taken by the other, we at once form conclusions

in favour of the faster type. But if told that it uses an amount of coal greater than that used by the other and in proportion to the extra speed, we appreciate at once the fact that both types are doing equally well, and that, supposing the design of each locomotive to be fairly good, a certain quantity of steam will do just as much work in the one case as in the other. The quality of coal used also comes in as a factor. We may notice two engines doing much the same work on similar grades, and be surprised to find that one burns only 25 lbs. of coal per mile, and the other requires 40 lbs. But our surprise ceases when we find that the 25 lbs. engine uses the best coal procurable, whereas the 40 lbs. engine gets an inferior quality.

Unfortunately, however, for the figures given below, these details of coal consumption for any single trip (or for the uphill portions of any single trip) are rarely, if ever, obtained. Even the most complete locomotive tests, made at the instance of Locomotive Superintendents, rarely give us more than the amount used per mile *for the whole trip, uphill and downhill included*, the coal being weighed at the start and finish. In the absence, therefore, of these important factors, our figures must be taken more as showing what actually *is* done in daily practice, than what *could* be done.

In order that comparisons may be more easily made, we divide our statistics below into several groups, according to the severity of the gradient on which the performance was made. The grades selected are, as explained in the Introductory Remarks, such as by their length will give us reliable results. They are as follow :—

(1) On the London and North Western—

(*a*) *Crewe to Whitmore* (*fairly easy*).
(*b*) *Oxenholme to Grayrigg* (*hard*).
(*c*) *Penrith to Shap Summit* (*hard*).
(*d*) *Tebay to Shap Summit* (*very severe*).

(2) On the Midland—

(*a*) *Bedford to Leagrave* (*fairly easy*).
(*b*) *Sheffield to Dore* (*hard*).
(*c*) *Settle to Dent* (*hard*).
(*d*) *Miller's Dale to Peak Forest* (*hard*).

(3) On the Great Northern—

(*a*) *Wood Green to Potter's Bar* (*fairly easy*).

(4) On the Manchester, Sheffield and Lincolnshire—
(*a*) *Sheffield to Woodhead Tunnel* (*hard*).

(5) On the Caledonian—
(*a*) *Midcalder to Cobbinshaw* (*hard*).
(*b*) *Beattock to Beattock Summit* (*very severe*).

(6) On the Glasgow and South Western—
(*a*) *Near Auldgirth to Carronbridge* (*fairly hard*).
(*b*) *Kilmarnock to Dunlop* (*very severe*).

(7) On the North British—
(*a*) *Newcastleton to Riccarton* (*very severe*).
(*b*) *Hawick to Riccarton* (*very severe*).
(*c*) *Portobello to Falahill* (*very severe*).
(*d*) *Perth to Glenfarg* (*very severe*).

In all the cases which follow, the first two or three miles up the bank have not been inserted. If this had been done, erroneous results would have been obtained, as a locomotive which has entered an up grade after rushing down a preceding descent would show vastly better results for the first two or three miles than one which had started from a station just at the foot of the ascent.

*I. Grades Rising at About* 1 *in* 200.—The banks we will consider under this heading are those from Crewe to Whitmore (London and North Western); from Bedford to Leagrave (Midland); and from Wood Green to Potter's Bar (Great Northern).

The Crewe to Whitmore bank is nearly 10 miles long, and consists of 1 in 177, 1 in 250, and short bits of easier grades. All trains from the North having to stop at Crewe, the locomotive has thus practically to start on the bank. In spite of this disadvantage, however, this bank is generally negotiated in fairly good style. With the slower trains we found that 6 ft. compound "City of Carlisle," with 16 coaches on, maintained an average of 40 miles an hour all the way up; on another occasion an engine of the same class took 13½ up at an average of about 43, never dropping on the worst parts under 37 in one case and 41 in the other. The Scotch expresses and the best trains from Manchester and Liverpool were, of course, much better. "City of London," with 14 coaches on the up Scotchman, never fell below 47 miles an hour, even on the bit

of 1 in 177, and averaged 48. "Archimedes," with 17 coaches on the same train, did not fall below 42 miles an hour, and averaged 44. Both these are very good performances, the first especially so.

The Midland line from Bedford to Leagrave rises on varying gradients, averaging about 1 in 250. As all trains which do not stop at Bedford have to reduce speed considerably through that station and approaches, the locomotive gets a bad start on the bank. With the light Leeds expresses of from 8 to 10 coaches the speed seldom fell below 44 or 45, and was frequently 46 to 48 for miles together. Heavier trains of 13 or 14 coaches were generally about three or four miles an hour slower in mounting. Trains of 15 coaches and upwards generally appeared to need two engines. With engine 1741 and 10 coaches on one of the up Leeds expresses 45 and 46 were the lowest speeds touched, and 49 the highest.

From Wood Green to Potter's Bar is just about eight miles of 1 in 200. In this case the locomotive gets a pretty good start on the bank, generally rushing through Wood Green on its way North at from 48 to 55 miles an hour. As the Great Northern trains are tolerably heavy, and their express engines of the "single" type, the speed generally falls with a heavy load to about 37 or 38 miles an hour at Potter's Bar. With a train of only 10 or 12 coaches it rarely gets below 42 or 43. On one occasion, however, with engine 48 (8 ft. single) and 13 coaches the last mile was run at 46, and the last three or four averaged 47; and with engine 8 and 17½ coaches the last three miles were run at 42. These are performances above the average. In general, however, the North-going trains from King's Cross take this bank rather quietly, preferring to run hard over the easy road north of Potter's Bar to Peterborough. Perhaps better results are shown on the bank south of Stoke Tunnel, which is somewhat steeper. Enough, however, has been said to show that on these comparatively easy grades all the three companies we have discussed do about equally good work, with the North Western perhaps a little ahead of the others. We now come to:—

*II. Grades Rising at from* 1 *in* 140 *to* 1 *in* 150.—Here our single instance will be the bank from Auldgirth to Carronbridge on the Glasgow and South Western Railway, forming the worst part of the long-continued but fairly gradual ascent from Dumfries to New Cumnock up Nithsdale. Three or four summers ago the writer was enabled to make very complete observations of the excellent work of the Glasgow and South Western locomotives on this section. The figures for the two best runs are given below, as well as those

showing what is the general average performance. It will be noticed that all are extremely good :—

| Mile posts. | Gradient. | Engine 68 and 12½ coaches. Speed in miles per hour. | Engine 53 and 13½ coaches. Speed in miles per hour. | Engine 70 and 14½ coaches. Speed in miles per hour. |
|---|---|---|---|---|
| 85 to 84 | 1 in 200 rising | 50 | 49 | 48 |
| 84 to 83 | Ditto | 50 | 49 | 46 |
| 83 to 82 | Ditto | 51 | 48 | 45 |
| 82 to 81 | Gradual ascent | 52 | 51 | 49 |
| 81 to 80 | 1 in 200 rising | 54 | 51 | 49 |
| 80 to 79 | 1 in 150 rising | 50 | 50 | 47 |
| 79 to 78 | Ditto | 48 | 46 | 43 |
| 78 to 77 | Ditto | 46 | 45 | 41 |
| 77 to 76 | Ditto | 46 | 44 | 40 |
| 76 to 75 | Ditto | 42 | 43 | 40 |
| 75 to 74 | Ditto | 42 | 43 | 39 |

*III. Grades Rising at from* 1 *in* 90 *to* 1 *in* 120.—The banks discussed under this heading are those from Oxenholme to Grayrigg, and from Penrith to Shap Summit (London and North Western); from Sheffield to Dore, from Settle to Dent, and from Miller's Dale to Peak Forest (Midland); from Sheffield to Woodhead Tunnel (Manchester, Sheffield and Lincolnshire); and from Midcalder to Cobbinshaw on the Caledonian.

The Oxenholme to Grayrigg bank is a long stretch averaging about 1 in 125, but throughout its length it consists of various grades, of which the hardest is 1 in 109. The North Western expresses from the South, always very heavy, generally run over this piece without the aid of a pilot engine. If extremely heavy, they occasionally use an assistant engine right through from Preston to Carlisle; but as a rule the practice is either to run right through unaided, or to take the pilot at Tebay for the very severe grades up to Shap Summit. As to the general average performance of the best Scotch trains, we may say that with from 12 to 14 coaches it rules about 42 miles an hour up this bank, rarely sinking below 37 at the top. On one occasion, with 15 on, "Teutonic" much improved on these figures, which, as stated above, may be taken as a fair sample of what is generally accomplished.

From Penrith to Shap Summit is, more or less, similar to the preceding. It, however, contains an eight-mile stretch of 1 in 125 without break. Some of our performances up this grade were superb, and seemed to surpass the speeds attained up the Grayrigg bank, just referred to, and were really much superior to what we

usually obtained on other lines. For instance, "Alchymist" (6 ft. compound), with 13 coaches on, never fell below 42 miles an hour on any part of the 1 in 125, and averaged 45 throughout. This is very fine, but not nearly so good as the remarkable performance of "Cook" and "Leviathan," which, with 16 coaches, stopped on Shap Summit 35 minutes 41 seconds after leaving Carlisle, never dropped below 50 miles an hour on the 1 in 125 south of Penrith, and averaged 52 miles an hour on that bank throughout. Of course, there were two engines, but then the load was 16 coaches. We may, however, fairly say that one of the engines with eight coaches (half the load) would have done as well. How much superior this is to the work done by, say, the light Midland up Leeds expresses, with their loads of 8 to 10 coaches, on the bank from Sheffield to Dore, will be seen below. In fact, it is precisely on these heavy banks that we see the superior uphill work done by the North Western and Caledonian companies. Unfortunately, our comparisons are more or less restricted to light trains, as on most of the other railways the practice of using pilots prevails to too great an extent with heavy trains on steep gradients. With light loads, however, we may make comparisons from one line to the others. Instances therefore on both the Midland and Caledonian lines will be found below.

A few miles south of Sheffield, on the Midland Railway, we come to a six-mile stretch of 1 in 100, leading up to the Bradway Tunnel, which here penetrates the Pennine range. Most of the trains using this line are the more or less light Leeds expresses, averaging 8 to 10 coaches. The results we obtained with these trains were, we confess, somewhat disappointing. The speed, even with these moderate loads, generally fell to 34 miles an hour at the top of the bank, and very rarely averaged 37 all through. With about 12 or 13 coaches the average was only about 32 or 33, and the speed near the top generally fell to 30. These results, in fact, are so much poorer than those on the section just previously described that we must direct attention to the preliminary remarks relative to the quantity and quality of coal used. Probably if these were known in each case, sufficient reason would be found for the lower speed in the smaller coal consumption of the locomotive. In fact, we have the Midland doing much better work on the next bank described, viz., the very long and severe one, averaging 1 in 100 (with intervening bits still more severe), extending for nearly 15 miles north of Settle, on the Settle and Carlisle line. Here we occasionally find loads of 13 to 15 coaches hauled up these banks by one engine;

but as a general rule we must state that the use of pilots is excessive. But to show what the Midland can do, we may cite the cases of engine 1522 and 13 coaches going up the bank at a steady 34 miles an hour, and only falling to 31 at the worst parts; and of engine 1579 and 15 coaches averaging 32 throughout and never getting below 30. With light loads engine 1578 and 9 coaches averaged 39, with a lowest speed of 35; and on another occasion two engines with a load of 20 coaches averaged 38, with a lowest speed of 35. These last two instances are much better than the work done from Sheffield up to Dore, and probably mean increased coal consumption by the engine. Similarly, good work is done by the up trains from the North mounting the heavy grades from Carlisle to the summit level. Of course, this does not compare with the North Western work just cited, even after making allowance for the harder grade of the Midland bank. Much the same may be said of the severe stretch of 1 in 90 taking the Midland Manchester line over the Peak Forest summit in Derbyshire. Here again trains are generally light, and have two engines if fast and heavy. A good average performance was one made by us behind engine 1332 (7 ft. coupled) and 9 coaches, when the speed averaged 35 throughout, and did not fall below 33.

Another severe bank on which we have made several observations is that from Sheffield to Woodhead Tunnel on the Manchester, Sheffield and Lincolnshire Railway. Here for 17½ miles the line winds continuously upwards at an average grade of 1 in 128. The loads taken by the fastest expresses are not heavy, and perhaps the best trains are not timed so sharply as to allow the locomotive to utilise all its power. A striking performance over this bank was, however, done by engine 561 and 8 coaches. The speed never fell below 44 miles an hour, and the average was about 45½, taking the bank throughout. This is very excellent work indeed. It is a little better than the best Midland examples cited above, but, of course, not so good as the best North Western instances. Similar work is done by the Manchester, Sheffield and Lincolnshire up the other side, *i.e.*, from Manchester to the Summit Tunnel.

A road very similar to that just described is the section of the Caledonian from Midcalder to Cobbinshaw, on the line from Edinburgh to Carstairs. The gradient rises for over 15 miles on varying grades, averaging about 1 in 120, the last few miles being the worst. Like the Manchester, Sheffield and Lincolnshire, it is a long piece of uphill, and the trains running over it are generally light. For the best performances we must look to the work of the faster

Scotch expresses. The slower express trains through to the South do nothing like so well. One of our best instances is from a run with the up 10.15 a.m. from Edinburgh. In this case the engine was 124, and the load about 9 coaches. The speed averaged nearly 49 miles an hour all the way up, and even at the top, where the gradient is steepest (1 in 100 for six miles), the engine was running at 44½. On the lighter parts of the bank (which are on grades of 1 in 120, 132, 142, and 229), there was no difficulty in maintaining 50 miles an hour. This performance is, therefore, in advance of the Manchester, Sheffield and Lincolnshire just cited, and makes a close approach to the North Western instances given above.

*IV. Severe Grades Rising at from* 1 *in* 65 *to* 1 *in* 80.—The gradients we propose to discuss under this heading are those from Kilmarnock to Dunlop (Glasgow and South Western); from Newcastleton and from Hawick to the Summit Tunnel, near Riccarton, and from Portobello to Falahill (North British), and from Perth to Glenfarg, also on the same line; from Tebay to Shap Summit (London and North Western); and from Beattock to Beattock Summit (Caledonian).

The Glasgow and South Western expresses, all of which stop at Kilmarnock on their way North, are confronted with a very steep, if somewhat short, bank almost immediately on leaving that station. The effect of grades on train-speeds can, unfortunately, not be so well observed on this stretch as on some others, as the gradients chop and change about a good deal, and occasional very short easy stretches intervene, thus giving a rest to the locomotive, and perhaps making the locomotive work appear better than it really is. In order, however, that the effect of the grades may be more correctly appreciated, we give in the table below particulars of the speed, mile by mile. The performances, considering the respectable loads conveyed, are remarkably fine. Up the other side of the bank, *i.e.*, coming south out of Glasgow, we do not think the work is so good.

| Mile-post. | Gradient. | Engine 89 and 17½ coaches. Speed in miles per hour. | Engine 68 and 12½ coaches Speed in miles per hour. |
|---|---|---|---|
| 23 to 22 | 1 in 180 rising | 33 | 36 |
| 22 to 21 | 1 in 87 chiefly, but partly 1 in 180 and 286 | 36 | 39 |
| 21 to 20 | 1 in 87 rising | 31 | 36 |
| 20 to 19 | 1 in 152 chiefly, and easier | 34 | 39 |
| 19 to 18 | 1 in 75 rising | 35 | 39 |
| 18 to 17 | Ditto | 28 | 32 |

The North British Waverley route is the very hardest main line in the kingdom. The three banks we have selected are all in great part 1 in 70 to 1 in 80; and as they are all situated on a length of 98 miles of line, and are all run over by the same engine, bringing the Scotch expresses from Edinburgh to Carlisle, or *vice versâ*, we will discuss them together. Unless the loads are very light, which is not often the case, pilot engines are always employed. The results throughout are not so good as are obtained on the rival Caledonian line. With two engines and 18 coaches we mounted the heavy banks of 1 in 67 and 1 in 75 to Riccarton and the tunnel beyond at a steady 29 miles an hour, hardly at all deviating from this speed; with two engines and a load of 14½ the speed was 32 to 34 throughout; while with two engines and only 11½ coaches 35 to 37 miles an hour was maintained. Up the other side an excellent performance with two engines and 19½ coaches was noted. The same plodding regularity was observed, the speed seldom getting under 32, and seldom above 34 miles an hour. From Portobello to Falahill the line abounds in bits of 1 in 70, etc., and is quite as stiff as the sections just mentioned. Pilot engines are almost invariably used. With two engines and 11 coaches the speed varied from 34 to 37 miles an hour, according to the severity of the gradient. With heavier loads the results were more or less similar to those obtained south of Hawick. An exceptionally good performance, however, was that done by engines 343 and 488 with 15 coaches behind. Running through Portobello at high speed, they passed Millerhill in 4 minutes 12 seconds (3 miles 19 chains of 1 in 80, 1 in 100, level, and 1 in 175); Eskbank in 2 minutes 19 seconds (1 mile 57 chains of 1 in 175, 218, 250, and 228); Gorebridge in 5 minutes 52 seconds (4 miles 5 chains of 1 in 70); Fushiebridge in 1 minute 9 seconds (60 chains of 1 in 70 and 111); Tynehead in 5 minutes 49 seconds (3¼ miles of 1 in 70); and stopped at Falahill Summit in 3 minutes 26 seconds (1 mile 75 chains of 1 in 70 and 100). This performance ranks among our best uphill feats.

Another severe piece of 1 in 74 exists on the newly-opened line through Glenfarg, forming part of the main line from Edinburgh to Perth *viâ* the Forth Bridge. Here we find some of the trains are very heavy and, consequently, need pilot assistance. With reasonably light trains, however, only one engine appears to be required. A fine example of work was noted here some time ago, when one of the 7 ft. coupled class took seven coaches up the 6-mile ascent of 1 in 74 at a steady 35 or 36 miles an hour. This performance falls little

short of the best work performed on their mountain sections by the London and North Western and Caledonian companies, which we now come to consider.

When the fast North Western Scotch expresses have surmounted the difficult Grayrigg bank, there still lies before them a short but more severe task. This is the Shap bank, consisting of about 5 miles of 1 in 75. Immediately preceding it is the easy descent from Low Gill to Tebay, and this, of course, gives the locomotive some assistance in the way of impetus over the first part of the bank. Unlike the North British, the North Western do not habitually use pilots up this stretch of 1 in 75, unless the trains are pretty heavy. Of late, however, perhaps more pilots are being used than formerly. Still, trains of 14 or 15 coaches frequently go up without assistance, and on one occasion "Teutonic" took 15 up, and never fell below 25 miles an hour. The average was a good deal over 30, owing, of course, to the high speed at which the train was running on entering the bank at Tebay. With lighter trains of 7 or 8 coaches the average from Tebay to Shap Summit throughout is often over 40, and sometimes nearly 45, and the lowest speed generally 36 to 37. These results are admirable throughout.

Quite equal to the North Western in the matter of uphill running is the Caledonian. In fact, on banks of 1 in 70 and 1 in 80 we fancy it is a trifle superior, just as our observations on grades of about 1 in 120, etc., seemed to point to the North Western as being slightly the better there. The Caledonian trains are now so fast and heavy, and their road so severe, that the locomotives have to work very hard to produce such excellent results as they do. The hardest nut they have to crack is, of course, the ascent of Beattock bank from the South. This is 10 miles long, and consists of 2 miles of 1 in 88, 2 of 1 in 80, and 6 of 1 in 75. Pilots, even with very heavy trains, are rarely used. Some marvellous work is done hereon. On a wild, stormy night, with a strong headwind, engine 124 took 15 coaches up unaided in 20 minutes (equalling 30 miles an hour throughout), and the last mile at the top was run at 25 miles an hour. With lighter loads the feats are even more astonishing. The 7 ft. single engine, No. 123, took 8 coaches up on one occasion at an average of 44 miles an hour, and the last mile was done at 37. Engine 124, with the same load, achieved perhaps a more remarkable performance still. It was stopped 2 or 3 miles up the bank by signals, and, on starting again, the speed gradually rose, until the last few miles were done in 90 seconds each, which equals 40 miles an

hour. This is, indeed, brilliant. It is strange to look back to some of the lines we have been discussing and find that with similar loads, on gradients of only 1 in 100 to 1 in 120, their speeds were lower than on the Caledonian 1 in 75. Yet it would be rash to hasten to conclusions, and suppose the Caledonian and North Western companies' engines to be superior to all others. It must be remembered that in our comparisons above, many of the factors are missing; and without all the factors, as pointed out in our preliminary remarks, the results are, of necessity, more or less fallacious. They only show what is done in daily practice by the various locomotives, irrespective of coal consumption; *they do not show what the locomotive can do.*

# FOREIGN BOOKS ON RAILWAYS.

ALLUSION having been made in the Preface to the numerous and valuable treatises on this subject in various foreign languages, it may not be out of place to give the titles of some of the more important and recent of these works. Few direct references have been made to any of them in the foregoing pages, but they will be found of considerable assistance to all interested in studying railway construction, maintenance, and working under every aspect, and in the fullest detail.

We are indebted to German industry and research for—

*Handbuch für specielle Eisenbahn-Technik.* By E. HEUSINGER VON WALDEGG. 5 vols. Leipzig. 1869–76.

*Grundzüge des Eisenbahn-Maschinenbaues.* By G. MEYER. Berlin. 1883–86.

*Das Eisenbahn-Geleise.* By A. HAARMANN. 2 vols. Leipzig. 1891.

*Encyklopädie des gesamten Eisenbahnwesens.* Edited by Dr. VICTOR RÖLL. Wien. 1890 . . .

Of this standard work of reference 5 vols. (*A—Personenverkehr*) have already (April, 1893) been issued.

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Among French works we have—

*Traité complet des Chemins de fer.* By G. HUMBERT. 3 vols. Paris. 1891.

*La Voie, le Matériel Roulant, et l'Exploitation Technique des Chemins de fer.* By CH. COUCHE. 3 vols. Paris. 1868–76.

An English translation of this valuable work by J. N. SHOOLBRED and J. E. WILSON has since been published.
3 vols. text. 3 vols. plates. London. 1877-82.

*Les Chemins de fer.* By P. LEFÈVRE and G. CERBELAUD. Paris. 1888.

A very neatly got-up and handy 8vo volume by two thoroughly capable writers.

*Les Chemins de fer et les Tramways.* By A. SCHŒLLER. Paris. 1892.

From Belgium we note—

*Traité d'Exploitation des Chemins de fer.* By FLAMACHE, HUBERTI, and STÉVART. Bruxelles. 1885 . . .

Of this work 3 vols. have already been issued, and it will probably be completed in 2 more (1893-4).

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One of Italy's most recent contributions is—

*Le Strade Ferrate.* By L. LORIA. 2 vols. Milano. 1890-92.

It will be evident from the above brief list that if smaller traffic requirements and almost universal absence of competition afford Continental railway companies few opportunities for the display of anything approaching British energy in actual working, there is still no lack abroad of capacity of the highest order in dealing from a literary point of view with a subject so inseparably connected with national wealth and prosperity.

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