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RAILWAYS

By

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AND

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By

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CONTROLLER OF COSTS AND STATISTICS, LONDON

MIDLAND AND SCOTTISH RAILWAY COMPANY

(CHAPTERS II-X)

AND

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(CHAPTER I)



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RAILWAYS

CHAPTER I

INTRODUCTORY

“THE worst of science is it stops you thinking,” said Anatole France profoundly and, apparently, paradoxically. But it is clear that pre-occupation with physical changes and developments in any body of applied knowledge precedes clear thought about the consequential changes in its relationship to its environment. Conversely, a radical change in environmental conditions, without any interior change in an organism within it, also involves extensive modifications in the interactions of the two. In the new world of science and finance, and particularly of democratic and semi-socialized forms of government in which we now live, transport occupies a more important place than ever, and the position of railways in the economic structure of all countries requires to be re-examined without prejudice from the past, but

losing none of its lessons. The first fruits of division of labour were functional, and the second, into which we now enter, are spatial or localized. They depend on high specialization and centralization with mass production, and this involves per unit of production a larger distributive mileage, and a clearer call for speed and direct or individual consideration, with, for example, fish trains, banana vans, milk tanks, each the object of precise timing, direction and care. The economics of private capital enterprise have been well worked out in practice and theory; the economics of social capital in restricted fields are known by experience, but over wide fields only in theory. No one has yet worked out the economics of a system of State and private capital ownership in undetermined rivalry within or beyond national boundaries, and their equilibrium, or the possibility of it, is hardly understood. In one country we may see State and private railways together; or in a municipality study "rate-backed" trams struggling against privately-owned bus facilities, or we may consider the transport costs of goods selling in a neutral market where one supplier has State-owned railways and the other private ownership. The latest example in the competition between

a new form of transport—which can rely on various kinds of adventitious advantages and aids, and has more than a simple element of commercial backing or uneconomic support—and an old form of transport regulated to a strait-jacket, is also significant. The peculiar dangers of competition between the two forms of capital, unco-ordinated and not thought out as a problem, but empirically experienced, need hardly be emphasized.

This book is neither a textbook on railway economics nor a manual of statistics, but it contains enough economics, statistics and history to form a basis for the new thinking which is here urged.

Railways had their origin in Great Britain, and therefore their experience may be taken as the more typical, and space is saved by referring only to the more striking differences between them and the other most important private system, that of the United States.

Dr. Lilian Knowles used to say in her caustic way that a "pass" student of economics knew that the Industrial Revolution took place in the eighteenth century, and an "honours" student that it didn't. She did as much as anyone to concentrate attention upon the real significance of the expansion in transport and

financial structure in the second quarter of the nineteenth century, and to show how little all that had gone before in invention and factory production could have done for the world in its absence. This book is in no sense a history of early railway development, but no one can get the transport problem of to-day in current perspective unless he has some regard for it, and, at the same time, no one will get far with that problem if he sees it entirely through the analogies of the displacement of canals and turnpikes a hundred years ago, without probing those comparisons for the essential points of historical difference. For the capital accounts of to-day are heavily loaded with what some regard as the blackmails of the 'forties, and in international comparisons of costs Great Britain notoriously suffers through the heavy initial outlay in lands and parliamentary expenses to acquire them against bitter opposition. It is, of course, easy to exaggerate this element in British costs, for probably three-fourths of the capital of British railways was expended in the seventy years since 1858. But, on balance, the British landlord has made no real gain or unearned increment, and his agricultural rents have sunk to a figure below the economic return upon his invested capital in farming. For while

the advance of railways here gave him some splendid opportunities for plundering the British public, through what amounted to a rent charge in perpetuity for trifling disturbance; and while that very disturbance gave him often the advantage of real betterment in adjoining properties, and an astonishing advance of site values; and while, again, large parts of the financial burden of Local Government were taken from his shoulders through Railway rating—despite all this, on balance, through the advance of railways he was a loser. The United States was certainly supplying this country with cereals to some extent before the Napoleonic wars, but, as Cunningham has observed: “It has only been as a consequence of this introduction of railways that the English farmer is regularly, and ordinarily, exposed to competition with the wheat growers of the most fertile regions of the West. The development of the railway system in America has done much to deprive the landed classes in England of their natural protection which was afforded by distance and difficulty of transport.” So in the long run, the British public has been made to pay something more for travel and manufactured goods to make up a little for the cheapness of its food. Even here, if the farmer

has lost on balance, the manufacturer enjoys a net gain, for apart altogether from the transport of produce, the cheapness of living and accessibility of varied food supplies for his work-people has been a material factor in his costs and in their efficiency and output. But nothing is more characteristic of the British method of looking at bits of a problem instead of the whole, than a habit of referring to the disadvantageous comparative cost of a particular ton-mile haul here with a foreign competitor, as though it were some current iniquity or moral obliquity, disregarding both its historical origins and all the other counterweights in the industrial scale that it has involved.

Cunningham has said that none of the other improvements of the nineteenth century awakened so much foreboding as was roused by the railways at first, and in no other case has the boon to the public been so immediate and obvious. One must not think merely of the fate of turnpikes, trusts which were a mere mode of ownership and working, and on which, in Mr. McAdam's words "the calamity of railways" fell. The loss involved in superseding old methods was comparatively slight, especially having regard to stimulus to business of all kinds, so that wagons formerly necessary

for throughout traffic became fully occupied in the larger traffic to and from local stations. As Professor Clapham says in his *Economic History of Modern Britain*: "The railways were fed, in the jingle of the nursery, by 'coach, carriage, wheelbarrow, cart' . . . journeys behind horses multiplied, but long journeys behind horses stopped." With the petrol-driven vehicle that has superseded the horse, a new type of co-operation between road and rail becomes necessary, and the rail may give back something in short-distance traffic, something in classifications of its traffic, but it is co-operation all the same. The canal monopoly, broken by the railways, was of a different order, for in 1825 the Trent and Mersey had paid a dividend of 75 per cent., the Birmingham 70, Coventry 44 and Oxford 32, and even thirteen years later these were not lower than 32½, 12, 46 and 30 respectively, while Warwick and Birmingham had increased from 11 to 30 per cent. Their final decline was greatly assisted by the fruitless application of large sums to the opposition of railway Bills instead of to self-improvement.

History repeats itself. Relative taxation burdens were rigorously debated. The coaches were taxed—½d. per mile per seat, against the railways ¼d. per mile per passenger *actually*

carried, and licence duties were imposed on the vehicles and the staff and horses, together with turnpike tolls. But the road defenders never referred to the burden of poor-rates on railways, nor the heavy cost of their permanent way. Professor Clapham says the discussion was inconclusive, and, indeed, idle. "No tax remission or new tax which any Government could have contemplated would have saved the coach run in direct competition with the railways."

It need not be supposed that the system that superseded them has ever drawn heavily upon the country's resources as a monopoly. Lardner in 1850 said that the *gross receipts* on all existing railways never reached 8 per cent. on the capital expended.

It is interesting to look at the percentage which railway net receipts (or profit, including debenture interest) has borne to the total non-wage income of the country, which I compute (using the data in *British Incomes and Property*) as follows :

1842	.	.	.	.	.	1.4 per cent.
1852	.	.	.	.	.	4.1 "
1862	.	.	.	.	.	6.0 "
1872	.	.	.	.	.	6.5 "
1882	.	.	.	.	.	6.6 "
1892	.	.	.	.	.	6.5 "
1902	.	.	.	.	.	5.3 "
1912	.	.	.	.	.	5.2 "
1922	.	.	.	.	.	2.5 "

We can discern here the influence of changes in the gold price level (after 1892), which, of course, have quicker influence upon the general mobile elements of business than upon railway rates. The "Standard Revenue" allowed as a maximum (but not guaranteed as a minimum) by the Railways Act of 1921 also closely approximates to $2\frac{1}{2}$ per cent. of the non-wage income of the country for 1924.

Now in an ordinary business, the ultimate effect of a completely new price level (say 50 per cent. increase) upon the economic results, *ceteris paribus*, is to increase the yield by 50 per cent., or more usually to bring about a new capitalization 50 per cent. higher, upon which the old rate of interest is earned. In either case, the old purchasing power of dividends or yield is preserved. But by the Railways Act, this economic result has been prevented, and the general body of old railway shareholders has permanently suffered, compared with the general body of citizens. New shareholders, in choosing from rival investments in a competitive field, of course buy themselves free of the disability (which is thrown finally on to the former owner) and the "capital levy" or "spoliation" is achieved once for all.

Very different are the views we may find

about the future of railways, or even their present value in the body politic. Clapham reminds us that in 1841, when less than 2,000 miles were open, joining, it is true, the chief centres of population, some people were thinking the railway system was not very far from complete. To-day, popular interest in relative national efficiency is unabated, but seldom well instructed. Professor Marshall recently pointed out that there were in Great Britain "a greater number of trains, and especially of fast trains, than are to be found in any other area of equal size in the world. Nowhere else are there so many pairs of points between which the passenger has a large choice of the time of day at which he will start on his journey, and yet travel at an average rate exceeding forty miles an hour. Nowhere else are small packages collected and delivered over so many considerable distances within the twenty-four hours."

Readers of this book will see why even the fundamental principles of railway working, in the principles of rate-charging, may be in transition. Some American writers foresee that railways will some day think little about the values of different classes, but will make equal charges for equal demands on their service; but Lowry has confined the prophecy (as to cost of

service) to the Eastern States and left the South and West to be for a much longer period governed by value of service.

Marshall concluded that a fairly old railway, holding the greater part of the transport of a compact industrial district, is likely to have so completely adjusted the appliances to the traffic, that each of them is well occupied and does its work so economically that any addition to that work would have to carry nearly full costs. In such a case cost of service would automatically become the chief regulator of charges. Such tendencies must be profoundly affected by the advent of rival forms of transport, basing charges upon quite different principles. The price of right judgment is eternal vigilance. He who would make progress must, like a navigator, take his bearings every day. The ensuing chapters are a contribution to his equipment for this end.

CHAPTER II

ORIGIN AND DEVELOPMENT

IN this book, which deals with railways, it is not possible to trace the development of transport as an essential factor of trade from the earliest times until now, nor is it possible to go far beyond Great Britain, except to direct attention to a few distinctive differences of methods in other countries, and only a short reference to the evolution of the British railway system is possible. The history of the British roads prior to, and during, the Roman occupation, and their gradual disuse thereafter, the fitful endeavours to maintain the roads and bridges during the feudal period, the succession of the parish roads, the construction of through turnpike roads from the early part of the eighteenth century, the revolution in road construction effected by McAdam and Telford 100 years ago, and the new revolution now in progress, must all be avoided. Inland water transport, also, can only be mentioned. From the earliest times

the streams and rivers of Great Britain were navigated by light boats or barges and, probably, formed the principal means of native transport, even during the Roman occupation, though the Romans did not despise waterways, as during Hadrian's time the existing Fossdyke Canal was constructed. In later times, the maintenance of navigable rivers like Thames, Lea, Trent, Mersey and Severn, was entrusted by the King or Parliament to Commissioners appointed for the purpose, and in the eighteenth century canals were constructed in many parts of the country to carry the coal and other mineral deposits which were then being developed. With the close of the French wars the modern industrial period began, the use of steam as a motive power was discovered, factories were springing up, and the first flow of international trade on a large scale, removed from the fear of war, was setting in and required cheaper and more adequate transport.

As early as the sixteenth century, wooden floors had been placed on colliery roads to improve their surface and increase the drawing power of the horses which pulled out the coal vehicles; and in the seventeenth century raised wooden rails were in use at certain spots where the gradient or curve of the road required special

care in moving the vehicles. In time, these wooden rails ran continuously and were protected with thin strips of iron, and the wagon wheels in turn were made of iron in order to reduce the friction. In 1767 the Colebrookdale Iron Works Company cast a number of iron plates and used them as rails because, it is thought, iron being little in demand, the work would keep their furnaces going and, if the demand rose, the plates could be lifted and sold as pig-iron. Whether that was the reason or not, the use of the plates as rails was found to be a considerable improvement on the wooden rail reinforced with iron, and in a few years, special castings of iron rails about three feet long were made. These rails were sloped so that the flat wagon wheels might keep to the track, and by the end of the eighteenth century flat or edge rails were used, the wheels being "flanged" with rims bearing on the inner edge of the rails. Other types of rails were tried. Some known as plate rails were L-shaped and the wheels were guided from the inner side by the upper section of the rail. Others had oval tops and the wheels were grooved much like a bicycle wheel stripped of its rubber tyre, but the edge rail, with flanged wheels, alone proved satisfactory and was generally adopted, the rails

being supported by stone or iron chairs fixed to cross-sleepers laid at intervals of about three feet. While cast-iron later gave way to wrought-iron, and it in turn to steel, and the rail types and fastenings have seen many changes, there have not been material alterations in the general design of the rail tracks since the introduction of the edge rail.

The railway, while it had thus reached much of its present form over 100 years ago, was still only a specialized roadway along which wagons could be moved with less labour than on the ordinary road, because of the reduction of friction on the wheel surfaces. Horses usually provided the motive power and it was the accident of the design of the colliery wagons, probably governed by the capacity and size of the horses which hauled them, which fixed the gauge, or width of track between the heads of the rails, and ultimately fixed the standard gauge for British railways and led to its adoption on the greater part of the world's railways. The original gauge of the colliery wagon with flat wheels was, apparently, 5 feet outside, and when the edge rail with flanged wheels bearing inside was used, the length of the wagon axles was unaltered, and the measurement of the inside gauge being 4 feet 8½

inches that ultimately became the standard gauge.

Various forms of motive power were tried, stationary engines working cables, pneumatic or "atmospheric" tubes, and even sails, but Trevethick, experimenting with an engine mounted on a carriage, discovered that by the transmission of the engine power to wheels on the axles, a carriage could be propelled along a railway, and the mere adhesion of smooth moving wheels to the rails provided tractive power. George Stephenson followed in 1825 with his "locomotion," which was used on the newly-opened public railway between Stockton and Darlington, and in 1829 in a competitive trial on the Liverpool and Manchester line, the prize of £500 was awarded to him and Henry Booth for the famous locomotive the "Rocket." The principal conditions of this competitive trial provided that the engine should not weigh more than 6 tons, have a speed of 10 miles per hour, be capable of drawing a train of 20 tons if the engine weighed 6 tons, and the price should not exceed £550. The outstanding features of the "Rocket," still retained in the most modern types, were the tubular boiler with the water outside the tubes, and the blast pipe which carried the used steam from the cylinders to the

chimney, and created an induced draught which obviated the use of bellows.

With the success of the "Rocket" and the Liverpool and Manchester Line, the practicability of steam power for transport was made clear, numerous new lines were projected, and the modern railway thus originated has exercised, with the steamboat, an incalculable influence in the advance of civilization. The development of the resources of Great Britain, the westward expansion of North America, the organization of the resources of India and consequent amelioration of famines, were all impossible without the building of the railways.

Railways or modern transport, as a whole, are not alone responsible for even the industrial contribution to that development, but they were, and are, an essential part of it. That the light internal-combustion motor vehicle running on twentieth-century roads has reduced the advantage which the nineteenth-century railways had over horse-drawn vehicles on the roads of McAdam and Telford, is undoubted. Motor-cars have penetrated into regions where the railway could not economically go and have created a large amount of new traffic, apart from short distance and light traffic previously carried by rail; but the enormous quantity of traffic which

the railways now carry could not be conveyed by road. Save in a few special areas where traffic is sparse, the need for and economy of railway communications is undoubted, and in many parts of the world there are no other means of transport by land.

Before the construction of a public railway in Great Britain can be commenced, it is necessary to obtain the sanction of Parliament. Any owner of land, subject to the by-laws of local authorities, can build a railway line for his own use, and there are many such lines ; but if he wishes his line to cross a public road, an Act of Parliament must be obtained. To do so, it is necessary to comply with certain Standing Orders of Parliament before even a Bill is read. The route must be surveyed, plans deposited with the various local authorities through whose areas the line is proposed to be built, notice of intention to apply for a Bill advertised, and written notices served on each owner or occupier of property which it is proposed to take compulsorily. The actual Bill, accompanied by plans, estimates and other details of the proposals must then be deposited with the Parliamentary examiners of Private Bills, and a deposit of 5 per cent. of the estimated cost of the railway is required to be made as security for its com-

pletion. When the Bill becomes an Act the promoters are incorporated into a Statutory Company, in contradistinction to a Company registered under the Companies Act, and the Act and the General Acts incorporated with it take the place of an ordinary Company's Memorandum and Articles of Association. The Act so obtained authorizes the Company to acquire, by compulsion if the price is not agreed, the lands, way-leaves and other rights described, to raise capital and to work the railway. In turn, the Company is placed under a number of obligations; the quantity and nature of its capital is determined, it must not undertake businesses beyond the scope of its authority from Parliament, it must not run trains to convey parties to a prize-fight, it must provide smoking compartments on its trains and means of communication between passengers and the guard where a train travels twenty miles without stopping, and it must satisfy the Ministry of Transport on a number of matters connected with public safety, such as the signalling arrangements and the suitability of the bridges, tunnels and other works. These, and many other obligations follow the obtaining of railway powers, but the chief obligations after the initial stages are in relation to rates and fares chargeable to its users, and the compiling and

publishing of accounts and statistics of its working.

But of the Bills which are proposed, many do not become Acts of Parliament. A Bill, when it has complied with all other formalities, is remitted to a Committee of Members of either House, and many persons have the right to appear before that Committee as objectors to the Bill as a whole, or to seek the deletion or modification of particular powers sought, or to have new clauses inserted for their protection. Landowners whose property it is proposed to acquire, or who fear the proximity of a railway will harm the amenities of their property, local authorities, trade associations, and persons with whom the proposed railway may compete, are all entitled to be heard. When one House has finished with the Bill it goes to the other and, as contested proceedings before a Parliamentary Committee are expensive, it has frequently happened that "ransom" terms have been given to objectors rather than that the promoters should stand the racket of a prolonged fight in Committee. On the other hand, there have been instances where landowners, after receiving compensation for land taken for railway purposes, voluntarily returned part or whole of the payment when they found that their property had

not deteriorated to the extent anticipated, or that it had, in fact, benefited by the making of the railway.

In Great Britain the railways, with minor exceptions, were built without State aid, and usually to connect the existing towns and sea-ports, and it followed that they were largely constructed on land already developed through manufacturing areas, with a consequent heavy expense in the acquisition of land and compensation for disturbance of its occupiers or interference with their amenities, and compensation had also to be paid for interference with the profit-earning capacity of interests affected by the construction of the railway, including existing transport agencies. The early railways in Great Britain were strenuously opposed by the land-owning interest, who generally supported the proprietors of the canals and turnpike roads. The great landowners who, with the restricted franchise, then largely controlled the affairs of Parliament, not only retarded railway construction, but placed many burdens on the authorized railways, which are still borne by them.

In America the position was different. The earliest railways there, as in Great Britain, were built to meet the requirements of developed localities and industries, but as their poten-

tialities were recognized, there was a clamorous demand for railway construction to open up vast undeveloped regions. Construction was facilitated at little cost beyond that of the physical work, and in many cases State aid was given the promoters. Capital subscriptions, gifts of cash, exemptions from taxation, exclusive grants of development rights and other privileges were inducements offered ; and when these failed, the State itself undertook both construction and operation of new lines. In both the United States and Canada such assistance was given and the Canadian Pacific Railway, one of the largest privately-owned railways in the world, was granted large tracts of land for its construction, including a wide margin on each side, and still possesses millions of acres of land apart from that required for its tracks and buildings. Similarly, Congress of the United States, and many of the individual States, assisted railway construction by grants of many millions of acres of land. In the poorer parts of Ireland, and in a few parts of Great Britain, State assistance has been given for the construction of railways, but the lines so constructed are unimportant and usually a burden upon the Company working them.

Not only did the public attitude to railway

construction differ greatly in the two countries, thus swelling the preliminary expenditure in Great Britain in comparison with that in America, but British construction costs were greater. The land acquired had to be fenced off, bridges built over many roads and canals, and station accommodation built in towns where land had a high value ; all expenses which weighted the cost of construction and sometimes cramped the plans of the promoters and caused further expense, when later on the development of traffic necessitated the widening of tracks and the improvement of station accommodation. The British permanent way was laid down expensively but, as it has turned out, economically, easy gradients and curves were made, and bridges were constructed of substantial masonry with resultant economy in operating and maintenance expenditure. In America the lines did not require the same elaborate expenditure but, in addition, they were often laid at a minimum expense, regardless of the future, though many of the original deficiencies have since been made good by expenditure of capital or revenue moneys. The American expenditure, on the other hand, was frequently inflated by the practice which grew up of building railways by construction companies who, by various peccant

devices, loaded the railway capital with unnecessary charges and then sold the lines to operating companies. This practice was facilitated when the operating company was controlled by a company which also controlled the construction company. While at various times similar manipulations have taken place in Great Britain, these have been exceptional, and the reason is found in an identity of interest between the promoters and the owners of much the greater part of the British railways. The first railway prospectus to be issued was, probably, that of the Liverpool and Manchester Railway in October 1824, and many of the original capital holdings in it have remained unaltered and are now merged in the capital of its successor, the London Midland and Scottish Railway. In the early years of railway construction there was an immense amount of speculation in railway shares, including those of undertakings which failed to obtain powers to build their proposed lines. In Mr. F. W. Hirst's book on *The Stock Exchange*, in this series, this phase, known as "the railway mania," which culminated in the Stock Exchange crisis of 1847, is discussed. Out of it, the main British lines emerged with safety and their securities have taken a high place in public opinion, second only to those guarantee-

by taxes or rates, thus enabling capital to be provided at low rates with a consequential reduction of railway costs.

Reference was made earlier to the fact that the width of the colliery wagons determined the "standard" railway gauge of 4 feet 8½ inches; but for a long period there were two rival gauges. The 4 feet 8½ inches gauge prevailed in the North of England, but there were a number of other gauges, and Brunel, in building the original Great Western line, adopted one of 7 feet. There was keen rivalry between the two main gauges which, in the end, was settled by Parliament in favour of 4 feet 8½ inches and, as late as 1892, the last of the 7 feet track was converted to the standard gauge. In Ireland there was a variety of gauges and the line which now connects Dublin and Belfast was commenced by two companies—from the Dublin end at a gauge of 5 feet 2 inches and from the Belfast end at 6 feet 2 inches. One company objected and was informed that though the two ends were made there was little likelihood of the intervening section ever being built. Following the usual British practice in Irish matters, a compromise was effected and 5 feet 3 inches was made the Irish standard because, it is suggested, that was the average of all existing systems. There is a second or "narrow" gauge

in Ireland of 3 feet in use in twelve separate sparsely populated areas, and it is improbable that the advantage of continuous rails would there warrant the cost of standardization. Similar gauge difficulties arose in the United States where the early lines using British-built locomotives were, necessarily, to the British gauge; but ultimately the standard of 4 feet 8½ inches was made general in North America and it is, also, the usual European gauge, except in Spain, Portugal and Russia. In Great Britain there are a number of unimportant exceptions to the standard, nine other varieties with a total length of 150 miles being in existence. If the origin and course of railway development had been different, it is probable that a wider gauge than 4 feet 8½ inches would have been laid, but it is unlikely that the British standard will now be altered, and, on the whole, it is a suitable one. The same conclusion cannot, however, be reached regarding the British "Construction Gauge" which governs the height and width of the locomotives and vehicles. The early tunnels, bridges and other works were constructed when the size of locomotives and vehicles which could safely run on the 4 feet 8½ inches gauge was not contemplated, and the stock requires to be built to conform to the minimum clearance governed by

the width and height of such works, known as the "Loading Gauge." Although the main lines of the various companies have standard loading gauges, each has many sections where further restrictions apply, and the largest rolling stock cannot be run on such sections. As opportunity offers, the old works are altered to give greater clearance and a gradual improvement has thus been effected, but the low loading gauge has cramped the locomotive and rolling stock designers, and the large stock employed in other countries could not run on the British tracks. In this respect the British railways have suffered owing to the substantial nature of early construction work and the process of improvement has, necessarily, been slow.

Before we consider in more detail the various branches of railway working, the following round figures deduced from the Ministry of Transport Railway Returns for 1926 will give a broad idea of the financial aspects of the British railways. The coal stoppage of 1926 and the severe trade depression of the past few years have seriously upset the railway revenues, and the normal gross railway earnings, assuming the results are as contemplated by the Railways Act 1921 (as explained later), are estimated to be 210 million pounds per annum and are substituted for those of 1926.

The capital expenditure was, roundly, 1,200 million pounds, made up of :

	Millions. £
<i>Way and Works—</i>	
Railway lines, stations, bridges, tunnels, signals and other works with land therefor	900
<i>Working Stock—</i>	
Locomotives, carriages, wagons and workshops	180
	<hr/>
<i>Total Railway Capital Expenditure</i>	1,080
<i>Other Businesses—</i>	
Docks, steamboats, canals, hotels, surplus lands and other non-railway property	120
	<hr/>
<i>Total Capital Expenditure</i>	1,200
The receipts from capital subscribed by the public were	1,150
	<hr/>
leaving for capital expenditure temporarily provided out of reserves and various other sources	50
	<hr/>
	Millions. £
The normal railway receipts per annum are estimated at	210
and the working expenses, less sundry credits, at	160
	<hr/>
making a net receipt from railway sources of	50
together with net receipts from other sources of	3
	<hr/>
making a total net revenue of	£53
	<hr/>
or 4.6 per cent. of the capital receipts.	

ORIGIN AND DEVELOPMENT 37

The railway users contributing the receipts of 210 millions pay the working expenses and remunerate the capital employed, and an approximate allocation of this sum would be :

	Working Expenses (Less Sundry Credits). Millions. £	Return on Railway Capital of £1,080 Millions. £	Total. Millions. £
Use of way and works	23	42	65
Use of working stock	27	8	35
Operating expenditure	95	—	95
General expenditure, rates, etc.	15	—	15
	<u>£160</u>	<u>£50</u>	<u>£210</u>

The average railway user paying £1 for conveyance of himself or his property therefore pays for each of the following items :

	Working Expenses.	Return on Railway Capital.	Total.
	s. d.	s. d.	s. d.
Use of way and works	2 2	4 0	6 2
Use of working stock	2 7	0 9	3 4
Operating expenditure	9 1	—	9 1
General expenditure	1 5	—	1 5
	<u>15 3</u>	<u>4 9</u>	<u>20 0</u>

and the last item includes about 10d. for local

rates, National Insurance, etc. Income-tax is not included, as that is a liability of the individual recipient of the payment for use of capital. It may also be estimated that approximately 10s. 6d. out of the working expenses of 15s. 3d. is paid in remuneration of labour directly employed by the Railway Companies, apart from labour employed by them in respect of other businesses and capital expenditure.

CHAPTER III

WAY AND WORKS

THE description "Way and Works" embraces the land occupied by the railway, and the lines and other fixed property required for the passage and handling of traffic, including its reception, storage and discharge. As we have seen, 900 million pounds of the capital expenditure on British railways is invested in Way and Works, the maintenance of which (23 millions) and remuneration (42 millions) represents 65 million pounds per annum, or *6s. 2d.* in each pound paid by the users of it. At the outset, it is necessary to make clear the general principles which govern the charge of expenditure to capital account in Great Britain. When a new line is constructed, capital account is charged with the actual cost to the company of the land purchased, of compensation for damage to other property not acquired, and of the cuttings, embankments, tunnels, bridges, signals, yards, railway track and stations, etc., and until the

works cease to be used, this expenditure remains unaltered in the capital account. When perishable works, such as the running lines and buildings, are worn out, the cost of replacement is charged to revenue as "Maintenance of Way and Works," either directly or through an equalization reserve which is built up out of charges to maintenance during the life of the works. If, on replacement, an improvement is effected, such as the installation of a heavier type of rail, or the enlargement of a station, the amount of the expenditure represented by the current cost of replacing the equivalent of the old work is charged to maintenance, and the balance is charged to capital account. An illustration may make this clearer. A building which originally cost £5,000 to construct in 1888 may require to be rebuilt in 1928. If rebuilt to the 1888 design the cost, owing to the rise in price levels, would be £9,000, but to meet new traffic conditions, a larger or better equipped structure is ordered which costs £12,000, and this is allocated—£9,000 to maintenance, representing the cost of making good the old asset—and £3,000 to capital, representing the additional asset provided. If, on the other hand, the building be no longer required, the amount of £5,000 standing in capital account against it

would be written off. It will be seen that the capital expenditure account disregards changes in value of money, and until an asset ceases to be necessary, it is retained in capital at its first cost, however often it may be renewed. Capital expenditure does not, therefore, represent either the present value of the assets, or the cost of their construction at the present time, and there is no writing up or down of values during the life of the assets or at their replacement. It is not suggested that this method has invariably been applied by each of the many companies during the past 100 years. In that time capital expenditure has, no doubt, been both overcharged and undercharged, according to the point of view of the then management, but the method explained has gradually been developed and is now generally applied. There is one conservative exception. It may happen that necessary expenditure which would be a charge to capital under a strict application of this method is not charged to capital because it has no value in earning revenue or economizing expenditure. In such cases a prudent company will meet the expenditure out of its current profits, or out of sums provided by its past profits. The reason for the stabilization of expenditure on capital assets in railways, a practice differing from that

operating in the case of companies created under the Companies Acts, is sometimes misunderstood. It is based on the general principle that a statutory company, such as a railway company, is the owner of a State concession, which is authorized by Parliament to perform certain services subject to regulation of the charges to be made therefor. These charges, in so far as they represent use of capital, do not vary with price levels, and Parliament has neither increased nor decreased them when the purchasing power of money decreased or increased, and in the Railways Act of 1921, the governing principle is the fixation of railway charges at a level which, apart from the remuneration of new capital, etc., will always yield the 1913 level of profits in terms of currency at any particular time and not in terms of the purchasing power of the profits in 1913. In the United States, a different basis has been adopted, as under the Transportation Act of 1920 the rates are to be fixed to yield a fair return (now determined to be at the rate of $5\frac{3}{4}$ per cent.) upon the value of the undertakings, and the profits aimed at will, apparently, rise or fall with the variations in the value of the railway property due to variations in price levels. American practice, generally, has varied considerably from that in Great Britain, and the

accounting procedure required in the United States necessitates the capitalization of the increased cost of renewals solely due to a rise in prices with, of course, a decapitalization if the reverse applies. In addition, American practices have resulted in the "watering" of capital by the writing-up of the apparent capital expenditure, and the issue of stocks opposite such increase in book values. There is no trace of a similar practice in Great Britain in modern times, and whether it occurred in the years before 1868, when the precise form of Accounts was first regulated, is not ascertainable, though the Parliamentary control of stock creations probably prevented it. The present-day cost of replacing the Way and Works is a speculative figure, but when regard is had to the rise in wages alone in recent years, it can safely be assumed that the cost would very largely exceed the 900 million pounds expended, even if the lines were planned to meet present conditions only.

The land acquired for the property when constructed, the compensation paid to interests affected, and the cost of the cuttings, embankments, and road-bed, represent permanent assets which not only remain at a stable amount in the capital account until they cease to be used, but

require little expenditure to maintain them. There is a certain amount of maintenance expenditure in dealing with slips in the slopes of cuttings and embankments, and making good subsidences, but this is relatively small. In Great Britain, following the example of Telford and McAdam in laying out the turnpike roads, the railways were originally planned with the easiest gradients practicable, having regard to the country to be traversed. The gradient is the rate of rise or fall expressed as a ratio of vertical to horizontal measurement. Thus if over, say, 400 units, there is a rise or fall of one unit, the gradient is described as a rising or falling one of 1 in 400. The steepest gradient on any section of line is known as the "ruling gradient," because it rules the maximum weight which an ascending locomotive can haul over it, and, therefore, rules the maximum weight of trains on that section. The curvature of the track is also of importance, as it causes increased resistance to traction, which the locomotive has to overcome, and it is, therefore, desirable that curves should be as easy as possible. In addition to the resistance due to the curve proper, centrifugal force acts on a train running at speed round a curve, by reason of the outer wheels pressing upon the outer rails. This force is, to

some extent, counterbalanced by building the track with an inward slope, termed super-elevating the outer rail, and where sharp curves occur a maximum speed which may be run is laid down to ensure safety in rounding them. On curves of under 10 chains radius a third, or a check, rail is laid inside the inner rail, and this, bearing against the back of the flange of the inner wheels, affords additional security. Generally, the British railways were laid, even in the earliest times, with easy curves and gradients, necessitating considerable expense in building earthworks, bridges, and viaducts, and in driving tunnels or making deep cuttings. On the original passenger railway from Liverpool to Manchester there is a well-known instance of this, where the engineer, George Stephenson, built an embankment for $4\frac{1}{2}$ miles across a bog known as Chat Moss. The foundations were obtained by laying hurdles and brushwood on the bog and constructing upon them an embankment which contained 670,000 cubic yards of material. The lines from Euston, St. Pancras and King's Cross stations all required expensive tunnelling in order to pass through the ridge of high ground to the North of London. The Severn Tunnel and the Forth Bridge are further instances of very expensive works constructed to

overcome natural obstacles, rather than to avoid them by making wide detours from the direct line. Works of this nature represent large portions of the capital expenditure of the British railways, but they reduce the direct cost of haulage, either by saving in locomotive power in ascending gradients or in reduction of the length of haul. The annual cost of remuneration of such capital expenditure forms part of the current cost of transport by rail, and the heavy initial expense incurred in the lay-out of the British railways has permitted the original tracks, without extensive alterations, to carry an immense volume of modern traffic at low operating charges. The American railways are a notable contrast, as, partly owing to lack of capital funds and partly to a difference between the national temperaments, they were not built so substantially as those in Great Britain. With usually an abundant supply of timber, impermanent wooden trestle bridges were generally built in America where, in similar circumstances, iron or masonry was used in Great Britain. This difference in construction methods has necessitated the spending of large sums on the maintenance and improvement of American railways and much of the railway property has since been rebuilt on more permanent lines, with easier

gradients and curves, in order that the huge present-day trains may be handled. Some of the early American expenditure might appear to be uneconomical, but the methods adopted there, though unsuited to British conditions, were largely justified by the pioneer nature of the lines and the undeveloped country they opened up.

Though there has been but little alteration in the principles of construction of the railways since their inception, the rails and their fastenings are very different from those of 100 years ago. The rails of the original Liverpool and Manchester line were of wrought iron and about 15 feet long, weighing 35 lb. per yard, and resting on stone blocks. The life of these rails was short—numerous patterns were tried, and ultimately the present "bull head" rail was developed; made of steel, 30 to 60 feet in length, and weighing from 60 to 100 lb. per yard, according to the class of track. The life of the modern rail depends upon many circumstances; such as atmospheric conditions, the curvature and gradient of the line, and the density of the traffic. Near Widnes, the rails, owing to the chemical fumes emitted from the neighbouring works, have a perceptibly shorter life than elsewhere, and in damp tunnels or on heavy down

gradients, where goods trains run with brakes applied, the life is also reduced. The average life of rails on the main lines in Great Britain is about $21\frac{1}{2}$ years, and after that life has expired, about two-thirds of the rails have a further useful life in sidings and branch lines, where traffic is light. The rails on their vertical axes are canted inwards at an inclination of 1 in 20 towards each other, to conform to the wheel flanges, and rest in cast-iron chairs into which they are wedged on their outer sides with tapering oak "keys," the chairs being secured to the familiar "sleepers" or "cross-ties" by screws. Between the chairs and the sleepers a felt pad is inserted on some railways, and the sleeper is embedded, but not covered, in ballast. The sleepers, usually, are of Baltic Redwood, though other wood is sometimes employed, and are 8 feet 6 inches long, 10 inches wide, and 5 inches deep. The life of the sleepers is an important factor in maintenance costs, and before they are placed in the track they are each impregnated with from $2\frac{1}{2}$ to 3 gallons of creosote to preserve them from decay. The recovered sleepers have a substantial value—some are re-used on sidings and colliery lines, others are used for fencing or other purposes, and when at last their useful life has expired, they are used as

firewood. Earlier mention has been made of the use of stone sleepers, and on the Liverpool and Manchester and the London and Birmingham lines, stone blocks were originally used, but they were found to require constant attention and were displaced by the timber sleepers of today, though a few are still in existence in little-used sidings. More recently, many experiments with steel and reinforced concrete sleepers have been tried, but with unsatisfactory results, and the general experience is that for Great Britain the creosoted wooden sleeper is the most satisfactory, and yields the longest life at the lowest cost per annum. In foreign countries, particularly where attacks from insects are troublesome, steel sleepers are in use, but so long as suitable timber can be brought into Great Britain at a reasonable price, it is improbable that metal or concrete will take the place of the timber sleeper.

On the Northern Pacific Railroad, in the United States, trials of concrete tracks have been made but, apparently, they were not successful. In December, 1926, an experimental reinforced concrete track, one-quarter mile in length, was opened on a section of the Pere Marquette Railroad in Michigan. The rails are bolted without sleepers to stirrups embedded in the concrete,

and the method of construction is fully explained and illustrated in the *Railway Age* of 8th January, 1927. The test will be an interesting one to engineers, and if it is found that the loss of resilience is immaterial, and that the concrete bed will not break under the incessant hammering of the locomotive wheels, the results may be far reaching. Should the experiment prove a success, the daily work upon the track will be much reduced, and if the road bed has a reasonably long life, the economy in maintenance will be marked.

Ballast requires careful selection, as it must be capable of gripping the sleepers, and be easily handled and weather-resisting. While broken basalt or granite is, perhaps, the most suitable material, it is expensive and is not obtainable in every district, and furnace slag is a substitute, and when neither stone nor slag can be obtained with economy, pit gravel or engine ashes are used. On the main lines in Great Britain, after extensive use of high-grade ballast, carefully attended and drained, a firm and lasting track has been built, which now requires only a moderate quantity of stone to be used when the sleepers are renewed.

The "bull head" track, supported by chairs on sleepers at intervals averaging $2\frac{1}{2}$ feet,

embedded in high-grade ballast, is claimed by British engineers to be the smoothest running and safest track in the world, but American engineers, though agreeing as to its comfort and solidity, prefer a rail shaped like an inverted T. This requires no chairs and is merely spiked to the sleepers, though in recent years, as heavier rails are laid, steel plates are placed between the rails and sleepers, partly to lengthen the sleeper life and partly to distribute the stresses on the rail fastenings more evenly. The comparative advantages of the two classes of rail are strongly contested on various technical grounds, which cannot here be examined at length. To the layman, the T rail appears to be one which is more easily laid and adjusted than a "bull head" rail, but a considerable portion of the weight of the former is required to function in place of the chair. While 95 lb. per yard is the usual weight of ordinary "bull head" rails on first-class tracks in Great Britain (there are certain exceptions for special purposes), T rails weighing 150 lb. to the yard are now extensively used in America. The American preference for the T rail may have originated for the reason that large quantities of high-grade oak sleepers were available at small prices, but had the available wood been soft, the use of chairs and "bull

head" rails might have been preferred. Whether with the growth in weight of locomotives, chairs and "bull head" rails will ultimately be required in America, is a matter of speculation. There are some small stretches of T patterns of rail in use in Great Britain and Ireland, but they appear to be gradually giving way to the "bull head" pattern.

The length of rail used has grown from 3 or 4 feet to 60 feet since the first lines were laid, and as the joint is the weakest part of the track, the increased length has reduced maintenance and added to the traveller's comfort, but the additional expense of handling long rails (a 60-foot rail 95 lb. to the yard weighs 17 cwt.) places a restriction upon their practicable length. The rails at their joints are connected together with "fish plates" to preserve their continuity, but as a 60-foot rail in Great Britain will, between winter and summer temperatures, expand appreciably, continuous contact of the rails is not feasible. A patent was once taken out for hollow rails which were to be filled with hot water in cold weather, so as to prevent ice forming on them and causing the wheels to slide! Perhaps the inventor also had in mind continuous rails which would be kept at an even temperature to avoid expansion or contraction.

An expensive item in track construction, over and above plain road-track work, is the installation of points and crossings to enable trains to move from one line of track to another, and the additional cost occasioned in their construction may be seen from the following British figures in 1925 :

	£
The cost of re-laying one mile of average track if there are no points and crossings is	3,980
but the average mile of track requires an expenditure upon points and crossing work, in addition to the plain track included above, of	540
	<hr/>
making a total of	£4,520
and as the material removed from the old work is worth	1,520
	<hr/>
the net cost of a mile of re-laying, including points and crossing work, is	<u>£3,000</u>

These figures exclude the cost of the signals and their connexion with the track.

The elaborate modern signalling installations have evolved from very primitive arrangements. The first signals were given by hand by railway policemen who were stationed at intervals along the line, but as the speed, number and variety of the trains increased, the need for more adequate protection became evident, as it is

becoming evident on the motor roads of to-day. During the French wars the first "telegraphs" had been installed in France and Great Britain. Poles with semaphore arms were erected at intervals and, by a system of codes, messages were relayed from post to post by manual operation of the movable arms; a means still used for communication between ships. The modern railway signal-post is an adaptation of the semaphore telegraph, but one of the earliest forms of mechanical signalling consisted of a post carrying a red and a green disc, one above the other, at each station. If a driver standing at a station saw the red disc turned against him, he was debarred from proceeding to the next station. If, however, the red disc were turned edgewise to him and the full green disc shown, he had authority to proceed. There was nothing, however, to indicate when a train had passed the next post, and that the section to which the disc applied was clear, and to overcome this difficulty, a time interval was established between each station, it being presumed that the road was clear for a following train at a fixed interval of time after the previous one had left. There was still no means of knowing that a train had arrived, but on the discovery by Wheatstone and Cooke of the practicability

of the electric telegraph, the use of it was applied to train working, and it became possible to learn by telegraph of the arrival of the trains at the far end of each section.

Gradually it was found that these methods of working restricted the use of the line, because of the distance between stations, and intermediate signalling points, ultimately known as block posts, were established between stations. The introduction of block working, which provided that bell and block indicator instruments electrically connected were established at all stations and block posts, was a big advance in train operation. Under a code of bell signals it is now possible for a signalman at one station to offer and describe the class of train to the block post or station ahead, and the acceptance of this train by the station ahead is shown on both block instruments and indicates that the line is under occupation. These block instruments are electrically interconnected with each other and, in some instances, are interlocked with the signals.

To-day, signalling apparatus, along with telegraphs, block working and telephones, regulate and control the movement of all trains on the track. The principle involves the connecting up of all points and signals to a common operating point, namely, a signal-box or ground

frame, from which they can be manipulated for the instruction and control of engine-drivers in such a way as to ensure that no two paths for a train or train movement, which would result in trains colliding, can be given simultaneously. This security is provided for in the frame into which the levers operating points and signals in the cabins are built. This frame is so constructed that the pulling over of a sequence of levers, authorizing a train movement, operates a locking system in the frame, which locks up and prevents the movement of all other levers, which, if pulled, would authorize a conflicting train movement.

The familiar inclined or "off" (meaning line clear) and horizontal or "on" (meaning stop) positions of the signals, with green and red or yellow lights at night, appear very complicated at busy junctions, but they are quickly read by the engine-drivers, who are not permitted to work trains on any section until they are acquainted with it. All the signals governing the direction in which a train is moving are, in Great Britain, to the left of the signal posts; and counting from the left, or downwards if vertically below one another, a group of signals refers to the corresponding lines counting from the left. Those signals with a deep > shaped

end, known as distant signals, may be passed in the "on" position, as they merely warn the driver to reduce speed because the next or "home" signal is at danger and cannot be passed. On the other hand, if the driver finds the distant signal is "off," a reduction of speed is unnecessary. Were it not for this device, an express train would require to slacken speed for every "home" signal, unless it could be seen sufficiently far away to stop at it if it were at the "on" position. Where a signal is not visible from the signal cabin, an electrical "repeater" in the cabin shows the signalman if the signal arm is responding to his lever movements and whether the signal lamp is lit. There are many varieties and amplifications of these general signalling arrangements—such as automatic movements of signals by passing trains, substitution of coloured lights by day as well as night for the semaphore arms, and locking of signals and points by track circuits—all aimed at eliminating the risk of accidents.

All the other permanent works which go to make up the railway are included in the general description of Way and Works—i.e., the stations, platforms, warehouses, engine sheds, workshops, turntables, fixed weighbridges, water tanks, etc.—and though they require substantial annual

charges for their upkeep, they do not present many special features. Public roads, however, are peculiar. Where, in constructing a railway, a road is carried over the line by an embankment, Parliament has properly placed upon the railway company an obligation to build and maintain the necessary bridge, but a further obligation is placed upon the company to maintain the road surface on the bridge and its embanked approaches, and the road maintenance authorities are thus saved considerable sums which they would have to provide had the railway not been built. On the other hand, a railway company is not required to rebuild its bridges if, owing to a change in the character of the road traffic, a stronger bridge is required. When, therefore, the needs of modern road transport call for stronger bridges over the railway lines, the additional strength in these bridges is paid for by the road authority, who also frequently undertake the maintenance of the road surface in consideration of a capital payment by the company. Such payments relieve the future railway working expenses, but there is an additional charge to be met for remuneration of the capital sum paid. This further illustrates the complementary nature of capital expenditure and working expenditure,

and the necessity for having regard to both in considering the cost of conveying traffic. If a railway company by spending one million pounds of capital, which it can raise for $5\frac{1}{2}$ per cent. or £55,000 per annum, can reduce its total working expenditure by £56,000 per annum, it has reduced its true cost by £1,000 per annum, and not by the £56,000 shown as the diminution of working expenditure. This underlying principle is often overlooked, and its great importance in considering railway finance is emphasized by the fact that the gross receipts per annum under normal post-war conditions represent $19\frac{1}{2}$ per cent. of the capital outlay—a percentage which overstates the relationship when it is remembered that the capital is mainly at pre-war cost and the receipts are at post-war values. If the receipts be scaled down to compare with 1913 rates, the proportion is reduced to about 12 per cent. That preponderance of railway capital in ratio to annual receipts or turnover as compared with similar figures in ordinary industrial and motor transport undertakings is largely due to the enormous amount of capital that must be expended before any revenue can be earned, owing to the expensive nature of the permanent Way and Works. Of that expenditure, a large part is laid out in providing that the tractive

energy employed upon the road may be used with the utmost economy, by the reduction of the resistance to be overcome by the locomotives; and a further large part is laid out to enable high-speed traction to be performed in safety.

CHAPTER IV

WORKING STOCK

THE term "Working Stock" comprises the locomotives, carriages, and wagons, and it has earlier been explained that the capital cost, including manufacturing works and plant, of the British working stock was 180 million pounds, and that their use represents 35 millions out of the receipts of 210 million pounds per annum, or 3s. 4d. in each £ paid for use of the railways.

This can further be sub-divided approximately, thus :

	Loco- motives. Millions. £	Car- riages. Millions. £	Wagons. Millions. £	Total. Millions. £
Capital Cost . . .	60	55	65	180
Annual Charge—				
Return on capital . . .	2.6	2.5	2.9	8.0
Maintenance . . .	12.9	7.2	6.9	27.0
Total . . .	<u>15.5</u>	<u>9.7</u>	<u>9.8</u>	<u>35.0</u>
Per £ of Receipts	<u>1s. 6d.</u>	<u>1s. 10d.</u>		<u>3s. 4d.</u>

The annual charge represents merely the cost of providing and maintaining the stock, and does not include the cost of working and cleaning it, which is covered by the operating expenses.

The locomotive charges are in respect of 24,000 locomotives and 2,000 motors, mainly electric, forming part of motor carriages; the carriage charges are in respect of 51,200 passenger-carrying and 21,600 other vehicles, such as mail, guard, fish, horse, fruit, etc., vans; and the wagon charges are in respect of 721,000 freight train vehicles, apart from certain vehicles used for railway service purposes.

In addition to the railway-owned stock, there are 189 passenger cars owned by the Pullman Car Company, and about 600,000 privately-owned wagons using the railway lines, but the railway companies' maintenance expenses for such stock are relatively unimportant.

The use of locomotives was a doubtful policy in England until the success of the "Rocket" in October, 1829, as a perusal of the Board Minute of the Liverpool and Manchester Railway Company makes clear. Weekly board meetings were held at which the question was discussed at great length, and the secretary and treasurer, Mr. Henry Booth, appears to have

been the leading advocate of the locomotive. In April, 1827, he reported that he had discovered a method of producing steam without smoke, and Mr. George Stephenson and he were authorized to make experiments to decide the merits of the invention. In September and October, 1828, the relative merits of horses, locomotives and fixed engines with ropes were still being discussed, and in 1829, the danger of explosion and other ill-effects apprehended from the use of locomotives was considered, and, after several meetings, it was formally decided on 20th April, 1829, that "it would not be expedient, at the present moment, to adopt any system of moving power which would preclude the Company from Benefiting by any Mechanical Improvements in the conveyance of Carriages on Railways that may hereafter take place, and that therefore to determine on a system of Fixed Engines for the whole line would not be advisable." At the same meeting it was decided to postpone further discussion until "the locomotive engine" had been tried, and to advertise a prize of £500 for "the most improved locomotive." It was not considered essential that "improved moving power" should be provided by a steam engine, and the possibility of a gas engine was contemplated, but after the success

of the "Rocket" in October, 1829, there was no further doubt.

The Manchester and Birmingham Railway nine years later adopted the following general specification for their locomotives on the recommendation of their engineer and Stephenson.

SPECIFICATION FOR LOCO-MOTIVE ENGINES

The engines are to be constructed with six wheels. The centre, or driving wheels, to be six feet diameter and without flanges.

The fore and hind wheels to be not less than $3\frac{1}{2}$ feet diameter, and the distance between the centre of their axles to be exactly 10 feet.

All the wheels to have cast-iron naves with wrought iron spokes rivetted to the inner tire. If the Manufacturer prefer it, the wheels may be made according to Lash's patent.

The axles to have outside bearings, and adapted to working on a railway the clear width of which is 4 feet $8\frac{1}{2}$ inches between the rails.

The cylinders to be $12\frac{1}{2}$ inches diameter with an 18-inch stroke and fixed in a horizontal position.

The pistons to have metallic packing.

The slides to be worked on the principle of Mellings's patent.

The boiler to be made of the best wrought iron, the firebox of copper, and the tubes of brass.

The engine to be capable of drawing on a level a gross weight of 120 tons exclusive of the engine at the rate of 20 miles an hour.

The tender to contain not less than 115 cubic feet of water.

The preceding brief specification is for the purpose

of giving a general idea of the intended construction of the engines, the details being left to the choice of the Manufacturers.

The whole must be made and finished in the most perfect manner ; the workmanship not being inferior to that in the most approved engine now employed upon the Grand Junction and Liverpool and Manchester Railways.

GEO. W. BUCK.

1st August, 1838.

The subsequent stages in the development of the locomotive have been the subject of many books, and it is, in fact, the aspect of railway work, other than rates and charges, upon which most has been written in Great Britain, but one other historical note may be of interest. In 1838, the Liverpool and Manchester directors examined "a model of a contrivance for removing obstructions from railways, to be attached in front of Locomotive engines and called in America a Cow-Catcher." The contrivance was not adopted, as it was not required for the fenced railways in Great Britain, but at this early stage in locomotive history the distinct needs of each country were causing differences in the designs of railway equipment.

The steam locomotive is designed to perform three main functions—the generation of steam from water in its boiler, the application of the

expansive energy of the steam to create mechanical power in the cylinders, and the conversion of that power into tractive effort through the driving wheels—and it is the aim of every locomotive designer to correlate these functions to the best advantage.

The boiler consists of a cylindrical-shaped barrel fitted with longitudinal tubes. At one end there is the firebox or combustion chamber and the gases generated in it are conveyed through the tubes to the chimney. The tubes and the firebox, except under the grate, are surrounded with water which must be replenished to keep the tubes and plates covered, and the hot gases from the firebox convert the water into steam, which collects at the top of the boiler and in the dome which surmounts it. The steam is taken to the cylinders from the top of the dome, as there it is drier than at the water surface, and the drier the steam the greater is its efficiency. The action of the steam in a cylinder is, perhaps, most simply expressed as the reverse of the action in a syringe; the admission of steam into a cylinder forces a piston to the other end, and this force applied through a connecting rod to the axle of the driving wheel causes the wheel to revolve. The admission and exit of the steam to and from the cylinder

at each stroke of the piston is governed by a valve which, co-ordinated with the piston, is worked backwards and forwards and admits steam into each end of the cylinder alternately.

The tractive power which the locomotive can develop is governed by :

- (1) The pressure of the steam in the cylinders ;
- (2) The diameter of the cylinder and the length of the piston movement or " stroke " ;

- (3) The diameter of the driving wheels ;

and upon the sizes and proportions of the boiler and other parts, and their inter-relation, the efficiency of the locomotive depends.

The locomotive designer is limited in many ways by restrictions which do not affect the designer of stationary or marine engines ; the weight must not exceed on any pair of wheels the maximum which the permanent way and bridges can bear at the highest speed ; and the height and width must not exceed the " loading gauge," explained earlier. The boiler has of necessity to be placed above the axles of the driving wheels, and on large modern locomotives it is difficult to get space for an adequate diameter of boiler inside the restricted British " loading gauge." There is still, perhaps, room for in-

creased boiler pressures which will give the steam a greater expansive power, but the additions to the cost of boiler construction and maintenance as the pressure increases, have a deterring effect on the engineers' designs, though boiler pressures have increased from the 50 lb. to the square inch of the "Rocket" to 250 lb. in some of the most modern types. But apart from increased pressure, many other devices have been tried in order to obtain greater power from the steam generated. One, which is still controversial, is the "compound" type of locomotive. In the ordinary or "simple" locomotive, the steam when used in the cylinders is turned into the blast pipe used for creating a draught through the boiler, and escapes through it into the smoke-box and up the chimney. In the "compound" locomotive there are both high and low pressure cylinders and the steam, after acting at high pressure in the first cylinders, passes at a lower pressure into the second cylinders and is thus used again before it is turned into the blast pipe. The principal advocate of this type in Great Britain was the late Mr. Webb of the London and North Western Railway, who, in 1882, built the first of a series of types of compound engines, employing at first two high-pressure and one low-pressure

cylinders and, later, two high-pressure and two low-pressure cylinders. Three-cylinder compound locomotives were later built by the Midland Railway, and are still built by the London Midland and Scottish Railway for passenger express trains of medium weight. In France, and other countries in Europe, greater use is made of the compound type with two high-pressure and two low-pressure cylinders—but four-cylinder compounds although, as mentioned above, built by the old London and North Western Company, are not now being constructed in Great Britain. It is claimed by its advocates that the compound type is more economical than the simple type because of lesser coal consumption, and this superiority, though strongly urged by one school of engineers, is as strongly denied by another. Comparisons under like conditions are not often obtainable, and, in determining the relative value of two types of equal power, the quantity of coal consumed is only one factor, capital cost and maintenance being others.

In recent years the use of super-heated steam has received greater attention than compounding. By this invention ordinary wet or "saturated" steam is passed through a number of heated tubes before entering the cylinders, and in this

way the temperature is raised so that all moisture is removed from the steam and a greater volume is obtained. Many locomotives have been adapted or built with apparatus of this nature in the past few years, and though its greatest value is for passenger locomotives, freight locomotives in use for long journeys have also been super-heated, but it has not been thought necessary to instal superheaters on locomotives working on suburban services or shunting work, though this is done in America.

Most "simple" locomotives are fitted with two cylinders, sometimes placed "inside" and sometimes "outside" the frame, on each side of the locomotive. If "inside" cylinders are used, they require to be connected to a cranked axle between the driving wheels, but if "outside" cylinders are used, straight axles can be used. Outside cylinders are preferred in America on account of the greater simplicity of the drive and readier access to the parts, but in Great Britain the inside position is usual if there are only two cylinders. The British preference for the inside cylinder design is attributed to its compactness; the fact that radiation losses are diminished; and the lesser tendency to a lateral swaying when running, because the reciprocating forces are applied closer to the longitudinal

centre line of the locomotive. The most recent large passenger locomotives of the London and North Eastern and London Midland and Scottish Companies are fitted with three cylinders, one inside and two outside; but the Great Western and Southern Companies prefer four cylinders, two inside and two outside.

The diameter, number and arrangement of the locomotive wheels are more obvious to the casual observer than other parts of the locomotive, and it is by wheel arrangement that locomotives are now generally classified. The wheel notation is divided into three groups, of which the second represents the driving wheels, and the first and third the carrying wheels at each end. The first number, therefore, represents the carrying wheels, if any, in front of the driving wheels, the second the driving wheels, and the third the trailing wheels, if any. Where the locomotive is not fitted with the first or third group, that is indicated by a nought—(e.g. a 0-6-0 locomotive has 6 driving wheels and no front or rear wheels). When driving wheels only are provided, the whole of a locomotive weight is termed "adhesive," but its speed, owing to the single rigid base consisting of driving wheels only, is restricted to lower rates than where there are two or more sets of wheels. For freight-train traffic

in Great Britain the total adhesion or all driving wheel type predominates, usually 0-6-0 or 0-8-0, with wheels of from 4 feet 6 inches to 5 feet 3 inches diameter, though there is a considerable number of the 2-6-0 and 2-8-0 types. In America, leading wheels are usually provided on freight locomotives, and the chief types are the 2-8-2 and 2-10-0, described as the "Mikado" and "Decapod" respectively. For shunting purposes, the all driving wheel type, usually 0-6-0, is general. Fast passenger train locomotives require a flexible wheel base, and four leading wheels on a separate "bogie" is practically universal. In Great Britain, the 4-4-0 type is used for express passenger trains of medium weight and the 4-6-0 or 4-6-2 type for the heavy trains, while in America the passenger trains are chiefly worked by 4-6-2 and 4-8-2 locomotives. Another important division of locomotives is between tender and tank types. The tender is a separate unit with 4, 6 or 8 wheels conveying, in Great Britain, from 3 to 8 tons of coal and from 2,000 to 5,000 gallons of water, but in America, with much longer journeys, tenders with a capacity of 15 to 20 tons of coal and 10,000 to 18,000 gallons of water are used. In the tank type, the coal and water is carried on the main frames of the

locomotive, the coal usually at the rear, and the water either at the sides or in a "saddle" tank on top of the boiler. In Great Britain, locomotives designed for shunting only are of the tank type, and owing to the ease of working in either direction, many tank locomotives are built for suburban passenger services, where the runs are of moderate length, even though high speed is required. Notable instances of their use are on the fast trains between London and Southend, London and Brighton, and Manchester and Blackpool. The development of the locomotive has been steadily in the direction of obtaining greater power and the many variations in design have all been to that end. Greater speeds have not been the aim in most cases, the need to make the most economical use of the tracks being the incentive, and there has been a continuous growth in the weight of trains. As a heavy train, within reasonable limits, is more cheaply hauled per ton of traffic than, say, two light trains of the same capacity, the provision of the stronger and more expensive locomotive illustrates further the purchase of cheaper operating cost at the expense of additional maintenance and capital cost of equipment.

A brief reference to electric locomotion is

necessary. If electric power is used, it is obvious that the generation of power at a central station has many advantages denied to the generation of power on the locomotive. There is the further advantage that a high power can be taken from the transmission lines when starting and accelerating, by the use of electricity, and the consumption of power reduced when the speed desired has been attained. On the other hand, the distribution costs of electricity increase rapidly as the point of delivery is removed from the generating station; as although electricity can be transmitted at high voltage, and transferred to low voltage before delivery to the train, the cost of transmission is greater than the cost of generation, and increases rapidly with the distance on account of the high capital cost of the transmission plant. While for busy services with frequent stops within a fairly short radius from the power station electricity has displaced and will continue to displace steam power, there does not appear to be any prospect of electrification of long distance trains or lines where traffic is light, until a supply of electricity at low cost at the point of user is assured. The cost of generation at the power station is not the deterrent for electrification; the serious factor is

the cost of supplying the transmission equipment.

In the development of passenger vehicles there has been a great advance since the first railway "Coach" ran, and little is left of it except the name. Not only the name, but the design followed that of the Stage Coach, and the road vehicle, merely adapted to run on rails, was the first type of railway coach. "Dickey" seats were provided for the servants of the inside passengers and the third-class coaches were simply uncovered wagons, with seats laid across, in which passengers undertook all-night journeys. The first step towards greater comfort appears to have been the draw-bars with screw couplings invented by Mr. Booth. Roofs were soon added to the third-class carriages, the length of the vehicles increased, and six wheels were required; but the British railways were slow to adopt the system, which originated on the Baltimore and Ohio Railroad in 1833, of building carriages with two four-wheeled "bogie trucks"; a device which lessened the rigid wheel base and enabled curves to be taken at greater speeds. The four-wheeled bogie has now given way, on very long carriages, to the six-wheeled bogie, but there are still many non-bogie carriages in use on branch lines. On the suburban lines,

where there is a heavy passenger traffic, trains are often made up in sets which are not divided between overhauls, except where an accident or defect necessitates the withdrawal of one carriage. The London and North Eastern Company have gone further, and built sets of carriages for both suburban and long-distance traffic on an "articulated" (or jointed) system. Sets of 2, 3, 4 or 5 carriage bodies are built, resting upon bogies at each end of the set and between each pair of bodies, and the connecting, or joint, bogie between each pair of bodies is described as "articulated." A set of two sleeping-cars, for example, rests upon three bogies if articulated, and two would otherwise be required for each body. The London and North Eastern Company have adopted this class of stock as a standard, and it now represents about 10 per cent. of their passenger accommodation, and to a small extent stock of this type is in use on the Great Western Railway. The advantage claimed for it is that it runs more easily, and the disadvantages include lesser mobility, as if one bogie is out of order, the whole set, of which it forms a part, has to be withdrawn. There are also constructional difficulties, owing to the greater strain upon the bogies, and in regard to the space between the

coaches and platforms built on a curve. The latter difficulty applies to all long stock as, unfortunately, many of the older platforms were built on curves, and unless the carriage doors are at each end only, the length must be restricted, or there is a dangerous gap between the platforms and the doors of the centre compartments. An important development, not only for the comfort of the passenger, but for his safety, was the invention of the continuous brake, which is a compulsory fitting to passenger carriages in Great Britain under an Act passed in 1889. There are two main types of brake in use which answer the Government requirements, and can be applied to every vehicle on the train by the driver or the guard, and are automatically applied if the train breaks in two: the automatic vacuum brake, and the Westinghouse automatic brake. In the former, by the use of an ejector or pump on the locomotive, the air is exhausted in a pipe which runs the length of the train and in brake cylinders on each vehicle. The admission of air into the pipe by the driver or guard forces up a piston in the cylinder which actuates a brake upon the wheels. In the Westinghouse brake, the compressing of air by means of a steam pump on the locomotive, supplies the pressure to corresponding pipes and

reservoirs. This pressure is maintained while the train is running, and its release opens valves between the reservoirs and the brake cylinders, and by air pressure applies the brakes. In ordinary working, the brake is applied at each stoppage or speed check, by the gradual release of the pressure, so that a train can be stopped without discomfort to the passengers. The modern passenger communication "cord" is connected with the continuous brake, and while it only partially applies the brake, it directs the attention of the driver and guard to the carriage concerned. Many will remember the earlier communication cord which was supposed to ring a bell in the guard's van, but rarely worked when it was required. The vacuum brake has become the standard for steam trains in Great Britain, but in North America the Westinghouse is universal. In Germany and certain other European countries a new type of air-brake, the Kunze-Knorr, is now being fitted generally.

Another use made of the locomotive steam is in the heating of carriages by means of a system of pipes connected from the locomotive throughout the train. This comparatively recent improvement has entirely displaced the hot-water heaters which were previously placed on the

carriage floors in cold weather and ceased to function in a short time. Each compartment of a carriage has a regulator which, except in summer when the steam is discontinued, usually turns the steam heat "on" or "off" as the dominant passenger wishes. The supply of steam for this purpose causes an appreciable drain on the steam supply, and occasionally, if the driver is short of steam, he cuts off the supply to the heating apparatus, and the carriage radiators cool forthwith.

While the carriages have probably reached the maximum size which the loading gauge and platform curves in Great Britain permit, they have developed considerably as regards comfort, and the modern stock, with electric lighting, steam heating, comfortable seats, and corridor communication on long-distance trains, has little in common with the early coaches. One interesting survival is the provision of arm-straps at the doors of some of the present carriages which, whatever their present use may be, were provided to assist the coach passengers to descend backwards on to the roadway. The arm-straps, in practice, are probably even less used than the ash-holders provided for smokers. In 1872 the Midland Railway Company took the bold step of providing third-class carriages on all of its

trains (a practice adopted on the Belfast and Northern Counties Railway ten years earlier), and a few years later abolished the second class, to the consternation of many people. Now with third-class restaurant cars provided, there is little difference between the classes except that the first class gives rather more privacy because it is less used. There are not yet, however, any third-class sleeping cars in existence, as it is thought that such cars if designed on the lines of the first-class sleeping cars with twelve separate compartments could not be remunerative. It has been suggested that if a separate compartment were not provided for each passenger third-class cars might be remunerative, but such accommodation would require to be on the lines of either the American type with rows of two berths, upper and lower, separated from the centre corridors by curtains only, or the continental type of car with four or six berths per compartment. On the steamers plying between Great Britain and Ireland the old rooms with four or more berths are looked upon with disfavour by passengers, who prefer the single-berth rooms even at a higher price.

In addition to 51,200 passenger carrying vehicles with an aggregate seating capacity of 2,760,000, the British railways have 21,600 other

vehicles running on passenger trains for the conveyance of mails, newspapers, horses, fruit, milk, fish, luggage and other traffic requiring rapid transit; an important element to the railways, representing a revenue of 17 million pounds per annum. These vehicles of many types are all fitted with continuous brakes and can thus be run on express passenger trains, or on separate expresses carrying no passengers, such as fish and newspaper trains, one of which runs 162 miles without a stop. While the vacuum brake is now the general standard for steam trains, there are still a considerable number of trains with Westinghouse brakes, and a number of vehicles have, therefore, to be equipped with both brakes to permit of through running on either class of train.

A subject of many experiments in railway working is the construction of a light, cheaply worked combined engine and carriage, suitable for the conveyance of a moderate passenger traffic. As far back as 1849 a combined unit of this type was employed on the Eastern Counties Railway (now part of the London and North Eastern Railway), and while it is stated to have been worked at less operating cost than a small train, the experiment was not, apparently, a success. Many other combined units of this

nature have since been tried, and in recent years a number of varieties have been constructed for use in various parts of the world, but it is too early yet to say whether they will be employed permanently. The Operating Department usually prefers the ordinary separate locomotive because it can be employed for casual shunting purposes, and on days when traffic is above normal several coaches, and one or two parcels or goods vehicles, can be attached to one locomotive, thus avoiding having a second engine in steam. But, notwithstanding this, there appears to be ample work for a light combined unit which, with a frequent service of a tramway nature, would connect the larger towns with the smaller stations and halts more economically than an ordinary train. Economy on balance is required as, if all the locomotive stock would still be required for occasional use, the saving in working costs might be swallowed up by heavier capital charges.

The wagon stock for freight traffic is very varied in nature, and the outstanding characteristics of the British stock compared with that of other countries is its small unit capacity and the variety of its ownership. In its origin the British railway was regarded merely as a special type of highway, over which anyone could run

his locomotive or vehicles on payment of a toll, but at an early stage the locomotives and carriages were solely railway-owned and only the wagons were provided by users, and then only for certain traffics, mainly coal and other minerals. There are now 721,000 wagons owned by the railway companies for public traffic and about 600,000 wagons owned by traders, and, of the latter, about 550,000 are used for coal traffic. As the coal wagons require to be sorted into ownership order and returned to their owners, usually empty, the restricted use of them is a handicap to the railways; but the system has continued for 100 years and is claimed by many to be justified by the nature of the British coal trade. All over the country there are retail dealers in small quantities of coal, who prefer buying a few wagon-loads in hired wagons, and leisurely loading their road-delivery vehicles from the wagons as customers' orders are received. At one station in England there are 80 separate merchants who, between them, discharge an average of 45 wagons per day—say, 5 tons for each merchant. It is mainly this class of dealer which prefers the use of small wagons, and considers the ideal wagon to be one of 8 or 10-tons capacity, disliking the fact that it is being ousted by the 12-ton type. A further

reason why the private ownership of wagons is advocated is that it guarantees a reasonable supply of wagons to the collieries, and enable them to store coal in wagons pending orders and thus keep their output fairly steady. There is some force in this, though it is an expensive means of storage ; but there does not appear to be sufficient reason why the present wasteful system should not cease and mineral wagons given universal use to the ultimate advantage of the country generally. During the War the railway companies, who previously insisted on the return to each company of its wagons sent with loads to other companies, agreed upon a system of common user, and, with some modifications in regard to special types of wagons, this arrangement still continues and has resulted in greater mobility and use of the stock ; the advantages outweighing a number of minor disadvantages. The total number of wagons belonging to each railway is agreed and the numbers moving from and to it are noted, and a balance is periodically struck between the companies and adjustments made by transfers of wagons, regardless of owning companies, to restore each company's home stock again. Or it may be that a company with an excess is very busy and a company with a shortage is not, and in that event the adjust-

ment is not made, or is only partially made, the number not transferred being lent at a hire charge. A pool on this wide scale is impracticable for the numerous privately owned coal wagons, but what has been done in regard to railway-owned wagons could be done with all wagons if they were railway-owned, and complete railway ownership is, one must think, ultimately inevitable, though the financing of the purchase is not a simple problem in the existing circumstances.

A question of, perhaps, equal importance is that of wagon capacity, particularly as regards coal wagons. The average coal wagon (railway and privately owned) has a capacity of about 11 tons and is loaded to about $9\frac{1}{2}$ tons or 87 per cent. of maximum weight capacity. Coal wagons are not now being built with less capacity than 12 tons, and their load, at 87 per cent., would be about $10\frac{1}{2}$ tons. If 20-ton wagons were standard and were loaded to only $17\frac{1}{2}$ tons on the average, a considerable saving would be effected, as can be seen by the following illustrative figures for two trains, one of 12-ton wagons and one of 20-ton wagons, each with a maximum capacity of 480 tons of coal, viz. :—

RAILWAYS

	12-Ton	20-Ton	Ratio.	
	Wagons.	Wagons.	12-Ton.	20-Ton.
<i>Train of 480 tons capacity—</i>				
Number of wagons	40	24	100	: 60
Load of wagons, tons	420	420	100	: 100
Length of wagons, feet	780	588	100	: 75
Loaded or gross weight of wagons, tons	700	624	100	: 89
Cost of wagons (say)	£5,500	£4,560	100	: 83

To carry equal quantities of coal, the superiority of the larger wagon is marked. The length of the train and consequent siding necessity is reduced by 25 per cent. ; the weight to be hauled, apart from the brake van, is reduced by 11 per cent. ; the actual tractive effort for a given gross tonnage is less if large wagons are used ; the cost and, therefore, interest on capital is 17 per cent. less and the maintenance of wagons is reduced. There is also a reduction of 40 per cent. in the number of wagons with consequential reductions, though not in so great a ratio, in the cost of shunting. As upwards of 22 million hours are spent by locomotives in

shunting freight traffic each year, and over one-half in weight of the freight traffic is coal, the shunting expenses could, obviously, be reduced considerably if the wagons were reduced in number by increase in capacity and universal user, and did not require to be shunted into ownership order when being returned to the coal-pits ; and there would be a further consequential reduction in the actual train mileage with lesser congestion and a beneficial effect upon the movement of both coal and other trains.

On the other hand, a change over to larger wagons would not be possible in all cases without, probably, a large outlay on alterations of the screens or other equipment at the collieries, the tipping appliances at ports, and the turntables, traversers and loading arrangements in railway yards. The further difficulty already referred to in connexion with the customers of the retail coal trade has also to be considered, but the balance is greatly in favour of universal use of, and larger capacity of, coal-wagon stock.

The same considerations apply, though with lesser force, to other mineral and low-grade traffic, but as regards merchandise traffic the position is more doubtful. There are comparatively few privately owned wagons used for

this traffic, and although the average wagon capacity, in weight, is about 10 tons, the average load is about 3 tons. That, however, does not mean that only three-tenths of the wagon space is used, as the load is governed more by the cubic capacity than by the weight capacity of the wagon. A fully loaded 12-ton wagon containing returned empties may contain only one ton of traffic, and several hundred thousand wagons fully loaded with empties are dispatched each year. Other traffics also weigh lightly, and the loading of wagons to the utmost cubic capacity practicable receives very close attention and supervision at railway depots. The miscellaneous character of merchandise traffic on British railways is realized when one considers the statement of the London Midland and Scottish Railway Chairman in February, 1927, that 100 million consignments were loaded and unloaded by the company's staff in 1926 and their average weight was between 5 and 6 cwt. With the small size of consignments in Great Britain, there does not appear to be any probability of any marked increase in the merchandise wagon capacity, nor does that appear to be desirable, except, perhaps, for the few trades which forward large consignments to one station. A hopeful sign is the growing system of for-

warding full wagon loads to central depots from which the consignor then distributes the quantities required by his customers. In America, full car load consignments are regarded as all-important to the success of the railways, and 96 per cent. of the freight traffic in the United States is so carried, but British conditions do not admit of this for merchandise traffic. Owing to the short distances in Great Britain, and the quick and efficient services available, retail traders increasingly tend to work with small stock margins. The saving which they thus make in their warehousing charges is probably more than offset by the additional expense thrown upon the wholesale trade, and upon the railways, in dealing with small consignments—an additional cost passed on to the retailer in higher prices and carriage charges.

The physical nature of British wagons, apart from size, presents few special features, and in their general design wagons have altered little in the past 100 years. The provision of brakes on either side and the substitution of oil for grease lubricants are recent developments, as are the provision of insulated vans for perishable traffics, and the growing practice of building covered wagons with continuous brakes for fast services. They differ radically from American

stock in not having automatic coupling gear, and on the wagons used in Great Britain automatic couplers are not considered to be an advantage, their weight adding materially to the tare weight of the wagons.

British railway companies, in addition to performing practically all the repairs of their locomotives, carriages and wagons, very extensively engage in the building of such stock and the manufacture of parts therefor, and have the large sum of 22 million pounds invested in workshops and equipment. It is often alleged that this policy is not economical, and that the railway functions should be confined to transportation and not the manufacture of plant for that purpose. It is not a simple question to decide, but, though there are exceptional cases, or exceptional times, where it is cheaper to purchase stock, on balance the policy of manufacture has been truly economical. It is necessary as regards repairs, and the equipment provided for this purpose, if used to its full capacity in the periods of the year when repair work is slack, can, with the greater spread-over of standing charges, be used with economy in construction work. With the formation of the large groups in Great Britain, that economy has been increased by the resultant ability to concentrate

a particular class of work for the whole of one group in one existing shop, and another class in another shop, so that there is a continuous output of standardized parts and assembly of units.

CHAPTER V

OPERATING AND PUBLIC SERVICE

THE Operating Expenditure embraces the cost of working the trains and stations, provided and maintained by the Engineering Departments, and also the cost of obtaining traffic, and amounts in Great Britain to about 95 million pounds per annum, the main items being :—

	Millions. £	Per £ of Receipts. s. d.
<i>Locomotive Running Expenses—</i>		
Labour	22	2 1
Fuel	16	1 7
Other	2	0 2
<i>Traffic Expenses—</i>		
Labour	48	4 7
Other	7	0 8
	£95	9 1

The chief items in the Locomotive Running Labour Bill are for engine drivers and firemen, but it also includes engine cleaners and shed

and supervisory staff engaged on the duties of arranging the running of, and the preparation and disposal of the stock. This expenditure is not largely affected by the capacity of the stock in use. It costs very little more in labour to work a locomotive costing £10,000 than one costing £5,000, but the latter will have much less tractive capacity, and a larger proportion of the receipts earned by it will be absorbed in running wages than by the former. On the other hand, the maintenance, coal and capital charges of the former will absorb a larger share of the receipts, and regard must, of course, be had to both of these elements, and others, in considering the relative value of the two locomotives. Generally, however, the tendency is to provide greater power at the expense of maintenance and interest in order to reduce the direct operating expenditure on wages. Similar considerations apply to fuel consumption, and the continuous improvements in locomotive design have, at the expense of maintenance and interest, effected large reductions in fuel consumption in relation to the power exerted by the locomotives. The energy created by the combustion of fuel being the basis of railway working, the efficient and economical use of coal in the hauling of trains is a matter of

primary importance, and though it cannot be isolated from other factors such as locomotive design and lay-out of permanent way, conservation of coal is very closely watched. If the labours of the Engineers could be regarded as perfect and weather conditions were always the same, the quantity of coal consumed would form a reliable index of the quantity of traction used by the Operating Department which, placed in relation to the service performed, would form the ideal statistic so often sought for by railway administrators. And though that ideal is not obtainable, the careful examination of coal consumption on particular locomotives, or trains, or sections of track, is a necessity in all railway working. In such examinations it is necessary to have regard to the value of the particular type of coal consumed, a principal measure being its heating capacity. That measure is the British Thermal Unit (B.T.U.) and is the quantity of heat required to raise the temperature of 1 lb. of pure water by one degree Fahrenheit. This, expressed in units per lb. of coal, is known as the calorific value and varies according to the combustible elements in the coal. Calorific values of Locomotive Coal range in Great Britain from 12,000 to 15,500 B.T. Units, and it is, therefore, necessary to exercise caution in com-

paring the consumptions of particular types of locomotives. In Eastern Europe and in America a lower grade coal is used, known as "brown coal" or "lignite," with a calorific value as low as 6,000 units. A greater quantity of low-grade than high-grade fuel is required to produce the same quantity of heat and it is necessary to equip locomotives burning low-grade fuel with large grate areas to cope with the greater consumption, and the fact that such coal burns less freely. The use of imported coal in British locomotives, during the prolonged coal stoppage of 1926, not only greatly increased the coal consumption per mile, but the coal was unsuitable for the grates constructed to burn a different quality, with the result that they became choked and required to be raked out frequently, with resultant loss of heat and power. The coal consumed by the British railways in steam locomotives is normally about $13\frac{1}{2}$ million tons per annum, but details are not available to equate this consumption to British Thermal Units, though the average calorific value of such coal is probably about 13,500 B.T. Units. In selecting coal from the many varying qualities obtained in Great Britain, regard cannot be had solely to calorific value. The distance it requires to be hauled has a considerable bearing

on the purchasing agent's policy, as subject to the suitability of the coal for the locomotive grates in use, the most economical coal is that which gives the greatest number of B.T. Units per £ of cost at the point of consumption.

If an ample and steady supply of coal can be obtained, it will be obvious that it is cheaper to transfer it from the wagons to the locomotive tenders, either directly or by a mechanical coaling plant, but that is not always possible owing to the variations in the demands of coal consumers generally, and considerable quantities of coal are stacked on the ground, to be drawn upon in winter when delivery of supplies is irregular, or to meet emergencies such as the stoppage of supplies owing to labour disputes. The consequential cost of double handling, provision of storage accommodation, wastage and interest on capital tied up is material and is, therefore, avoided unless it is justified by a corresponding saving in prices, or by avoidance of risk of stoppage.

Only a very small proportion of the coal consumed in the locomotive firebox is actually converted into tractive power. Not only is there a loss of power in starting and clearing out fires, and in standing time at terminals and intermediate stopping places, but there is a loss

due to imperfect combustion and to escape of heat in the grate and in the smoke-box. Of the steam generated there is a small loss by radiation and mechanical friction and a large loss through the discharge of semi-exhausted steam. These losses vary considerably according to the design of the locomotive, the nature of the fuel and the type of work performed, but the average portion of the calorific value of the coal consumed represented by potential tractive power is thought to be not more than 6 per cent., and owing to the partly controllable factors such as standing time and starting and clearing out fires the used tractive power represents an even lower proportion. Coal consumption is, therefore, watched, not only statistically by reference to the hours and miles of each locomotive, but practically by supervision of each driver's consumption, as the stoking of a locomotive fire can be as wasteful as that of an ordinary household fire. In Great Britain all locomotives are stoked by hand-shovels, but in America, where the quantity of coal consumed is much greater by reason of the greater power of the locomotives, the colder weather experienced in winter and the generally lower quality of the coal, mechanical stoking appliances have come into general use on large locomotives in recent years,

as manual stoking was no longer physically possible.

From time to time the use of oil as fuel for locomotives has been tried on British railways, particularly in 1921 and 1926 during the coal stoppages. While this use was on locomotives built for coal fuel and adapted to consume oil, the experience was sufficient to show that coal was the cheaper fuel, and when ample supplies of it were obtainable the locomotives were reconverted to consume coal. Even if locomotives were specially built for oil fuel it is considered that the cost in Great Britain, on all heads, allowing for the greater calorific value of oil and other factors, would leave a substantial margin in favour of coal.

Next in importance to suitable fuel is an ample supply of suitable water, as though any water will generate steam, all spring water contains mineral substances in solution which, on evaporation of the water, are deposited in hard crusts in the boiler tubes and firebox plates, and these encrustations, reducing the efficiency of the heating surface, cause increased consumption of fuel. Where there is no alternative to the use of such "hard" water, it is passed through a water-softening plant which, by the introduction of other reacting mineral substances, removes

the principal impurities. On the other hand, water may contain acids which pit the boiler plates and the tubes if of steel, necessitating the use of brass or copper tubes where the water cannot be purified. A careful choice of water if there are alternatives is, therefore, essential and affects the selection of engine shed and water tank sites. The length of a locomotive run originally depended upon the capacity of its tender, and either the tender had to carry a large dead weight of water, or the distance between stops was small. In 1859, however, Ramsbottom, the then London and North Western Railway Locomotive Engineer, constructed a water trough which enabled his tenders to replenish their water supplies while running at high speeds. The trough is laid between the rails for a length of 1,500 to 2,500 feet, on a level section of the line where an ample supply of water is obtainable. A scoop under the tender, through the speed of the train, forces the water into the tender tank at the rate of about 200 gallons per second, so that a tender tank with a capacity of 3,000 gallons can be filled in a quarter of a minute. The level of the water in the trough is governed by a valve similar to that in a cistern, and though the upkeep of the trough and apparatus is expen-

sive, it is justified by the diminution in the dead weight hauled and the saving of time, with its consequential saving of labour, fuel and capital. Troughs of this nature are now employed on most railways with long distance runs, where the gradients permit of their use on the sections where watering is necessary. Without this device it would be impracticable for long distance non-stop runs to be made, such as those on the London Midland and Scottish Railway from London to Carlisle (300 miles), on the London and North Eastern Railway from London to Newcastle (268 miles) and on the Great Western Line from London to Plymouth (226 miles).

The portion of operating expenditure represented by labour accounts for 70 million pounds per annum or 6s. 8d. out of each £ of receipts, and is made up of:—

	Millions. £
Station masters, clerks and other salaried grades	16
Signalmen and gatekeepers	6
Guards	5
Engine-drivers, firemen, etc.	22
Porters, shunters, ticket collectors, etc.	18
Carriage and wagon cleaners and miscellaneous	3

This huge bill represents the labour cost of dealing with the traffic carried by 400 million

train miles run annually, apart from the labour upon maintenance of the lines and rolling stock and in general administration.

After coal, the labour expenditure on operating the railways is the element most susceptible to alteration, as the volume of traffic varies, but even this has its limitations. The fact that the number of passengers on a particular train may fall from 300 to 200, will have no appreciable effect on the labour cost of running it, and even the elimination of one train each way per day on a short branch may not reduce the labour cost, because of the arrangements referred to later regarding the guaranteed day or week for all grades engaged in the movement of traffic. Similarly, a stoppage of traffic due to some exceptional cause, such as a severe snowstorm, will not permit of a labour saving and, in fact, the reverse is the result, as the labour bill runs on while the line is blocked, and when the delayed traffic is moved, additional expense is incurred in overtime in order to clear it.

Probably the most severe and least warranted criticism of the British railways in recent years was that regarding the movement of coal in the winter of 1926/1927, after the cessation of the prolonged stoppage of the coal mines. There was not an immediate stoppage of imports

of foreign coal when home production was resumed, and the Railway Companies were still engaged in handling imported coal at ports, with equipment laid down to deal with an outward and not an inward flow of traffic. Neither the mechanical appliances for the transfer of coal from wagons to steamers, nor the sidings required for the use of both loaded and empty wagons, were suitable for dealing with inwards traffic. These difficulties were added to by the fact that coal wagons were being used on unusual routes, and when the home pits resumed work some time elapsed before a full supply of wagons was available. The great uncertainty as to retail prices, and the reluctance of the public to buy on a falling market, except in the smallest quantities, delayed the discharge of wagons, and the consequent longer time the wagons were under load further accentuated the shortage and delayed the steady output at the pit heads so necessary for a prompt replenishment of the coal consumers' stocks.

The quantum of operating expenditure cannot be regulated day by day, or even week by week, by the expected volume of traffic or the receipts therefrom. Seasonal traffics, or traffic at large goods stations or coal pits are, of course, estimated in advance and staff arrangements

made to meet them ; but the day to day services for the transport of passengers, milk, mails, fish, newspapers and general merchandise are not withdrawn if there is a falling off in traffic, until it appears to the Company to be more than a temporary phase, and even then the reduction is not infrequently less than strict commercial reasons would warrant. Certain trains are run all the year round which only occasionally, perhaps, are commercially justified, because of the obligation to meet public requirements which is the duty of any public utility, whether a railway or an electrical or postal or telephone service. Not only an unprofitable train but an unprofitable section of a line cannot always be discontinued if it appears to be reasonably necessary for public requirements, as the railways must take the "lean" with the "fat" and find their reward from their traffic as a whole. Operating expenditure is, therefore, not controlled by simple commercial standards, and instead there is substituted control by measurement of work, partly by regulation of the numbers of men at each point, and partly by statistical comparisons ; both are required, and the use made of each depends upon the individual view-point. The service, apart from special trains for varying traffics such as holiday makers

or exceptional movements of coal, having been broadly settled as a matter of public convenience, largely determines the staff necessary to work it, but elaborate rosters of locomotive and staff workings are necessary to ensure economy. For the movement of the scheduled trains, the controller must "diagram" every locomotive movement so that the fewest locomotives may perform the work; light or empty running being reduced to a minimum, and the turns of duty of the locomotive crews so arranged that they will synchronize where possible with the required duties. A complete synchronization of either equipment or staff with traffic requirements is not possible, and even with a frequent service run at regular intervals that ideal is not achieved. If a particular duty requires to be manned for 20 hours of a day, the 8-hour day necessitates three men being employed, and though the difference of 4 hours between the 20 hours to be worked and the 24 hours to be paid for will, if possible, be made use of in other directions, that cannot be done in all cases. The allotment of locomotives sometimes presents even greater difficulties though they have not an 8-hour day. The locomotive is not a universal tool, adapted to any class of work, and though an express passenger locomotive may perform

the menial task of shunting, where it would otherwise be waiting under steam for its next train, that is not a work which would be allotted to it normally. The successful rostering of both locomotives and crews calls for the utmost skill and knowledge of train working, and every schedule of duties requires systematic comparison with the locomotive performances, so that the maximum use may be obtained. On the experience of one time table the next is framed, and several months before a new time table is issued, not only the public trains, but the locomotives required for the complete service, are arranged and the timing settled, with the maximum user of each unit and crew consistent with the public service aimed at. The arrangements for rostering guards' duties are more simple than those for the locomotive crews, and those for signalmen and general station staff are simpler still, though in settling the schedule of train runnings, regard is necessarily had to the effect on rosters of signalmen and station staff. If by running a proposed train on a branch line an hour earlier, a group of stations will each save one shift of duty for several men, obviously that economy should be effected, if the train running can be arranged without undue interference with the public convenience.

That is a simple case compared with one where the branch service has to connect with one or more main-line trains, whose running is connected with trains hundreds of miles away or is dependent upon the time of despatch of a Metropolitan mail service, or the distribution of a newspaper issue. But the actual train-running times are not the only difficulties in operating which require constant attention. The maximum weights of the passenger trains require to be laid down when the time table is compiled; and these are governed by the scheduled time of the train, the road over which it is run, and the type of locomotive allotted to it. The normal make-up of each train is then a matter of settled routine, varied only when observation shows that excessive accommodation is being provided, or when demands for additional accommodation are recurring. The authorized weight of each train is recorded and if this be, say, 300 tons, and the capacity of the type of locomotive allotted to it in the scheduled time is, say, 350 tons, it is not difficult to add an additional carriage if heavy bookings demand it; but if the normal load be 340 tons with a locomotive capacity of 350 tons and an addition of 40 tons is made, either bad running results or a higher capacity locomotive is required, and

the latter may not be available. The alteration of the size of any train is not, therefore, made casually, and on the London Midland and Scottish Railway it is permitted only when authorized by the central control, which is in direct telephone connexion with each station through district controls. Similar, though more elastic, rules govern the size of freight trains, but a more important control of their efficiency is the loading of the wagons and the movement of empties. As light loading of a wagon not only adds to the non-paying weight of a train in proportion to the paying weight of the traffic conveyed by it, but leads to unremunerative use of the capital represented by the wagon, during transit and while awaiting and under loading, the maximum possible loading of all wagons is under continuous check at the goods stations. The Operating Department, much as they might like to do so, cannot hold back all consignments between A and B until such time as a full wagon load is obtained, and there is, therefore, a certain amount of inevitable waste of capacity, but an endeavour is made to reduce that waste to a minimum by a close watch upon all loadings. For the smallest consignments, tranship wagons are employed which, loaded fully, are sent to a junction station

(e.g. from London to Crewe), where the contents of these and other wagons are re-sorted into station lots. This, while necessary, is not liked, owing to the expenditure caused by the intermediate handling.

While all departments are engaged in earning net revenue, the staff actually engaged in the movement and obtaining of traffic come most into contact with the public. The quality of the service rendered by such staff, in regularity of performance, and courtesy to their customers is, assuming adequacy and high quality of rolling stock and other accommodation, a most important factor. If a train service is irregular, or the accommodation is unsatisfactory, or it is difficult to ascertain full information regarding any projected use of the railway, its traffic is bound to suffer, whether the deficiency is due to the shortcomings of a carriage cleaner, or ticket collector, or booking clerk, or engine driver, or superintendent or general manager. Good service is of primary importance, and is, on the whole, obtained, notwithstanding the special difficulties of the past few years; but modern conditions require the railways not to wait for buyers but to go into the market to sell their services. They are not able to do so in the same way as the sellers of goods, or even the sellers of

other means of transport, who, free from statutory regulations, can vary their prices day by day as they wish. Even with this absence of elasticity they can, and must, take many steps to make the facilities they sell known to potential users. For freight traffic a little advertising is done, but the chief means of publicity is personal canvassing of traders by members of the staff, who seek to obtain knowledge of the traders' needs, and, with that knowledge, to explain how best they can be met by the railways. Only by such personal contact can the widely differing requirements of trade be met, and railway arrangements made to meet them where that is possible. For passenger traffic, the position is different, and there is comparatively little personal canvassing, though, for example, where it is known that a conference of delegates from various parts of the country is meeting, the delegates, if a list is obtainable, are advised of train and fare arrangements. Newspaper and poster advertising has, in recent years, played a growing part in obtaining passenger traffic, and has improved greatly, as compared with the badly displayed and uninformative advertising so frequently seen before the war. Whether general advertising, as distinct from advertisements of particular facilities, is worth

the expenditure, is very doubtful, though the experts who claim to have raised advertising from a business to an art have no doubts.

It is often urged that the British railways do not appear to appreciate the importance of simplifying their arrangements for meeting their customers' needs and that, for example, it is frequently difficult to find the name of a station or to know how to get to particular portions of it—a criticism which cannot be applied to the very clear directions on the London Underground Railways and some of the modern stations of the main line companies. In part, this is, perhaps, due to reluctance to recognize obsolescence in station structures, resulting from too substantial design, and tinkering alterations to meet new requirements; but even the oldest structure could clearly display the station name and directions for the guidance of customers who are not familiar with the lay-out of the station. Many of the London stations stand in their Victorian dignity and inconvenience, untouched by the architects and builders who have rebuilt or modernized, in the last twenty years, many of the business structures in the City and West End, and are adapting even the Bank of England to modern needs.

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Much could be written, and has been written, on the peculiar difficulties of London Passenger Traffic—a special subject which cannot be considered here.

CHAPTER VI

USE OF STATISTICS

IN addition to the direct supervision of operating expenditure, only briefly touched upon in the previous chapter, there is a statistical check effected by comparison of units of work done and units of traffic conveyed. By its nature, it is an analysis after the event which, however quickly it be performed, cannot affect the historical record of efficiency or inefficiency, but points out defects in organization, equipment, or supervision, which are capable of being remedied. The statistics compiled by Railway Companies, either for their own purposes, or to meet Government requirements are, perhaps, the most elaborate of any industry, and have rightly been divided by some one into two classes : those which are interesting, and those which are useful ; and it might be added that the margin between the two is not always clearly defined, and that those which are useful are not always used. Most of the statistics, it must be

emphasized, consist of aggregations or averages of similar units relating to possibly dissimilar conditions, which often require subdivision and analysis before they can be used to form the basis of unqualified conclusions. But even with this defect, the data can be compared with corresponding data collected from the same area in previous periods, and such comparison may show a general tendency which examination of detailed results by different people in various places may not have disclosed.

Figures extracted from the Ministry of Transport Summary Returns for the whole of the railways in Great Britain for the years 1922 and 1925 may be used to illustrate some of the possible dangers in comparing figures which might appear to be identical in nature but are really aggregates or averages of groups of figures which are not homogeneous (see next page).

Train hours, it may be explained, include the time a locomotive in steam, after completion of a journey, is waiting for a return train and the figure representing train miles per train hour does not represent train speed, as it reflects both speed and waiting time. It may be added that train hours in the United States exclude such time between trains, and the comparisons some-

FREIGHT TRAFFIC

	1922.	1925.	Inc. Per- cent. of 1922.	Dec. Per- cent. of 1922.
Train miles .	131,908,000	141,076,000	7.0	—
Train hours .	14,886,000	17,121,000	15.0	—
Tonnage con- veyed .	319,934,000	339,818,000	6.2	—
Ton miles (net) .	16,798,715,000	18,332,158,000	9.2	—
Wagon miles—				
Loaded .	3,045,705,000	3,329,647,000	9.3	—
Empty .	1,507,001,000	1,612,407,000	7.0	—
Train miles per train hour .	8.85	8.23	—	7.0
Average loaded wagon load, tons .	5.52	5.50	—	0.4
Average train load, tons .	127.54	130.02	1.9	—
Average length of haul, miles .	52.51	53.95	2.7	—

times made between such British and American figures are, therefore, unsound. Net ton miles represent the traffic weight multiplied by distance conveyed, and include both public traffic and Companies' own traffic.

The comparison of the above figures does not, it might be suggested, show the economy in

working which should be expected from a growth in traffic conveyed of 6·2 per cent. or, allowing for the longer haul, which was 2·7 per cent. greater, a growth in tons of traffic moved one mile of 9·2 per cent. To move that additional traffic, 7 per cent. additional train miles were run and those required 15 per cent. additional train hours, and although there had been a growth in wagon capacity, the average wagon load fell slightly, thus suggesting bad running of trains and bad loading of wagons.

If, however, the figures be more closely analysed, it will be found that though freight traffic as a whole increased substantially, coal traffic decreased slightly. Coal traffic is mainly conveyed in full train loads received in lots from the collieries, averaging, for each wagon, between 9 and 10 tons, whilst other freight trains are aggregations of wagons containing, on average, 8 tons of merchandise, or 8 to 9 tons of minerals (other than coal), received at various points from a great number of consignors, and the change between 1922 and 1925 in the average nature of the traffic necessitated less coal and more other trains. The change in the nature of the traffic is not the only factor which may result in an apparent deterioration of service, and it is mentioned merely because it is the

most obvious one in this case. Other factors include changes in the flow of traffic in particular areas, and a reduction on "A" branch of 1,000 tons compensated by an increase of 1,000 tons on "B" branch will not result in any reduction of mileage on "A" if the service on it is already a minimum one, but will cause an increase of mileage on "B" if the trains there were fully loaded before the additional traffic was received. In that event, the mileage increase with no increase of traffic would be unfortunate but not uneconomical. Similarly, an increase of hours without increase of mileage may occur, if "B" branch be more congested than "A," or if a stopping train be run in place of a fast one, or if weather conditions are unfavourable, as was the case in 1925 when abnormal fogs caused great delays. A further factor which may tend to cause a slowing down of freight trains is the quantity of passenger traffic, and between 1922 and 1925 this increased by 22 million train miles, or nearly 10 per cent.

The average wagon load reduction is also due to alterations in the nature of the traffic, and this can readily be seen by comparison of the loads calculated for each class as shown in the Ministry Returns, viz :—

	1922. Tons.	1925. Tons.	Inc. Percent. of 1922.	Dec. Percent. of 1922.
<i>Average Wagon Load—</i>				
General merchandise	2.86	2.90	1.4	—
Coal, coke, etc.	9.04	9.16	1.3	—
Other minerals	8.45	8.61	1.9	—
	<hr/>	<hr/>		
All traffic	5.52	5.50		0.4
	<hr/> <hr/>	<hr/> <hr/>		

Each of these classes of traffic shows an improvement in the wagon load, and the overall reduction is solely due to the change in nature of the traffic as a whole. This particular change is obvious from the available figures, but it illustrates the danger of treating as comparable data, figures which may not be homogeneous, and similar changes of less importance may be hidden in the general merchandise averages. A wagon may have a weight capacity of 12 tons, but be fully loaded with empty crates weighing only 6 cwt., and if light-weighting traffic increases disproportionately to the whole, the average load stated in tonnage will distort comparisons.

Even the statistics "Average Wagon Load" and "Average Train Load," which are deduced from the total ton miles and total wagon or train miles, are not accurate averages of the loads obtained unless there is uniformity in the length of journey of each weight of traffic, as the following hypothetical illustration shows:—

	Number of Wagons.	Load. Tons.	Length of Journey.	Wagon Miles. (1) × (3) (4)	Ton Miles. (2) × (3) (5)	Average Load per Wagon (tons). (5) ÷ (4) (6)
(a)	20	210	20	400	4,200	10·5
(b)	20	130	30	600	3,900	6·5
(c)	20	50	50	1,000	2,500	2·5
	<u>60</u>	<u>390</u>		<u>2,000</u>	<u>10,600</u>	<u>5·3</u>

It will be seen that although at each weight (a), (b) and (c), the ton-miles ÷ wagon miles give a true average load, the total ton miles ÷ total wagon miles give an average of 5·3 tons, whereas the true average load is $390 \div 60$ or $6\frac{1}{2}$ tons. If the length of journey in col. (3) be the same in each case, the average is sound, e.g.,

	Number of Wagons.	Load. Tons.	Length of Journey.	Wagon Miles. (1) × (3) (4)	Ton Miles. (2) × (3) (5)	Average Load per Wagon (tons). (5) ÷ (4) (6)
(a)	20	210	20	400	4,200	10·5
(b)	20	130	20	400	2,600	6·5
(c)	20	50	20	400	1,000	2·5
	<u>60</u>	<u>390</u>		<u>1,200</u>	<u>7,800</u>	<u>6·5</u>

As a test of the loading of wagons, the total tonnage loaded, divided by the number of wagons loaded, gives a true average, though this may rise or fall without alteration in loading efficiency

if the nature of the traffic alters. It is, however, a more reliable figure, and for all traffic in Great Britain the average load thus calculated is approximately one ton greater than the figure of $5\frac{1}{2}$ tons for 1925, shown in the published returns. From 1926 onwards both figures will be available in the Ministry of Transport Returns.

Another illustration of figures which may mislead can be seen from the Ministry Returns. Between 1913 and 1925 the number of passenger-carrying vehicles was reduced by over 4,000, but this was accompanied by an increase in seating capacity of 70,000, due to the fact that small vehicles were broken up and fewer but larger vehicles built in their place. Any comparison which treated a carriage as a similar unit in each of these years would, therefore, be unsound. An interesting example of a possible pitfall may be seen if the average age of a group of locomotives be calculated, as it is not sufficient to aggregate the ages and divide by the number in the group. It will probably be found that the older locomotives are lighter units than the younger, and the aggregate age divided by the number will give a very different result from a calculation based upon an aggregation of the age of each multiplied by its weight and divided by the total weight, e.g.—

(1)			(2)		
Number of Loco- motives.	Age.	Years.	Number of Loco- motives.	Weight. Tons.	Ton Age. Years.
10	30	= 300	10	400	30 = 12,000
10	20	= 200	10	500	20 = 10,000
10	10	= 100	10	600	10 = 6,000
—	—	—	—	—	—
<u>30</u>		<u>600</u>	<u>30</u>	<u>1,500</u>	<u>28,000</u>
Average	.	20	Average	.	18½

There is also a factor known as the "operating ratio" which is often misused. By the "operating ratio" is meant the proportion of receipts absorbed by working expenses in any period, and the movements in this are frequently taken as reflecting improved or diminished operating efficiency. They do so only when the conditions in the two periods or on the two railways compared are identical. The complementary nature of capital expenditure and working expenses has already been explained but, in addition to that factor, regard must be had to any other factors which disturb the relations between current expenses and receipts. If all other circumstances are unaltered but, owing to a reduction in the purchasing power of money, railway expenditure upon wages or materials increases, unless there is a corresponding addition to the amount of receipts, the net receipts will,

obviously, fall. But the alteration of railway rates, upwards, is a slow process and even if the rates are increased, there is a lag which increases the operating ratio. Assume, however, that the increased burden is passed on to the users day by day as it accrues, the operating ratio will still rise, e.g.—

	" A "	" B "	Increase
	Year.	Year.	Per cent.
	£	£	
Receipts	100	110	10
Expenses	70	80	14 $\frac{2}{7}$
	—	—	
Net Receipts . .	30	30	
Operating Ratio .	70%	72·7%	

In this illustration, an increase in expenses, due to a rise in prices of 14 $\frac{2}{7}$ per cent. is accompanied by an adequate increase in receipts of 10 per cent. without in any way affecting operating efficiency, although the operating ratio has increased from 70 to 72·7 per cent. and the net receipts are unaltered.

Though the use of average and aggregate figures relating to varying factors, without full regard to their composition, has led to many unsound deductions, such figures when used with discrimination are of considerable value to those interested in railway operations. The ordinary commercial comparison of the cost with the sale

price of a commodity is not practicable as regards sales of transport, for reasons considered later in connexion with rates and fares, and the railway manager who is unable in person to watch and control each operation must, by statistical data, measure the efficiency of the work performed, and by comparison of results at different times in different places, endeavour to locate inefficiency and find a remedy. He will not be satisfied with figures for the whole undertaking, though movements in these may point to the need for inquiry, but will seek by analysis of them to ascertain the causes of the local variations which are reflected, or have cancelled one another, in the figures for the whole undertaking.

The statistic "Net Ton Miles per Engine Hour" or the number of tons of freight handled, multiplied by the length of haulage and divided by the total number of hours freight engines were in traffic, is regarded as one of the most comprehensive measures of freight train working. The ton miles represent the volume of transportation performed, and the engine hours are an index of the locomotive cost of that work—use of capital, wear and tear of locomotives, coal consumption, wages of locomotive crews, etc. If wagons were lightly loaded, or

too few wagons were attached to the locomotive, or speed were reduced, or there were excessive time standing at stations, or an unnecessary number of locomotives were in use, the figure would be low and a fall in it should attract immediate attention to the need for investigation, though not necessarily condemnation, as only by sub-division and analysis will the cause be discovered. The number of ton miles may have fallen without reflection on the ability of the operating department because of a change in the nature of the traffic resulting in lesser weight for full wagon loads, or because full wagon loads were not obtainable without delay to traders, or because fewer wagons were consigned without justifying a reduction in train mileage, or because of fog. On the other hand, there may have been inefficient loading of wagons which can be traced to a particular station or district, or there may have been an uneconomical load (either too high or too low) attached to the locomotives, or the locomotives may have been in bad condition, or supplied with unsuitable coal, or the train-timing arrangements may have been faulty. While, therefore, mass figures direct attention to possible inefficiency, only by examination of the primary units can the facts be ascertained unless local

observation has already located the trouble. That applies to all industry, and the cabinet-maker who, for costing purposes, treats as like units a deal kitchen table and a mahogany card-table, will obtain the same unsatisfactory results as the railwayman who regards ton miles or engine hours as, necessarily, homogeneous units. The tons may include, without distinction, wagons loaded with equal weights of empty cases and of steel, though the former will necessitate, with the weight of the wagons, the haulage of 3 or 4 times the weight of the latter. Similarly, the engine hours may include, without distinction, an hour of a small locomotive hauling a few wagons on a branch line, and an hour of a large locomotive hauling 50 or 60 wagons on a main line. Where a series of trains are hauled regularly over a particular section by locomotives of similar capacity, and the traffic conveyed is broadly similar in nature, the position is different, and a very close control can be exercised by scrutiny of operating statistics, making due allowance for weather conditions; but these are merely instances of large primary and homogeneous cost units.

When the cause of any uneconomical feature is located, the finding of the best remedy may not be a simple task and, when it is found, if it is

a physical alteration, its cost needs to be compared closely with its value. A particular type of equipment may be becoming obsolete because of a change in nature or flow of the traffic. Assume that a locomotive which cost £5,000 can be replaced by a new and better adapted one, and that the old locomotive has a further life of 15 years, and an unexpired value of £2,500, and will realize only £300 if sold or broken up. To justify building the new locomotive, it must be seen whether the all-in cost of working it, compared with the all-in cost of similar work with the existing locomotive will exceed the loss due to the destruction of a value of £2,200 (£2,500 - £300)—i.e., Interest at, say, $5\frac{1}{2}$ per cent. on £2,200 or £121 per annum. That is a very simple illustration of the type of test which must be applied to the suggestions which are constantly being considered by the Railway Operating and Engineering Departments. The main test is not whether the proposal will show improved operating results or reduced expenses or increased receipts, but whether it will increase net revenue in a greater degree than the increase in the cost of finding capital for its execution. Sometimes other considerations, such as pressure from politicians, or local authorities, may necessitate unecono-

mical expenditure and thus place unfair burdens upon the railway users as a whole, but this form of "blackmail," which is quite distinct from requirements to provide adequate public facilities is, happily, less frequent than in the earlier life of the railways. An important consideration in determining whether an improvement is to be provided is the effect of local rates. If, by improving the gradient of a line at a cost of £100,000 capital, requiring £5,500 per annum in interest, a sum of £6,000 per annum can be saved in operating expenses, it has to be borne in mind that the increase of £6,000 in net receipts will increase the rateable valuation and probably about £900 must be paid out in additional local rates. Thus, if the work were executed, though it would be in the interest of the community as a whole, as it would represent a reduction in cost of production, and therefore a saving of £500 per annum, the additional rates of £900 would increase the cost to be borne by the railway users by £400 per annum. The National saving assumes that the additional £900 paid in rates relieves the burden of other ratepayers, and that the local authority does not merely increase its expenditure by £900 because of its receipt.

For internal control purposes, many statistics

are compiled either regularly or occasionally, and where possible these are obtained from the local data required for the statutory statistics supplied to the Ministry of Transport. At goods stations, the tonnage dealt with is recorded separately for various classes of traffic, and sub-divided between that handled by the consignor or consignee and by the Company's staff, the latter traffic being placed in relation to the hours worked by the handling staff and the number of consignments dealt with. Wide differences are found between the average costs at various points, owing to the variations in the classes of traffic handled, the periods of the day in which the traffic is received, and the nature of the equipment at the several stations. But comparisons between corresponding periods and between stations are regularly made with a view to detecting uneconomical working, arising out of overstaffing or bad supervision, or the need for improved equipment. A new class of traffic may be obtained which is expensive to handle manually or by a manually operated crane, but until it is seen that the cost of new mechanical appliances will be justified by the quantity of traffic to be handled, the seemingly uneconomical use of labour must continue, even though the local official, anxious to reduce his costs per

ton, may not appreciate the need to consider the problem from the net yield aspect only. Where, however, the provision of improved appliances will attract a new traffic which would not otherwise be obtained, a wider outlook is necessary, and it sometimes happens that the provision of such appliances will be justified by the additional net revenue obtainable from rail charges, even though the use of the new appliances, separately considered, is not economical. An analogous case is the performance of cartage services by a railway Company at a large station. If every small parcel were conveyed to and from the railway by an independent carrier, the station accommodation would require to be increased considerably to enable the traffic to be handled, but with a constant clearance of the traffic for delivery by the Company's vans, and the collection by them of the traffic for forwarding, both the staff and the accommodation at the station are more economically used. It thus happens that frequently the cartage service by itself is not directly remunerative, but its contributive value to the railway service renders it indirectly remunerative.

Another statistic regularly compiled shows the hours of work at yards where shunting is performed, in relation to the numbers of wagon

dealt with, the hours recorded showing locomotive hours on shunting duties as well as those of the shunters. Here again, the local circumstances vary greatly, but not only do the cost figures form the basis of useful comparisons for control of man power and locomotive power, but their use may indicate that physical alterations are necessary and, again, the test will be the cost of the new work in relation to its value in increasing net revenue either by savings in shunting work or in acceleration of train working.

For locomotive control purposes, not only are the hours in use and miles run recorded, but the number of locomotives available for use and the number actually used are also recorded, so that the capital sums locked up in:—

- (1) Locomotives not available for use owing to repairs, and
- (2) Locomotives available in excess of maximum user, and
- (3) Locomotives not used to their maximum hours or mileage

are available.

The first is a matter affecting the railway as a whole, bearing on the efficiency of the Maintenance Department; the second is a line, or divisional, or district matter, bearing on the

efficiency of the allocation of locomotive power, having regard to seasonal variations in demand and the suitability of the various locomotive types for particular work ; and the third is a more local matter, bearing on the efficiency of the locomotive schedules at each depot. A further and less obvious factor is the uneconomical use of capital, labour and coal, due to faults in the scheduling or working of trains. The latter trouble may be due to a variety of causes, including an uneconomical maintenance policy, bad workmanship in the shops, design of locomotives, delays due to station duties, need for improved signalling or tracks, or the much dreaded fog—a “ fault ” beyond even the control of the Operating Department. An apparent improvement in the average output of miles or hours per locomotive may be due to the withdrawal of slow trains, and may hide a lowered operating efficiency ; and a worsening of the average may be accompanied by improved operating efficiency, if it be due to the addition of necessary slow trains. In either event, whatever be the position, a close analysis of the data, and not a mere comparison of average or aggregate numbers, is essential in controlling the vast capital sums invested in locomotives and the expenditure incurred in working them.

It is, perhaps, only natural that the maintenance staff like to have an ample supply of locomotives in hand to stabilize their work, and the running staff a surplus of power available for emergencies, but the economic effects of any excessive locking-up of capital require to be made clear by analysis of the stock requirements.

A somewhat similar control of the carrying power represented by carriages and wagons is required. Carriages, being railway owned and quickly loaded and unloaded, can be employed continuously during working hours, but, as in the case of locomotives, a tendency to accumulate surplus stocks for peak demands requires to be watched closely, though the point at which it is profitable to refuse excursion traffic rather than have a large idle capital in normal times, is not readily settled. Obviously, the provision of a carriage which would be used on one day only in the year would be uneconomical, and the question resolves itself into a determination of the minimum amount which a carriage will earn to meet all expenses, including interest and wastage when it is idle.

The control of wagons is more difficult than that of carriages, owing to the irregular nature of their use, and to the varying times taken by traders in loading and unloading them. The

wagon mileage run, divided by the number of wagons, gives a rough idea of the use made of the stock ; but as the time a wagon is in use for transport purposes is only a very small proportion of its life, that statistical result is of little value in considering efficiency. If one regular series of journeys were over a distance of 20 miles and another were over a distance of 30 miles, there would be little difference between the number of wagons required for each service, but the miles obtained per wagon would vary greatly. On average, a wagon makes a loaded trip not more than once in 6 or 7 working days, but that average includes wagons used daily for fast traffic loaded and unloaded by the Company's staff, and coal wagons which hardly make two loaded trips in a month owing to the length of time they are waiting for orders, lying under load waiting for clearance, and being sorted and worked back to the owning colliery. The "Common User" arrangements for wagons, referred to earlier, make it wellnigh impossible to keep a record of the actual movements of each wagon, and although a record is kept of the wagons required for special classes of traffic or abnormal weights, the ordinary types of open and covered wagons are controlled in bulk only. Each morning the wagon position

at each station is telegraphed to Headquarters, and the additional requirements or surpluses indicated enable the Wagon Controller to see what transfers of empty wagons are necessary, and to regulate the movements of empties in the most suitable manner. Great stress is sometimes laid on the proportion of loaded to total wagon miles as indicating efficiency in control, but empty mileage, while often uneconomical, cannot be avoided where there is not an even flow of traffic in each direction, and frequently a rise in the proportion of loaded miles is merely an indication that there is a surplus of empty wagons at receiving stations for which there is little demand elsewhere. The highest proportion of loaded wagons in Great Britain in the last six years was in 1926 when, owing to the coal stoppage, there was a lessened demand for all classes of wagons and less empty journeys of coal wagons. The figures were:—

Year.						Loaded percent. of Total Miles.
1921	.	.	.	.	.	69·31
1922	.	.	.	.	.	66·90
1923	.	.	.	.	.	66·82
1924	.	.	.	.	.	67·23
1925	.	.	.	.	.	67·37
1926	.	.	.	.	.	70·14

and the high figure in 1921, when there was

another prolonged coal stoppage, shows the same tendency as in 1926. An analysis of the time spent by wagons in Great Britain in actual transit, in shunting, under and awaiting loading, available for use but not used, and out of use for repair, would be extremely interesting; but as this analysis would be required for probably 90 million trips per annum, the cost would be serious.

Apart from these, there are many other operating records, which may be termed statistics, and elaborate analyses of receipts are prepared for internal or public purposes. Some of these are of use in controlling wasteful mileage of trains, others are of assistance in rate fixing, and others, again, are merely interesting records.

The periods for which statistics are extracted vary according to their class, but whether the period be the day or the week, the growing tendency appears to be to summarize results into weekly and four-weekly periods, ignoring the calendar month. Comparisons are more valuable if those making them have not to discount the results, because the period may have five Sundays in one month and only four in another. There still, however, remains the disturbing effect of the movable holidays at

Easter and Whitsuntide and, in a lesser degree, the alteration every few years of the weeks in which Christmas or the August Bank Holiday fall; but until the League of Nations is able to secure the adoption of its suggested reformed calendar, that difficulty cannot be overcome, although a fixed Easter would lessen it. Attempts are sometimes made to overcome the difficulty by re-allocating the previous year's figures to make them comparable with the corresponding parts of the current year, but that is not always successful, particularly with the Easter period, which has not the same effect on traffic operation if it falls early or late in the spring.

Generally, it may be said that railway statistics, if properly used, are an essential factor in efficient and economical railway working; but if they are prepared as a matter of routine, because it is the custom or the law to do so, and are not used in a proper manner, they are of little value. Alike in times of prosperity and times of depression, the continuous sifting and examination of statistics which represent homogeneous units of work is essential in any business, and in none more so, perhaps, than that of transportation, because the charges for transport sold are not based upon cost and, thus, the

usual rough commercial measure of salesmanship is inapplicable. Every operation requires to be tested frequently, and with understanding, by an appropriate measure, in order to avoid the stereotyping of old methods while conditions are changing. The appropriate means of measuring cost is not always easily determined, but whatever it may be, it is not the mere recording of a series of numbers in a nicely bound book, and remarking with pleasure or disapproval that compared with a year ago the result is x per cent. better or y per cent. worse, or even jumping to the conclusion that the difference is due to the state of the weather or of trade. Such historical records may be very useful to economists, but their only justification in railway working is the use made of them to the end of improved efficiency.

CHAPTER VII

GENERAL ADMINISTRATION AND LABOUR

A RAILWAY Company in Great Britain is not a Company created under the Companies Acts, which govern the majority of Joint Stock Companies, but it is a corporation created by statute for specific purposes defined in its Act, which always incorporates provisions relating to its management, similar in many respects to those applicable to the ordinary Joint Stock Company. Its management is controlled by the Shareholders, who elect the Board of Directors and the Auditors. The owners of Loan and Debenture Capital have no controlling power or rights of voting at Company meetings so long as their interest is promptly paid, except where any proposals affecting them as a class are being considered. Generally, the voting power at Company meetings is exercised by the owners of Guaranteed, Preference and Ordinary Stocks, but not Debenture Stock, and, so far as the four large Companies of Great Britain are concerned,

the large quantity of such capital, and the widespread holding of it, renders it improbable that the majority of the voting power can be secured by any one section whose interests are not similar to those of the proprietors as a whole. The nominal amount of the issued Capital of the four large Companies and the amount of such Capital with voting rights at 31st December, 1926, was :—

	Total Issued Capital. Millions. £	Capital with Voting Rights. Amount. Per cent. Millions. of Total. £	
Southern	150	107	71
Great Western	147	102	69
London Midland and Scottish	406	305	75
London and North Eastern .	367	257	70
	<hr/>	<hr/>	<hr/>
	£1,070	£771	72
	<hr/> <hr/>	<hr/> <hr/>	<hr/> <hr/>

The voting power of all non-debenture stock holdings is of uniform weight in proportion to stock held in the London and North Eastern and London Midland and Scottish Companies, but in the Great Western and Southern Companies the small holdings have a relatively greater voting power than the large holdings. It is improbable that the control of any one of these Companies will fall into the hands of holding organizations, such as those which have

taken so prominent a part in American railway history and caused the States legislatures to intervene. In one case referred to in Professor Ripley's book on *Railroads—Finance and Organization*, a series of railroad companies with a total capitalization of 150 million pounds was controlled through one holding Company which, in turn, was controlled by 1½ million pounds of stock, and that amount was said to be owned by a single individual. Parliament would, no doubt, be urged to intervene if a similar position arose in Great Britain, owing to the danger that the powers of the controlling individual or group might be used in favour of particular rail users or suppliers of material, to the detriment of rail users as a whole, or of the minority stockholders. Such control arrangements are not, necessarily, unsound, but public opinion in Great Britain would be opposed to an outside organization controlling the policy and expenditure of Companies whose profits are a matter of public interest and regulation. Generally, it can be assumed that the election of Directors, which is vested in the Shareholders, is not tied to, or dictated by, any particular interest. It may be that many of the Shareholders take little or no interest in the policy of their Company, when their dividends are received with

regularity, just as many persons neglect to exercise their votes at Parliamentary and Local Elections; but that is not a peculiarity of railway shareholders, and the very few occasions on which there is a real difference of opinion amongst the general body of Shareholders is evidence of their general concurrence with the policy of the Directors.

The Directors stand in a fiduciary relation to the Shareholders and must exercise their functions fairly and reasonably to that end. By various statutes, decisions of the Courts and resolutions of the Shareholders, the scope of their authority is laid down, and the post of Director is not a sinecure. Many apparently small matters which would quickly be settled by an ordinary Company require to be considered minutely and legal advice, or even Court interpretations, obtained before a formal decision can be made. On all formal matters, and on all matters in connexion with the issue and transfer of stocks and the payment of interest and dividends, they act through their Secretary, who is their legal representative and keeper of the minutes of the proceedings of the Stockholders, the Board, and the numerous Committees of the Board. Through a series of such Committees dealing with Finance, Traffic, Way and

Works, Locomotives, Carriages and Wagons, Stores, Legal matters, Land and Rating, Catering, Steamers, etc., the Directors keep in contact with the work of each Department, the minutes of the Committees being submitted to the Board as a whole for approval. The Chairman of the Board cannot confine himself to the periodical meetings of the Directors, but is, necessarily, in daily touch with the Chief Officers of the Company, acting with Board powers in cases of emergency, and watching the daily progress of events with close interest. Others of the Directors are also in frequent attendance at Headquarters, performing their legal duties in connexion with transfers of stock and the drawing of cheques, and those who are Chairmen of the Sub-Committees attend to consider and discuss, as they are ready, the various matters which their Committees will deal with at their meetings.

The Auditors, usually two in number, are appointed by the Shareholders, and it is their duty to examine and report upon the Annual Accounts and Balance Sheets of the Company; which are certified by the Accountant as the officer responsible for their compilation, and by the Chairman and Secretary as representatives of the Board of Directors. The responsibility upon each Auditor is a personal one to

make a reasonable and proper investigation of the Accounts in the interests of the Shareholders, as he acts on their behalf and not on behalf of the Directors. He cannot, by reason of the magnitude of the work, examine every transaction, and he is authorized by Parliament to employ assistants who, in fact, perform a continuous audit, so that the closing of the audit follows shortly after the Accounts for the year are completed. The Accounts in a special statutory form, and not merely the Balance Sheet, require to be certified by the Auditors; their certificate stating that the Accounts are a full and true statement of the financial condition of the Company and that the dividends proposed to be paid are, in their judgment, *bona fide* due. If necessary, this certificate is qualified by directing attention to particular matters which the Auditors think of importance, and the Annual Meeting, when the adoption of the Accounts is considered by the Shareholders, has that certificate before it in the printed Accounts.

The Chief Officer of the Company is, usually, the General Manager, and his primary duty is to manage the undertaking as a whole in conformity with the general policy settled by the Board from time to time. In the past, in many cases,

he was really a combined Commercial and Operating Manager, conducting the business of obtaining and transporting traffic, and without complete responsibility for the policy of the Engineering Departments or Finance. In recent years the tendency has, however, been to co-ordinate the general policy of all Departments through the General Manager, though leaving with the Engineering Officers the responsibility for technical matters. He is thus responsible to, say, the Locomotive Committee for the general policy of locomotive power and for the staff arrangements of the Locomotive Department, but the Mechanical Engineer is responsible to that Committee for the technical side of his work. This measure of control obviates the difficulty which may arise if the Mechanical Engineer wishes to build a locomotive which the General Manager considers to be too light for traffic purposes, or which the Engineer feels is so heavy that it will add unduly to his expenditure on permanent way and bridges. Co-ordinated through the General Manager, the policy to be adopted is reviewed, as regards all Departments. Not until that is done is the approval of the Board or Committee sought, but when that approval is obtained, the technical responsibility for the

locomotive or permanent way or bridge work is an Engineer's one. The responsibility of the Accountant is partly to the Chairman and partly to the General Manager. The former requires to keep in direct touch with the Accountant on the financial position and policy of the Company, and the latter requires from the Accountant not only the necessary financial statements of working results, but his criticisms or comments upon them.

From the beginning of 1927, the London Midland and Scottish Railway Company have adopted a system of General Management which, in some respects, is like that usual in America. That Company, in place of a General Manager, has appointed a President, with four Vice-Presidents, who form an Executive Committee responsible to the Board. Each Vice-President controls and acts in the capacity of General Manager to a number of Departments, and settles all matters peculiar to them on his own responsibility, consulting his fellow Vice-Presidents or the President, where that appears necessary. All matters of general importance are seen by the President and each Vice-President, and once or twice each week the President and Vice-Presidents meet, as a Committee, to co-ordinate their action on such

matters, and to decide the policy to be adopted or, where necessary, to be recommended to the Board of Directors for adoption. This organization is similar to one under which there is a General Manager who concentrates the responsibilities of all the Company's Officers, and was decided upon to overcome the conflicting difficulties of a series of Officers, each responsible to the Board for his own functions, and the heavy burden of co-ordinating all these functions in one General Manager, and, at the same time, preserving unity of direction. The Vice-Presidents are representative of the four main branches of railway work—transportation, commercial, engineering and finance—and, with the President, relieve the Chief Officers of responsibility on all general questions of policy, and set them free to concentrate on their special responsibilities.

Whatever may be the organization at the apex, there must, necessarily, be a continuous chain of delegations of responsibility down to the lowest ranks, but in Great Britain there is not uniformity in the methods of connecting the several links. The London Midland and Scottish, Great Western and Southern Companies have adopted the Departmental system under which the whole of the staff in

one Department, through District and Divisional Officers, is responsible to the chief of that Department. The London and North Eastern Company's organization is partly a Departmental and partly a Divisional system. There are three Divisional General Managers responsible to a chief General Manager, each Divisional General Manager being in charge of the Way and Works, Operating and Commercial branches of work in his division, while the Maintenance of Rolling Stock, Finance, and some other branches of work are for the whole line the direct responsibility of Chief Officers. The advantage claimed for the Departmental policy is simplification of policy, without interference with local operating work; and the advantage claimed for the Divisional policy is the undivided local authority of the Divisional General Manager. There are advantages in each system, but the Departmental system has the greater number of adherents in Great Britain, and they consider that although the mileage of each of the amalgamated railways is large, the small area in which it lies, with the extensive use of long-distance telephones, enables the Departmental system to be operated with the greater advantage. Time will show which system will continue, but, in considering

the merits of each, comparisons of trans-continental American railways, covering very wide areas, with a network of British railways, of a similar total length, covering comparatively small areas, are of little value. Neither can the business of selling transport at thousands of stations be compared, as is sometimes done, with the business of selling, say, meat at the many branches of a meat company. Each meat shop can be regarded as a unit which, should it not earn its cost plus x per cent. can be closed down, but a railway division, or even station, cannot sell transport at cost plus x per cent. and be closed at once if that is not possible. There is another important difference in organization in Great Britain which cuts across the one mentioned above. On the London Midland and Scottish Railway the whole of the movement of trains, including control of locomotives and their crews, is under one Officer—the Chief General Superintendent—but on the London and North Eastern Railway the locomotives are under the control of the Mechanical Engineer, and the crews are under the control of Running Superintendents working under each Divisional General Manager.

Apart from these differences in the chain of responsibility, the work of the several Depart-

ments of the various railways does not differ greatly. The Engineer is responsible for the upkeep of the fixed assets, described in Chapter II; the Mechanical Engineer for locomotive maintenance, and the Carriage and Wagon Superintendent for carriage and wagon maintenance, described in Chapter III (though carriage and wagon maintenance is usually a function of the Mechanical Engineer); and operating and public services, described in Chapter IV, are controlled by variously described officers. The functions of these officers have already been generally considered, and in Chapter VIII the question of the fixation of rates and fares, which is administered by the Passenger Superintendents and Goods and Mineral Managers, is considered. The traditional policy of the British railways has been to regard Coaching or Passenger Traffic as separate and distinct from Freight Train Traffic, but it is not obvious why the whole work of obtaining traffic of all sorts should not be dealt with by a Commercial Department, which would leave the whole work of conveying the traffic, regardless of its class, to an Operating Department. As regards the other Departments—the Accountant's is, perhaps, the largest, and its main function is to see that there is an efficient and reliable system of recording, in terms

of money, the millions of transactions relating to the Company's receipts and expenditure; and to so arrange these records that a continuous survey of the various aspects and branches of the Company's business may be available to the Administration during the year, and complete and accurate accounts be prepared for the Shareholders annually. The Stores Department is another large organization, and has two functions—purchasing, and storage and distribution. It is responsible for the many and varied purchases which a Railway Company requires to make, totalling in Great Britain about 60 million pounds per annum. It must know not only the requirements of the railway from coal to paper fasteners, but constantly watch the trend of prices, the quality of the material supplied, the level of stocks, and the probable demands. An apparently tempting offer of a large quantity of materials at a low price may be made, but its acceptance will require close consideration of the probable movement of prices, the cost of carriage and storage, risk of deterioration, and loss of interest before it can be accepted; and the ascertainment of the economical level of the stock of stores is far from simple. Stocks of a value of about 23 million pounds are held by the Stores Depart-

ments of the British railways, including the value of labour on manufactured and partly manufactured articles, old material waiting disposal, and timber in process of seasoning. Generally, the materials remain in the physical custody of a Central or Departmental Storekeeper until actually used, and where that is not practicable, as in the case of a supply of rails placed alongside a track to be renewed, they remain in the book stock until actually used by the Engineer's Department. Old material recovered from maintenance work or other sources is also taken over by the Storekeeper when released from use and either reconditioned or sold, as appears to be desirable.

Other administrative departments are those which deal with the professional question of local rating, on which hinges the payment of 8 million pounds or so for local rates each year; the purchase and sale of land and the management of the numerous and scattered houses and stores let by the Company; and the Solicitor's Department, whose duties have been enlivened by the continuous legal work required by the Railways Act of 1921. Various other departments deal with such activities as electrical work, steamboat services, canals, docks, catering services, cartage services, superannuation funds

and savings banks, and the control and custody of cash.

The London Midland and Scottish Company have a separate officer responsible for all staff and labour questions, whose duties are akin to those of the Establishment Officer in the Civil Service, and the other Companies have a corresponding officer attached to the General Manager. In all grades of the Railway Companies' service in Great Britain, including steamers, hotels, etc., there were employed in April, 1927, 659,000 men and 24,000 women, whose salaries and wages represent an outlay of about 125 million pounds per annum. The great majority of these employees have been allotted standard rates of salary and wages and standard conditions of service, and there has been established a series of Agreements with the various Trade Unions concerned, governing the arrangements under which these rates and conditions are to be interpreted and varied. Prior to 1907 the Railway Companies did not officially recognize the Trade Unions, but in that year the Trade Unions had secured a sufficiently large membership to justify them in urging their claim to recognition, and the Amalgamated Society of Railway Servants presented an "All Grades" programme for improved

conditions and increased wages. This resulted in conferences between the Government, the Directors of the Companies, and the Trade Unions, and an Agreement was signed on the 6th November, 1907, providing "a scheme for Conciliation and Arbitration in questions relating to rates of wages and hours of labour of certain classes of railway employees." In 1911 a General Strike of railwaymen, for which it is difficult to assign any specific cause, started as a sectional strike in Liverpool and gradually spread throughout the country. The Government officially intervened in the Strike, and a Royal Commission was appointed to investigate the working of the Railway Conciliation and Arbitration Scheme. Following upon the report of the Royal Commission, the Conciliation Scheme of 1907 was modified with the object of ensuring that questions raised should be dealt with more speedily by the Boards.

In November, 1913, the Trade Unions gave notice to terminate the Conciliation Scheme, and just before the outbreak of war in 1914 were on the point of presenting to the Railway Companies another "All Grades" programme; but in October, 1914, an Agreement, known as the "Truce Agreement," was reached between the Railway Companies and the Trade Unions, under

which the Conciliation Scheme and all existing contracts and condition of service remained in operation, but at various dates during the war, increases in wages, known as War Bonus and War Wages, were granted to meet the increases in the cost of living. In 1917, the Government, who then controlled the railways, promised the Trade Unions that after control of the railways ceased, early consideration would be given to the programmes of the Trade Unions, and in December, 1918, the Government decided to grant an eight-hours' day to all members of the wages staff, and to set up a Committee to review rates of pay and conditions of service. Agreements were made in April and June, 1919, between the Railway Executive Committee acting on behalf of the Government, and the National Union of Railwaymen and Associated Society of Locomotive Engineers and Firemen, providing for improved conditions of service for all the staff in what had become known as the Conciliation Grades ; the principal items in this Agreement being as follows :—

(1) *Guaranteed Day*—

A full day's wages to be guaranteed for each day a man is available for rostered duty. In the case of trainmen, a

day's pay to be guaranteed for each time of signing on duty.

(2) *Guaranteed Week*—

48 hours to constitute a week's work and a standard week's wages to be guaranteed to all men available throughout the week, apart from payments for overtime, Sunday duty and night duty.

(3) *Overtime*—

Time-and-a-quarter to be paid for work in excess of eight hours, each day standing by itself.

(4) *Night Duty*—

Ordinary time between 10 p.m. and 4 a.m. to be paid at time-and-a-quarter, and overtime between these hours at time-and-a-half.

(5) *Sunday Duty*—

To be paid at time-and-a-half with double time for certain duties performed by permanent-way men.

(6) *Rest*—

Rosters to show 12 hours' rest between turns at Home stations, and 9 hours when away from Home.

(7) *Holidays*—

6 working days with pay per annum.

In August, 1919, a further Agreement was made with the National Union of Railwaymen and the Associated Society of Locomotive Engineers and Firemen, standardizing the rates of wages for drivers, firemen and cleaners on a service basis, and providing that enginemen working on mileage basis should be paid a day's pay for each 120 miles, and at the rate of an hour's pay for each 15 miles thereafter. This basis was altered on the application of the Railway Companies to the National Wages Board in November, 1923, and the present payment is at the rate of a day's pay for 140 miles, and an hour's pay for each 15 miles thereafter. During this period, negotiations were also proceeding with regard to the standardization of the rates of wages of other Conciliation Grades, and certain proposals with this object were made by the Government in September, 1919. The terms of this offer were not acceptable to the National Union of Railwaymen, who put forward counter-proposals, and as the Government would not depart from their offer, and the National Union of Railwaymen would not abate their proposal, a Strike commenced on September 26th, 1919. Negotiations for a settlement of the Strike were conducted between the Government and the Trade Unions, and an agreement was reached

on the 5th October, under which it was agreed that wages should be established at their then level up to September 30th, 1920, and that at any time after August 1st, 1920, they might be reviewed in the light of existing circumstances. Following this, negotiations were resumed and, as a result, an agreement was made in March, 1920, which provided for each Conciliation Grade a standard or "B" rate, 100 per cent. higher than its average pre-war rate, and a current or "A" rate, representing, generally speaking, the standard rate plus the existing War Wage of 38s. per week. This latter rate was subject to fluctuation in accordance with the cost of living on the basis of 1s. for each five points of variation (rise or fall) in the Cost of Living index figure, with the proviso that in no case would the wages fall below the standard, or "B" rate. In the higher rated Conciliation Grades wages generally have been reduced to the standard rates owing to reductions in the cost of living, but in the lower rated grades the current rates at the end of 1927 were about 1s. to 6s. per week higher than the standard rates, and only as the cost of living falls will these disappear.

Agreements were also reached with the Railway Clerks' Association and the National Union

of Railwaymen standardizing the rates of pay and conditions of service of clerks, station-masters, supervisors and controllers, on a somewhat similar basis. The principal agreements affecting railway staff are scheduled to the Railways Act of 1921, under which the Railway Companies were amalgamated, and under that Act a series of local Departmental Committees and Sectional Councils for each railway were set up with equal representation for the employees and the Company. The Departmental Committees deal with local questions of working hours, holiday arrangements, and other questions affecting the welfare of the staff, and railway working at the particular depot; and the Sectional Councils deal with the local application of the National Agreement on the railway concerned, together with other matters affecting the staff and company. Questions relating to hours of duty, wages, and conditions of service, upon which there has been failure to agree between the Railway Companies and the employees or the Trade Unions, may be referred to a Central Wages Board, and, failing agreement by that body, to a National Wages Board, originally set up in 1919 by the Government and reconstituted under the Railways Act of 1921. The Central Wages Board con-

sists of two representatives from each of the three Trade Unions concerned, and an equal number of Railway Companies' representatives. The National Wages Board consists of an independent Chairman, nominated by the Government, six members representing the Railway Companies, six members representing the Trade Unions (two from each of the three Unions), and four members representing railway users. The Railways Act provides that this machinery may be determined by 12 months' notice given by either the Railway Companies or the Trade Unions. The National Wages Board has functioned satisfactorily, and their recommendations, which are not binding upon either party, have, with one exception, been accepted. Arrangements on similar lines with the Craft and other Unions concerned with Workshop Staffs were completed in 1927.

The additions to the cost of labour since 1913, including the remuneration of the additional staff necessitated by the shorter hours of duty, and reflecting the variations in the volume of work done during the two periods, represent an addition of about 150 per cent. to the pre-war bill, which was 50 million pounds compared with about 125 million pounds in 1927, an increase, if allowance be made for the rise in prices, of

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about 50 per cent. on pre-war expenditure. The Companies have, from time to time, been criticized for paying unduly high rates of wages, but it may be noted that when, in November, 1923, and again in November, 1925, they asked the National Wages Board to authorize a reduction in the rates of wages paid, and a modification of certain conditions which they considered onerous, the Board rejected their claims.

CHAPTER VIII

GOVERNMENT REGULATION AND TAXATION

FROM its incorporation to its dissolution, a British railway is subject to many Government requirements to obviate danger to passengers and railway employees, and to protect the public interest. In 1842, on Mr. Gladstone's initiative, an Act was passed requiring Government inspection of any passenger railway before it was opened for traffic, and authorizing the Board of Trade to postpone such opening if it would be attended by danger to the public, and under a later Act, alterations of station arrangements affecting the public safety and signalling are examined by the Inspectors of the Ministry of Transport, to whom the Board of Trade railway powers were transferred in 1919. The Ministry requirements cover such matters as block telegraphs, signals and points and their inter-locking, passenger platforms and station lines, the width of the tread of station staircases, provision of clocks, gradients at

stations, diameter of locomotive turntables, design of bridges, rail joints, provision of quarter-mile posts and boards showing changes in gradients, continuous brakes on passenger trains, and hand-brakes on goods wagons. It is also necessary for a railway company to notify the Ministry of Transport of any accident which has caused, or might have caused, loss of life or personal injury to any person. Where the Minister thinks fit, he institutes an inquiry by an Inspector into the cause of the accident, and publishes a report upon the matter with such observations and recommendations as the Inspector may make; but there is no power vested in the Ministry to enforce such recommendations. An inquiry may also be held if a complaint is made that the hours of duty of a railway employee or employees are excessive or unreasonably rostered, and by an Act passed in 1900 the Ministry are empowered to make rules which, subject to an Appeal to the Railway and Canal Commission, on a number of matters affecting the safety of railway employees have the force of Acts of Parliament. The rules made under this Act cover such matters as labelling of wagons, protection of point-rodding, construction of gauge glasses, shunting of wagons by tow ropes, and provision of brake levers

workable from either side of wagons. Returns are also required by the Ministry of all breakages of important material in service, such as rails, tyres, axles, vehicle couplings and draw-bars.

Apart from such requirements, it is incumbent upon a Railway Company to arrange its records so that annual accounts and returns shall be compiled and published in a form required by Parliament. The returns issued with these accounts include statements relating to the mileage, quantity of rolling stock, renewals performed, train miles run, traffic conveyed, etc. In addition, a large number of statistics are required to be supplied to the Ministry each month showing numbers of passengers, tonnage and ton-miles of traffic, locomotive miles and hours, wagon miles, receipts from particular commodities, etc.; and at regular intervals returns are also required of passenger miles, marshalling yard costs, cartage costs and ton-miles at each length of haul for particular commodities. The latter sets of figures are published monthly, and about June of each year a large volume is published, giving a digest of the accounts and statistics for the previous calendar year. This is a most useful book, dealing with the principal facts relating to railway work

which can be reduced to figures, and has been compiled for many years, but owing to a re-organization of railway accounts and the introduction of new statistics in 1913 it is difficult to make comparisons with earlier years on many matters, and, for reasons of economy, returns were not compiled for the years 1914 to 1918.

Control of rates and fares for conveyance is exercised by a Railway Rates Tribunal and not by the executive government, the only function of the Ministry of Transport in this respect, apart from assistance to the Tribunal, being one of inquiry and representations to the company concerned, if any aggrieved trader makes complaint regarding particular rates or facilities. Charges for Government use of the railways are mainly provided for by special Acts of Parliament, and no special national taxation is imposed upon the railways as such except passenger duty; an anachronistic tax amounting to about £400,000 per annum, charged on passenger fares other than (roughly) those of third-class passengers.)

(Income-tax is charged on profits calculated under rules similar to those applicable generally, but the railway companies are singled out for anomalous treatment as regards payment of it; the tax for each year being payable

in instalments at the end of each quarter during the year. Railway salaried employees who are liable for Income-tax are also in a unique position, as they have no personal right of appeal against the assessments made in respect of their earnings.

As rate-payers, railway companies are assessed under the general law on the estimated rent which the undertaking in each rating area would yield if let to a hypothetical tenant. Such hypothetical rent is arrived at by deducting from the total profits the profits, described as the tenant's share, attributable to the capital invested in the railway on property other than land, buildings and other rateable fixtures. The chief items regarded as tenant's capital are rolling stock, stock of stores and the cash required to conduct the business; and in the estimation of the value of this capital and the amount which the hypothetical tenant would expect to earn upon it considerable difficulty arises. In many cases, though not all, the valuations of "land used as railway" are, because of the peculiar nature of its occupation, reduced by three-fourths in arriving at the amount upon which certain rates are levied, the reductions being similar to those given to other properties such as agricultural

land, canals, etc. In Scotland, a valuation is found for the whole system, and from it there is deducted the sum of the valuations placed upon buildings by the usual methods, and the remaining value, regarded as appertaining to "railway," is divided over the various areas proportionately to the mileage of lines therein. In England and Wales a local authority makes its own estimate of the rental value of the railway in it, regardless of any other local authority, on what Lord Campbell in 1851 described as the improbable and nearly absurd supposition that a person may be found who would take the portion of a railway which passes through a single parish, and no more, as tenant from year to year. While the method explained above is the one adopted by the Courts if a valuation is the subject of an appeal, the ascertainment of the actual receipts in a single parish, and estimation of the expenditure necessary to earn those receipts, and from the net receipts deducing what the rent should be, is so difficult that a large number of the valuations are on no definite basis, and are the results of bargains between the companies and the local assessors. That was the practice up to 1913, and during the years 1914 to 1921, when the railways were in Government pos-

session, the 1913 valuations were not disturbed except for new properties. After 1921 many difficulties arose in assessing the lines, the chief being the value and remuneration of the tenant's capital. Under old decisions of the Courts, the value of such capital invested in, say, locomotives, was not the capital cost but the actual value in the then condition of the stock. The inflation of prices following the war had the obvious effect of largely increasing the value of such assets, and as the profits as a whole were not greater than those of 1913, with a greater theoretical tenant's capital employed in obtaining them, the landlord's share of such profits, or the valuation, was diminished, e.g.,

	1913.	1922.
Total profits	100	100
Tenant's share	60	80
	<hr/>	<hr/>
<i>Valuation</i>	40	20
	<hr/>	<hr/>

These figures are merely illustrative, to indicate one of the post-war difficulties if the pre-war methods were followed, and as a temporary measure the pre-war valuations in England and Wales, other than those in the London area, have been continued, plus or minus a percentage corresponding to the movements in profits and less a further percentage agreed

upon as a temporary expedient. It is, however, proposed to discontinue this arrangement, and adopt a new system under which the whole of each undertaking in England and Wales will be valued as one, and the total apportioned on an equitable basis amongst all the rating areas through which the railway passes. In what form this proposal will be submitted to Parliament by the Government who, it is understood, accept the principle, is not yet known and many difficult questions require consideration; but the alteration has not been hurried unduly as the Royal Commission on Railways, 1865, recommended it. A similar recommendation was made by the Royal Commission on Local Taxation in 1901, and in numerous cases before the Courts the present system has been criticized, not only as regards railways, but also as regards other public utilities, such as water-works, extending over a number of parishes. In theory, the law provides, as Mr. Justice Wightman explained in 1859, that the total rateable value of the several parts of "apparatus" worked as one should be the rateable value of the whole, but without a co-ordinating authority, that has not been attained. At various times, where the profits obtainable by a part of a railway line have been small, the assessing authority

has sought to substitute the cost or physical value for the profits as the basis in assessing the property, but the Courts have not accepted that contention, which implies that the hypothetical tenant would pay the higher of two possible rents. In Ireland, as in Scotland, the principle of valuing each undertaking as a whole has been adopted for many years, the allocation over the several areas being based on train mileage; and though that method of allocation was challenged successfully in the Courts as regards the lines in Belfast, a resultant increase of valuations there was levelled out by reductions elsewhere.)

On the outbreak of the war in August, 1914, the Government, under powers conferred upon them by the Regulation of the Forces Act, 1871, took possession of the whole of the undertakings of the main-line companies and instructed each General Manager to "carry on," under the direction of a Railway Executive Committee set up for the purpose of working the railways as one for war purposes. The chairman of this committee was the President of the Board of Trade, though this was largely a nominal appointment, and the committee, consisting of the General Managers of the principal companies, was responsible for the working of the railways

until the latter part of 1919. On the passing of the Ministry of Transport Act of 1919, the Minister took control and retained it until 15th August, 1921. During the seven years of Government control, the railway net receipts, apart from such items as interests and rents, were the property of the Government, and in compensation the companies received amounts corresponding to those earned in 1913, together with interest on new capital expenditure. With the shortage of man-power and materials during the war period, maintenance work fell into arrear and, in addition to the payments for net receipts on the 1913 basis, periodical payments were made for what was known as "Arrears of Maintenance." These payments represented the estimated arrears of work at 1913 prices, plus 15 per cent. for rise in prices, and it was agreed that the 15 per cent. would be adjusted to the actual increase when the work was made good. These adjustments, and other claims in respect of restoration of stocks of stores, consequential damages due to Government control and other matters, were ultimately settled by the payment of a round sum of 60 million pounds. The actual cost to the Government of their control of the railways is obscured by two main causes. During the war period, and for part of the control

period thereafter, the conveyance of troops and other Government personnel, and coal, stores and equipment for Government purposes, including that between munition factories, was not separately charged for. In addition, the rates charged to the public were not increased to meet the increased costs due to the great rise in prices until after the war period, an exception as regards passenger fares in 1917 being due to an endeavour to restrict the use of the railways for unessential purposes. The actual result of working as compared with the compensation is, perhaps, impossible to ascertain, but having regard to the heavy cost of a prolonged coal stoppage in 1921, and the large increases in prices of both labour and materials after the armistice, it is probable that it resulted in a substantial deficit. What the result would have been if rates and charges had been advanced contemporaneously with the increase in railway outgoings, is impossible to guess. When in 1920 and 1921 the costs of railway working were at their highest, railway rates and charges were increased by varying amounts ranging from 50 to over 100 per cent. in excess of pre-war levels, but the post-armistice "boom" in trade was collapsing and the increases in rates could not then overtake the increases in ex-

penditure. The services rendered by the railways to the Government during the war were invaluable, not only in the conveyance of the forces and munitions, but in the supply of rolling stock and other equipment for transport purposes overseas, and in the manufacture of munitions in the railway shops. Many of the railway-owned steamers continued to ply between France and England, and on the Irish Sea, with prior use for Government purposes; but more than half of them were taken over by the Government and used for war purposes only, such as hospital ships, mine sweepers, naval tenders and seaplane carriers. When it is considered that, apart from payments for steamers, etc., destroyed, the whole of the railway properties and staff were, in effect, hired to the Government for an annual rent equivalent to the 1913 profits, and that such rent was not varied as the value of money fell, the suggestion of "profiteering" cannot be made against the railway companies.

Shortly after the armistice, Mr. Winston Churchill, in a speech dealing with the post-war policy of the Coalition Government, referred to the railway problem in terms which were read as meaning that nationalization was proposed. Whether that was then the policy of

the Government, or the announcement was made in error, was never made clear, but in the Session of 1919 the Government passed an Act forming a Ministry of Transport, and transferring to it the powers of the Board of Trade, and other departments, in connexion with railways, roads, tramways and docks. During the next couple of years, the Ministry, in addition to issuing the directions necessary for the working of the railways during the remaining portion of Government control, to 15th August, 1921, and liquidating as far as possible the Government liabilities arising out of control, considered what the future policy of the Government should be, and in 1921 their proposals were introduced into Parliament and, after prolonged discussions, the Railways Act of 1921 became law. This Act dealt with four main subjects:—

- (a) Liquidation of the Control Agreements.
(Already mentioned in this chapter.)
- (b) Amalgamation of the railways into four groups. Effective from 1st January, 1923.
- (c) Railway Regulation.
- (d) Charging powers of the new groups.
Effective from 1st January, 1928. (Considered separately in Chapter VIII.)

The policy of State Ownership, if ever seriously contemplated, was abandoned, and the whole of

the railways of Great Britain—other than the London Passenger Lines not owned by the main-line companies, and certain jointly owned and light railways—were ordered to be amalgamated into four undertakings by a complete fusion of the existing companies. The Act created a special Tribunal which was vested with full powers to approve satisfactory schemes of amalgamation agreed between the parties to each group, and to amalgamate compulsorily where such agreement was not reached. In most cases the companies came to agreements which satisfied the Tribunal and were accordingly ratified. Only in one case of importance—that of the Caledonian Railway—was there ultimately a difference of opinion necessitating the formation of a scheme of amalgamation by the Tribunal, and from the 1st January, 1923, the four groups were created by Orders of the Tribunal, which had the force of Acts of Parliament, and took over the properties of 123 old companies mainly in consideration for stocks of the new companies, though in a few minor cases cash payments were made. Thus, with very little trouble, capital assets representing over 1,000 million pounds were transferred to the new groups, and in the course of amalgamation, the nominal capital of the railways con-

cerned was reduced by 150 million pounds, the number of securities being reduced by over 500.

The precise arrangements affecting each of the stocks of the old companies are set out in Appendix (5) to the Ministry of Transport Railway Returns for 1924 and are, shortly, as follows :—

	South- ern. Mil- lions. £	G.W. Mil- lions. £	L.M.S. Mil- lions. £	L.N.E. Mil- lions. £	Total. Mil- lions. £
Nominal amount of Shares and Stocks of old com- panies exchanged	. 159	148	541	352	1,200
for					
Nominal amount of Stocks issued by new com- panies	. 150	137	399	362	1,048

The reduction of the nominal amounts of stock on amalgamation was very largely due to the exchange of stocks with fixed interest rates of $2\frac{1}{2}$ per cent. or 3 per cent. for stocks of smaller amounts with fixed rates of 4 or 5 per cent.—e.g., £100 3 per cent. Debenture Stock of the London and South Western Railway Company was exchanged for £75 4 per cent. Debenture Stock of the Southern Railway Company. In other instances, the nominal value was increased, e.g., £100 of North Eastern Railway Consols was exchanged for £100 4

per cent. Second Preference Stock, £50 5 per cent. Preferred Ordinary Stock and £40 Deferred Ordinary Stock of the London and North Eastern Company. In the past, various critics of British Railway Finance have suggested that nominal increases of capital arising out of consolidation or splitting of stocks were objectionable, and, if that be so, the nominal reductions effected in the course of the group amalgamations should be regarded as laudable. In fact, neither process is of great importance, as neither nominal additions nor nominal deductions affect the railway Capital Accounts. These show as receipts the amounts originally subscribed and not the nominal amount of stocks subsequently issued on consolidation or splitting, and the return upon railway capital, if calculated upon the receipts from capital issued, is not disturbed by alterations in stock descriptions or amounts. This system, which differs from that applicable to the companies registered under the Companies' Acts, follows a recommendation of a House of Commons Committee in March, 1890, that the original Stock or paid up Capital of Railway Companies should be recorded, and shown in the accounts as though no alteration had been made in the form of the stock. The Capital Accounts of the four Group

Companies have continued this system, and the capital expenditure and receipts as at the date of amalgamation represent the aggregate capital expenditure and capital receipts of the old Companies. On amalgamation, a number of relatively minor adjustments were necessary, such as the cancellation of subscriptions by one company to another brought into the same group, and these are set out in detail in Appendix (6) to the Ministry of Transport Railway Returns for 1924, which reconciles the Capital Accounts of the old Companies with those of the Group Companies.

The Act of 1921 in several respects altered the law relating to railway regulation. Apart from any other powers, application may be made to the Railway and Canal Commission, by any body of persons representative of the public generally, or of trade, or of any particular locality, for an order requiring a Railway Company to spend sums, not exceeding £100,000 in any one case, in the provision of additional or improved public facilities, provided such expenditure does not prejudice the existing Stock-holders. In addition, the Minister may, on the application of a Company, by Order authorize expenditure, including purchase of land, up to the same limit, so avoiding the

necessity for special statutory powers which would otherwise be required. The Minister is empowered to order a Company or Companies to conform gradually to measures of standardization of way, plant and equipment, or to adopt schemes for the co-operative user of rolling stock workshops and plant; but such orders are not enforceable if the Railway and Canal Commission find that they are prejudicial to the existing Stock-holders. The Minister is also empowered to confirm agreements for the purchase or lease of any part of one Company's system by another Company. The object of this section was to simplify the legal machinery if one Company wished by agreement to transfer particular sections of its system to another Company, but no such cases have yet arisen. From the passing of the Act it is not lawful for any Amalgamated Company to enter into a new agreement with any other Amalgamated Company, for the allocation of traffic or pooling of receipts or otherwise, in contravention of the purposes of the Act, unless the Minister after consideration of the matter signifies his approval; and if the matter is one of importance a Committee of Inquiry must first consider and report upon it.

It is too soon to express an opinion on the ultimate effect of the Railways Act of 1921, but one obvious result has been a pooling of resources of the undertakings forming the new groups, thus increasing the efficiency of the smaller lines which, standing alone, would have had great difficulty in carrying on during the last few years. On the other hand, it is often alleged that the economies held out by the Government when the Act was before Parliament have not been realized. There is some truth in this, but large reductions in Working Expenses have, in fact, been made and passed on to railway users in decreased rates and charges. Further reductions in expenditure will, no doubt, be obtained as the process of standardization of equipment and consolidation of the methods of working, which the various old Companies had independently developed, is effected; but the spectacular alterations which the Government apparently had in mind, such as the increased economy possible if heavy trains of high capacity wagons are run and the elimination of the privately owned wagon for ordinary traffic, are dependent on many factors outside the control of the Railway Companies.

The transfer of traffic from the privately

owned railways to the publicly owned roadways has made more difficult any comparisons with pre-amalgamation performance. This transfer which was, in part, inevitable, has, it is often contended, been accelerated by the fact that the Road Motor Companies have not to bear the full cost of their "permanent way," and avoid local taxation on their transportation profits. Where the cost of road conveyance is less than the economic railway charge, or where the road service is more convenient and the difference between rail and road charges is small, such as for short-distance traffic where the railway line does not cover the whole of the journey to be performed, it is useless for the Railway Companies to attempt to recover to their rails the traffics transferred to the roads or to obtain that created solely by motor services. But if traffic has been diverted because the road carrier is subsidized, and not because the road services are cheaper in a real economic sense, the position is different. There has been much public discussion of this alleged inferior position of the railways as compared with motor transport in relation to the State, and the discussion mainly turns on the adequacy, or otherwise, of the payments made by motor transport for the use of ser-

services provided out of public funds. The services necessary for each class of transport round which there are disputes regarding the incidence of the cost, as distinct from operating and other expenditure clearly borne by the respective users, are :—

	Railway.	Road Motors.
(a) Provision of capital for land, construction, compensation, etc.	Railway lines, bridges, tunnels, etc. (but not warehouses, engine sheds, etc.)	Roads and bridges (but not warehouses, garages, etc.)
(b) Repairs and renewals of	Ditto	Ditto
(c) Cleaning, lighting and other services for	Ditto	Ditto
(d) Regulation of traffic	Cost of working and supplying signals	By policemen and staff supplied by industry.
(e) Rates for Local Authorities' expenditure	Based on profits earned by lines	None charged on road profits.
(f) Passenger duty	Levied on certain fares	None.

That all of the items of cost (a) to (f) are met by railway users is undoubted, and the corresponding costs met by road motor users, as such, are represented by the duties payable on all

mechanically propelled vehicles used on public roads, and expenditure of the Motor Associations in regulating traffic. If such duties, which it is estimated will realize about 24 million pounds in the year 1927-1928, are inadequate to meet all the items of cost represented by them and properly attributable to road motors, the alleged inequality of treatment is demonstrated, even if for public reasons it is considered that road motors should not bear further charges. In the *Motor Industry of Great Britain*, published in the autumn of 1927 by the Society of Motor Manufacturers and Traders, Ltd., it is pointed out that in the economic cost of modern road transport, account must be taken of the cost of the "permanent way" over which the motors run, i.e., the roads; but that roads are necessary for other purposes than motor use, and the problem remains of distinguishing the amount of road expenditure for which motors are responsible and should equitably pay. To this statement there would probably be general agreement if "expenditure" means the same as "cost" and is not confined to current payments on account of roads, and subject also to separate consideration of the question of the local rates and passenger duty borne by railway users alone. The

economic cost of the roads includes, as does the economic cost of the railways, the cost of the capital invested in land, foundations, river diversions, etc., and comparisons of the costs of the two forms of transport, which ignore this factor in one case only, would not appear to be sound. If a portion of public property were converted into a motor road or motor parking area, its economic cost could not be confined to further expenditure upon it, but must include the cost of the land previously used for other purposes. That, it is suggested, is, in various degrees, analogous to the change in the nature of the user of public roads, many of which, from being rural roads mainly serving local purposes, have become predominately motor roads for traffic other than local purposes. The Motor Industry book, however, states further that: "It is clear that motor vehicles should not equitably pay for the whole of the extra road costs occasioned by their use, inasmuch as the benefits of quicker and cheaper transport of goods and persons is an economic asset of great importance, quite apart from the factor of remuneration to Road Hauliers." What is thus urged is contended, on behalf of the Railway Companies, to be the actual position—i.e., the

road hauliers are merely bearing part of the extra road costs occasioned by motor vehicles. The remainder of the economic cost of providing, maintaining and regulating the "permanent way" of motor transport is borne by the general body of rate-payers and tax-payers, and no rates are levied on the profits earned by the use of the roads.

Certain public services are, of course, carried on with aid from public funds, and though these are usually National or Municipal trading monopolies, or social services, in some cases they partly compete with privately owned services, and the question which appears to arise is whether road motor transport is to be a State-aided service. If so, unless the charging powers of the Railways Act of 1921 (considered in Chapter VIII) are nullified, the public, as a whole, will be the losers, as State-aided road services by attracting certain traffic from railways will increase the charges for the conveyance of traffic which remains upon the railways. The position is not comparable, as is sometimes suggested, with that when canals gave way to railways. Then the railway undertakings came into existence after close Parliamentary inquiry, subject to Government supervision and regulation, and without Government aid, and sup-

planted the canals by providing a form of transport which was economically cheaper. Now road transport is fostered by public moneys; new roads, such as that between Glasgow and Edinburgh, are built at huge cost without a public inquiry whether there are adequate and reasonable facilities in existence, and, when built, the subsidized roads are used to attack the existing transport facilities provided by private capital. It is urged on behalf of the railway companies that the new competition between two types of transport—one using railways provided by private capital and regulated by the State, and the other using, at less than cost, roads provided by public capital, without State regulation of services and charges, and free from rates on profits earned by the roads—is a particularly harmful system, which is increasingly resulting in avoidable waste at a time when the utmost National economy is necessary. The position is partly obscured by the fact that the rates and taxes which contribute to road services are widely spread, and few realize their incidence, but local authorities are becoming uneasy. In February, 1927, Mr. William Graham, M.P., who was Financial Secretary to the Treasury in the Labour Government of 1924, wrote to

The Times suggesting that the Government should make a short and comprehensive review of the whole position, and urged that "a determined attack must be made on the theory of 'inevitable warfare' (between road and rail transport) which will cost the country millions in avoidable waste and burden domestic transport for many years to come."

The Minister of Transport welcomed this letter in the House of Commons on 10th May, 1927, and though he thought that wasteful competition ought to be considered by every one, he said that the first effort ought to be in connection with London traffic. The congestion of the London streets is only one aspect of the matter, and a solution of the London passenger transport problem will bring little relief to the steel maker or the farmer, whose business is suffering from the combined effects of heavy highway rates and the greater cost of rail transport resulting from the avoidable waste caused by highway policy. It is contended that the roads are the King's Highways, and are used for many other purposes than commercial motor transport, and even by horse-drawn railway vehicles. That, of course, is true, but the growth of motor traffic has so greatly altered the use of the roads that the whole system of

imperial and local taxation for road purposes requires reconsideration. Out of the duties collected from motor vehicles, a series of so-called "grants" are now made to the local highway authorities in respect of part of the current expenditure upon some of the public roads used by motor vehicles, but the change in the nature of the use of the roads calls for a system under which the whole economic cost of motor transport shall be met by the motor users, and there would be no insuperable difficulty in dealing with the proportion of road cost apportionable to other users. The cost of providing and policing the roads, and the incidence of the payments therefor, could be settled if the review proposed by Mr. Graham were undertaken, though the voluminous accounts and statistics required in respect of the privately owned railways are not required in respect of road users generally. Railway Companies in Great Britain have, as a rule, not been permitted to use the roads for transport purposes, except in respect of the collection and delivery of traffic passing to and from their lines, but in 1928 they will ask Parliament for general road powers, though not for any advantage not possessed or to be possessed by other road users.

It has been suggested that railway branches which have become unremunerative should be converted into roadways, but the ratepayers will hardly hail the transfer with enthusiasm if a railway becomes a public roadway and the loss of rates and the charges for its provision fall upon the Local Authorities. Conversion of railway branches to privately owned roads, which would be rated and also maintained by their owners, would, no doubt, be preferred by the rate-payers generally, but there is no evidence of any desire on the part of the motor industry to own and maintain their own tracks, though a few special roads have been suggested. Whether it is in the public interest that certain railway lines suffering from road competition should be taken up, and what the effect would be in time of war, is an important national consideration in this connexion.

In the United States, regulation of railways has developed on lines differing from those in Great Britain. There have been many abuses which have caused the passing of special Acts regulating the conduct of the railways but, apart from anti-trust laws, and differences due to the different circumstances in America, the regulations which have been evolved have had very similar results to those in Great Britain.

A railway is, in each country, regarded as a public utility which, having been granted a right of way through public and private property, is subject to a reasonable public control of its charges, must provide accounts and returns of its working for the control of such charges, and provide reasonable and safe facilities for the public use. The different means by which such control is exercised in each country is, however, too large a subject to deal with in this book, though a few observations on the control of rates and charges are made later. The road-motor problem has arisen in the United States as well as in Great Britain, but, generally, the motor is looked upon as an auxiliary to the railways rather than as an effective competitor, except as regards private cars and short-distance traffic. In most States the Railway Companies are permitted to run motor services in connexion with their trains, and in some of the States competitive motor services have been prohibited where the Railway Companies' services would have been prejudicially affected. The whole question is under review by the Interstate Commerce Commission, the National regulating body, with the object of devising the most effective means of co-ordinating transport services as a whole in the most efficient manner.

The main features which appear to emerge are that the Motor Companies are treated as public utilities and regulated accordingly.

(In many countries the railways are owned and worked by the State, Great Britain and the United States of America being, in fact, the principal countries in which private ownership exists. The reason why the British railways were constructed by private capital was, probably, the practical one that ample private capital was available for the purpose, and the need did not arise for State construction. The principles of individualism were dominant when the railway era began, but abstract principles as a guide to public policy are rare in Great Britain, and the various forms of State and Local Authority trading which have developed are not the fruits of any theoretical consideration of the merits of individualism and socialism. John Stuart Mill had definite views on the matter and thought that the waste of capital involved in the construction of competing railways should be avoided and only one line permitted, it being "an unthrifty dispensation of the public resources that several costly sets of arrangements should be kept up for the purpose of rendering to the community this one service." He did not see anything unsound in State

ownership, and thought that control over a railway ought never to be parted with by the State unless on a temporary concession, as was done in France.

In 1844, Parliament, on the proposal of Mr. Gladstone, who was then President of the Board of Trade in Sir Robert Peel's Government, passed an Act which permitted the State acquisition of any railway after 21 years from its inception, provided it was not authorized prior to 1844. The price was to be 25 years' purchase of the average annual divisible profits of the three preceding years, but if the average were less than 10 per cent. of the capital, the Company had the right to require an arbitration on the additional amount, if any, to be paid for the value of its prospects.

These powers have never been exercised, nor could that have been done effectively without further legislation, but they show that at that time there was no theoretical objection to State ownership. From time to time, many suggestions have been made by various interests that the State should acquire the railways, and a railway nationalization society exists to promote that policy. Trade Unionists who wish to see the State their employer; those who wish to use the railway rates as an instrument to

foster home trade and discourage foreign trade ; traders who think their railway rates would be reduced ; those who believe in the State ownership of the means of production and distribution ; and even some railway shareholders who object to Government regulation, have all advocated nationalization, but the general body of opinion in Great Britain has been against that step. If it is ever seriously proposed by the Government, the mere transfer from private to Government ownership by an exchange of stocks would not be very difficult, and the recent amalgamations have greatly simplified the position. Some amount of saving would, no doubt, accrue, owing to the cheaper capital moneys obtainable with State credit, but whether this would materialize to the benefit of railway users in reduced rates or increased facilities, or whether that saving would be augmented by greater economy in working owing to the elimination of competitive services, or whether it would be eaten up by greater cost of State working, must be left to politicians to argue. One national economy can, however, be anticipated. The State, as a railway-owner, would hardly build or permit anyone else to build opposition roadways ; just as it does not permit any opposition to its business of carrying letters.

A re-examination of the whole question of State relations to transport is, perhaps, due, and the Government may consider that the advent of the road motor and their road policy has created an effective alternative means of transport which has caused the railway to cease to be a monopoly; and that, therefore, the existing restrictions and controls of railway rates and management should cease, and the railways left to the control of the law of supply and demand only, as in the case of their competitors, though without Government aid in the provision of their permanent way. That would be an interesting and lively position, but it is hardly probable, and, no doubt, we shall see a compromise dictated by reasons of expediency and not by logic. If, following many precedents, a series of Royal Commissions and other Committees of Inquiry is set up, one can only hope that action will follow more swiftly than it has on the recommendation of the Royal Commission of 1865 that a railway should be valued as a whole for local rating purposes.

NOTE.—There have been several recent developments which may affect the position explained above.

The Government have intimated that they have in contemplation an investigation into the need for better regulation of road traffic, and the possibility of greater

co-ordination of the internal means of transport in Great Britain.

The 1928-29 Budget proposals of the Government include a tax on petrol of 4*d.* per gallon, which, while not specifically set aside for the purpose, will be used for relieving the burden of rates on certain industries from 1st October, 1929. One part of that de-rating scheme will be effected by a 75 per cent. reduction of the rates on railways, on the understanding that the whole of such reduction shall be passed on to certain depressed industries by rebates on charges for rail conveyance.

The Railway Companies' Bills in Parliament for road powers have passed their second reading in the House of Commons with large majorities, and are under examination by a Select Committee of both Houses of Parliament.

(June, 1928.)

CHAPTER IX

RATES AND CHARGES

PARLIAMENT, when the earliest British railways were authorized, had little to guide it in settling the scales of permitted charges except the unsound precedents of the Turnpike and Canal Acts. It looked upon a railway as a highway for the use of the public, upon which anyone could travel or transport his goods with his own conveyance and means of traction and, accordingly, fixed the tolls to be charged for the use of the railroads on the lines of the tolls leviable on the turnpike roads and the canals. The right of anyone to use the railways continues, but the use of the steam locomotive as the means of traction inevitably made the railway companies the sole carriers on their lines, and scales of charges were authorized by Parliament to be charged where the companies hauled the traffic. The tolls and the subsequent conveyance rates represented the maximum amounts chargeable, and fixed at high

levels they were far from the actual rates fixed by economic conditions. A further restriction on rates was the futile one, that when railway profits reached 10 per cent. of the paid-up capital, a reduction in rates might be made by Treasury order, provided the Treasury guaranteed the divisible profits would be 10 per cent. of the capital stock during the continuance of the revised charges. As railway traffic grew, a further charge developed known as a "terminal charge," for the provision of station accommodation and services, such as loading and unloading and warehousing of goods, and although this charge was resisted by the traders, the Courts and Parliament agreed that these services were additional to those contemplated when the original tolls and carriage charges for use of the "highway" were authorized, and that reasonably necessary charges could be made therefor. Collection and delivery of traffic by the railway companies was the subject of a further charge, and other charges were made for special services during conveyance or at the stations. There was thus a great development from the early stage when the companies merely provided a highway for public use up to the stage when they provided all the familiar modern facilities. The original maximum tolls had attempted to

classify goods and mineral traffic into half a dozen groups, with a scale of charges governed by the value of the articles embraced in each; limestone in the lowest grade paying a toll of 1*d.* per ton per mile, coal 1½*d.*, bricks 2*d.*, grain 2½*d.*, and cotton 3*d.* Out of this developed classifications embracing the several thousand separate descriptions of goods conveyed, and ultimately a uniform classification was ordered by Parliament and applied to all companies. This merely decided into which particular class each traffic fell for charging purposes, the rate for each class being governed by the particular scales authorized to be charged by the various companies. But, in addition, there grew up a vast system of "exceptional rates," lower than such "class rates," under which probably 75 per cent. of the traffic actually passed. The reasons for these exceptional rates were many: special contracts under which the owner bore the risk of damage; reductions on account of large consignments; reductions because there existed an alternative shorter route or cheaper form of transport; and reductions due to the economic law that traffic cannot pass if the rate exceeds the value of the service. The rates in force, unlike the "class rates," were not, therefore, built up upon any arithmetical scale so

that a trader could, knowing the distance, calculate what the charge would be for any particular weight of traffic.

It is often suggested that freight rates should be charged at a fixed scale, based upon either the cost of the service or the distance of conveyance, but the universal experience is that these bases are impracticable. Many books have been written on this one matter and many Government inquiries have been held upon it, and only a brief consideration of it can be given here. The suggestion usually is, that the charge for transport should be the working expenses incurred, plus a uniform percentage addition for remuneration of capital. The inequity of this method of ascertaining cost has already been considered, and the effect on the prudent company, which has spent capital to reduce working expenditure—say in reducing a gradient or in electrifying a line—need not be laboured. But assume this defect is removed, and it is proposed to charge for conveyance the actual working expenses with an addition for capital; calculating the latter not as a percentage of working expenses but as a percentage of capital expenditure. It will be found that a large proportion of the cost of the service, including use of capital, is represented by the constant

element of fixed charges, and this proportion may be taken as about 70 per cent., the variable charges representing 30 per cent. If, therefore, the service of 100 units of traffic cost £100, the cost of 80 or 120 is not £80 and £120 respectively, e.g. :—

	100 Units. £	80 Units. £	120. Units. £
Fixed charges	70	70	70
Variable charges	30	24	36
	<hr/>	<hr/>	<hr/>
	<u>£100</u>	<u>94</u>	<u>106</u>
Cost per unit	20s.	23s. 6d.	17s. 8d.

The carrier, if he bases his charges upon cost, must, therefore, vary them from time to time according to the quantity of traffic offering, and that is not practicable. With one traffic passing in a fairly steady volume, experience would enable a reasonably near average figure to be estimated per unit of traffic, based upon two items, one representing the fixed and the other the variable charges. That is a general practice in estimating electric power prices, but a railway company does not sell one unit of transport in circumstances which permit an average figure to govern the rate therefor. There are immense numbers of differing units, conveyed under differing conditions and for

differing distances, and it is not possible to allocate to each its share of the total cost. Assume, however, that it were possible and that the above figures represent one class of traffic only—wagons of coal for export. For 100 wagons 20*s.* each represents the charge, but if owing to bad trade the traffic falls away to 80 wagons, the cost basis would increase the charge by 8*s.* 6*d.* per wagon and the result would probably be that the coal would not be sent. In that event £24 of variable charges would not be incurred, but the £70 of non-variable charges would run on, and there would be no funds to meet them.

Fixed rates per mile are equally impossible, though, if there were no other matters to consider, fixed charges per ton plus mileage charges, at a descending rate per mile, would be possible, and that in fact is the basis of the maximum charges. But if a certain traffic can be obtained at a rate (say 10*s.* 1*d.*) which will more than cover the actual out-of-pocket expense of handling it (say 10*s.*) and would not be obtainable if a higher rate were charged, because it would move by other means; the acceptance of the 10*s.* 1*d.* rate and the consequent contribution of 1*d.* to meet the fixed charges is in the interest of all other railway users who would otherwise

bear 1*d.* more. The quotation of the 10*s.* 1*d.* rate would not, however, be possible if the rates were charged on a fixed scale. Whatever system of rates is in vogue, it is subject to the economic law that a charge for a service cannot be operative if it exceeds the value of the service. This principle, known as "charging what the traffic will bear," is a governing factor in all transport charges and simply means that the value of the service to the trader fixes an economic maximum to the rate chargeable. If the value of the service is less than the out-of-pocket expense, performance of the service is not justified, but if there is a margin, however small, as in the 10*s.* 1*d.* rate referred to above, the quotation of 10*s.* 1*d.* and the conveyance of traffic at that rate is charging "what the traffic will bear." Theoretically, the same principle applies upwards as well as downwards, and in a complete monopoly uncontrolled by the State the rates could be fixed at a level which would yield extortionate profits, provided they did not prevent the traffic passing. There is, however, a schedule of charges beyond which railway charges cannot be increased and this schedule is based, so far as can be estimated, on the principle that traffic which can only bear low rates will produce x , and traffic which

can bear high rates will produce y , and that x plus y will, if possible, equal the cost of transport, including service of capital, for all traffics. The service of capital item is a difficult one to assess, and the governing principle which has emerged is that it shall represent a return on the capital invested sufficient to attract further capital for further developments, as the industry of the country expands. The application of the principle of "charging what the traffic will bear" has its inherent difficulties and, no doubt, abuses and errors have arisen out of it, as no fixation of rates can be scientific, and even the out-of-pocket expense is not precisely ascertainable. A few elements such as direct cost of loading and unloading may be ascertainable, but at best the direct cost of a particular service is merely an estimate of the probable share of the aggregate direct costs.

The Railway and Canal Commission is a special Court, created with powers to settle, amongst other matters, allegations regarding undue or unreasonable preference to particular persons or traffics. There have probably been very few cases in Great Britain where undue preference has been shown to a particular trader for personal reasons, because the railway company and that trader had common interests; but such

cases have been frequent in the United States and special Acts were passed in an endeavour to stop them. The British railways have generally been free from control by particular trading interests and the American abuses have not, therefore, been facilitated. Apart from cases of personal preference or discrimination, which are indefensible, there are many cases of local preference which are criticized from time to time, and by Statute the onus of disproving that such preference is undue rests upon the railway company. While it is incumbent upon a railway company to publish all its rates, at the stations concerned, and charge the same rates for equal quantities of similar articles carried in the same manner between the same points, the principle of "charging what the traffic will bear" results in discrimination as between commodities and as between localities. In many Acts the companies were required to discriminate between particular places, the first, perhaps, being in the Stockton and Darlington Act, where the maximum rate for haulage of coal for shipment was made $\frac{1}{2}d.$ per ton, whereas $4d.$ was chargeable for the same service if the coal were for land sale. The fact that from "A" to "B" a particular rate is lower than the corresponding one, in itself reasonable, from "C" to "B" is, *prima facie*, a

preference to "A"; but if the rate between "A" and "B" is sufficiently high to cover the direct expenses and make a contribution to the fixed expenses, and cannot be increased or the traffics would go to "B" by, say, the sea, the preference is not undue or unreasonable. If the rate from "A" were increased so that the traffic did not pass, the fixed charges would be spread over a lesser area and tend to increase the rate from "C." The subject is one of great complexity, but sufficient has, perhaps, been said to show that the underlying general principle of railway rates, where the undertaking is conducted on commercial lines, is to obtain the largest possible quantity of traffic at rates which will:—

- (a) In each case exceed the direct cost of the service;
 - (b) Where a proportionate share of fixed charges is not obtainable, contribute thereto what the traffic will bear; and
 - (c) In other cases contribute the balance of the fixed charges;
- but the rate in no case may exceed either—
- (d) The value of the service, or
 - (e) The maximum authorized by Parliament.
- A purely hypothetical illustration, assuming the

traffic is in two equal parts, "A" and "B," may assist:—

	Direct cost of Service. £	Fixed Charges including Return on Capital. £	Total. £
"A"—Paid by 100 units of traffic which cannot bear the full fixed charges . . .	30	60	90
"B"—Paid by 100 units of other traffic . . .	30	80	110
	<u>£60</u>	<u>140</u>	<u>200</u>

"B" pays £20 more than "A," but if the traffic of "A" were killed by an increase of rates, "B" would not gain but, in fact, suffer as much as it could bear of the £60 of fixed charges borne by "A." It may be suggested that the rate for "B" should be reduced to the level of "A," i.e., by £20, but that may cause a serious shortage in the railway net revenue, and if that is not maintained at a reasonable level, railway users as a whole will eventually suffer. There is the possibility that a reduction of the "B" rate will increase the traffic so that a greater net revenue may be obtained from "B," but it is assumed that that rate is at a level which, if reduced, will not increase net revenue, or ordinary commercial prudence would already

have caused it to be reduced. The economic law of increasing returns applies with particular force to railways, as an addition to its traffic does not cause a proportionate increase in the cost of working the whole; and therefore the obtaining of new traffic, or the retention of old traffics, which might otherwise leave, by charging lower rates is justifiable if such rates are as high as can be obtained and earn *any* net revenue. The more efficient a railway is, the more will it recognize that law; but it must also bear in mind the possibility of diminishing returns. An increase of traffic may cause congestion, and either reduce the net revenue or necessitate an enlargement of the lines or equipment, and reduce, at least for a time, the yield upon the capital outlay. A widened line or an electrification scheme may take many years to fructify fully, and the decision whether capital is to be invested in such works, having regard to the probable trend of traffics, is not the least of railway problems. It is of no service to railway users but, in fact, a disservice if additional facilities are provided which, ultimately, do not earn the interest cost of the capital spent.

Passenger fares, while governed by the same general considerations as goods rates, have developed on different lines. The earlier Acts

did not contemplate the large volume of passenger traffic which would be created by railway facilities, and merely permitted such traffic at fares lower than those charged by the stage-coaches which, prior to the railways, were $4\frac{1}{2}d.$ per mile inside, and $2\frac{1}{2}d.$ per mile outside. In 1844, however, the Gladstone Act, mentioned earlier, required each company to run one train per day at a speed of not less than 12 miles per hour, calling at every station and conveying passengers at fares of not more than $1d.$ per mile, and the apparently novel but necessary condition was attached, that the seats were to be protected from the weather. These trains were generally known as "Parliamentary Trains," but the rate of $1d.$ per mile was, in time, applied to additional trains, and in 1872 the Midland Company permitted third-class passengers to travel by all trains, and the same rule was soon applied by all the other companies, except on a few particular trains. A vast number of excursion and cheap fares, corresponding to exceptional rates, were in force from an early stage; but apart from the Act of 1844 the only statutory enactment regarding passenger fares generally was one relating to workmen in 1883, which required any companies, not already doing so, to provide services of work-

men's trains at fares and times considered reasonable by the Board of Trade.

In 1888 an Act was passed requiring the companies to submit to Parliament a revised classification and schedules of maximum charges for goods traffic, and after inquiry into the companies' proposals by the Board of Trade, these became law in 1891 and 1892. The classification divided the traffic into eight classes, and a uniform grouping of traffic under such classes was made for all the railways. In addition, each company was authorized to charge certain maximum charges for each class, viz. :—station terminals at each end of the journey; service terminals (loading and unloading, covering and uncovering wagons) where this work was done; and conveyance at rates per ton per mile tapering downwards according to distance. The new scales, carefully prepared after years of inquiry, altered the charges applicable to millions of rates, and as the Government would not delay the operation of the Act beyond 1st January, 1893, these could not be examined in time. Neither the traders nor the companies knew where they were, and at 1st January the companies took the drastic step of charging the new statutory rates in all cases where the existing exceptional rates

had not been examined as regards legality. Those traders who obtained reduced rates were pleased, but in the great majority of cases the rates were increased, and after heated complaints from traders and prolonged discussion in Parliament, the Government passed a further Act in 1894 which provided that where any rate was increased after 31st December, 1892, the onus of justifying the new rate lay upon the railway company, and the fact that it was lower than the authorized rate was not proof of reasonableness. As each increase of a rate required to be justified by proof of an alteration in the circumstances relating to the traffic concerned, the power of increase was of little value to the companies, as the costs of particular traffics could seldom be proved, and, in effect, the accident of the amount of the rate on each traffic between any two stations at December, 1892, fixed a new maximum for it, and the enterprising company which had made experimental reductions was usually tied to them whether the experiments were successful or not.

With this restriction of particular rates, the companies were in a difficult position, and eventually the Government had to intervene. Increased expenditure on wages was forced upon the companies in 1911, not before it was due,

and the Government passed a short Act in 1913, authorizing the Courts to sanction increases of rates to meet the higher cost of labour, without proof of the share of the additional cost applicable to each particular rate. As a result, on 1st July, 1913, there was a general increase of exceptional goods rates, other than coal rates, by 4 per cent.; but even this was contested, and not until the end of 1919, after many delays, partly due to the war, did the Courts approve the increase made.

During the war the charges of 1st July, 1913, were continued with a few exceptions. Excursion fares had been restricted, and at the beginning of 1917 an increase of 50 per cent. in passenger fares was made with the object of restricting civilian travel, this being followed by increases of season ticket rates of 10 per cent. or 20 per cent. in 1918. In 1919 the Ministry of Transport Act authorized the Minister to direct what rates and charges should be imposed, without appeal to the Courts and regardless of the existing statutory maxima, and on the recommendation of an Advisory Committee, the rates on freight train traffic were, in January, 1920, increased by amounts varying from 25 to 60 per cent. over pre-war rates, together with certain flat rate additions

per ton, ranging from 3*d.* to 4*s.* in order to meet, if possible, the huge increase in expenditure which had taken place. These additions were found to be insufficient, and a further increase of nearly all freight train rates to 100 per cent. over pre-war charges was made in September, 1920, the flat rate additions being maintained or in some cases increased. Passenger fares were increased to 75 per cent. over pre-war levels, and season tickets to 50 per cent., and the parcel charges were also heavily increased. From 15th August, 1921, these rates and fares, being in force at the end of Government control, became the statutory maxima until 1st January, 1928, subject to a power vested in the Railway Rates Tribunal to revise the charges in either direction. From time to time various alterations were voluntarily made by the railway companies which reduced the freight rates to about 55 per cent. over 1913 levels; but from 1st February, 1927, an increase to about 63 per cent. was made, passenger fares, which had been reduced to 50 per cent. over 1913 rates in 1923, being left unaltered.

Under the Railways Act of 1921, an entirely new principle is attempted to be applied. Rates and charges are to be fixed by a new Court styled "The Railway Rates Tribunal" on a

level which will, with other sources of revenue, so far as practicable, yield with efficient and economical working and management, an annual net revenue known as the "Standard Revenue." In the first instance, as from 1st January, 1928, this standard consists of the net revenue of the year 1913, together with certain allowances for fructification of works which were not fully remunerative in that year, remuneration of capital expenditure since 1st January, 1913, and an allowance of not more than one-third the value of the economies rendered possible by amalgamation, and effected by early steps of the companies. Each amalgamated company stands by itself, and the amounts of the standard revenue aimed at, as determined after several years' discussion, are :—

	£
Southern Railway	6,631,479
Great Western Railway	8,312,013
London Midland and Scottish Railway .	20,326,622
London and North Eastern Railway .	14,787,733
	<hr/>
	<u>£50,057,847</u>

These amounts represent the net sums available from all sources for remuneration of the capital issued, and are equivalent to the following percentages of the total capital receipts of the companies :—

	Per cent.
Southern Railway	4.33
Great Western Railway	4.97
London Midland and Scottish Railway	4.75
London and North Eastern Railway	4.52
	<hr/>
Total	<u>4.65</u>

If from these sums there be deducted the amounts required to pay the full interest and dividend on all pre-ordinary and preferred ordinary stocks, the balances are equal to the following rates per cent. of the nominal amount of the ordinary or deferred stocks :—

	Per cent.
Southern Railway	2.85 (on Deferred Stock)
Great Western Railway	7.95 (on Ordinary Stock)
London Midland and Scot- tish Railway	7.87 (on Ordinary Stock)
London and North Eastern Railway	4.18 (on Deferred Stock)

The capital figures used in these calculations include amounts for capital issues in respect of which additions will probably be made to the standard revenue at the first review in 1929, and these additions will have the effect of increasing each of the above rates. There is not, it must be emphasized, any guarantee that these amounts will be realized, nor if they were, that they would be the dividends paid, and they merely represent the upward limits to profits aimed at by the

Tribunal in fixing rates ; but they set up standards which Parliament considers the railways are entitled to earn. Restriction of profits was a feature of the early Railway Acts, and is open to the objection, in times of prosperity, of removing the incentive to do better, but an attempt is made to overcome this by giving each company a share in the profits earned in excess of its standard. At the end of the first year, 1928, and at intervals of one year thereafter, if necessary, the actual net revenue is to be reviewed, and if an excess be found which is likely to continue, the Tribunal shall modify all or any of the charges so as to effect a reduction of 80 per cent. of the excess, the remaining 20 per cent. being added to the standard ; and with allowances for additional capital, this forms a new standard for comparison with future years. If, however, the net revenue falls below the standard, the Tribunal is required to modify charges to make good the deficiency, but no addition to the standard arising from increased charges can be made. One other provision which is regarded as of importance may be mentioned. The net revenue includes the amounts earned by the many ancillary and subsidiary businesses carried on by the companies, and if the Tribunal considers that the net revenue resulting from

any such business is unduly low, it may, in fixing railway charges, make such deductions for that circumstance as it thinks proper.

Whether the standard revenue will be obtained by all or any of the companies is a matter of speculation. The circumstances have so greatly changed since 1921, by reason of the Road policy of the Government, and the period of bad trade, that the future is indefinite. It is clear, however, that the companies have an ideal to aim at, and the more they strive to obtain their standard by new methods and concentration of their large capital resources the better will be their position, and even with attainment of the standard, they have a stimulus to improve further upon it. While, if they fail to attain it, and the result is a stagnation of transport facilities which will cause further Government intervention, they can at least show that the annual value of their properties, as settled by the Act of 1921, has not been reduced by their inability to adapt themselves to post-war conditions.

The fixation of the rates and charges to earn the standard revenue is on an entirely new basis. The mere amount which the rates and charges should yield is a difficult feat in estimating and was made up for the four groups thus:—

RATES AND CHARGES

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	Standard Revenue (as above). £	Working Ex- penses to earn such Revenue, less Net Receipts from other Sources. £	Amount which Rates and Charges should yield. £
Southern .	6,631,479	16,839,120	23,470,599
Great Western .	8,312,013	23,833,180	32,145,193
London, Mid- land and Scottish .	20,326,622	59,466,521	79,793,143
London and North Eastern .	14,787,733	46,436,233	61,223,966
Total .	£50,057,847	146,575,054	196,632,901

The net receipts from other sources, deducted in ascertaining the figures in the second column, include those arising out of non-railway businesses, such as docks, steamers, catering, and also rents and net earnings from interest on investments, etc. In framing the estimates of working expenses, one of the chief matters which engaged the attention of the Tribunal was the amount necessary to meet the renewals of permanent way, rolling stock and other assets upon which expenditure falls irregularly. A great amount of detailed examination of these and other figures took place, and the amounts quoted represent the final figures as

agreed. Less difficulty will be experienced in considering the position at the annual reviews, as actual accounts will then be available, and the principal questions which can be anticipated will be in regard to the abnormality of any features, and whether there is efficient and economic management.

Having ascertained the estimated amount to be raised by rates and charges in the first year, the Tribunal's labours were directed to the allocation of this over the various traffics. At earlier stages, after prolonged inquiry, a Rates Advisory Committee appointed by the Minister of Transport had fixed a new classification of freight train traffic under which 21 classes (excluding coal) were made. The first 6 cover mineral traffics in owners' wagons in lots of six tons or more, and the remainder the traffic carried in companies' wagons, the same traffics sometimes appearing in 3 or 4 separate classes according to the weight of the consignments. The Tribunal then fixed standard charges, for each class, per ton mile for conveyance, tapering downwards with the distance, together with standard terminal charges, and from these rates were built up and applied to the anticipated traffic in the first year. But although it was hoped exceptional rates would largely disappear with

the elaborate revised classification, the change in circumstances since 1921, owing to trade depression and road competition, has caused many new exceptional rates to be quoted, and a considerable volume of traffic will continue to be carried at exceptional rates. The yield of the new standard rates was therefore estimated on the basis of the volume of traffic expected at other than exceptional rates, and to it was added the probable yield from exceptional rates. A very large proportion of traffic is carried over the lines of more than one railway, and the conveyance portion of the standard charges for through traffic was, under the old system, calculated for each company separately, and therefore if traffic passed over, say, three railways each for 20 miles, the conveyance rate on each line was at the 20 mile scale. From 1st January, 1928, through rates will be charged on a continuous mileage scale and, in addition, the shortest distance on each railway between the points of consignment and not the distance the traffic is actually worked over will determine the charges. Many minor alterations in conditions of carriage and in procedure in event of disputes have been made, and a lengthy time will, no doubt, elapse before all the alterations are fully assimilated; but it is thought that

the average level of rates will be about 60 per cent. higher than in 1913.

Parcel rates and passenger fares have also been reviewed, and the latter are settled as regards ordinary fares at about 50 per cent. higher than pre-war, i.e. first class $2\frac{1}{2}d.$, second class $2d.$, and third class $1\frac{1}{2}d.$ per mile. Season ticket rates, previously unregulated, are settled on tapering mileage rates, and scales for workmen are also laid down. In passenger traffic, as in goods traffic, much the greater proportion of passenger journeys—about two-thirds—are charged for at rates below ordinary fares, and even the ordinary fares do not realize the full rates per mile quoted above, owing to the fact that the fare is charged on the shortest mileage route, which is not necessarily that used. As a result, the average fare per mile for all classes of traffic was slightly in excess of $0.8d.$ in 1926. The comparable figure before the war is not available, but various isolated tests for particular purposes resulted in averages of about $0.55d.$ The average rate per mile is likely to fall below $0.8d.$ with the large extensions of cheap travelling facilities which were introduced in 1927. The number of passenger journeys annually is about 1,750 millions and the total passenger mileage is over 20,000 millions per annum, representing

a revenue of 77 million pounds. That this vast traffic could not be carried without excursion fares based on what the traffic will bear is obvious, and low fares charged to attract pleasure traffic to the railways are justified on that commercial ground. That traffic at ordinary fares suffers owing to them is evident, but the only money test which can be applied is whether the fares as a whole are designed to give the maximum obtainable net revenue.

The Railways Act of 1921, while it lays down a system of standard charges for all classes of traffic, and not maximum charges as in the past, provides that such charges shall be made without variation in either direction, "unless by way of exceptional rate or exceptional fare." It was contemplated by the Government when the Act was passed that with a new classification the greater number of exceptional rates would cease to exist. In some quarters, even, the hope was held that in a few years all such charges would cease, and railway rates be reduced to a simple scale applicable between any two points. That theory appears to be sound to many persons, but practical considerations render it incapable of application. The deep-rooted traditions of British trade and the new means of transport provided by motor

roads, have, in part, caused this position ; but even if they had not, the economic law that traffic will not pay more than it can bear, would either have forced an abandonment of the theory of uniform rates, or the railways would have been unable to render to the trade of the country the facilities which it requires.

The broad effect of the Act of 1921 in regard to rates and charges and profits can, perhaps, be summarized thus :—

- (1) Rates and charges borne by railway users are regulated as regards their general level by the Rates Tribunal and particular grievances will also be corrected by the Tribunal.
- (2) An upwards limit of railway profits has been fixed subject to increase if a surplus is realized. These profits, if obtainable, will yield a reasonable return on capital, and thus enable future developments to be financed.
- (3) This fixation of profits, with its attendant regulation and supervision by the State, places upon the companies the legal responsibility of ensuring efficient and economical management and, on the other hand, places upon the State the

moral responsibility of ensuring that the rights of the railway stock-holders shall not be prejudiced by Government action or inaction.

The general principles applicable to railway charges are not peculiar to Great Britain, and the United States Transportation Act of 1920 which is, in many ways, similar to the British Act of 1921, does not attempt to alter the rates basis and, as in Great Britain, it regulates the general level of profits. The profits are not, however, based as in Great Britain, on those of 1913, but are to represent for the first two years 6 per cent. and subsequently $5\frac{1}{2}$ per cent. (after meeting Income-Tax) upon the value of the railways. The meaning of "value" has not been settled, but that it is a physical and not a profit earning value seems clear, though a recent (November, 1927) decision of a District Court throws some doubt on this. If it represents the present cost of constructing the existing assets and buying the land owned by the railways, less accumulated depreciation, the profits measured by $5\frac{1}{2}$ per cent. on value will include the increase arising out of the rise in prices and as prices fall, so will profits. This means, very broadly, that the purchasing power of the profits contem-

plated, ignoring new lines, etc., will be stabilized, though the nominal amount in dollars will not; as compared with the British Act, which stabilizes the amount of profits contemplated regardless of purchasing power. A further difference arises out of what is known as the "recapture clause" in the American Act, under which profits earned in excess of the standard are, as to one-half paid over to the Interstate Commerce Commission, and as to the other half placed in reserve by the Company. If, later, the railway fails to earn its standard profit, it may draw upon this reserve, and the moiety held by the Commission is to be used in the public interest for various railway purposes including loans to weak companies. Consolidation of the railways into groups is, for 7 years, left to the voluntary action of the companies, but their financial structure differs so greatly from that of the British railways that comparisons with the British amalgamations are not possible here. The most notable post-war feature of the United States Railways has been the marked expedition with which they have handled the vast amount of traffic carried in the last few years. By close co-operation with the railway users, difficulties arising out of congestion, delays in loading and unloading wagons,

and packing of commodities, have been very largely overcome and the greatly increased demands of the country handled with great efficiency. The level of rates and charges in relation to the pre-war level is a little less than in Great Britain, but comparisons owing to the different circumstances are valueless. Freight charges are considerably lower in the United States, mainly because of the greater size of consignments and longer distance they are hauled, but, on the other hand, there is not the same relative volume of passenger traffic as in Great Britain, nor the same excursion facilities, and passenger fares are higher in the United States. Comparisons of British and Foreign Railway charges inevitably break down owing to lack of similarity of conditions and, perhaps, the only common feature is that in all countries the principle emerges that uniform rates defeat their object, and that the only sound basis is that the rates shall cover the minor direct costs and contribute what they can bear towards the major indirect costs subject to public regulation, so that the whole of the rates shall not be excessive, and that there shall not be discrimination against individuals.

CHAPTER X

ACCOUNTING AND FINANCE

	Millions. £
THE Ministry of Transport Returns show that at 31st December, 1926, the capital expenditure of the British Railways was	1,206
and we have seen how this money was spent, and that it represents the cost of the land, works and equipment and neither the cost of construction at the present time nor the present value.	
Of this amount, the receipts from capital subscribed by Stockholders represents . . .	1,153
Various other receipts have realized . . .	I
and the balance of	52
has been temporarily met out of the general funds of the Companies.	
The connexion between the authority to raise capital given by Parliament in the many private Acts of the Companies and the above payments by Stockholders is, shortly, this :—	
Parliament has authorized the issue of . . .	1,28
The Companies' Stockholders by resolution have authorized their Directors to create and issue of this	1,16

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	Millions. £
The Directors have, in fact, issued stocks with a nominal value of	1,172
But of this nominal additions (less deductions) made on the consolidation or exchange of stocks represent	49
And the actual stock issues were	1,123
For which premiums (less discounts) were paid, amounting to	30
Making the receipts, as above, of	<u>£1,153</u>

Each stock issued, and the return upon it, is fully described in the Ministry of Transport Returns, and, in total, the yield upon the receipts from capital issued has been in the last few years :—

			Receipts from Capital Issued. Millions. £	Interest and Dividends Paid. Millions. £	Average Yield. Per cent.
1913			1,108	46·2	4·17
1922			1,122	52·0	4·62
1923			1,128	50·0	4·43
1924			1,133	50·1	4·41
1925			1,151	49·3	4·28
1926			1,153	42·0	3·63

Note.—The approximate figures for

1927 are			1,168	46·7	4·00
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With normal trade prosperity, the interest and dividends of the amalgamated railways as con-

templated by the Railways Act of 1921, together with those of the other railways, are equal to about 54 million pounds, an average of 4.6 per cent. on the capital receipts of 1,168 millions at 31st December, 1927. The low return in this industry is due to the fact that a great part of the capital was issued when money was cheap—e.g., the Debenture and Preference Stocks, fixed rate securities representing 74 per cent. of the total, receive only about 4 per cent. of their nominal value. The Debenture Stocks, as distinguished from a few Mortgage Loans or Debenture, are really certificates entitling the owners to receive x per cent. in perpetuity on their face value, and they have no other claim except that, in the event of default in payment of the interest, the holders can appoint a receiver to work the line for their benefit until all arrears are paid off, though they cannot seize and dispose of the assets to redeem their capital. In recent years, some relatively small blocks of redeemable Debenture Stock have been issued, but these are exceptional. The Preference Stockholders' dividends are payable out of profits only at fixed maximum rates, and the greater part of these Stocks have no cumulative rights as each year's dividend is payable out of that year's profits only. The Ordinary Stockholders are entitled to what is

left of the profits after meeting prior capital charges, and, in some cases, the Ordinary Stocks are divided into Preferred and Deferred holdings, the former differing little from Preference Stocks.

The method by which a British Railway Company may raise its capital is provided for in its Acts of Parliament, and if any alteration is sought to be made in the classes of capital or in the conditions attached to it, or if any additional capital is required, the Company must obtain an Act of Parliament before the change can be effected. This is a further difference between a Company incorporated by a separate Act and one incorporated under the Companies' Acts as the latter can alter its capital under the terms of its Memorandum or Articles of Association, sometimes with, and sometimes without, the assent of the Court. The standing Orders of Parliament require that not more than one-fourth of the capital powers sought by a Railway Company shall be in respect of Loan and Debenture capital, though this proportion is not always insisted upon; and there is a further restriction effected by the reduction of Debenture powers authorized, where land has been acquired since 1860 which is subject to a rent charge. Rent charges are regarded as

effecting reductions of the capital outlay contemplated and, therefore, Debenture powers are reduced by the capitalized value of the liability for such rent charges.

A further difference between a Railway Company and a Company formed under the Companies' Acts, is that Railway Balance Sheets do not show capital receipts as liabilities and capital values as assets. Parliament has required what is known as the Double Account system under which the balance between the capital receipt and the capital expenditure is introduced as an asset or a liability, according to whether the expenditure or the receipt is greater. This is more than a formal book-keeping method, as the underlying principle is that the expenditure is not written up or down during the period the asset provided by it continues in use, and additions to or reductions of capital stocks can only be effected by obtaining an Act of Parliament. The cost of reproducing the assets of the British Railways is, probably, very much greater than the capital expenditure of 1,206 million pounds, but neither that expenditure nor the replacement cost of the properties represents their value. In the Act of 1844, and again, but more definitely, in the Act of 1921, the net revenue which a Company can earn under the

exercise of its Parliamentary concessions is the measure of its value and only by that measure can railway values be considered.

Aggregating all the British Companies as one, and eliminating duplications and cross-entries, the Ministry of Transport Summary Balance Sheet at 31st December, 1926, can be condensed thus :—

	Millions. £
<i>Liabilities—</i>	
Interest and dividends accruing or payable	21
Savings bank deposits	18
Superannuation funds	42
Accounts payable and liabilities accrued .	15
Miscellaneous	7
Reserves for renewals and other specific purposes	80
General reserves	6
	<hr style="width: 100%; border: 0.5px solid black;"/>
	189
	<hr style="width: 100%; border: 0.5px solid black;"/>
<i>Assets—</i>	
Capital expenditure in excess of capital receipts	52
Cash, and investments in Government securities	71
Other investments	7
Stocks of stores and materials	23
Accounts receivable	19
Miscellaneous	17
	<hr style="width: 100%; border: 0.5px solid black;"/>
	189
	<hr style="width: 100%; border: 0.5px solid black;"/>

The items of 18 million pounds for Savings Banks and 42 million pounds for Superannuation

Funds represent liabilities to the staff, which must ultimately be met, and these liabilities are inclined to grow rather than diminish, as the incomings will probably exceed the outgoings for some time to come. Each of the large Companies has a Staff Savings Bank for the use of its employees and their dependants, and as amounts can be put aside periodically by deductions from salary and wages payments, apart from cash deposits, a simple and useful means of saving is thus provided, and since 1913 the balances in these banks have been doubled. Superannuation Funds mainly represent the funds contributed to by the Companies and the Salary Staffs to provide definite pensions, based upon salary and service at age of 60 or upwards, with provisions for payments at death or breakdown. There are also included in this item various provident and sick funds, but the Superannuation Funds represent much the largest part of it, and the amount has trebled since 1913 and is likely to grow further, as the funds have not yet reached maturity.

The reserves of 80 million pounds for maintenance and other specific purposes are not surplus profits available for dividends, and very largely represent provisions for the renewal of permanent way and rolling stock. The large

programmes for renewal of equipment which have been in hand in the last few years, and are still incomplete, were rendered possible by these funds which were at a very high level after the arrears of the war period, and at the end of 1926 were still about five times greater than in 1913. They are credited yearly with the provisions for renewals and debited with the expenditure upon the work performed, and for some years to come the latter will, probably, exceed the former. Provisions are not made in respect of renewals of all property, but only in respect of large works and equipment which fall in for replacement at irregular intervals. As explained in Chapter II, these reserves are charged with the cost of replacement at current prices, and the sums provided out of revenue are also calculated on that basis. The largest of such provisions of one Company, as explained in 1925 to the Rates Tribunal were :—

	Annual Provision. £
<i>Permanent Way—</i>	
Net replacement cost of 10,940 miles at £3,000 per mile = £32,820,000, divided by average life of 21·6 years . . .	1,519,000
<i>Locomotives—</i>	
Net replacement cost of various types £32,672,000, divided by average life of 33½ years	980,000

	Annual Provision. £
<i>Carriages and Wagons—</i>	
Net replacement cost of various types £68,576,000, divided by average life of 30 years	2,286,000

The general reserves are available for dividends on the ordinary stocks and have been heavily drawn upon in the last few years; about 27 million pounds having been used, leaving 6 millions in hand at the end of 1926. Luckily for railway shareholders and railway users, these funds were greatly strengthened out of the compensation paid in respect of Government possession during the war, or a serious crisis would have arisen in 1926 when, as a result of the coal stoppage, and the General Strike on top of trade depression, the gross receipts were 30 million pounds less than in 1925.

On the Assets side, the 52 million pounds balance of capital expenditure and capital receipts, made up as explained earlier, represents capital expenditure temporarily financed out of the general funds held by the Company, but it is not possible to connect this with particular items on the other side of the balance sheet. From time to time, issues of stock are made to keep the balance of Capital Account within reasonable limits, and in order to re-

plenish the Company's liquid resources. Actual cash held by Bankers is kept at as low a level as convenient, according to the time of the year; surplus funds being invested in first-class securities which can be realized at short notice as required. In normal times, a large amount of liquid resources is not necessary, as short term loans can be obtained at low rates, but provision has to be made for the unexpected, and the post-war policy of holding substantial amounts in cash and quickly realizable securities (71 million pounds at the end of 1926) is a sound one making the Companies free from, possibly, onerous terms of borrowing if emergencies arise. As between the four large Companies the amounts held vary considerably, i.e.,

	Millions, £
Southern	9·3
Great Western	20·7
London Midland and Scottish	28·7
London and North Eastern	6·7

and the last figure reflects the difficult experience of the London and North Eastern Company, who have been particular sufferers from the effects of the depression in the export trades in the past few years.

The 23 million pounds invested in the Stores

and Materials may be taken as the cost price of the stocks held, as it is not the practice to write these up or down as market values vary. The amount includes large sums in respect of Companies' own manufactures or partial manufactures, and a simple illustration of these is sleepers, which will include :—

New sleepers seasoning—at price paid.

Creosoted sleepers—at price paid plus expense of creosoting.

Creosoted sleepers, with chairs attached—at price paid, plus price of chairs and fastenings and expense of affixing these.

and not until the chaired sleeper is actually used, will it be withdrawn from stock account and charged to expenditure. The custody of this huge stock of materials, held at various parts of the system, and the continuous watch on the levels of the stocks, is a most important matter. The stocks must be ample to meet normal demands, and augmented when a scarcity appears probable, but the tendency to hold excessive stocks and too many varieties must be resisted, and the happy mean is not easily found, though about three to four months' supply is the average of all stocks held.

To illustrate the amount and distribution of railway revenues, the following condensed

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figures are taken from the fully detailed figures given in the Ministry of Transport Returns for 1925 in respect of the whole of Great Britain :—

	Millions, £
Receipts from all businesses	225·4
	Millions, £
Expenditure in relation thereto	188·7
<i>Less</i> —Interest and rents	5·6
	<hr style="width: 100%;"/> 183·1
Net Revenue	42·3
Transferred from reserves, and profits on sales of investments	7·0
	<hr style="width: 100%;"/> 49·3
Distributed to stockholders (see page 225)	<hr style="width: 100%;"/> 49·3

The actual amount distributed to the Stockholders after deduction of Income-Tax, was less than the above amount by about 10 million pounds, but tax is ignored in the figures; the payments made by the Company as such being set against the amounts recovered from the Stockholders by deduction, and though occasionally payments not recoverable are charged off, these are minor amounts.

It may be estimated that approximately 120 millions of the above expenditure was in payment of salaries and wages and, reducing the above figures to a small measure, we find that

per £1 of Receipts obtained there was distributed :—

	s.	d.
In remuneration of labour	10	8
In purchases of materials, payment of rates, etc., less interest and rents received	5	7
In remuneration of capital	3	9

and there was distributed in addition to the 3s. 9d. for remuneration of capital a further amount corresponding to 7½d. which was paid out of past profits. The total labour bill of the Companies was, probably, about 125 million pounds, including work on capital account and other non-revenue charges.

The form of Railway Accounts is designed to show the subjects of expenditure rather than its objects and, for all general purposes, the classification of expenditure under like subjects, such as maintenance of signalling, is preferable to a classification aimed at showing the total expenditure on all subjects for particular objects, such as conveyance of mails separately from conveyance of wheat. Every Company compiles special records relating to particular activities, some continuously and some at intervals, but generally they are comparisons of like units of expenditure. The published accounts, for example, show one

figure for Shunters' wages, and the weekly primary records from which this figure is compiled enable this expense to be considered currently in relation to the work at each station, but the accounts do not show the expenditure in respect of the shunting of coal separately from the shunting of china-ware or any other commodity. Even as between the two main railway services, passenger trains and freight trains, representing about 46 per cent. and 54 per cent. respectively of the gross receipts, the accounts do not attempt to divide the working expenses. While certain expenditure can be allocated with reasonable accuracy, by far the greater part of railway expenditure is incurred without reference to any one class of traffic, and the amount attributable to each class is not ascertainable. Many elaborate formulæ have been devised to make such divisions but, apart from a few basic figures, they consist of a series of arbitrary assumptions which produce figures of no definite value. It is, of course, possible to lay down a formula to be applied to a block of expenditure in order to obtain arithmetical results which, if printed, may delude some people into regarding them as absolute costs. In one country the problem has been solved by the simple declaration that one

passenger mile costs the same as one ton mile and, if the resultant figures are regarded as figures and are not used, the formula is as good as any other, and much more simple than most. There is no common basis available which will enable the cost of the service represented by passenger miles to be compared with the cost of the service represented by ton miles, and the obvious difficulty of measuring the relation of the cost of conveying one passenger in a sleeping car for 300 miles, to the cost of conveying one ten-ton wagon load of coal for 30 miles, illustrates the nature of the problem.

In the United States elaborate rules were laid down on the matter by the Inter-State Commerce Commission, and figures stated to represent the cost per passenger mile and per ton mile are published, but no practical use appears to have been found for them. The handbook published by the American Railway Accounting Officers' Association states, that the figures are only useful when the separation of expenses can be made on a satisfactory basis, as otherwise the result is as unsatisfactory as the basis of such separation, and the President of the Association stated, *Railway Age*, 18th June, 1927 :—“ We must never overlook the fact that the railroad

handling both freight and passenger service with the same fixed property, Locomotives and Track, is operated in the conduct of transportation as a whole, that the attempt to separate out any particular feature of operation and determine its cost, while being helpful and perhaps enlightening to the management of a railroad, and those making a thorough and specific study of such a question, will give results which may be grossly misleading to others; and that the possibility of misuse of such results is obvious."

Even if it were possible to obtain actual figures for the current expenditure in connexion with the movement of particular traffics, there still remains to be found the factor of service of capital expenditure in respect of such traffics, before the cost is ascertained. If the current expense in moving two similar blocks of traffic is £800 and £1,000 respectively, but for the former a capital outlay of £8,000 and for the latter £4,000 was necessary, the true cost (if the capital requires 5 per cent.) is, obviously, £1,200 in each case, and it would be unsound to use the figures of £800 and £1,000 as governing the appropriate charges for the services performed. If, therefore, a cost system is applied to railway work, the capital requires allocation as well as the working expenses, and the

difficulties are increased, if an impossibility can be rendered more impossible. Assume, however, that all these difficulties cease to exist and we know the cost of each of the millions of services rendered by a railway company, the question will still remain whether any practical use can be made of the figures obtained. They will be interesting to statisticians, no doubt, but they will have little or no commercial value for the reasons considered earlier. The element of out-of-pocket expenses in each cost will have a value, but not one commensurate with the cost of obtaining it. Costs are, of course, compiled by every railway company, particularly as regards units of maintenance and manufacture of materials and rolling stock, but these services are not transportation operations and the ordinary commercial methods are applicable to them.

The scope and size of this book prevent more than a passing reference to the railway-owned auxiliary and subsidiary businesses. As we have seen, the earliest railways were, in theory, toll-takers only, but the businesses of rail haulage and the provision of terminals followed quickly, and have become integral parts of railway operations. The same may be said, with less accuracy, of the specialized services at stations; such as

the provision of storage accommodation for luggage and goods and lairage accommodation for live-stock, the hire of pillows and rugs to passengers, the provision of hampers for merchandize, the exchange of foreign currencies, the provision of sleeping berths on trains, and the numerous other services performed beyond the original conception of railway functions. A further group of services for the comfort of railway travellers is the provision of bookstalls, tobacco, fruit, etc., kiosks, and refreshment rooms at stations and restaurant cars on trains. Catering services are performed either by the railway company or by contractors, but generally the practice is for the railway company to work its own catering services in conjunction with its hotels, though the Pullman Cars and the Southern Railway Cars are exceptions. The railway-worked hotels are a distinct departure from the transportation function, and their object is to foster and facilitate passenger traffic and, apart from any value which their clients may contribute to the railway line as passengers, a not inconsiderable matter, they are themselves remunerative. The railway hotels appear to have originated with that at Euston, which was originally designed in 1838 as two separate buildings—an hotel and “dor-

mitories"—for the accommodation of the London and Birmingham Railway passengers, and attractions in the prospectus were the provision of baths in convenient situations and the assurance that a licence for the sale of wines and spirits was not contemplated. From this to the Gleneagles hotel of their successors, the London Midland & Scottish Company, is a long step, but the aim is much the same.

The largest of the other railway-owned businesses is, probably, that of docks, and in nature they are mainly waterside stations, though their charges as a rule are regulated by special dock powers and not railway powers. Steamers and road cartage services are mainly connexions between railway points or feeders of railway services, and steamers, like docks, are the subject of specified statutory powers and restrictions. Of canals, it is difficult to say anything without considering in detail much historical data, but they mainly represent undertakings which the railway companies had to acquire before they could obtain authority to construct lines. The thousands of houses (58,590) owned by the railways constitute another "side-show" which is mainly forced upon them, and is not a voluntary excursion into this class of business. Apart from these

visible separate businesses, there is the important one of manufacturing supplies. This is not an essential railway business, but for reasons of either economy or convenience, railway companies manufacture articles from tickets to locomotives, which could be purchased from outside manufacturers. The economy of these operations is not ascertainable from the published accounts and each company must review each manufacture from time to time, by comparison of their costs with the comparative costs of outside work, but in settling the policy to be pursued, regard must be had not only to comparative prices, but also to the probable trend of prices outside if the company ceases to manufacture, and to the reactions on repair expenditure if manufacturing work is not performed.

The present form of the British Railway Accounts was drafted by a Committee of Railway Accountants and others, including the late Sir W. M. Acworth, and approved by Parliament in 1911, but a recommendation of that Committee to ensure uniformity in the manner of compilation of the Accounts, by the formation of a Standing Committee, was unfortunately not adopted by the Government. As a result, the Accounts, while outwardly the same, have not

a uniform meaning, although a very great degree of standardization was obtained by voluntary means. Under the Railways Act of 1921 the Minister of Transport was given power to direct the manner of compilation of the Accounts and it is expected that these directions will be mandatory from the beginning of 1928 and, at the same time, various alterations in the form will be made to meet new requirements of the Railway Rates Tribunal and to remedy a few defects due to changes in circumstances since 1911. It is necessary that the accounts of a public utility, like a railway, should be in a form to meet the tests of "publicity and measurement," and while minor criticisms can be made of their scope and form, the British railway companies' accounts successfully meet these tests. Adequate information regarding the results of each business is becoming an essential factor in modern industrial conditions. Not only in regard to the requirements of the general public, but in regard to the interests of labour and of the shareholders is this necessary, and while not perfect, the published accounts of the railway companies give a lead which might, with advantage, be followed by other large industries.

NOTE ON BOOKS

THERE is a regrettable lack of books on British Railways, of interest to the general reader. On particular aspects many have been written, but a great part of modern railway literature is contained in the publications of railway and transport journals, such as the *Railway Gazette* and *Modern Transport*, and in the proceedings of Societies such as the Institute of Transport and the Institution of Civil Engineers. Modern books of general public interest include :—

British Railways, by Hugh Munro Ross. (London : Edward Arnold, 1904.)

The Railways of Great Britain, by Lord Monkswell. (London : Geoffrey Bles, 1926.)

An Economic History of Modern Britain—The Early Railway Age, by J. H. Clapham. (Cambridge : University Press, 1926.)

Control on the Railways, by Philip Burt. (London : George Allen & Unwin, Ltd., 1926.)

The Elements of Railway Economics, by Sir William M. Acworth. (Oxford : University Press, 1924.)

Books of general interest, primarily intended as text-books for students, include :—

The History and Economics of Transport, by Adam W. Kirkaldy and Alfred Dudley Evans. (London : Sir Isaac Pitman & Sons, Ltd.)

Railway Statistics, their Compilation and Use, by A. E. Kirkus. (London : Sir Isaac Pitman & Sons, Ltd., 1927.)

In the United States many valuable books have been written on railway matters, including :—

Railroads—Finance and Organisation, by William Z. Ripley. (New York : Longmans Green & Co., 1915.)

Effective Regulation of Public Utilities, by John Bauer. (New York : The Macmillan Co., 1925.)

Principles of Railway Transportation, by Eliot Jones. (New York : The Macmillan Co., 1925.)

Efficient Railway Operation, by Henry S. Haines. (New York : The Macmillan Co., 1919.)

The *Encyclopædia Britannica* and Palgrave's *Dictionary of Political Economy* contain articles on railway matters and, in London, the special libraries of the Institute of Transport and the London School of Economics contain much literature of interest.

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