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RAILWAY STATISTICS:

THEIR HISTORY

and

ECONOMIC SIGNIFICANCE.

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M. Com.

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by

A. L. CLIFT.

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I N T R O D U C T I O N

INTRODUCTION.

"The problems of transportation rise above all others in importance, as bearing directly on the commercial life of the nation. All production, pastoral and industrial, with the labour involved, would practically cease if adequate marketing facilities were withdrawn, which is only another way of saying that the trade of the country is dependent upon the operation of railways and the problems of transportation in all their aspects can only be properly considered, and conditions measured in the light of full and accurate statistical information." ^{1.}

The chief function of a railway is "to sell transport" and its interest lies in disposing of it in the manner best calculated to yield the largest net revenue, due regard being paid to other considerations always present with a good seller. As is the case with all other business concerns, an effective supervision of the various processes and departments is essential if economy and efficiency

1. From report of Comptroller of Railway Statistics (Canada) for year ended 30th June, 1907.

are to be attained. This effective supervision is, in practice, obtained through the medium of statistical summaries of all the operations of the railway. But as regards the merits of a control so exercised, i.e., by means of statistical units, opinions differ, largely owing to the fact that many of the statistics are not available until a long time after the period to which they relate. It was obvious that personal inspection by the superintendent of a wide area or of a large department is theoretically much to be preferred. But is it possible? Naturally, such a superintendent is far too busy a man ^{to} spend much time out of doors. He must be provided with some comprehensive measure of the work that has been carried on in his section so that he may see the results at a glance. But the officials of railway companies are not the only people who are interested in the accounts and statistics or for whom these statistics must be prepared.

Two other sections of the community are, or should be, equally interested in both the form of statistics and also the figures of working which the forms contain. The two parties mentioned are the proprietors of the companies and the general public. The former, being the owners of the companies, are naturally interested in economy of working as this is the obvious prelude to increased profits. Statistical returns are, to them, the only means of keeping in touch with the operations of the railways and the financial results thereof. They provide this second interested party with the means of maintaining a comprehensive supervision over the use made of its capital.

A more correct designation for the third party interested in statistical summaries of railway working, mentioned above as the general public, would be "the users of the railways". This, by far the most numerous party, has an interest partly similar, partly antagonistic to that of the other

two parties. While resembling them in the desire for cheap working, they are quite opposed to them in the objects to which they hope the economy will lead. Their principal object is low transport rates, and economy of working to them is but an essential step to this end.

The general position then of these three parties is perhaps best represented in the words of Mr Newhook as "a triangle of forces" which "comprises" practically the whole of the community.

"It may happen that in one and the same person is represented two or even three of these interests, which only tends to prove that the true welfare of any is dependent upon the rest, and that their stable equilibrium is not attained without equal consideration of all these forces or interests." ¹.

1. 'Railway Accounts and Finance' P.IX A.E.Newhook.

The equal consideration ^{of} all these forces or interests does not necessitate such a wide study as would at first be supposed. Although their objects are opposed, these three parties are yet interested in the same two fundamental points, i.e., economy of working and the level of transport rates. The second point is not very definite. Does it mean that the parties are interested in certain particular rates or that they regard as being of greater significance, the average level of all rates? In individual cases, especially in the party which comprises the general public, it is most probable that interest lies only in one or two particular rates. But, when all the individual cases are added together, it becomes apparent that the sum of interests is concerned with the general average of all rates.

We are thus chiefly concerned with statistics in their ~~e~~ relation to efficiency and economy of working, and to the general level of rates which includes the fixing of individual rates.

Now that we have a general idea of the uses of statistics and of the classes of people who are most interested in them, it will be convenient to indicate the scope and aims of this work. The title

"Railways Statistics: their History and Economic significance" is practically self-explanatory, but there are one or two limitations which it is desirable to add ⁱⁿ ~~to~~ an introduction.

In the first place, English statistics will be those chiefly considered, especially in regard to the historical part. Two sections will be devoted to describing and explaining the statistics that are demanded of the English railways at the present time. They will be rather tiresome, no doubt, but the information they contain is necessary to a proper understanding of the latter sections which are chiefly critical.

It was intended that the present form of statistics used in this country should be compared and contrasted with those of U.S.A. where the subject of statistics has received more attention than in this country. Despite many attempts, however, I have been unable to obtain sufficient information from America, so that the intention has had to be abandoned.

The main objects, however, will be to discover how much useful knowledge the statistics give and what is their value in the forming of rates,

and what alterations are necessary in order to render them more useful in the consummation of their principal objects.

One further matter remains to be explained.

It is well, perhaps to draw a distinction between the two words "accounts" and "statistics" as used in this paper. It is true ^{that} ~~and~~ the figures recorded in the accounts of a railway form an important section of the statistics necessary for efficient administration, and are the basis of some of the other statistics as well. Nevertheless, the two words are used here in the same sense in which they are employed in the Railways (Accounts and Returns) Act 1911, i.e., the ACCOUNTS ARE THE FORMS RELATING to capital and those which show the balanced income and expenditure statements. The statistics consist of all the other returns - statements which are not balanced.

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PART I.

HISTORICAL.

SECTION 1.

THE HISTORY OF ENGLISH RAILWAY STATISTICS.

It is certain that statistics in one form or another have been employed by railway officers ever since railways came into existence. Statistics of working and receipts were not compiled and published however for the use of the general public until the legislative authority stepped in and compelled such returns to be made. In some countries, the governments required these statistics from the railways from the very commencement of railway working. In other countries the governments did not interfere until comparatively later in the history of their railways. Much may have depended upon whether the railways were state-owned, state-aided or in the hands of private people. In England, the railways were constructed by private initiative and capital, subject to the permission of Parliament. This latter body seemed to take a great interest in the construction of railways, if one may judge from the time and expense that were involved in gaining their permission. Each case was investigated on its own merits before a decision was arrived at, but nevertheless there seems to have been no system in their decisions. There was

no comprehensive scheme for providing the country with the best possible means of communication. In fact the needs of the country were given scant consideration; it was presumed that individuals would naturally invest their money in districts which paid them best and that those districts would, conversely, need the railways most. There seems more than a faint suggestion of the old "laissez-faire" spirit in this argument. But the fact remains that the railways were constructed piece-meal without any coherent plan for the greatest benefit of the country at large. It is, perhaps, to this fact that we must look, to furnish the reason why standard forms of statistics and accounts from all railways were not required until such a late date in the railway history of this country. It was not until 1868 that an attempt was made to standardise the returns of all the railway companies. The result was very unsatisfactory and it is but comparatively of recent date that the Government has succeeded in compelling the railways to publish uniform - really uniform - returns.

the fact remains

To find the earliest statutory regulation concerning railway statistics and accounts in this country, we must turn to the Regulation of Railways Act, 1840. The requirements here are very meagre and would certainly not lead to uniformity. Section III, which is entitled 'Returns to be made by Railway Companies' says,

'And be it enacted, That the Lords of the said Committee (the Board of Trade) may order and direct every Railway Company to make up and deliver to them Returns, according to a Form to be provided by the Lords of the said Committee, of the aggregate Traffic in Passengers, according to the several Classes, and of the aggregate Traffic in Cattle and Goods respectively, on the said Railways, as well as of all Accidents which shall have occurred thereon, attended with personal Injury, and also a Table of all Tolls, Rates and Charges from Time to Time levied on each class of Passengers, and on Cattle and Goods conveyed on the said Railway'.

Then follows the penalty to which the railways would become subject if they did not produce the Returns within thirty days of their being demanded. Such Returns would be of very little use in indicating economy or the lack of economy in working and would give very little idea even of the amount of work done. The next statutory mention of accounts occurs in the Railways Regulation Act of 1844 which, however, attaches 'certain conditions' only 'to the Construction of future Railways authorised or to be authorised by any Act of the present or succeeding Sessions of Parliament'. Section V, which deals with the accounts to be kept and which are to be open to inspection, reads as follows:-

'And be it enacted, That from and after the Commencement of the Period of Three Years next preceding the Period at which the option of Revision or Purchase becomes available, full and true Accounts shall be kept of all Sums of Money received and paid on account of any Railway within the provisions herein before contained by the Directors of the Company to whom such Railway belongs or by whom the same may be worked; and every such Railway Company shall once in every Half Year during the said Period

of Three Years cause a half-yearly Account in abstract to be prepared, showing the total Receipt and Expenditure on account of the said Railway for the Half Year ending the Thirtieth Day of June and the Thirty-first Day of December respectively, or such other convenient Days as shall in each Case be directed by the said Lords Commissioners, under distinct Heads of Receipt and Expenditure with a Statement of the Balance of such Account duly audited and certified under the Hands of Two or more Directors of the said Railway Company and shall send a Copy of the said Account to the said Lords Commissioners on or before the last days of August and February respectively, or such other Days as shall in each Case be directed by the said Lords Commissioners, if and when they shall think fit, to appoint any proper Person or Persons to inspect the Accounts and Books of the said Company during the said Period of Three Years."

Obviously the results of this Act should be more profitable to all concerned. The requirements were indeed formed with a specific object. The country had by this

time felt the effects of railway booms with the resultant failures. Rash and unchecked speculation had been rife, and by this time it was felt that it was expedient that 'the Concession of Powers for the establishment of New Lines of Railways should be subjected to such Conditions as are for the Benefit of the Public'. Consequently the Act aims at preventing the profits on the working of the railways from being too high for if, after 21 years from the passing of the Act for the construction of any future railway, the profits of three consecutive years exceed 10% p/a the Treasury may revise the scale of tolls, fares and charges applicable to the different classes and kinds of passengers, goods, and other traffic and fix a new scale which in their judgment and 'assuming the same quantities and kinds of traffic to continue' would 'be likely to reduce the said divisible profits to the said rate of ten pounds in the hundred'.

Here we find that railway accounts and statistics are for the first time to be employed in the statutory fixing of rates, but it is to be noted

that their use in this case is quite different from the use to which is advocated that statistics should be put at the present time. It is now hoped by some people that by the proper utilization of statistics and accounts the true cost of carriage shall be obtained and that this figure shall be of use in the fixing of rates. By the Act of 1844, no attempt was made to obtain the cost of carriage. It was merely intended that the true profit should be ascertained and maintained within a certain figure. There was no encouragement given to the companies to study economy in working when they had reached their maximum rate of profit, for any decrease in working costs would lead to a profit beyond the legal maximum and only the public would benefit. It is highly probable however that the returns made by the companies were not always 'full and true accounts' such as a later statute required. In the following year 1845, certain sections of two acts affected the accounts kept by railway companies. In common with other companies they came within the scope of the Company Clauses Act, 1845, when the keeping of accounts was made obligatory. The two sections with which we

are chiefly concerned read as follows:-

(Sec CXV) 'The Directors shall cause full and true Accounts to be kept of all Sums of Money received and expended on account of the Company by the Directors and all Persons employed by or under them, and of the Matters and Things for which such Sums of Money shall have been received or disbursed and paid'.

~~(Sec CXVI) 'The Directors shall cause full and true Accounts to be kept of all Sums of Money received and expended on account of the Company by the Directors and all Persons employed by or under them, and of the Matters and Things for which such Sums of Money shall have been received or disbursed and paid'.~~

Sec CXVI) 'The Books of the Company shall be balanced at the prescribed Periods, and if no Periods be prescribed, Fourteen Days at least before each Ordinary Meeting and forthwith on the Books being so balanced, an exact Balance Sheet shall be made up, which shall exhibit a true Statement of the Capital, Stock, Credits, and Property of every Description belonging to the Company, and the Debts due by the Company

at the date of making such Balance Sheet, and a distinct View of the Profit or Loss which shall have arisen on the Transactions of the Company in the course of the preceding Half Year, and previously to each Ordinary Meeting such Balance Sheet shall be examined by the Directors or any Three of their Number and shall be signed by the Chairman or Deputy Chairman of the Directors'.

These accounts were to be open for inspection by shareholders during prescribed periods only. The railways were more directly affected by the Railway Clauses Consolidation Act of 1845, section CVII of which reads,

'And be ^{it}/enacted, That the Company shall every Year cause an annual Account in Abstract to be prepared, showing the total Receipts and Expenditures of all Funds levied by virtue of this or the special Act for the Year ending 31st December, or some other convenient Day in each Year, under the several distinct Heads of Receipt and Expenditure with a Statement of the Balance of such Account, duly audited and certified by the Directors or some of them and by the Auditors, and shall, if required, transmit a Copy of the said Account, free of charge to the Overseers of the Poor of the several Parishes through which the Railway

shall pass and also to the Clerks of the Peace of the Counties through which the Railway shall pass, on or before the Thirty first Day of January then next; which last mentioned Account shall be open to the Inspection of the Public at all Seasonable Hours, on payment of the Sum of One Shilling for every such Inspection'.

Few comments are needed, for the sections quoted explain themselves. But what do they amount to? Very little. Let us summarise the position at the end of 1845. Parliament had endeavoured to secure a faithful record and account of all the financial transactions of the companies to be kept under the authority of the directors; a power for any shareholder within certain limits to examine the companies' accounts; the periodical exhibition of a balance sheet showing all the capital, stock, credits, and property of, and debts due by, the company, and giving 'a distinct view' of the profit and loss; the appointment of auditors independent of the directors, but interested as shareholders; and the payment of a dividend out of profits coupled with a prohibition against reduction of capital by means of dividends, and allowing the formation of a reserve fund out of revenue. The total requirements were very meagre,

since merely one or two of the most obvious accounts were called for. Moreover it is obvious that since the requirements were asked for in such general terms, there would be little, if any, uniformity in the returns of the various companies. Thus the provisions of the law were defective in so far that they did not secure a uniform system of accounts. Each company was at liberty to adopt the form it considered most convenient, and to vary that form from time to time. The result was that no adequate means were afforded by which to compare the financial affairs of two railways or even to compare the accounts of the same railway at different periods. This uncertainty deprived the public of the power of ascertaining the relative condition of different companies; it deprived one company of the means of taking advantage of the experiences of others, and it left shareholders without an adequate check on the governing body.

We may thus conclude that, owing to the lack of uniformity demanded in the accounts all the legislation up to 1845 was rendered of little value. In spite of this grave drawback, however, things remained unaltered for more than twenty years. No precise form of accounts was prescribed for the Railway Companies before 1868.

This does not mean to say that the lack of uniformity and of much valuable information in the accounts had not been noticed in the interval. As early as 1849 a Select Committee was appointed by the House of Lords to consider the possibility of providing for a more effectual audit of railway accounts. The committee made three reports in the third of which they indicated a serious omission in the law as it then stood. This was the want of any prescribed and uniform system of accounts and they recommended the enforcement of a statutory form to be binding upon all railway companies. Little notice was taken of the report, however, and so nothing was done to remedy matters.

At last in 1867 a Royal Commission on Railways was appointed which, in its report, severely criticised the then existing legislation regarding railway accounts and returns. In the recommendations of the Committee following paragraph appears:-

'We do not consider that any direct legislative enactments would cause greater economy in the working of railways; but we are of opinion that with the object of affording a more accurate view

of the operations of the railway companies and of making any undue extravagance apparent, and thus stimulating economy, it is desirable that the several railway companies should render their accounts to the Board of Trade, showing receipts from traffic and the detailed cost of working the line upon a uniform plan; and that after consultation with the railway companies, the Board of Trade should not only prescribe the form of such returns and accounts but lay down the basis on which they are to be computed.'

In the following year steps were taken by means of the Regulation of Railways Act, 1868, to give effect to these recommendations.

Section 3 enacts that:-

Every incorporated Company, Seven Days at least before each ordinary half-yearly Meeting held after the Thirty-first Day of December, 1868, shall prepare and print according to the Forms contained in the first Schedule to this Act a Statement of Accounts and Balance Sheet for the last preceding Half Year and the other Statements and Certificates required by the same Schedule and an Estimate of the proposed Expenditure out of

Capital for the next ensuing Half Year and such Statements of Accounts and Balance Sheet shall be the Statement of Accounts and Balance Sheet which are submitted to the Auditors of the Company.' Then follows the fine in case of default.

'The Board of Trade with the Consent of a Company may alter the said Forms as regards such Company for the Purpose of adapting them, to the Circumstances of such Company, or of better carrying into effect the Objects of this Section'.

In addition, the accounts were to be signed by the directors and printed copies distributed amongst the shareholders. It was no longer necessary for the auditors to be shareholders. In the first schedule to the Act there were fifteen forms under the following heads respectively:-

1. 'Statement of Capital Authorised and Created by the Company'.
2. 'Statement of Stock and Share Capital Created Showing the proportion received'.
3. 'Capital raised by Loans and Debentures Stock, showing Balance being available Borrowing Powers'.

4. 'Receipts and Expenditure on Capital Account'.
5. 'Details of Capital Expenditure for Half Year.'
6. 'Return of Working Stock'.
7. 'Estimate of further Expenditure on Capital Account'.
8. 'Capital Powers and other Assets available to meet further Expenditure.'
9. 'Revenue Account'. A very detailed form.
10. 'Net Revenue Account'.
11. 'Proposed Appropriation of Balance Available for Dividend'.
12. This consists of five abstracts:-
 - (a) Maintenance of Way, Works, etc.
 - (b) Locomotive Power.
 - (c) Repairs and Renewals of Carriages and Wagons.
 - (d) Traffic Expenses.
 - (e) General charges.
13. General Balance Sheets'
14. 'Mileage Statement.'
15. 'Statement of Train Mileage.'

These requirements were supplemented and modified to a slight extent during the next few years. It will therefore be better to take note of these additions and

modifications before proceeding to criticise the Act of 1868.

Additional returns, mainly of a statistical nature were required by Section 9 of the Regulation of Railways Act, 1871. 'Every company shall annually prepare returns of their capital, traffic, and working expenditure for the last preceding financial year of the company in accordance with the forms contained in Schedule One to this Act, and a copy of each return, signed . . . shall be forwarded to the Board of Trade' at certain prescribed times, neglect of which would subject the company to a severe penalty. 'The Board of Trade, with the consent of a company, may alter the said forms as regards such company for the purpose of adapting them to the circumstances of such company or of better carrying, into effect the objects of this section.'

This last sentence is purposely included here as it occurred also in the Act of 1868. The provision it made, however, was modified by Sec. 32 of the Railway and Canal Traffic Act, 1888, which enacted that:-

'Returns required of a railway company under Sec.9 of the Act of 1871 shall include such statements as the Board of Trade may from time to time ~~require~~

prescribe, and that the forms referred to in that section may from time to time be altered by the Board of Trade as they may think expedient.'

The additional returns required under the Railway Regulations Act, 1873, concerning signal arrangements scarcely concern us here. The same remark applies to the provisions of the Railway Returns Act, 1878, which requires half-yearly returns on prescribed forms of the continuous brakes employed by the company.

We are now in a position to review the accounts and statistics required of the railways prior to the passing of the Act of 1911. It is possible that the forms contained in the Act of 1868 and the less important acts mentioned above were sufficiently comprehensive and detailed for the time at which they were enforced. Even this admission, however, is doubtful when the statistical sections are considered. The accounts would probably exhibit a fairly true and full summary of the financial position of the companies, for their business at that time was far less complicated than it is at the present time. But the statistics were scarcely of any value at all. Railway working has never been so simple that two or three elementary statistical accounts would

render an adequate representation of the working performed by a company during any lengthy period. Of much less use would such returns be when applied to railways that had amalgamated into substantial companies and had been in existence for many years. Yet the statutory forms in use up to the present century merely contained:-

1. A mileage statement.
2. A statement of train-mileage under the heads of
 - (a) Passenger trains.
 - (b) Goods and mineral trains.
3. A few particulars in regard to working stock
4. Some information of little importance demanded by the lesser acts already mentioned.

Moreover, no definite system underlay the construction of these forms, but one can scarcely expect system when the returns themselves were so very meagre. Even at that time they should have been separated from the financial accounts and greatly enlarged.

An omission in the requirements which reduced the value of the returns for purposes of comparison was the fact that no uniform date for the end of the financial year was provided. The railways were thus allowed to draw up their half-yearly forms at dates

suitable to themselves, irrespective of the dates chosen by other companies.

It will be noticed in the forms provided by the Act of 1868 that the accounts of the subsidiary enterprises in which the railways were engaged, were included in the accounts dealing with actual railway working. This was a serious fault, although perhaps not so grave at that time when subsidiary enterprises formed an unimportant section of railway business as it would be at the present time.

'The business transacted by the larger railway companies has become more and more complex, tending always to embrace fresh enterprises, which are in some cases only slightly connected with the primary service of railway transportation'.¹

At the present time many railway companies possess harbours, docks, steamers, and hotels, and the catering business is a most important subsidiary enterprise. Obviously, to obtain a true account of actual railway working, information concerning the above businesses must be separated from the rest. It will be found that this has been done in the more recent statutory forms.

1. Report of Committee on Railway Statistics apptd. by the Board of Trade.

In the Introduction, it was said that the accounts and statistics should be so constructed that they would be of the greatest possible use in connection with that fundamental point of railway business i.e., the economy of working. What may be said then of the forms as laid down by the Act of 1868? Despite the detail of the financial accounts, they are rendered practically useless by the meagreness of the statistics. To consider the economy of working is impossible without an accurate knowledge of the work done. But from the few compulsory returns indicated above, what idea can possibly be obtained of the amount of work performed by the railways? Dare it be said 'None at all'? Well, at most, very, very little.

That the provisions made by the Act of 1868 were insufficient was gradually realised as time went by. It is obvious that even the best of statutory forms must become inadequate and antiquated if they have been in use for forty years, and the returns in question had survived longer than that, during which time the railways had made much progress. As one may expect there had been for many years a strong agitation for more instructive accounts, but as the reform party was itself composed of two sections which could not agree

beyond a certain point, little was achieved for some considerable time. Eventually, however, the Board of Trade was prevailed upon to appoint a Departmental Committee to enquire into the weaknesses of the then existing forms, and, if possible, to make suggestions for their improvement.

The Committee was appointed by a minute signed by the Rt. Hon. Lloyd George on the 15th June 1906. The late Sir William Acworth, then Mr Wm. Acworth, was one of the nine members.

The terms of reference were:-

"To consider and report what changes, if any, are desirable in the form and scope of the Accounts and Statistical Returns (Capital, Traffic, Receipts and Expenditure) rendered by Railway Companies under the Railway Regulation Acts".

The report was made on 25th May 1909. The Committee itself consisted of equal numbers of the reform party and of practical Railway representatives, so that on several important points no definite conclusions were arrived at. The railway managers conceded much, but they strongly disagreed with the proposals of the advance wing of the other party concerning ton-mile and passenger-mile statistics. The inclusion or exclusion

of these formed such an important question in the matter of railway statistics that a separate section of this paper will be entirely devoted to it. As most of the debates of this Committee also turned upon this point, little remains to be said of its work.

One of their observations is worth quoting, for, indirectly, it was a criticism of the Act of 1868. 'It is obviously of the first importance from the point of view of comparison between the different railway companies, that there should be uniformity of practice among all the companies with regard to the keeping of accounts and statistics, that is to say, that every heading, both in the accounts and in the statistics, should bear precisely the same meaning in the case of all railways - should in fact, be standardised?' It may be supposed from this statement that the Act of 1868 had failed also in its attempt to establish uniformity. There were two reservations added to the report, one signed by the three representatives of the railways and the other by the "van of the reform party," Messrs Acworth, Parish, and Peel. The former did not agree with too great an extension in the use of statistics, while the latter recommended additional statistics,

a schedule for which was included. They also urged the Government to compel the railways to publish ton-miles and passenger-miles.

The recommendations of the Committee which had been agreed upon by all the members, were immediately acted upon, for the Railway Companies (Accounts and Returns) Act, 1911, included the forms constructed by the Committee in practically every detail. The complete Act will be described in another section. Here it will be sufficient to draw attention to the additional forms required by it. Many of the forms were merely taken from the Act of 1868 and extended.

The following are the new forms required for the financial accounts:

Abstract F - Expenses of Collection and Delivery of
Parcels and Goods.

Abstract G Receipts and Payments in respect of Running
Power Expenses.

Abstract H Mileage, Demurrage, and Wagon Hire.

Abstract I Jointly owned and Jointly Leased Lines,
Receipts and Expenditure.

No. 11. Receipts and Expenditure in respect of Omnibuses
and other Passenger Vehicles not running on the
railway.

No 12. Receipts and Expenditure in respect of Steamboats.

- No 13 Receipts of Expenditure in respect of Canals
- No 14 Receipts and Expenditure in respect of Docks, Harbours and Wharves.
- No 15 Receipts and Expenditure in respect of Hotels, and of Refreshment Rooms and Cars where catering is carried on by the Company.
- No 16 Receipts and Expenditure in respect of other Separate Businesses carried on by the Company.
- No 17 Electric Power and Light Account.

The Statistical forms included the following additions:-

- No 1 Mileage of Lines (This was so extended from the form in the schedules of the Act of 1868 as to be practically new)
- No II Rolling Stock (This is divided, under lettered heads, into six separate forms).
- No III Horses and Road Vehicles employed in the Collection and Delivery of Parcels, Goods and Passengers.
- No. IV Steamboats.
- No. V Canals.
- No. VI. Docks, Harbours and Wharves.
- No. VII Hotels.
- No. VIII Land, Property, Etc., not forming part of the Railway or Stations.

- No IX. Other Industries (if any). (This form
 to be in the discretion of the company.)
- No X Maintenance and Renewal of Way and Works.
- No XI Maintenance and Renewal of Rolling Stock.
- No XII Engine Mileage.
- No XIII Passenger Traffic and Receipts.
- No XIV. Goods Traffic and Receipts.

It can easily be seen from a glance at the above additions, that the accounts and statistics which concern the subsidiary enterprises in which the railways are engaged, have been separated very clearly from those forms which deal with actual railway working. After the war ended certain companies intended to make voluntary additions to their statistics, but refrained from doing so when the Government appointed a Minister of Transport in 1919, because they realised that he would require additional statistics. The Minister of Transport by sect. 18 of the Ministry of Transport Act of 1919 received wide powers as regards statistics.

This is the section:-

'For the period of two years after the passing of this Act it shall be the duty of the owners of any railway, light railway, tramway, canal, inland navigation, dock, harbour or pier undertaking.....

to furnish to the Minister in such manner and form as he may direct, such accounts, statistics, and returns, as he may require for the purpose of his powers and duties under this Act.

The Minister sought the help of the railway companies to aid him in framing his requirements, as he desired that the statistics should be of the greatest possible use, both to the Ministry and to the internal management of the railways. The General Managers appointed a special Committee which drew up a list of statistics and also prepared detailed instructions in order to obtain a uniform method in the compilation of the figures. These new requirements came into force on January 1st 1920, but in the following year they were made permanent by section 77, sub-section (2) of the Railways Act, 1921. This section lays down that:-

'It shall be the duty of every railway company to compile and render to the Minister the statistics and returns set out in the Eighth Schedule to this Act, sub-divided in the case of an amalgamated company in accordance with such operating areas as may be agreed between the Minister and the Company, subject, nevertheless, to such variations of those statistics and returns as may from time to time be agreed between the Minister and the Railway

Companies Association".

In the schedule are nineteen headings, referring to statistics, most of which are required monthly. Two of these statistical returns are only required annually however.

These are:-

No 14 - Census of Staff, showing number of men in each grade at each rate of pay.

No 19 - Capacity of wagon stock of various types.

These statistics would naturally not be required at shorter periods as they are not likely to fluctuate to any great extent in a period less than twelve months. The remaining statistical returns are worth quoting in order to show the detail that is now demanded from the railways. This schedule may be described as a triumph for the advance wing of the reform party whose 'academic enthusiasm'¹ for detailed statistics has at last been rewarded by the inclusion of ton-mileage figures, etc.

¹ W. R. Lawson: 'British Railways'.

'While sympathising with the statistical experts and appreciating their academic enthusiasm on behalf of ton-mileage, we have to consider here only the practical merits of the proposal'

1. Freight receipts, tons and ton-miles....	Monthly
2. Tons and Receipts of selected commodities conveyed at freight train rates.....	Monthly
3. Commodity ton-miles.....	Monthly
4. Passenger journeys and receipts.....	Monthly
5. Passenger - miles.....	Periodically
6. Quantities and receipts of parcels and miscellaneous traffic conveyed at coaching train rates.....	Monthly
7. Train-, and engine-miles and hours of company's engine over own and other systems.....	Monthly
8. Train -, and engine-miles and hours over company's system by own and other company's engines	Monthly
9. Locomotives in use	Monthly
10. Loaded and empty wagon-miles.....	Monthly
11. Consumption of coal, electricity and oil by locomotives	Monthly
12. Construction and repair of rolling stock	Half-yearly
13. Marshalling yard statistics.....	For a period of one month each half-year

- | | | |
|----|---|--|
| 15 | Tonnage conveyed on canals separating principal commodities..... | Monthly |
| 16 | Analysis of time spent by ships in port at railway owned docks..... | Monthly |
| 17 | Tonnage dealt with and cost of working at selected goods depots..... | (For a period
(of one month
(each half year |
| 18 | Tonnage carted and cost per ton at selected stations. Motor cost to be distinguished from horse cost..... | (For a period
(of one month
(each half
(year. |

All these statistics, except No 16 are published by the Ministry of Transport in various tables based on them. We shall consider these published statistics in another section however.

We have now traced the growth of English published statistics from the commencement of the railway era until the present time. One of the most striking features revealed by this historical sketch, is that the greatest progress has been accomplished during the present century. This point becomes of more interest when it is known that in many other countries also, the beginning of this century has coincided with the beginning of great progress in the preparation of

railway statistics. This advance towards more carefully compiled and fuller data has its origin, in all probability, in the rising costs and the increasing complexity of railway business, noticeable in this period. The amount of traffic has increased and the unit railway systems have become so vast owing to amalgamations that all three parties interested in railways have felt the need for more comprehensive statistics. The prices of necessary materials, rates and taxes, expenses which the railways cannot avoid or reduce, have risen very considerably, so that the railways have perforce to economise in other directions. More attention has thus been bestowed upon the securing of information, indicating the results of operation and of changes in policy.

RECENT CHANGES IN THE STATISTICS OF SOME OTHER COUNTRIES.

It has been said that since the beginning of this century there has been a general movement upon the part of nearly all ~~the~~ countries to obtain more detailed statistics from their railways. As this is a statement that should not be accepted without facts to support it, the following summary¹ of the changes in a few of the principal countries is of interest.

AUSTRALIA.

The Census and Statistics Act of 1905 made the power to collect statistics as ordered by the Minister for Home Affairs, more effective. In 1909 the Commonwealth Statistician made a report to the Minister on "The desirability of improved statistics of Government Railways in Australia."

In this report Sir George H. Knibbs drew attention to the important differences which existed in the various States

- (a) in the particulars compiled.
- (b) in the manner of compilation.
- (c) in the mode of presentation.

1. The information given is obtained from the report of A.E. Kirkus.

With a view to effecting an improvement in the statistics he recommended that all the railways in the Commonwealth should compile and publish on the same basis the statistics mentioned in the report and that they should classify their gross receipts and working expenses in a uniform manner! The Commissioners and General Managers of the Railways agreed to publish annually the uniform statistics recommended by the Statistician with two exceptions:-

- (1) Classification of tonnage carried and revenue derived therefrom;
- (2) Passenger-, and ton-miles.

But passenger-, and ton-miles have been voluntarily compiled by the railways of several States for some time.

Passenger - miles.

Tasmania	-	since 1901
New South Wales	-	since 1910
South Australia	-	since 1904
Victoria	-	since 1918

Ton - Miles.

New South Wales	since 1901
Tasmania	since 1901
South Australia	since 1901
Western Australia	since 1918
Victoria	since 1918

Commodity Ton - Miles ¹

New South Wales.

Western Australia.

Tasmania.

It is interesting to note that in 1919 a Committee of Officers appointed by the New South Wales administration enquired into the subject of the preparation of railway operating statistics. The whole system was re-modelled and a Central Statistical Bureau established to which were transferred the officers who had previously prepared statistics under the supervision of different chiefs. This centralisation has resulted in the improvement of supervision, uniformity of methods and a great extension of the statistics prepared.

CANADA.

The statistics returned by the railways to the Government were thoroughly revised and extended in 1906. The compilation and publication of ton - mile statistics were made compulsory although the railways had voluntarily prepared these statistics prior to that date.

1. To be explained later.

In 1915 the statistics were altered again, in order that they should conform to the schedules prescribed by the Inter-State Commerce Commission of America. This change was introduced in order to render the Canadian returns comparable with those of the U.S.A. - a very laudable object!

SOUTH AFRICA.

The compilation of ton-mile figures was suspended during the war period. ' Experience, however, shewed that the administration were placed at some disadvantage without ton - mile figures,' and so, in 1923, their compilation was resumed. More frequent and extended information has also been introduced both for the benefit of the general public and also for the Chief Administrative and Executive Officers.

INDIA.

The railways of India have always rendered copious returns to their Government, but, as much of the information was considered to be of little value, a Committee was appointed in 1922 to examine the form, scope and underlying principles of the statistics then in use, with a view to their reduction and improvement.

Ireland.

The statistics are similar to those prepared in England.

BELGIUM.

During recent years the statistics have been extended considerably, and further changes are contemplated. "Monthly returns, and in some cases - weekly returns, are now prepared in place of the old three-monthly statements, and this alteration enables such remedies as may be necessary to be applied quickly".

DENMARK.

The chief recent development occurred in 1918 when the Danish State Railways were required to publish monthly statistics. Apart from this, comprehensive statistics have been published annually since the railways commenced.

FRANCE.

French statistics have remained much the same as they were in 1900 with the exception of some minor modifications introduced to meet changes in the organisation of the railways.

GREECE.

There have been no changes in the statistics compiled by the State Railways since the commencement of this century, but a considerable improvement is contemplated.

ITALY.

The present statistics were introduced in 1905 when the State took over the railways. 'The State Railways are now; however, 'actively engaged in revising all their working statistics with a view to their simplification and the addition thereto of new information.'

ROUMANIA.

The statistics in use up to the outbreak of war have been continued, but they have been arranged differently since January 1st 1924 in order to make comparison with other countries possible.

SWEDEN.

Throughout this century the statistics have been continually improved and altered, with the object of:

1. extending and making the statistics more complete,
and
2. excluding details which are thought of insufficient importance. Monthly statistics were inaugurated in 1913 and these also have continually been improved.

CHINA.

The recent developments in China are full of interest and as the authorities have exhibited such a broad-minded policy I take the liberty of quoting the whole paragraph:-

'The Statistics relating to Chinese State Railways compiled prior to 1915 were, it is stated "Of a very summary character and gave little useful information." They were therefore entirely revised and brought into conformity with the statistics of other countries as from 1st January 1915. The Chinese Administration realise that while statistics are essential to those responsible for the working of the railways, they are necessary also for the purpose of enlisting public confidence and support, and in the preface to the annual report for 1916 the Standing Committee on the Unification of Railway Accounts and Statistics stated:-

The railways in our country are still undeveloped. There are many lines yet to be built, and the building of those lines largely depends upon the co-operation of the public as well as of foreigners. The authorities should therefore keep the public informed as to the conditions and results of the

railway operations with all sincerity, so that the co-operation of the public and foreigners may be counted upon.... It seems fitting, therefore, that in these early reports, at least, considerable analysis should be made of results and that the considerations should be set forth by which such results are measured. Such analysis and considerations are offered with the object of educating the people to understand the importance of railway administration as well as the real conditions, to the end that public opinion may be enlisted in a wise furtherance of railway policy'.

These are indeed admirable principles to work upon.

To what end is this universal improvement in the compiling of statistics leading? Is it leading to universal uniformity so that international comparison of railway working will be facilitated? I think so.

The fundamental problems of all railway systems that have reached an advanced stage are naturally very similar. To elucidate these problems and explain the results of railway working obviously necessitates the same basic figures. The basic figures which are common to most railway systems of the world are:-

Particulars of locomotives carriages and wagons owned,
available for use and in use.

Train - and engine - miles.

Train - and engine - hours.

Coaching vehicle - and wagon - miles.

Freight tons.

Freight net ton - miles.

Freight train receipts.

Quantities of and receipts from certain selected traffics,

Passengers, number of.

Passenger - miles.

Passenger train receipts.

Fuel consumption and lubricating oil used.

Number of employers and particulars of earnings.

Expenditure under various headings.

Most of these basic figures, since they are employed
in English railway statistics, will be explained in later
sections.

P A R T II.

DESCRIPTIVE.

SECTION II.THE RAILWAY ACCOUNTS AND RETURNS ACT, 1911.

I intend in this section to explain the more important items in the accounts and returns required by the Act of 1911.

The first seven forms relate to the capital of the company, a fact which suggests that full details are given in this connection. That this is so is only right, for the construction and equipment of a railway involved considerable expenditure, the greater part of which is irrecoverable if the railway does not prove a success. It is essential that proper records should be kept of the money raised for, and the expenditure involved in bringing the line up to the stage when it begins to earn revenue and in carrying out any subsequent extensions or substantial improvements.

The first statement, which dealt with the capital in general, is divided into three sections, the first and most important of which is entitled 'Nominal Capital Authorized and created by the Company'. This statement gives the Acts of Parliament which have been granted to the Company together with the amount of capital each Act has authorized. The amount of capital created and the

balance of capital authorized but not created are also shown. The figures given under the three heads are further divided into 'Shares and Stock' and 'Loans or Debenture Stock', two forms of capital which present a sharp legal distinction. The other two sections of Statement No. 1. are divided similarly but deal with other capital over which the Company has control.

No. 1. (b) shows the nominal capital authorized and created by the company jointly with some other company. This merely supplements the first statement.

The third section is rather more interesting for it deals with the nominal capital authorized and created by some other company on which the company either jointly or separately guarantees fixed dividends. The company making the returns may have a more or less direct interest in the undertakings of some other companies and for that reason shoulders the responsibility of guaranteeing certain dividends out of its own revenue.

Statement No. 2. shows the amounts and various classes of share capital and stock created, together with the proportion issued. Columns are also devoted to the nominal additions to, or deductions from capital, so that the amounts on which dividend is payable can be obtained.

In the 3rd Statement is given the capital raised by loans and debenture stock, the amounts of the two forms of capital being separated. As may be understood from the first Statement, a company must be authorized by an ~~act~~ of Parliament before it can raise capital in any way. The ordinary loan, not so much favoured by English railways as by the railroad companies of America, is a sum advanced upon bonds redeemable within a time limit. Debenture stock is a special form of loan receiving a fixed rate of interest. It is transferable but not always redeemable.

Statements No.4, No.4 (a), and No.5, may be grouped together for the purposes of description and explanation. Statement No.4 is entitled 'Receipts and Expenditure on Capital Accounts', while No.5 supplements this by giving the details of capital expenditure for the year to which the returns relate. The former is noticeable as being the first balanced account. The balance, whether debit or credit, is carried to the Balance Sheet, this being a peculiarity that will be referred to later when the Balance Sheet is being discussed. The first two items on the 'receipts' side of No 4 show the amount of capital received. These items are followed by certain provisions

for taking into account the premiums received over the nominal stock issued, and the discounts suffered in the disposal of stock under the nominal amount. According as the premiums or discounts are the greater, so the balance must be added to or deducted from the nominal issues to show the total receipts. This will be better explained by the actual figures taken from the returns for 1923 of the London, Midland and Scottish Railways.

By Receipts	Total
Shares and Stocks(No 2)	£ 293,281,009:14: 1
Debenture Stock (No 3)	107,030,417:15: 7
Premiums on) Shares and) Stocks) 19,500,635: 7: 1	
Premiums on) Debenture) Stock) 5,120,881: 3: 6	
Total	
Premiums 24,621,516:10: 7	
Discounts on) Shares and)) Stocks) 8,197,022: 0: 9	
Discounts on) Debenture) Stock) 1,900,151:15: 4	
10, 079,173:16: 1	
Balance of Premiums and Discounts	14,524,342:14: 6
Total Receipts.	414,835,770: 4: 2

On the expenditure side is shown how the capital has been disposed of. Statement No. 5. gives the same items in more detail for the particular year. Moreover in this latter form the expenditure on lines is divided under three columns:-

- (1) Land and Compensation.
- (2) Construction of Way and Stations, Engineering etc.
- (3) Law Charges and Parliamentary Expenses.

This division certainly makes the form more instructive and it is a pity that such division is confined to this form for if it were introduced into Statement No. 4. the value of the latter would be greatly increased.

The following items, quoted from No. 4, show how detailed is the information required concerning the capital expenditure of the railway companies:-

- 1) Lines open for traffic.
- 2) Lines not open for traffic
 - (a) New lines.
 - (b) Widening of existing lines.
- 3) Lines leased.
- 4) Lines jointly owned.
- 5) Lines jointly leased.
- 6) Rolling stock.

7) Manufacturing and repairing works and plant:

(a) Land and buildings.

(b) Plant and machinery.

At this point provision is made for giving the total capital expended upon the railway. That which follows is more or less extraneous expenditure.

8) Horses.

9) Road vehicles employed in the collection and delivery of parcels and goods and in the conveyance of passengers:

(a) Goods and parcels road vehicles.

(b) Passenger road vehicles.

10) Steamboats.

11) Canals.

12) Docks, harbours and wharves.

13) Hotels.

14) Electric power stations, etc.

15) Land, property, etc., not forming part of the railway or stations:

(a) Used in connection with railway working.

(b) Not used in connection with railway working.

16) Other industries (to be stated separately).

This item in the case of the L.M.S. Railway is a limestone quarry, which accounts for more than £45,000 of the company's capital expenditure.

17) Subscriptions to other companies.

(for details, see Table No 4 (a).

18) Special items.

Table No.4 (a), then, shows the subscriptions paid out of capital under statutory authority to other companies or joint committees. A column is provided for the separate amounts of the subscriptions and another in which the nature of the security or investment must be noted.

Statement No. 6. gives an estimate in similar detail to No. 4. and No. 5. of the further expenditure on capital account both for the ensuing year and 'subsequently until completion.' The total of the column showing the estimated expenditure during the ensuing year should be compared at the end of the year with the total of Statement of No. 5. in the next issue of the report.

The capital powers and ~~and~~ any other assets which are available to meet the further expenditure on capital account are set out in Statement No. 7.

This seeming excess of detail in connection with the capital of the railway companies is of greater value than would at first sight be supposed. It should certainly be of use in checking a tendency towards careless expenditure from capital on things that should be paid for out of revenue.

The revenue accounts are introduced by the 8th statement which deals with the 'Revenue Receipts and Expenditure of the Whole Undertaking.' This shows the gross receipts of all the various branches of the railway concern. No great detail is shown here, but opposite the chief items in this statement are references to other statements wherein the detail may be found. We thus find that a study of this account involves us in a study of nearly all the remaining accounts.

'Railways' is the first item in No. 8. and we are referred to Statement No. 10 which shows the receipts and expenditure in respect of railway working proper. Much detail is given but again there are references to several abstracts which follow this account. In No. 10. on each side of the account, is a column wherein the percentages

of the item stated, assuming the whole traffic receipts as 100, are given. The figures opposite the various receipts in the column on the credit side of the account of course total 100. In the column on the other side of the account, is placed the percentage of the expenditure on each department of railway working proper. These are very interesting and illuminating figures indeed. Unless there is some special reason for abnormal expenditure on one or more items, these percentages should be fairly steady from year to year. It is possible to see at once from this column providing other things have remained equal, in what branch or branches of railway working economies have or have not been effected. If a profit has been made on the year's working this column does not of course total 100. In the case of the L.M.S. return, mentioned above, the percentage of the total expenditure to the traffic receipts was 81.3

As this statement is so important, showing, as it does, a detailed account of all the receipts and expenditure in respect of railway working in its narrowest sense, it would seem desirable to include a copy of it here. The following example is taken from the returns for 1923 of the L.M.S. Railway.

No. 10. Receipts & Expenditure in respect of Railway Working.			
Dr.	To Expenditure.	% of Traffic	
		Receipts	
A - Maintenance & Renewal of Way and Works	8,974,658:12: 0	11.38	
B - Maintenance & Renewal of Rolling Stock			
(1) Locomotives	5,097,543:12: 0	6.46	
(2) Carriages	3,177,990:19: 0	4.03	
(3) Wagons	3,034,752: 8: 0	3.85	
	11,310,286:19: 0	14.34	
C - Locomotive Running Expenses	15,936,030: 7:0	20.20	
D - Traffic Expenses	21,635,299: 7:0	27.43	
	37,571,329:14: 0	47.63	
E - General Charges	2,213,428: 8: 0	2.81	
Law Charges	103,813:12: 0	.13	
Parliamentary Expenses	15,787:16: 0	.02	
Compensation (Accidents & Losses			
Passengers	14,408: 6:0		
Workmen	189,107: 0:0		
Damage & Loss of Goods	317,774:13:0	.66	
Rates &c	2,835,673: 2: 0	3.59	
Taxes	321:15: 0		
Tithe Rent Charges	7,249:17: 0	.01	
Government Duty	152,824: 4: 0	.19	
National Insurance:-			
Health	256,039:19:0	.33	
Unemployment	197,470:10:0	.25	
Expenses of Amalgamation and Rates			
Tribunal	17,086:11: 0	.02	
G - Running Powers (Balance	49,959:11: 0	.06	
TOTAL TRAFFIC EXPENDITURE			
	64,127,361:12: 0	81.30	
J - Joint Lines	1,563,694:12: 0		
Miscellaneous	83,780:18: 0		
	65,774,837: 2: 0		
Total Expenditure	15,695,863: 9: 0		
NET RECEIPTS			
	81,470,700:11: 0		

No. 10. Receipts & Expenditure in respect of Railway Working.

By Gross Receipts.

Cr
% of Traffic
ReceiptsPASSENGER TRAIN TRAFFIC:-

Ordinary Passengers:-

First Class	1,899,970: 2: 0
Second Class	1,342: 1: 0
Third Class	<u>18,904,201: 7: 0</u>

20,805,513:10: 0

Season Tickets

First Class	1,357,683: 0: 0
Second Class	6,512: 0: 0
Third Class	<u>2,397,486: 5: 0</u>

3,761,681: 5: 0

Workmen's Tickets

1,446,605: 3: 0

Total Receipts from Passengers

26,013,799:19: 0

Mails

1,007,033: 5: 0

Parcels up to 2 cwts, Parcels Post

and Excess Luggage 4,121,931: 2: 0

Other Merchandise by Pas-

senger Trains 1,864,252:15: 0

5,986,183:17: 0

F - Less Expenses of Collection

and Delivery

374,392: 6: 0

5,611,791:10: 0

Total Passenger Train Receipts

£ 32,632,624:15: 0 41.37

GOODS TRAIN TRAFFIC:-

Merchandise 26,263,051: 4: 0

F - Less Expenses of Collec-

tion and Delivery

3,140,516: 1: 0

23,122,535: 3: 0

Live Stock

940,755: 8: 0

Coal, Coke & Patent Fuel 15,568,297: 3: 0

Other Minerals 6,615,189: 2: 0

Total Goods Train Receipts

46,246,776:16: 0 58.63

TOTAL TRAFFIC RECEIPTS

78,879,401:11: 0 100.00

H Mileage, Demurrage, & Wagon Hire (Balance)

37,416: 4: 0

J

Joint Lines

1,741,388:12: 0

Miscellaneous

812,494: 4: 0

TOTAL

81,470,700:11: 0

The first item of expenditure on the above statement is 'Maintenance and Renewal of Way and Works,' and a reference is given to Abstract A. In this abstract the expenses of maintenance and renewal are divided up under very detailed heads. These items explain themselves so that no comment is necessary. The only point that may lead to controversy is the question of the method of arranging for depreciation. A note is appended to this abstract saying, 'When any sum is transferred to or from a depreciation fund or suspense account, the net sum to be stated.' This instruction seems rather ambiguous but the generally accepted method is to charge the actual outlay to the account and then if it is found necessary to make any transfer to or from a depreciation fund or suspense account, that amount is shown separately. It would be irrelevant, however, to enter more fully into the question of depreciation here.

Returning to Statement No. 10 once more, it is found that the next three items of expenditure are:- 'Maintenance and Renewal of Rolling Stock:'

'Locomotive Running Expenses:'

'Traffic Expenses.'

Each of these three items have abstracts (B, C & D respectively) in which the full detail concerning that expenditure is shown. In fact Abstract B. relating to rolling stock is divided into three abstracts:-

B (1) Locomotives.

B (2) Carriages.

B (3) Wagons.

In all the abstracts as yet mentioned, both the expenses incurred in superintendence and in the works superintended are shown. Abstract D. is a fair example of the detail which these abstracts contain. Under the heading of 'Traffic Expenses,' it includes all the expenses connected with the handling and hauling of goods and passenger traffic which have not already been provided for in the other three abstracts. Its various items are as follows:-

Salaries and Wages :-

Superintendence.

Stationmasters and Clerks.

Signalmen and Gatemen.

Ticket Collectors, Policemen, Porters, etc.

Guards.

Fuel, Lighting, Water and General Stores.

Clothing.

Printing, Advertising, Stationery, Stamps and

Tickets.

Wagon Covers, etc.

Expenses of Joint Stations and Junctions.

Cleansing, Lighting of Vehicles, and Lubricating.

Shunting Expenses (Other than Mechanical):-

Wages.

Other Expenses.

Working of Stationary Engines, Hoists, Cranes, etc.

Coal, etc., Tipping Expenses.

The principal operating and maintaining departments thus being dispensed with, the next item in No. 10, is 'General Charges' Abstract E. which relates to this item shows it to consist of expenses, such as directors' fees, salaries of the chief officers, insurance and superannuation subscriptions, which cannot be directly allocated to any specific branch of working. Most of the remaining items are quite definite and need no abstracts to explain them.

The final item included in the total traffic expenditure is 'Running Powers' This is a balance brought from Abstract G and may be either credit or debit. 'Running Powers' refers to the powers

possessed by certain companies of running trains over other companies' lines. Ordinarily the gross receipts accrue to the company owning the lines, but it is usual for the owning company to make an allowance to the running company. These allowances whether received or paid by a company are placed to the Running Powers Account (Abstract G). The balance of this Account is then shown on the expenditure side of No. 10. The reasons for this method of procedure can be gathered from a footnote to Statement No. 10. which reads thus:-

'Gross receipts to include the whole of the receipts from traffic carried over the company's lines except where (a) the traffic is carried over the company's lines by trains of other companies and no annual payment is made therefore, or where (b) the payment made is by way of a fixed rent. The proportion of traffic receipts accruing to other companies in respect of running powers exercised by them over the company's lines not to be treated as a deduction from the company's traffic receipts in this statement, but to be entered as a payment in the Running Powers Account (Abstract G). The proportion of the traffic

receipts accruing to the company in respect of trains run by the company over the lines of other companies to be excluded from the traffic receipts in this statement and entered as receipts in the Running Powers Account'.

We can now turn to the items under 'Gross Receipts' in Statement No. 10. The total receipts from passengers, divided into the three classes of passengers and three kinds of tickets, i.e., 'ordinary', 'Season' and 'workman's', are first given. More will be said concerning passenger receipts when the statistical returns are discussed. Passengers trains also carry certain kinds of goods and parcels and these are provided for under the receipts from passenger train traffic, as will be seen in the above example. The receipts from these goods are lowered by the ^ddeduction of expenses of collection and delivery, details of which expenses are given in Abstract F. One may be tempted to ask why these expenses do not appear as part of the expenditure on the Dr. side of the account? They are not placed there, I believe, in order that one of the principles underlying these accounts and

statistics should not be violated, viz: the principle of separating all railway working proper from other business undertaken by the company.

Receipts from goods train traffic follow those from passenger train traffic and are sub-divided under

Merchandise.

Live Stock.

Coal, Coke and Patent Fuel.

Other Minerals.

The expenses of collection and delivery according to Abstract F. are deducted from the earnings derived by the carriage of merchandise.

Below the two totals of 'Total Traffic Expenditure' and 'Total Traffic Receipts' are found one or two other headings.

'Joint Lines', shows the two totals brought from Abstract J which deals with receipts and expenditure from jointly owned and jointly leased lines. The lines mentioned here are only those in respect of which the accounts are prepared by or for the joint committee and are not embodied under their respective headings in the accounts of the parent companies.

'Miscellaneous', makes provision for items of receipt and expenditure which should appear on this account and yet are not provided for in any other way i.e.,

items such as 'cloak-rooms'. The 'Miscellaneous' on both sides does not necessarily refer to the same undertakings.

Having explained the item 'Railway' in all its detail, we can return to Statement No. 8, 'Revenue Receipts and Expenditure of the Whole Undertaking'. The next six items concern undertakings not strictly connected with railway working. The following are such undertakings:-

Omnibuses. and other passenger Vehicles not running on the Railway.

Steamboats.

Canals.

Docks, Harbours and Wharves.

Hotels and Refreshment Rooms and Cars where catering is carried on by the Company.

The sixth provides a place for any other business not provided for elsewhere. In the case of each of these undertakings we are referred to other statements (11, 12, 13, 14, 15 and 16 respectively) where the receipts and expenditure are given in full, the summary only being shown in statement No. 8.

These complete the revenue accounts which are summarized in No. 8. It would have been of greater advantage, in my opinion, if the next three items under 'Miscellaneous Receipts(Net)' had also possessed published revenue accounts. The net rents from houses, lands, hotels, etc., are required, but the expenses which they necessitate and which must be fairly considerable, are not shown. The cost of rent collection in proportion to receipts, gross or net, would, if shown, prove rather interesting, but we are to see neither the expenses nor the gross receipts from these properties.

'Interest and Dividends from Investments in other Companies', gives the revenue obtained from the company's investments which are tabulated in Statement No. 4. (a).

Statement No. 8. is very well set out and in conjunction with the other accounts and abstracts mentioned above provides a mass of useful information. My one complaint is that it precedes the accounts and abstracts which it summarizes instead of following

them, and, therefore, causes much inconvenience to those using the returns.

The balance (net income) from No. 8. is carried to Statement No. 9. which gives details of the proposed appropriation of net income. To this amount is added the balance brought forward from the corresponding account of the previous year and, if necessary a certain amount appropriated from the Reserve, also. The fixed charges have first claim on this sum, the dividends on guaranteed and preference stock forming the second item. The balance then remaining is available for dividend on the ordinary stock but a certain amount is generally carried forward to the next year's Account although this is not provided for in the forms.

The remaining form of account, as distinct from statistical returns, is the all-important Balance Sheet. This calls for little comment as its actual items do not concern us to any great extent. It differs from those of other companies, however, in respect of the entries relating to capital. Instead of the liabilities to shareholders and the

fixed assets of the company appearing at the head of each side of the statement, provision is made only for the balance of the two, and the full details are set out in the capital accounts, Nos. 1 - 5.

If the Statement No. 4. shows a debit balance, the expenditure having exceeded the receipts, this balance appears among the assets on the Balance Sheet. Thus we find at the head of the assets in the General Balance Sheet of the E.M.S. Railway for the year 1935, the following item:-

'By Capital Account: Balance
at debit thereof as per

Account No. 4.	...	...	...	£23,193,654.	7.	2.
----------------	-----	-----	-----	--------------	----	----

But if No. 4. shows a credit balance, the receipts having exceeded the expenditure, then a liability appears on the Balance Sheet.

Statistical Returns.

Much of the information in the statistical part of the returns consists of an inventory of the property in the possession of the company. The returns need little explanation for the 'inventory' is but a simple one and gives no great detail. Several forms at the end are reserved for some elementary figures of the year's working.

Land and property, the subjects of the statistics relating to capital expenditure may be divided under the following heads:-

1. That which forms part of the railway or stations.
2. That which does not form part of the railway or stations but is used in connection with railway working proper.
3. That which is used in connection with the extraneous businesses undertaken by the railway.

Of the first class one has to be content with very little information - just three statements all of which are concerned with the mileage of lines.

I shall have some criticism and recommendations to offer concerning these meagre returns, in a later section.

The three statements to which I have referred,
show the mileage of lines,

(I (A)) open for traffic;

(I (B)) authorized but not open for traffic;

(I (C)) run over by the company's engines.

Statement No. I (A) requires

1. Lines owned by the company,
 - (a) main and principal lines, in detail:
 - (b) minor and branch lines (summarized by districts).
2. Lines jointly owned (company's share of ownership),
 - (a) as enumerated in Abstract J. in detail:
 - (b) other joint lines.
3. Lines leased or worked,
 - (a) by the company (in detail):
 - (b) jointly with other companies (Company's share):
 - (c) as enumerated in Abstract J. (in detail).
4. Grand Total.

In each case the length of the first track, which is obviously the length of the road, is required first. The length of extra tracks are shown in order in the next columns and a separate column is reserved for 'Sidings reduced to Single Track'.

The horizontal totals of all the columns, placed in.

the final column gives the total mileage of single track for each particular district or line.

Statement I (B) gives in similar geographical detail,

1. miles authorized:
2. miles constructed and not open for traffic:
3. miles under construction:
4. miles not commenced or in abeyance.

Passing on to the second class of property mentioned above, i.e., that which does not form part of the railway or stations but is used in connection with railway working proper, we again find but one statement. It is fairly comprehensive, however, inasmuch as it is divided into six returns, which deal with :-

- (A) Steam locomotives and tenders.
- (B) Rail Motor Vehicles.
- (C) Trains worked by electric power.
- (D) Coaching Vehicles (other than electric).
- (E) Merchandise and mineral vehicles.
- (F) Railway service vehicles, and horses for shunting.

The six returns devoted to the third class of railway property are disappointing and appear to me to be of little value in their present state. Here is a

list of the returns and the information which they afford:

III. Horses and road vehicles employed in the collection and delivery of parcels and goods, and in the conveyance of passengers.

IV. Steamboats.

This gives a list of the boats over 250 tons, with their date of construction, horsepower and net registered tonnage, with a total of steamboats not exceeding 250 tons each.

V. Canals.

Name and length in miles only.

VI. Docks, Harbours and Wharves.

Name and length of quay.

VII. Hotels.

Name and situation.

VIII. Land, Property, etc., not forming part of the railway or stations.

This is rather a misleading title in view of the preceding returns. The average of land and the number of houses are all the information that is demanded by this return.

Returns No. X and No. XI. supplement Abstracts A and B

respectively, of the financial accounts. The former refers to the 'Maintenance and Renewal of Way and Works', and shows:

- i. The quantities of principal materials used:
- ii. The number of miles maintained:
- iii. The number of miles of track renewed.

The latter return shows, in three columns headed -

'In Company's Workshops',

'By Contract', and

'Total',

The number of the various kinds of rolling stock maintained and renewed during the year. Returns are made for four kinds of rolling stock and for four classes of work, viz:-

Rolling Stock.

1. Locomotives.
2. Rail motor and electric train vehicles.
3. Coaching vehicles.
 - (a) carriages.
 - (b) other coaching vehicles.
4. Wagons.

Classes of Work.

1. Renewals.
2. Heavy repairs¹
3. Light repairs.
4. Under or awaiting repair at end of year.

The definitions of 'heavy repairs' and 'light repairs' are not given so that, unless the companies have agreed upon a uniform classification, the distinction is worth little. In any case this division of repairs conveys very little information to the minds of persons not actively engaged in railway working. Apart from this, Returns Nos. X and XI are very useful since they explain, and provide a useful check upon, the expense as detailed in the corresponding abstracts.

The information contained in the remaining returns is also rendered, in far more detail, in the monthly statistics so that little need be said concerning it here. The following are the returns:-

- XII. Engine-mileage.
- XIII. Passenger traffic and receipts.
- XIV. Goods traffic and receipts.
- XV (A). Tonnage of the principal classes of minerals and merchandise carried by goods trains.
- XV (B). Number of live stock carried by goods trains.

XVI. Summary of financial results.

It is unnecessary to describe each in detail.

Suffice it to say that with the exception of the first and last returns, they were totally inadequate as a record of railway working until the monthly statistics, which remedied the omissions, were published.

The last return - the summary of financial results - is interesting, for it presents a few salient features of the accounts for comparison in a succession of years. It was laid down in the Act, i.e., in 1911, that this summary - the 'Summary of Financial Results secured in comparison with those for past years' - was not to be made retrospective~~ly~~, but was to be extended year by year until 10 years were given. Since the recent amalgamations, however, comparison with previous years has been impossible, so that 1923 - the first year in which the accounts of the amalgamated companies appeared - has become the base year of the ten year's summary.

This return affords excellent data of the rise or fall of the different parts of the financial business of the company which issues it.

An example of the form is given here: it has been thought better to give an actual example rather than a copy of the blank form for its use can then be more appreciated. The return is taken from the Annual Report for 1924 of the Great Western Railway Company.

XVI. Summary of financial results secured in comparison
with those for past years (G. W. R.)

<u>No.</u>	<u>19231</u>	<u>1924.</u>
	£	£
4. Total Expenditure on Capital Account.	167,805,054.	169,705,471.
8. Gross Receipts from Business carried on by the Company.	36,723,331.	36,408,336.
8. Revenue Expenditure on do.	29,778,508.	30,339,505.
8. Net Receipts of ditto.	6,944,823.	6,068,831.
8. Miscellaneous Receipts, Net.	1,292,200.	1,384,263.
8. Total Net Income.	8,237,023.	7,453,094.
9. Interest, Rentals and other Fixed Charges.	2,415,111.	2,462,528.
9. Dividends on Guaranteed and Preference Stocks.	2,578,565.	2,662,226.
9. Balance after Payment of Preference Dividends.	3,243,347.	2,328,340.
9. Dividend on Ordinary Stock.	3,396,517.	3,184,642.
Rate per cent.	8½.	7½.
Deficit.	152,970.	856,302.
Appropriation from Reserve for Contingencies.	150,000.	850,000.
Brought forward from previous year.	304,932.	301,962.
Carried forward to subsequent year.	301,962.	295,660.

SECTION 111'RAILWAY STATISTICS - GREAT BRITAIN'(MINISTRY OF TRANSPORT.)

In the previous section, the various accounts and statistics demanded of the railways by the Act of 1911 were described and explained. In this section I intend to continue the survey of English railway accounts and statistics by describing the various forms, units and combinations of units employed by the Ministry of Transport, under the Act of 1921, in its monthly issues of 'Railway Statistics' - Great Britain". The question of ton-mile and cognate statistics will not be dealt with in this section, however, for they are so numerous and of such importance that they will receive treatment in a separate section.

When all the statistics at present published, have thus been noted and described we shall then be in a position to review them all and criticise them both separately and in a body.

Table 1 shows the aggregate figures for passenger train and freight train traffic from January 1st.

to date, and the increase or decrease compared with the corresponding period of the previous year.

This is a very useful table, showing the year's work to date at a glance but as the same statistical units appear in later tables we can immediately pass on to Table 1a which is perhaps the chief table contained in the report, and occupies eight pages. It gives the summary figures for the month for which the report is issued. Figures are given separately for the four great railways - the Great Western, The London and North Eastern, The London Midland and Scottish, and the Southern - in columns on the right hand side of the table, while the totals appear in a column on the left, the description occupying a middle column.

Here again the increase or decrease compared with the corresponding month of the previous year is shown in each case, thus making the table exceedingly valuable for purposes of comparison.

One warning, contained in a foot note, is given concerning the statistics of passenger train traffic, and should be borne in mind when comparisons are made - 'The receipts shown are for the throughout journey, and do not represent the amount accruing to the Company on whose line the

traffic originated.'

Passenger train traffic is recorded under the following heads, the figures for each of which are again sub-divided under headings which are nearly similar in ~~case~~ each case.

- (1) Passenger Journeys (excluding Season Ticket Holders).
- (2) Passenger receipts (excluding Season Ticket Holders).
- (3) Receipts per Passenger Journey (excluding Season Ticket Holders).
- (4) Season Tickets (Receipts from Tickets issued during month.)

The sub-headings are,

- i At full fares.
- ii At Reduced Fares (again sub-divided)
- iii First Class (Ordinary)
- iv Second Class (Ordinary)
- v Third Class (Ordinary).
- vi Workmen (omitted from Season Tickets).

A further principal heading is provided by 'Parcels and Miscellaneous Traffic -Receipts' which is sub-divided under the various goods that can travel by passenger train.

The figures for Freight train traffic are rendered under the following headings:-

- (1) Tons (excluding Free-hauled).
- (2) Net Ton-Miles (excluding Free-hauled).
- (3) Average length of Haul (Miles).
- (4) Tons (Free-hauled).
- (5) Net Ton-Miles (Free-Hauled).
- (6) Freight Train Receipts (Less cost of
and
Collection ~~of~~ Delivery).
- (7) Receipts per Ton (less Cost of Collection
and Delivery).
- (8) Receipts per Ton-Mile (less cost of Collection
and Delivery).

Each of the above is sub-divided into:-

- i General Merchandise.
 - ii Live Stock (or included in i).
 - iii Coal, Coke or Patent Fuel.
 - iv Other Minerals.
- (9) Live Stock (Number).

This latter figure is sub-divided to show the figures for the various animals conveyed.

Nothing in the above calls for explanation for the "Average Length of Haul" will be dealt with in the next section.

Tables 11 - V (inclusive) give detailed information concerning the summaries, mentioned above that are given in Table 1A.

Table 11 shows the tons, receipts, and receipts per ton in respect of 72 principal commodities of freight train traffic. The figures are wisely divided under 'At "Station to Station" Rates' and "At "Collection and for Delivery" Rates".

In addition the figures for the corresponding month of the previous year are given.

Table 111 gives the passenger traffic (excluding season ticket holders) in detail.

The columns are headed by

'Full Fares.'

'Excursion and Week-end'

'Workmen'

'Other Descriptions'

'Total'.

Each of these is divided into

'Passenger Journeys'

'% of Total'

'Receipts'

'Total'

'Per passenger Journey'.

Figures are given under all three classes and totals, for all the chief sections of the four big railways.

Table IV. gives the 'Parcels and Miscellaneous Traffic charged at Passenger Train Rates' in detail.

Table V. 'Tons and Receipts per Ton for
Throughout Journey in respect of
Principal Commodities by Freight
Trains'.

The figures are given for the various sections of the chief railways and the whole table appears to comprise a mass of information. On the contrary its value is reduced considerably by the omission of certain figures to which attention will be drawn in the critical sections.

We must now return to Table IA. and attempt to sort out the mass of information that it still contains. We have noted the revenue statistics above:- there remains the working or operating statistics. To each of the summaries given in this table there is devoted a separate table containing the details, in the latter part of the report. By examining the summary and table together our progress will be both quicker and clearer.

ENGINE-MILEAGE (Table VI.)

Full details of all the statistics rendered in the monthly report will be found in the appendix. It is unnecessary to mention every figure contained in the tables; therefore I shall confine myself to drawing attention to and explaining the more important statistics.

Engine-mileage is divided under 'Coaching', 'Freight' and 'Departmental Miles'. Each of these include figures for the various types of work performed by locomotives, such as 'train-miles' and 'shunting-miles'. Train-miles which will be considered in the next section, consist of the mileage of engines working loaded and empty trains irrespective of the number of vehicles hauled. The divisions of mileage made, are, of course, intended to facilitate the allocating of costs to different departments and to enable comparisons to be made. The information is compiled in accordance with the instructions laid down in connection with Return XII of the First Schedule to the Railway Companies, (Accounts and Returns), Act, 1911, a section which, as stated above, also records train-mileage.

An interesting feature of the different sections of Table VI. is the division of week-day and Sunday mileage. 'Engine-miles follow the wages in accordance with the time the engine-men commence work. All the work performed by engine-men who book on duty at any time between 12 midnight Saturday and 12 midnight Sunday is shown as Sunday mileage.

ENGINE HOURS "IN TRAFFIC". Table VII.

The true criterion of efficiency is not only the quantity of work done with a given equipment, but the proportionate cost of the operation. This proportionate cost can be easily obtained from the statistics which are gathered in a few months after the period to which they apply. But what is wanted is a measure of cost from day to day. Now it will be found that most of the costs of a railway do not vary directly with the traffic, and gradually, by a process of elimination, we can conclude that the only costs which can lay claim to corresponding directly with the running of trains and therefore to the productive work of the equipment are those of fuel consumption, wages of train men and lubrication. These costs are engine costs and vary directly with the hours that the engines are "in traffic". Thus

the engine-hour is a fair measure of day to day costs, being, in fact a more reliable measure of expenditure than the engine-mile for this reason:- an engine standing "under steam" while "in traffic" is still incurring the above expenses although engine-miles would not record them.

Engine-hours are calculated from the time the engines leave the shed at the commencement of a turn of duty until their return thereto. But by itself this unit is a measure of time only and conveys little useful information. This weakness can be remedied by comparing it with the figure representing the work done. The running of trains and wagons forms the unit of product and ^{the} engine-hour the measure of cost. The two together give the expenditure incurred in performing a given amount of work. The ordinary engine-hour, however, possesses an inherent defect. It ignores the capacity of the locomotive both as a consumer of costs and as a performer of work. It would seem easy to determine upon a standard engine-hour unit and allot to each engine or class of engines a coefficient by means of which its hours could be converted to standard engine-hours. Again, in the case of engine-hours as in the case of engine-miles, the figures are

divided and sub-divided; the division between coaching and freight appears through-out, under the chief headings of 'Train', 'Shunting', 'Departmental' and also under the various classes of engines such as 'steam' 'electric' etc.

TRAIN MILES PER HOUR. (Table VIII.)

This is rather a useful unit especially in reference to passenger trains. For the service of freight-trains I prefer the ton-mile unit and my reasons for this will appear in the next section.. Train-miles per hour are divided up in the first place under the various classes of engines, and, then for each class under 'Coaching' and 'Freight', and finally in each case under 'Per train-hour' and 'Per engine-hour'. Train miles per engine-hour is the most appropriate unit for the supervision of passenger train working amongst the above. There is little variation in the average speed of passenger trains from month to month, the figure therefore provides ~~the~~ a valuable check on the amount of unproductive time spent by engines in terminal stations assisting and shunting.

AVERAGE TRAIN LOAD.

This is the next item in Table 1A.

It will be discussed in the next section as it is a figure derived from ton-mileage.

AVERAGE WAGON LOADS.

The same remarks apply to this as to the preceding unit.

WAGONS PER TRAIN, TOTAL WAGON-MILES AND WAGON-MILES PER ENGINE-HOUR (Table IX.)

The inherent weakness in a unit which included the 'wagon' as a factor, deprives such unit of any real value. The wagon itself is a variable unit and may include vehicles whose maximum capacity is anything between 10 and 50 tons. Nevertheless these figures provide a rough ^hcheck upon the use made of the wagons and of the efficiency of the trains. What value these figures possess is certainly enhanced by their division between 'empty' and 'loaded'. But again a 50 ton wagon may only be carrying one ton and yet it is 'loaded'. The next two items in Table IA. belong to the next section.

ENGINE HOURS IN TRAFFIC PER WEEK DAY PER ENGINE IN USE. (Table XIA.)

and

ENGINE MILES PER WEEK DAY PER ENGINE IN USE. (Table XIA)

The above two items appearing in Table IA give only a portion albeit the most important portion of the information contained in Table XI.A. The numbers of engines in stock and in use are also shown. All the figures are divided under various classes of locomotives.

ELECTRIC MOTOR VEHICLES. (Table XI B)

This gives information similar to that in Table XI.A.

'SHUNTING' AND 'OTHER MILES' (excluding 'Departmental')
PER 100 TRAIN-MILES, STEAM LOCOMOTIVES. (Table XII.

This should be an exceedingly useful table to the manager who is endeavouring to reduce the proportion of unproductive running on his line. A sharp rise in any of the figures of this table would need to be investigated. 'Other Miles' include the miles worked by engines assisting trains, whether required or not (but these cases are separated in the table) and 'light' miles i.e. miles run by engines with no trains. All the miles are divided between 'Coaching' and 'Freight'. 'Other miles' then, can from their very nature be ascertained with only a small margin of error. But what of the 'shunting miles'? How are these obtained? According to the explanatory notes in the report, 'shunting hours have been converted into miles on the basis of 5 miles per hour'. Such a method of conversion hardly conforms with accuracy. Shunting hours would seem to provide a fairer test, for the shunting miles that engines do during shunting hours cannot be exactly determined. Shunting hours themselves are fixed in a somewhat arbitrary manner but, nevertheless they can be calculated more accurately. 'The whole of the time

regular shunting engines were occupied on their appointed shunting ground, after deducting locomotive duties and meal times (unless worked) has been charged to shunting, together with any time spent by such engines in running light between Shed and Station or Depot where the distance was 40 chains. In the case of train engines stopping at Stations or Depots for shunting purposes, the whole of the time (exclusive of time spent on Locomotive duties), from commencing the shunting operations until the engine was again coupled to its train ready to resume the journey or was ready to depart to Shed, etc., has been allocated to shunting. If any engine disposed of its train intact, no shunting time has been included, but if it broke up or re-marshalled its train, the time so occupied until ready to leave has been charged to shunting.*

CONSUMPTION OF COAL, LUBRICATING OIL.
(Steam Locomotives) Table XIII.

This table shows for each of the different railways.

- (1) The pounds of coal consumed per Engine-Mile.
- (2) The pints of lubricating oil used per 100 Engine-Miles.
- (a) Passenger Service.
- (b) Freight Service.
- (c) Shunting by Shunting Engines.
- (d) All services.

The sub-divisions are given for both (1) and (2).

This information enables a superintendant to check the consumption of coal and lubricating oil, for any waste or extravagance would immediately show itself in the figures. Personally I do not think that this table has been carried far enough. It would serve a much more useful purpose if the figures could be given for each type of locomotive.

Table XLV. deals with the electrical working and summarises most of the facts connected with it.

PART 3.

C R I T I C A L.

SECTION 4.

TON-MILES AND PASSENGER-MILES.

A separate section is to be entirely devoted to the question of ton-miles and passenger-miles partly because these statistics are so important in themselves and partly because they have been the subject of controversy in railway circles in this country for so many years. Practically every other civilized country has required statistics of ton-miles and passenger-miles from its railways for many years past. The continuous use of these statistics has proved, and is a proof of, their value; yet in this country, the 'practical' men have effectively resisted their introduction until a few years ago when the Railways Act, 1921, was passed. This tardy introduction may have been due in no small measure to the unenthusiastic words of the report of the Board of Trade Commission:- 'Practically no instance has been brought to our notice of any definite increase of earnings or decrease of expenditure in any specific case which was the result of the use of ton-mile figures and which could not or ought not to have been brought about by other means. Having regard however to the fact that ton-mile statistics deal with large averages, this absence of specific instances of their utility in effecting some definite improvement

in detail is not altogether surprising and is not inconsistent with their general utility in relation to railway control'.

The ton-mile is 1 ton hauled 1 mile.

Ton-mileage is thus weight multiplied by distance i.e. the tonnage carried multiplied by the number of miles it has been hauled. To illustrate this it may be said that

10 tons hauled 10 miles are equal to

20 tons " 5 " " " "

50 tons " 2 " " " "

100 tons " 1 " " " "

100 tons miles.

Similarly a passenger-mile is 1 passenger carried 1 mile.

The foundation of the whole system of statistics based upon ton-mileage and passenger-mileage is the principle of that comprehensive figure - the combination of the two factors of weight and of distance.

As carriage of goods is the business of a railway, it receives its earnings for the carriage of certain weight (or numbers in the case of passengers) a certain distance. What is more obvious in seeking a unit which shall represent the work done than to take these two fundamental factors of weight and distance and reduce them to one compound unit?

Mr Priestly, before the Departmental Committee of the Board of Trade, said,

"I cannot see how it is possible for anyone to form any reasonable idea of how his business is being conducted if the different factors making up the business are not resolved into some unit which expresses the service performed. The service on a railway is transportation. That transportation involves the carriage of quantity for distance. The multiplication of one of these factors by the other represents the service performed, and the terms in common use to express the result are passenger-miles and ton-miles. These are the only factors which express the service performed without any possibility of error".

The last sentence is rather a sweeping statement for there are strong arguments against Mr Priestly's assumption. Scientifically, his assumption appears to be correct for it corresponds more or less with the compound units of 'work done' in physics, the "foot-pound" and the "dyne" which are also produced by the combination of weight and distance. Before the introduction of ton-mile and passenger-mile

statistics into England the "train-mile" was the unit most generally used. Even today, it is highly probable that English railway managers still rely to a great extent upon this figure. It certainly has its uses, especially when used in conjunction with other statistics but, nevertheless, it has a fundamental defect as a unit. The mile is constant but the train is not. A train may consist of any number of wagons within wide limits and a fortiori the number of tons it may haul have an even wider range. The train-mile is thus a variable unit possessing no exact value at any one instant and possessing still less value for the purpose of comparing the results of different periods. The ton-mile is vastly superior for many purposes to its rival.

Let us see what was the opinion of the Departmental Committee on this question. Under the heading of 'Ton-mile Statistics compared with receipts per Train-Mile as a measure of efficiency in Railway Working' the following paragraph appears:-

'The only figure available for general purposes at present in the case of English railways is that

of the average gross receipts per train-mile which expresses the relation between the gross receipts and the number of train-miles run. It must, however, be observed that the reliability for comparative purposes from year to year for the average receipts per train-mile continues only so long as the average rate obtained remains constant.

It is clear, for instance, that a rise in the average receipt per train-mile may be attributable to improvements in loading, but equally it may be due to an increase in the rates charged, or to a change in the average length of haul, or to an alteration in the relative proportions of high-class traffic and of traffic carried at lower rates. The average receipts per train-mile do not afford the material for distinguishing between these two wholly different sets of causes. They contain, as Sir Hugh Bell remarked, two variables, and introduce confusion by mixing the records of the actual work performed in conveyance of traffic with those of the price received in payment for that work'. As the witnesses differed considerably the Committee came to the conclusion that 'it is not reasonable to attempt to compare the relative value of information respecting actual work performed and

of information respecting the financial results of that work. The load per train-mile and the receipt per train-mile respectively relate to two distinct sides of railway business and neither can claim the right to usurp the province of the other. Each has its own value within its own limits'.

It has been mentioned above that there are other statistics which can be derived from ton-miles and passenger-miles. These derivative statistics are in many cases of more value than the basic statistics, a fact often overlooked in discussions concerning the advisability of preparing ton-and passenger-miles. The following are the more important statistics that may be deduced from ton-mileage and passenger-mileage:

- (1) The average train-load of goods.
- (2) The average train-load of passengers.
- (3) The average wagon-load of goods.
- (4) The average coach-load of passengers.
- (5) The average length of haul for goods.
- (6) The average length of haul for passengers.
- (7) The average receipts per ton per mile.
- (8) The average receipts per passenger per mile.

(9) The average density of traffic per mile of road.

(10) The average density of traffic per mile of track.

The derivative units will be explained later in this section.

Two of the principal objections against the compilation of ton-mile statistics put forward by the English railway companies were :-

(1) That these figures are not available until long after the time to which they refer and as they are not so comprehensive that they can displace the statistics in use they are not worth the cost of preparation.

(2) 'Ton-mile figures are mis-leading and might give away information to competitors or convey a wrong impression to the public'.

This second objection is a contradiction in itself.

The question as to whether these figures are mis-leading will be dealt with shortly. But the railway companies declared that they were mis-leading and 'might convey a wrong impression to the public'.

Nevertheless, they said that the statistics might give away information to competitors. This certainly is not logical. If the figures mislead, how can they be of use to rival companies? Moreover it must be understood from this objection that the statistics

in use were not sufficiently explanatory to be informative. Surely this objection contains secret admiration for ton-mile figures.

In regard to the first objection it will be shown later that ton-mile statistics must be used in conjunction with other statistics if their efficiency is to reach its maximum. Mr. Burt, then an official of the N. E. Railway, before the Committee said, - "So far from the ton-mile summaries taking the place or obviating the necessity of detailed figures, they really give an additional importance to all the detailed statements and directly contribute to making those detailed statements more effective for practical use".

The expenses of compilation can be dealt with here. The North Western Railway had estimated that the expense of compiling ton-mile figures for that railway alone would be at least £15,000 per annum. The Grand Trunk Railway of Canada had prepared them for £1,000 per annum, a fact which suggests that the English estimate was somewhat exaggerated. Moreover the North Eastern Railway of England, having prepared these figures for the first ten years of this century,

told the Committee that their statistics office cost them altogether £3,000 per annum. The Committee came to the conclusion that this cost was negligible if the collection of the figures could be proved to be advantageous, for it formed but .07% of the total goods and mineral receipts. The higher cost in the case of the English Company was due to circumstances, the existence of which the other companies were not slow to point out. Conditions in railway working in England are different from those obtaining in countries like America and India, and with the very large proportion of inter-change traffick, complicated arrangements of joint lines, running powers, etc., the compilation of ton-mileage statistics is not such a simple matter as it is in those countries.

It has been said that the 'terminals' invalidate the use of ton-mile statistics although they naturally do not affect to any great extent passenger-mileage. The same amount is added to the rate on account of terminals, whether a consignment is sent six miles or sixty miles, and therefore instead of the rate varying directly with the distance, it is affected by the inclusion of a constant.

Acworth says 'collection and delivery is not only expensive, but it is equally expensive whether goods are carried on the railway for ten miles or five hundred miles. The same may be said of terminal service and accommodation when the goods reach and leave the railway line. Sorting weighing, invoicing, loading, unloading, checking etc. have to be performed and paid for'. Before the war the companies reckoned that terminal service including collection and delivery, cost, on the average, 8/6 in London and 4/- in the provinces. Now suppose two separate tons of similar goods are leaving London, one ton for a place to which the rate is 15/- and the other for a place to which the rate is 30/-

Rate - terminals = Haulage cost.

i. 15/- - 8/6 plus 4/- = 2/6.

ii. 30/- - 8/6 plus 4/- = 17/6.

If the shorter distance is 60 miles then the longer distance for which the haulage cost is seven times greater is probably nine times further, i.e. 540 miles.

The average cost per ton-mile is likely to be seriously affected by the fact that 540 ton-miles

cost 30/- yet 60 ton-miles cost half as much i.e. 15/-. Again foreign received or foreign forwarded traffic only pays one terminal to one company and 'through - through' traffic none at all.

Consider a consignment of 1 ton carried 100 miles and 10 separate consignments each carried 10 miles. If the terminals are 4/- at each end, the former will be charged with 8/- for 100 ton-miles, and the latter 80/- for an equal ton-mileage.

The safeguard in this case lies in the stability of the average haul. The average distance all the consignments are carried varies very little from year to year, and the proportion of the terminals charged to long and short distance traffic is therefore practically constant.

It would be even better perhaps to deduct the total amount of terminals (for such figure should be obtainable) from the total receipts. If this figure is then divided by the ton-mileage, the absolute receipt for haulage only would be obtained. Some people, however, object to the figure of the total ton-mileage on the grounds that it cannot be obtained with sufficient exactitude. In calculating

ton-miles small fractions of tons and miles are disregarded. These fractions, they say, would amount to a considerable figure during the year and therefore the official ton-mileage is much less than the actual ton-mileage. In addition, inaccuracy may result from the wrong routing of a few score passengers or a few hundred tons.

The effect of these inaccuracies upon the yearly figure, however, is really negligible, a fact which can easily be proved by an example. During the eleven months ending 30th November 1925, all the Standard Gauge Railways of Great Britain together earned in freight train receipts (less cost of collection and delivery) £97,903,904, and for the same period their ton-miles amounted to 16,550,879,305. (This last figure is of the net ton-miles excluding free-hauled). Let us convert the money to pence and then divide this figure by the ton-mileage in order to obtain the freight receipts per ton-mile. The number of pence is 23,496,936,960. and the desired quotient is, correct to two places of decimals, 1.42d. The railways themselves only calculate to two places of decimals, and indeed it would be absurd to go further.

Now it will be found that an error, or accumulation of errors, amounting to 1000 ton-miles will only affect the eighth decimal place, or if it is wished to be a little more generous in the allowance for inaccuracies, an error of 10,000 ton-miles will only affect the seventh decimal figure of the result. The argument, therefore, that ton-mileage cannot be reliable on account of discrepancies that must occur by reason of inaccuracies in calculating distances and amounts, wrong routing, and clerical errors, has not much force. In case it may be thought that too long a period and consequently, too large amounts have been instanced, the figures for the Great Western Railway during the month of November 1924 may be used. These will give much the same result.

Freight Train Receipts (less C & D)	£1,426,057.
" " " (in pence)	342,253,680.
Net ton-miles (not free-hauled)	257,378,596.
Receipts per ton-mile	1.33d.

An error amounting to 10,000 ton-miles would affect only the fifth place of decimals in the figure for receipts per ton-mile.

But the question naturally arises: What is the use of a statistic which is not exact within tens of thousands? Well, the degree of accuracy is known, and in all properly used statistics it is taken into account. The published receipts themselves are not absolutely accurate since there are many settlements, over-charges and under-charges, adjusted in subsequent months or years, and in fact train-miles themselves do not represent the exact distance run by the trains. On the whole the figures overstated or understated in the total ton-mileage tend to cancel each other. Any very extraordinary and unaccountable difference in the final figure would be obvious to a railway manager and would lead to investigation. Another factor, which is ignored by, and is said to militate against the usefulness of, the ton-mile unit, is the question of the cubic capacity of wagon stock. Ton-mileage takes into account only the weight hauled, and is not a satisfactory guide to the efficiency of train loading or, rather, it is not a satisfactory factor in estimating the cost of carriage. We will cite the well-known example and imagine two trains, one consisting of trucks full of coal, the other of trucks full of furniture.

In the former case, each truck can be loaded to its fullest capacity, while in the latter case, each truck may be full and yet run with a light load. It may be said that where the trucks have light loads, extra trucks may be added to the train, so that the engine would still have its maximum load. A fair test of this train load is obtained by the 'traction ton-mile' statistic about which more will be said later. The fact remains, however, that an engine hauling its maximum load in trucks running with light loads, is hauling too great a proportion of dead weight, i.e. the non-productive weight (or "tare") of the wagons themselves. Of course in such a case the freight (e.g. furniture) pays a higher rate than freight which loads to the maximum but that does not negative the fact that the trucks are running 'light'.

Ton-mileage, then ignores this important factor of railway working and cannot be considered an entirely satisfactory unit of work.

At the same time it must be remembered, that the use of ton-mileage statistics directs attention to the better loading of wagons, for the figures for the average starting loads, the average loads

of wagons and the average loads of trains are all based on ton-mileage. The returns in use before 1921 took no account of the length of the journey which each wagon was to go, and consequently the loading of each wagon was of equal importance, whether it had to run 200 miles or 10 miles. But it is obvious that light loading for a long distance is a greater fault than light loading for a short distance. In this respect, however, a charge has been brought against ton-mile statistics that their use leads to an undue concentration of attention upon the securing of heavy loads to the detriment of public convenience. Instances were quoted before the Committee of traffic being delayed for the purpose of getting full loads with a view to the production of a higher figure for the average load. This tendency can be checked by the employment of a very useful statistic called 'ton-miles per engine-hour' which prevents a too exclusive reliance from being placed upon the train load figure as a measure of efficiency.

It is now time to mention the other statistics belonging to the ton-mile groups.

The Average Load.

The term average load covers four different units, viz:-

- (1) The average train-load of goods.
- (2) The average train-load of passengers.
- (3) The average wagon-load of goods.
- (4) The average coach-load of passengers.

All these are obtained from the basic units by the elimination of the factor of distance.

The methods of ascertaining these figures are as follows :-

- (1) Divide the ton-mileage by the goods-train-mileage.
- (2) Divide the passenger-mileage by the passenger-train-mileage.
- (3) Divide the ton-mileage by the goods-wagon-mileage.
- (4) Divide the passenger-mileage by the passenger-coach-mileage.

The importance of the figure for the average train load i.e. the average number of tons of paying freight carried by goods trains has been emphasized above. It remains to add, that this figure can only be obtained by means of the ton-mile figure, and so renders the compilation of this

latter statistic almost indispensable. The same remarks naturally apply to the average wagon-load unit. Both aim at ensuring a profitable use of rolling stock. A certain proportion of non-productive dead weight has always to be carried so that full loading is essential in order to lower the proportion of the former. A wagon of ten tons tare, running about with a load of two tons is a loss to the company except under very special circumstances. This effort to increase the proportion of paying freight has led to the introduction, especially in America of high capacity wagons. Some railway managers have placed almost exclusive reliance on the starting-load of a train, a figure which can naturally be obtained without the aid of ton-mile statistics. But this figure will not furnish a true average train-load since it has the defect of ignoring the distance factor. A train may start full, but finish a journey 'light' and this would not be revealed by starting-load figures. The object of the average train-load is to betray unproductive light running.

The Average length of Haul.

- (a) For goods.
- (b) for passengers.

This figure is generally called 'the average lead', and is obtained by dividing the passenger-mileage by the number of passengers and the ton-mileage by the number of tons. It is one of the most important units of the ton-mile group, for the distance traffic is carried has a very serious bearing on the question of cost. As pointed out above it costs considerably less to carry 1 ton 100 miles than it does to carry 10 tons 10 miles, although the amount of work done, 100 ~~mi~~ ton-miles, appears to be the same. The difference in the cost is due to the terminals, expenses which are incurred for each ton whether it is hauled 10 miles or a 100 miles. The cost per ton per mile is, therefore, progressively less as the distance increases.

This fact was borne in mind by the Departmental Committee of the Board of Trade as the following extract from their report shows:-

'A more just comparison of the level of the rates in this country and the U.S.A., would be rendered practicable if it were possible to produce actual figures to show the average haul in this country, i.e. the average length of journey which each ton of goods is carried. If, as is probable, the average haul of goods in this country, were found to be at most one fifth or one-quarter of the average haul in the U.S.A. it would follow that a comparison of the average rates charges in the two countries would not be fair without taking into account the fact that the terminals charged in this country are a far larger proportion of the total rate than in the U.S.A'.

The average lead will often furnish the explanation of fluctuations in other units. Decreased receipts per passenger or per ton of freight need not necessarily be due to an increase in the lower rated traffic, but may be a direct outcome of a reduced length of haul. I am of the opinion that the knowledge of the average haul for certain commodities which are carried in full train loads, such as coal, would be extremely useful.

The Average Receipts.

(a) per ton per mile.

(b) per passenger per mile.

This figure is supposed to be of great importance in the construction of rates and fares, but of that more will be said anon. It is certainly complementary to the previous unit. A decrease in average receipts generally corresponds to a reduced average haul, and vice versa, although this may also be brought about by an increase in traffic at reduced fares or lower rates which has the effect of lowering the general average.

The Average Density of Traffic.

(a) per mile of road.

(b) per mile of track.

The basis of this figure is the ton-mile. The actual figure is obtained by dividing ton-mileage by the route-miles in the case of goods, and the passenger-miles by the route-miles in case of passenger traffic. It is intended to give a true indication of the amount of traffic passing over the road, but, personally, I am not at all satisfied with this figure. In one section over which heavy

traffic runs, the tonnage during a certain period may be heavy and yet the number of trains passing may be small. Yet in another section where the traffic consists of light goods, the tonnage may be smaller, although the 'density' of train movement is at its maximum. The efficiency of any section of the line is best judged by the number of trains passing over it, ^{always} ~~although~~ assuming, of course, that those trains are running with heavy loads. Thus the average density of traffic as defined above is of little value since the means of supervising the loading of trains is provided by other statistics.

Traction Ton-mile.

This unit provides a means for measuring the effective power supplied to a train, but that is not where its importance lies. By measuring the effective power supplied, i.e. the traction ton-miles (T.T.M.), against the work done which is the gross-ton-miles^{*} actually hauled, a figure is produced

* The gross ton-mileage indicated the weight of the merchandise in the wagons added to the weight (or "tare") of the wagons themselves. It is the measure of all the work of actual haulage performed by the locomotives.

which represents the degree of efficiency obtained. The traction-ton-mile is one of the best units in existence for the direct measure of efficiency in operation and enables a check to be exercised on the productive work accomplished by the locomotives. In this respect it is decidedly superior to the wagon-mile which takes no account of the class of vehicle, the weight, or the load. Nevertheless the chief aim of the wagon-mile is to enable a supervision to be kept over the effective user of rolling stock so that the percentage of unproductive user (i.e. empty mileage) to productive user (i.e. loaded mileage) shall be as low as possible. For this purpose the record of wagon-miles has to be kept in two parts, viz:-

- (a) loaded wagon-miles and
- (b) empty wagon-miles.

The figures obtained are often used in conjunction with the traction ton-miles and provide a check upon them, for any train may be running with 100 per cent traction ton-mileage and yet consist of empty wagons.

If the percentage of the gross ton-mileage to the capacity T.T. M. be found for each train per section of the line, then the percentage of the available power utilised on each section during any period is obtainable.

Enough has now been said about the ton-mile unit and its derivative statistics to indicate the advantages and the chief disadvantages of employing them. It has been stated that the ton-mile figure is in itself but a means to an end, and that it serves principally as a basis for many other units in conjunction with which it should be used. Considered in this light there seems little doubt that ton-mile figures are well worth their cost of preparation. The statistics of the 'ton-mile group' would seem to be of immense value to their users in the supervision and control of railway traffic. It was suggested in the 'Introduction' that statistics could be of assistance in at least two ways, viz:-

- (1) They should be of use to railway superintendents in their efforts to economise in the costs of railway working.

(2) They should form a basis from which railway rates should be systematically calculated.

The ton-mile group certainly seems to comply with the first object. Their use in regard to the second point will be discussed in a later section.

However, we have already established their worth, so that it will now be instructive to see which statistics of this group are at present published in England.

Those that are published are contained in the monthly copies of 'Railway Statistics - Great Britain', issued by the Ministry of Transport.

Table I shows the aggregate figures for the year to date together with the absolute and percentage increase or decrease compared with the corresponding period of the previous year. In this table are figures for the Net Ton-Miles (excluding free-hauled) set out under the three heads of :-

- i. General merchandise (including live-stock).
- ii. Coal, coke, and patent fuel.
- iii. Other minerals.

The following averages are also set out:-

Average train-load (Tons).

Average wagon-load (Tons).

Net ton-miles per -

Train-engine-hour.

Shunting-hour.

Total-engine-hour.

This latter item is a further example of the numerous combinations of statistics that are obtainable from ton-mile figures.

Table I. 4. gives the summary figures for the month to which the issue relates, and contains the following items relevant to our present topic.

Net ton-miles (excluding free-hauled).

Net ton-miles (free-hauled).

Receipts per ton-miles (less cost of collection and delivery).

Average train load (tons).

Average wagon load (Tons).

Net ton-miles per

Train engine hour.

Shunting hour.

Total engine hour.

Net ton-miles per route mile per working day.

In addition, full statistics are given concerning loaded and empty wagon-miles.

In addition, full statistics are given concerning loaded and empty wagon-miles. The list given above compares favourably with the various statistics discussed in this section. There is one addition I should like to see made because I consider the additional information thus afforded would increase enormously the value of the statistics. The freight ton-miles should be sub-divided to show the extent of traffic in the different classes, thus obtaining "commodity" ton-miles. An elementary classification is already in force, for the net ton-miles are set out under the three heads mentioned above, i.e.

- i. General merchandise (including live-stock).
- ii. Coal, coke and patent fuel.
- iii. Other minerals.

But I should prefer the classification to go much further and include the ton-miles for each important commodity. The average haul and the average ^{receipt} per ton per mile of each commodity or group of commodities in the classification would then be ascertainable.

In Table II, the tons, receipts, and receipts per ton in respect of seventy two principal commodities

by freight trains are already given. I contend that the value of these figures would be considerably enhanced, in fact, more than doubled, by the addition of the suggestions I have made above. The tons of a commodity form only one factor contributing to its importance to a railway. The distances which the tons travel are almost equally important and ton-miles would give both. Again 'the receipts per ton' figure conveys nothing to a mind that does not know the average haul. If the average haul and the average receipts per ton per mile were given the difficulty would be immediately solved.

The same remarks apply, with, perhaps even more emphasis to the case of passenger statistics for passenger-miles are only required periodically and consequently are rarely published. The number of passenger journeys and the receipts per passenger journey are given, and these figures are sub-divided into first, second, and third classes, excursion and week-end and workmen's etc. But again this information is of comparatively little value, when the distance each passenger travels, or, at least, the average distance travelled by all passengers is unknown.

There is still room for great improvement in this direction.

SECTION 5.

GENERAL REVIEW.

The various statistics and returns that are published have now been described and explained. The next step is to examine and criticise them as a whole with a view to obtaining answers to questions such as the following:- Do they form a complete and lucid record or analysis of railway working? Do they indicate the cost of doing the work and the directions in which it is possible to reduce such cost without reducing efficiency? Do they present a clear statement of the general physical condition of the property? Do they indicate directions in which it is possible to foster traffic? etc. etc.

Such questions will best be answered by a methodical examination, interspersed with criticism and suggestions, of the available accounts and statistics. As the construction and equipment of a railway naturally precedes the working of it, we will examine the accounts connected with the railway capital expenditure first. It is essential that proper records should be kept of the money raised for,

and the expenditure involved in constructing and preparing the railway to earn revenue and in making any subsequent additions. As regards the nominal capital and capital created and raised, it was shown in a previous section that the information is complete. If the items of capital expenditure in connection with railways are analysed, it will be seen that they fall under the following heads:-

- (1) Land and Compensation.
- (2) Law charges and Parliamentary Expenses.
- (3) Construction of Permanent Way, Works and Stations.
- (4) Equipment (Engines and Rolling Stock).
- (5) General Buildings (Workshops).
- (6) Works, etc., not directly connected with railway working.

The English returns conform on the whole to this division of expenditure. It is convenient that they do so, for the above heads also give the key to the maintenance expenses in which the railways are involved.

There is room for improvement in Statement No.4. (Receipts and Expenditure on Capital Account) of the annual returns, on the lines of No.5. (Details of Capital Expenditure for the year to which the return relates).

In No.4. heads (1). (2) and (3) mentioned above, are given in one figure, a fact which is to be deplored. Again, "Rolling Stock" is given in one lump sum instead of several sums relating to its natural divisions, e.g. Locomotives,

Coaching Vehicles,

Wagons, etc.

I should imagine however, that unless the railways have prepared such figures for their private use, it would be impossible now to effect such a division of expenditure.

Only a part of head (5) (General Buildings) appears upon the account viz:- Manufacturing and repairing works and plant:-

Land and buildings

Plant and machinery.

Head (6) (Extraneous Expenditure) is given in sufficient detail.

While engaged upon the subject of capital expenditure, it will be convenient to examine the statistics of the physical condition of the property and equipment and to see whether the accounts and statistics are complementary or not.

Head (1) (Land and Compensation). No statistics are given. Details of the land owned by the companies, divided into sections giving cost and dimensions

together with average cost would be useful.

(Head 2) (Law charges etc). No statistics are given. They are scarcely necessary.

Head (3) (Permanent Way, etc). There is a mileage statement showing separately the mileage of single, double, treble and quadruple track, and of sidings, also the equivalents in single track mileage for each section of the line. This is all the information rendered under this head but of course much more could be demanded, e.g. information concerning the pumping plant, coaling plant, signalling appliances, telegraph lines and instruments, etc. The difficulty is where to draw the line, but at least two more returns under this head should be required. They would be

- i. Stations and similar buildings used for railway purposes.

Classified under size and purpose, giving cost. Also particulars for each section.

- ii. Bridges - dimensions and cost on each section.

Head (4) (Equipment).

Separate statements are devoted to each class of rolling stock, but these statements are by no means exhaustive. Particularly is this so in the case of

the return concerning steam locomotives where merely the description by wheel type and the number of each class is given. This description by means of wheel types appears to be a very childish classification of engines. The chief thing is to know their tractive power and average weight. This information may be conveyed to the mind of a practical railwayman by means of the 'wheel type' classification. I should doubt it, however. In any case these published reports, are intended as much, if not more, for the general public than for practical railwaymen. To them this description must mean nothing. The tractive power and the purpose of the engine should determine the type, and then according to type, the number, average weight and average cost per locomotive should be given. Another useful figure which could be added with advantage to this return is the 'Life between general repairs for each type of engine'. This is an important figure, for a 'general repair' may mean the loss of a month or more of revenue - earning work. A record could be kept of each engine:

'Date entered service' -

'Date ceased work', -

'Miles run between general repairs' -

From these figures the average life between general repairs, in miles, could be easily calculated.

The returns relating to coaching vehicles and goods and mineral wagons could also be improved. Two suggestions are offered here. The average tare of the vehicles if given would be helpful for comparative purposes with other statistics. Efforts to decrease the proportion of tare to capacity in new rolling stock could then be better appreciated and, in fact, might even be stimulated.

A second improvement, and this applies equally to locomotives, lies in the possibility of publishing the average age and the average life of the various types of rolling stock. By this means an effective check could be kept on the condition of the rolling stock, or, at least, the figures would be of value to the owners of the railway, and would keep them informed as to the enterprise and vigilance of the management. After a few years a proportion between average age and average life would be ascertained, which, if exceeded, would show an unwise policy on the part of the management.

Head (5). No statistics are given which bear directly on the workshops, and plant belonging to the railway. Now workshops etc. are not outside undertakings of the companies, but neither can they be described as a direct part of railway working. They represent, however, an important part of the capital expenditure and so particulars of them should certainly be rendered.

The statement could give the description and cost of plant owned, together with any additions during the period covered, and details of the work done in the workshops.

Head (6). Very meagre returns are available concerning the capital expenditure on extraneous undertakings. They are probably sufficient, however, since they do not directly concern the working of the railways. The returns relating to capital expenditure have, perhaps, been rather severely criticised but the suggestions made, if adopted, would certainly enhance their value. As at present constituted, they enable one to obtain a clear view of the size and extent of the business but they do not show the condition of the various assets during the period to which they relate and that is a serious drawback.

The majority of people interested in the returns must want to know the condition of these assets, i.e. the physical condition of the railway concern as a whole. It is insufficient to know that there are so many engines and so much track, unless the numbers or proportions of those in good, medium or bad condition is also given. Statements of this nature would exercise a salutary influence in securing that there should be no long continuance of deterioration of capital assets.

Having dealt with the assets of the railways, we naturally turn to the statements concerning railway working. Statement No.8. of the annual returns shows the revenue receipts and expenditure of the whole undertaking and this shall be our base for the examination. This statement corresponds to the 'Profit and Loss Account' of an ordinary business and of course gives the net profit or loss, or, as it is called in this case, the total net income or expenditure for the period under review. It has already been described in another section. Suffice it here to say that it shows at a glance the absolute and relative profitableness of the various undertakings of the company. Its first item, 'Railway', will give us

the key to the majority of the remaining accounts and returns. Statement No.10 (Receipts and expenditure in respect of railway working) is the 'Trading Account' the balance of which, 'the gross profit', is carried to statement No.8. under the item 'Railway'. We are now confronted with the two basic features about which nearly all the statistics are concerned - railway expenditure and railway earnings. We will examine the latter first.

Railway Earnings.

The chief sources of railway income are:-

- i. The transport of passengers with their luggage.
- ii. The transport of anything else,
 - i.e. goods traffic, which can readily be sub-divided into.
 - (a) Goods.
 - (b) Minerals.
 - (c) Live stock.
- iii. Other services not directly connected with transportation.

With the latter source we are not at present concerned.

Perhaps sources i. and ii. would have been better described as 'passenger trains' and 'goods trains',

for the former, in addition to passengers, convey luggage, parcels, mails, and milk. Why is the revenue from the carriage of these goods included under 'receipts from passenger train traffic' and not added to the receipts from the conveyance of other goods under 'receipts from goods traffic' as distinct from passenger traffic? In other words, 'Why is railway income (and expenditure, as we shall see later), divided under 'passenger train traffic' and 'goods train traffic' rather than under 'passenger traffic' and 'goods traffic'? The reason lies in the fact that it is not the earnings from passengers and goods that differ - they both consist of money - but the division is based on the different quality of the services rendered by good trains and passenger trains. The latter run at higher rates of speed and the vehicles of which they are composed are usually of more costly construction than those of good trains. The Stations for passenger train traffic are more costly and expensive to maintain, and in fact both earnings and expenditure in connection with this traffic are high in comparison with those for freight train traffic.

Since the services differ so essentially it is but wise to make such a division if any idea of the relative profitableness of the two services is to be obtained.

What information can be gleaned from the statistics relating to earnings from passenger train traffic? The number of passengers carried is given monthly under the various classes together with the total receipts, average fare per passenger and the number originating on the company's system.

Passenger-mile figures and the average receipt per passenger if given monthly would increase the value of the returns manifold. Somewhat similar detail is available of the receipts from parcels and miscellaneous traffic charged at passenger train rates. Information relating to receipts from goods traffic is slightly more extensive. The tonnage originating and 'through through' tonnage, total receipts and average receipts per ton are given for each of the principal commodities. The total net ton-miles are given for the traffic as a whole.

The following are complete lists of the particulars needed concerning revenue from passengers and goods.

Passenger Revenue Statistics.

- i. Number of revenue passengers originating by classes.
- ii. Number of, and total earnings from revenue passengers carried, by classes.
- iii. Number of revenue passenger-miles, by classes.
- iv. Total parcel earnings.
- v. Total miscellaneous coaching earnings.
- vi. Total coaching earnings.
- vii. Earnings per passenger.
- viii. Earnings per passenger-mile.
- ix. Miles per passenger.

Goods Revenue Statistics.

- i. Number of tons forwarded.
- ii. Number of tons carried.
- iii. Net ton-miles.
- iv. Average haul.
- v. ~~Average~~ Total earnings from tons carried.
- vi. Other goods traffic earnings.
- vii. Total goods traffic earnings.
- viii. Earnings per ton.
- ix. Earnings per ton-mile.

It will be seen that the information afforded by the English Railways contains most of the particulars set out above.

The revenue figures should, of course, be compared with the statistics of the work done. But as the work done corresponds to the expenditure of the railways, it must be considered under its proper headings.

Railway Expenditure.

The major portion of railway expenditure is divided under five heads:

- A. Maintenance and Renewal of Way and Works.
- B. Maintenance and Renewal of Rolling Stock.
- C. Locomotive Running Expenses.
- D. Traffic Expenses.
- E. General Charges.

Thus the expenditure records are kept according to services rendered rather than by departments. But there is no attempt to separate the expenditure between "passenger" and "goods" services. Such a division would afford most valuable information to those directing the operation of a railway and would also be very "informative" to those people who are sufficiently interested in railways to read the reports. As this question possesses some inherent difficulties, however, it will be discussed separately in the next section.

Returning to the main heads of railway expenditure we may say that the first four are truly working expenses, since they vary, although not proportionately, according to the amount of traffic. The fifth, 'General Charges', may be regarded practically as a constant.

Generally speaking, in respect of the working expenses, the following information should be rendered:

- i. Details of expenditure.
- ii. Statistics of work done.
- iii. Some unit or units by which the work done may be measured.
- iv. Cost per statistical unit.

We will now see what information is actually given.

A. Maintenance and Renewal of Way and Works.

The total sums expended on the various objects that constitute the Way and Works, the quantities of the principal materials used, and the number of miles of road and of single track maintained are given. These totals are essential of course, but they convey nothing to the average mind. Certain units which best describe the work done should be decided upon and then the cost per unit should be obtained and compared with similar figures for previous years. Of course, it is possible

for the reader of the report to find these figures for himself but I think that they should be included in the report.

Suitable units for this class of expenditure would be the 'track-mile' and the 'gross-ton-mile'. The cost per track-mile of each of the above items of expenditure is obviously useful. The gross ton-mile figure represents one of the chief causes for rendering maintenance necessary so that the cost per 1000 gross ton-miles is equally useful.

Another average which is useful in stimulating efforts towards economy in working is the number of men at work on the line, etc. per mile of track. Moreover, averages should be kept for different sections of the line.

B. Maintenance and Renewal of Rolling Stock.

Similar remarks apply to this section of expenditure; totals are given but averages are absent, although they afford far more valuable information than the totals.

Furthermore although the elementary division between locomotives, passenger vehicles, and goods wagons is made, yet that is not enough. The average

expense of maintenance and renewal for each type of rolling stock would be of immense value in determining the relative value to the company of various types of vehicles. In the case of locomotives, a division should be made between locomotives used for passenger traffic and those used for goods traffic as this would admit of a better allocation of expenses to the two services.

Locomotives:-

The cost of repairs, etc. should be considered in relation to the work done. The three best figures for recording the work done by an engine are:-

- (1) engine-miles.
- (2) engine-hours.
- (3) gross-ton-miles hauled.

The average cost of maintenance and renewals per engine-hour, per engine-mile, and per 1000 gross-ton-miles (as the single unit is too small for consideration) should be calculated and shown in the statements.

Other rolling stock:-

The two most useful averages in connection with vehicle repairs are:-

- i. maintenance cost (per vehicle-mile'.
- ii. " " 'per vehicle during a given time'.

This second average is most useful when contrasted with the passenger earnings per coach, and freight earnings per wagon, during a similar period.

Statistics of the maintenance and renewal of rolling stock are given, but I am inclined to regard their value as being practically nil. The classifications are most elementary. The average number of days under repair per vehicle is not given, so that we cannot judge of the efficiency of the repair department nor can we judge of the number of revenue-earning days during which the vehicles were absent from the line.

C. Locomotive Running Expenses.

These expenses differ from traffic expenses as they are costs directly incurred by the running of locomotives. Thus they vary nearly in proportion to the amount of traffic during a given period. On the other hand, traffic expenses are expenses common to all the traffic in general and which, although they are affected by the amount of traffic in the long run, are not affected by any temporary change in that amount.

It is a great pity that the locomotive running expenses are not at least divided between "passenger

traffic" and "goods traffic". The statistics available concerning locomotive working are so detailed that it is difficult to suggest improvements. Yet the value of these statistics is reduced in some cases by the meagre information concerning the expense of engine running.

The following statistics, giving great detail in connection with engine working, are available:

Engine-mileage.	)	
Engine-hours.	)	Divided between
	)	'coaching' and
Train-miles per engine-hour.)	)	'freight'.

Wagon-miles per engine-hour

Ton-miles per engine-hour.

Number of engines in traffic.

Number of shunting miles, etc. per 100 train-miles.

Consumption of coal and lubricating oil per engine-mile (divided between coaching and freight).

On the whole, one cannot criticise such a selection of statistics.

D. Traffic Expenses.

The statistical units suitable for the purpose of controlling or measuring the internal costs of the department are few. The chief unit is the 'train-mile'

so that the figure obtained is 'traffic costs per train-mile'. Why is the train-mile unit employed when it has been shown that the ton-mile and passenger-mile are much more stable units? Generally speaking station, office, signalling and other expenses are the same whether trains run heavy or light, and as they certainly vary in the long run with the train traffic, the train-mile is evidently a more convenient unit. The ton-mile and passenger-mile units are more useful for measuring the general cost of operation.

It would also be exceedingly useful to show the proportion which the various internal costs bear to the total receipts.

The percentage would fluctuate with the amount of traffic carried but not in direct proportion. An increase in receipts will generally lower the proportionate costs. An average figure would be obtained after a few years for each item of costs and it would be the duty of the superintendent to keep his expenditure below that figure. If it were exceeded, it would show that there had been either a decrease in receipts or an increase in costs. The real cause could easily be determined.

While dealing with traffic statistics, it will be convenient to mention some unit statistics, most of which can be obtained from the reports as at

present constituted, which provide the means for measuring the efficiency of the working and which may lead to economies being effected.

The statistics concerning the working of locomotives have already been reviewed.

Wagon User.

Wagon-miles:

Loaded.

Empty.

Total.

Percentage loaded to total.

Average wagon load.

Wagon-miles per wagon-day.

Net ton-miles per wagon-day.

Percentage of goods wagons unserviceable.

Running of trains.

Train-miles per train-hour.

Train-miles per engine-hour.

'Light' engine-miles per 100 train-miles.

Loads of good trains.

Number of wagons per train:-

Loaded.

Empty.

Total.

Net ton-miles per train-mile.

Gross ton-miles per train-mile.

Density.

Goods trains per running-track mile per day.

Passenger trains per running-track mile per day.

Net ton-miles per running-track mile per day.

Passenger miles per running-track mile per day.

Not all of these figures are available but they would be very valuable if prepared for different sections of the line.

Efficiency.

Wagon-miles per engine-hour.

Passenger-coach miles per engine-hour.

Net ton-miles per engine-hour.

Gross ton-miles per engine hour.

A warning is needed concerning the first two 'efficiency' statistics. It is usual for the passenger service to take precedence over the goods service and often goods trains are delayed to allow passenger trains to pass. Such delays, although caused by the passenger service are reckoned against the goods department and are apt to spoil 'the wagon-miles per engine-hour' figure.

In regard to the question, mentioned at the beginning of this section, as to the value of statistics for indicating directions in which it is possible to foster traffic, I think that commodity statistics provide the answer . If commodity statistics, particularly commodity ton-miles, were taken out for each section of the line, the figures obtained would provide admirable indications. Commodity ton-miles have already been discussed above.

It has perhaps been noticeable that there is a certain degree of instability in all the statistical units mentioned above and in the foregoing sections This is a draw-back that must always be borne in mind when using railway statistics, for a combination of these units is apt to increase such instability. Moreover the number of statistical units employed to measure the work of a railway seems excessive but it is almost impossible to reduce their number. It is the dream of all railway managers and traffic superintendents that a unit shall be discovered which will enable them to measure accurately the work involved, and its cost, in any particular service. But such a unit, I am convinced will never be evolved. It is evident that in dealing with such a problem as this,

it is hopeless to expect scientific exactitude: one can do no more than isolate each process to the best of ones ability and select units, whether of cost or product, suitable to the work done and to the methods by which it is accomplished.

Perhaps three of the best units, since they dovetail into one another, are the following:-

- (1) Train-miles per engine-hour.
- (2) Wagon-miles per train-mile.
- (3) Ton-miles per wagon-miles.

But none of these are units which could be exactly defined.

Other Services not directly concerned with Railway Transportation.

Very little need be said about the information concerning extraneous services as they are rather beyond the scope of this paper. The receipts and expenditure for each service are given in sufficient detail but more statistics relating to the actual work done would surely be welcome.

SECTION 6.ALLOCATION OF COSTS BETWEEN PASSENGER AND GOODS TRAFFIC.

As the business of transportation falls naturally into two principal sections, passenger train traffic and freight train traffic, the first sub-division for the classification of costs is made upon these lines. The great question is: What proportion of the working expenditure is incurred in the carrying of passengers and what proportion in the transport of freight?

The aim, of course, is to go further than this and to find the actual cost of transport of each commodity. When this could be ascertained it would be known whether any particular rate was remunerative or not, or, at least which of the rates were the most remunerative. In short, it is an attempt to form a costs account, similar to those used by manufacturers. Owing to the special circumstances of railways, however, the numerous services, all slightly or widely different, which they render, such an allocation of costs to each item is almost a matter of impossibility. ✓
We will neglect this more advanced question and examine the possibility of dividing the costs between passenger and freight services, for even a division such as this would have its uses. For instance it would be useful to compare it with the average receipt and to find the relative profit of the two services.

It would also enable a manager to obtain an idea of the minimum paying train loads in this way. He could easily obtain the cost of the freight train-mile which we will say is 90 pence. If the average receipt per ton-mile were 3 pence, then each freight train would have to carry an average load of 30 tons to pay expenses. The tonnage difference between the average train load and 30 tons would represent clear profit. There are certain costs which can be definitely charged to one service or the other but in the opinion of most experts, such costs only represent about 50% of the total. Acworth said, 'The bulk of the expenditure is incurred on behalf of the traffic as a whole; only a small proportion can even be allocated so far as to say that it belongs wholly to passenger or wholly to goods; only the merest fraction can be assigned to particular groups of passengers or classes of goods; for individual passengers or single consignments of goods practically no expense is incurred at all' x

Now I beg to differ with the first part of his statement, and in fact with any of the experts who say

x Elements of Railway Economics. (Cap.V.) W.M. Acworth

that at least 50% of the costs are incapable of allocation to one of the services. We will examine the expenditure of a railway and determine which of the costs appear to be common to both services. Figures from the statement of receipts and expenditure in respect of railway working in the annual report for 1925 of the Great Western Railway Co. will serve our purpose.

A. Maintenance and Renewal of Way and Works, (£4,500,000).

Most of the expenditure is common to both services but the costs incurred in the maintenance of stations, & wagon workshops could be definitely carriage workshops, allocated, i.e., £4,000,000 is general, while £500,000 (a low figure) is capable of allocation.

B. Maintenance and Renewal of Rolling Stock.

This expenditure is divided between locomotives, carriages, and wagons. The cost of repairing locomotives could be fairly accurately divided between freight-train locomotives and passenger train locomotives so that the whole of this expenditure £4,250,000 is capable of allocation.

C. Locomotive running expenses.

About 93% of this expenditure could be definitely

charged either to passenger train engines or freight train engines, i.e., £6,000,000 out of a total of £6,500,000.

D. Traffic expenses.

A large part of this expense can be assigned to one service or the other. To determine the proportion we will examine it in detail.

Traffic Expenses.

<u>Item.</u>	<u>Unassignable.</u>	<u>Assignable.</u>
Salaries and Wages:-		
Superintendence	£630,000.	
Station Masters & Clerks		£1,430,000.
Signal Men and Gatemen	£940,000.	
Ticket collectors & porters		£2,350,000.
Guards		£ 860,000.
Fuel, Light, Water, General Stores Stores	£280,000.	
Clothing		£ 90,000.
Printing, Advertising, Tickets		£ 260,000.
Wagon Covers, etc.		£ 90,000.
Expenses of Joint Stations, etc.	£ 3,000.	
Cleansing and Lubricating and lighting of vehicles		£ 350,000.
Shunting expenses	£790,000.	
Working of Hoists, Cranes		£ 110,000.
Railway Clearing House	£120,000.	
Miscellaneous	£ 50,000.	
Totals (About)	<u>£2,810,000.</u>	<u>£5,540,000.</u>

E. General Charges.

The rest of the expenditure is common to both services. It totals about £2,600,000. We will now collect all the amounts assignable and unassignable together.

	<u>Unassignable.</u>	<u>Assignable.</u>
	£	£
Maintenance & Renewal:		
Way and Works	4,000,000	500,000
Rolling Stock		4,250,000
Locomotive Running Expenses	500,000	6,000,000
Traffic Expenses	2,800,000	5,540,000
General Expenses	2,600,000	
Totals	<u>£9,900,000</u>	<u>£16,290,000</u>

Thus we can conclude that about 63% of the expenses can be clearly ear-marked to one service or another. I believe that with the help of expert accountants and statisticians this figure could be greatly increased. But the question arises, how is the other 37% to be allocated? Several methods have been suggested and are in use at the present moment on various railways, but they are all dependent, wholly or in part, on some arbitrary foundation, so that the result cannot be an exact figure. In fact it is practically impossible to divide these general expenses accurately.

A common basis for apportioning these unidentified costs is to divide ~~it~~^{them} between the coaching and freight services in the proportion that the coaching and freight train-mileage bear to each other. In other cases the gross ton-mileage has been used as a basis for the apportionment. The French method is slightly more complicated, for it is based upon the reduction of the whole of the traffic to 'equivalent' ton-miles. It is assumed that the carriage of one passenger costs as much as the carriage of one ton of freight. From this assumption the passenger-miles are reduced to ton-miles. Other coaching traffic is dealt with in a similar manner, and so the total ton-mileage is found. The total expenditure divided by the aggregate ton-mileage, gives the cost of the 'ton-mile'. If this is multiplied by the freight ton-miles and the equivalent passenger ton-miles, then the total costs attributable to passenger and freight traffic respectively, are obtained. A method used in America was described by J. C. Lawrence, a member of the Washington Railway Commission in 1910 as follows:-

'Assume that the cost of movement of two average empty freight cars equals the cost of movement of one average loaded freight car, and of two average loaded freight cars equals the cost of movement of one average passenger car. Then reduce the freight car-mileage to the basis of the movement of a passenger car and compare the mileage thus obtained with the passenger car-mileage'. This method seems even more arbitrary than the others.

I have thought out a method which appears to me to possess more reason and fewer arbitrary assumptions. It would perhaps be difficult to introduce, but once the preliminary work were accomplished, it would be easy of application. This is the method:-

Determine what parts of the railway property and staff would have to be maintained if only goods traffic were obtainable. Calculate the annual cost of maintenance and of running the freight trains. Let us say this cost equals £X. Now determine what parts of the railway property and staff would have to be maintained if only passenger traffic were obtainable. Calculate the annual cost of maintenance and of running the passenger trains. Let us say this cost equals £Y. Then divide the charges

general to both traffic between freight service and passenger service as X is to Y.

The calculations suggested should be quite possible to skilled accountants and railway experts. The cost of running a train is now fairly accurate and the number of trains running annually is naturally known. Most of the permanent way ~~sh~~ould have to be maintained in either case although there may be certain sections of the line devoted entirely to one kind of traffic. In regard to the 'Works', either the passenger stations or the goods yards would be unnecessary. The traffic expenses would be reduced in either case although signalling costs would alter but little. The amount of rolling stock necessary for one service or the other could be easily ascertained. In fact either the wagons or coaches would become superfluous. It should be quite possible to determine the total costs which the one class of traffic would occasion if the other were non-existent. Then it seems quite logical that the general costs should be divided in proportion to these total costs, for shch would be the proportion in which the costs were incurred. If the total expenditure of a company in respect of railway working were £70,000,000 it may be found that an expenditure of £50,000,000 would be essential even

if there were no goods traffic. On the other hand the costs might only be £40,000,000 for the goods traffic if there were no passenger service. In this case the general charges would be divided in the proportion of 5/9ths to passenger and 4/9ths to freight traffic. This method may not be perfect but it is certainly based on sounder reasons than the instances mentioned above.

SECTION 7.STATISTICS AS A FACTOR IN RATE-FIXING.

I have no suggestions to offer in regard to the use of statistics in determining rates, as I am a firm believer in Acworth's theory and the three principles which he laid down, viz:-

1. Get traffic. The more traffic carried, the less it costs to carry. Therefore, first and foremost, get traffic.
2. Charge no rate so high as to stop the traffic from going: subject to
3. That no rate shall be so low as not to cover the additional cost incurred by the railway in dealing with the traffic to which the rate applies.

It is evident that if these principles are applied each rate is a law in itself.

Conditions that no statistics can measure are taken into account. If rates were based upon some mathematical formula and external conditions such as competition, were ignored, the railways would lose a large proportion of their traffic. Again in the case of the 'cost of service theory'; its supporters are of the opinion that the actual costs of carriage of each class of goods should be ascertained (and statistics would loom

large in this process) and then rates should be charged accordingly. It is only because the railways have been able to consider each rate separately with all the special circumstances connected with it that they have been able to build up such a vast transport service, and therefore to serve the public on the whole so cheaply. Even if it were possible to obtain an ideal formula for determining rates, it would be fatal to attempt to alter the existing rates and to introduce a new basis. The railway rates and the business and industry of the country have grown up together and the latter I am convinced could not - and would not - withstand the shocks to their delicately adjusted systems that would result from a wholesale change in the rates. Such new formula could only apply to new traffic for which rates would have to be fixed. Returning to Ackworth's three principles, quoted above, and which I maintained to be the best method for fixing rates; it would naturally follow that statistics would be employed only in the application of the third principle, i.e., in calculating the additional cost incurred by the railway in dealing

with the traffic to which the rate applies. Now, it was stated in the previous section that it is practically an impossibility to find the cost of carriage of any single commodity. We can conclude from this that statistics do not figure very prominently in rate-making.

I N C O N C L U S I O N .

IN CONCLUSION.

In conclusion I should like to quote from an article on 'Statistics of Railway Costs,' by R. L. Wedgwood in the Economic Journal for March, 1909.

'Looking at the field of railway costs as a whole, one must admit that no system of statistics can be perfect - no system can completely cover the immense variety of operations involved; and yet the problem of evolving a satisfactory system of some sort is mainly a matter of detail, of analysing individual operations, selecting for each the appropriate units of work done and cost incurred, and subsequently of combining, as far as possible the scattered elements in the order of their contribution to the final result - transportation. When the statistical results at best can be merely indications of the actual results, practical men differ and will differ to the end of time as to the point to which the statistics may profitably be carried. The decision will rest partly upon consideration of cost and partly upon consideration of the time taken to obtain the particulars required - the delay necessarily intervening between the occurrence of the events and the completion of the record; and slight differences in circumstances may well produce important divergences in the decision ultimately taken.

The point which may be well emphasized is the need of coherency in any system of statistics, if we are not to be the dupes of our own figures. It is useless to build upon cost per train-mile if the train-load is meanwhile diminishing; it is useless to put faith in the train-load if the train-miles per engine-hour are falling; it is useless even to trust to ton-miles per engine-hour and pay no consideration to cost per engine-hour. We may very well be spending on the working of more powerful engines all that we are saving by the reduction of train-miles'.

DETAILS OF STATISTICS PRODUCED IN ENGLAND
AMERICA AND INDIA.

N.B. The following pages give the railway statistics of the three countries mentioned above, in the order named. The statistics are grouped under headings which will be found to be similar in the case of each country. This arrangement facilitates a comparison. The information has been obtained from the Report of the Committee for the Revision of Statistics on Indian Railways, 1923.

E N G L A N D (Ministry of Transport).PASSENGER STATISTICS.REVENUE STATISTICS.

Number of passengers originating (Excluding season-ticket holders), under full fares, reduced fares and total :-

Showing percentage of total receipts per passenger journey under each head.

Reduced fares sub-divided under :-

Excursion and week-end!

Workmen.

Other descriptions.

NUMBER OF PASSENGER JOURNEYS.

Percentage total.

Passenger receipts.

Receipts per passenger journey, under first, second and third classes, and workman separately (excluding season-ticket holders).

SEASON TICKETS.

Receipts from tickets issued during month:

At full fares.

At reduced fares under -

Traders tickets.

Other descriptions.

Receipts under first, second and third class separately.

Parcels and miscellaneous traffic charged at passenger train rates under 20 heads showing -

Numbers.

Gross receipts.

Average per unit.

TRAIN MILES.

Loaded	-	} For week days and Sundays separately, and for total.
Empty	-	
Engine & brake	-	
Total	-	

SHUNTING MILES.

Shunting engines.	} For week day & Sundays separately, and for total.
Train engines.	
Other steam and	
electric traction.	

ENGINE MILES.

Assisting required.

Assisting not required.

Light	) For week days and
Total other miles.	} Sundays separately and for total.
(Excluding Depart- mental)	

DEPARTMENTAL ENGINE MILES.

By department	}	For week days &
(includes coaching &		Sundays separately
freight.)		and for total.

TOTAL ENGINE MILES.

Steam tender & tank engines	}	Coaching & freight separately.
Electric engines.		
Steam petrol & rail motors		
Electric motor vehicles.		

ALL TRACTION.

Coaching.

Freight.

Departmental.

Grand total.

ENGINE HOURS IN TRAFFIC.

Train hours.	}	Week days Sundays & Total.
Shunting hours.		
Other hours (excluding departmental)	}	Week days Sundays & Total.
Departmental hours.		
Total engine hours(Including departmental)	}	Total.

Steam tender & tank engines

Electric engines.

Steam petrol, etc., rail Motors.

Electric Motor vehicles.

Total engine hours (including
departmental).

Coaching.

Freight.

Departmental.

Grand Total.

AVERAGES. ETC.

Train-miles per train-hours.

Train-miles per engine-hour under Steam engines,
rail motors, electric locomotives, electric motor
vehicles and total.

Shunting miles per 100 train-miles.

Assisting required miles per 100 train-miles.

Assisting not required miles per 100 train-miles.

'Light' miles per 100 train-miles.

COAL CONSUMED.

Lbs. per engine-mile.

LUBRICATING OIL USED.

Pints per 100 engine-miles.

GOODS STATISTICS.

REVENUE STATISTICS.

Number of tons & net ton-miles of freight
traffic under, -

General merchandise (including live stock).

Coal, coke & petrol fuel.

Other minerals

Total,

showing figures for both including free-
hailed and excluding free-hauled.

AVERAGE LENGTH OF HAUL. -

Total freight train receipts - (excluding cost of
collection & delivery).

Receipts per ton.

Receipts per ton-mile of freight traffic under --

General merchandise (including live stock).

Coal, coke & patent fuel.

Other minerals.

Total,

showing average length of haul for freight,
including free-hauled and excluding free-hauled.
Ton and receipts per ton for 72 principal commod-
ities..

TRAIN MILES.

Loaded.	}	Week days & sundays separately & total.
Empty.		
Engine brake.		
Total.		

SHUNTING MILES.

Shunting miles.	}	Week days & Sundays separately & Total.
Train engines.		
Other steam & electric Traction.		
Total.		

ENGINE MILES.

Assisting required miles.	}	Week days & Sundays separately & Total
not Assisting/required miles.		
Light miles.		
Total "other" miles (ex- cluding departmental)		
Total departmental miles.		Week days & Sundays separately.
Total engine miles.		
Steam tender & tank engines.		
Electric engines.		

Steam, petrol, etc., rail motors.

Electric motor vehicles.

Total.

ENGINE HOURS IN TRAFFIC.

Train-hours.

Shunting-hours.

Other-hours.

Departmental.

} Week days & Sundays
} separately & total.
}

Engine-hours in traffic-)(including departmental).

Steam tender & tank engines.

Electric engines.

Steam, petrol, etc. rail motors.

Electric motor vehicles.

Total engine-hours.

WAGON MILES.

Loaded.

Percentage of total.

Empty.

Percentage of total.

Total.

AVERAGES ETC.

Train-miles per train-hour.

Train-miles per engine-hour under engines -

Rail motors.

Electric locomotives.

Electric motor vehicles.

Shunting miles per 100 train-miles.

Assisting required miles train-miles.

Assisting not required miles train-miles.

Light miles -

shown separately for steam, tender &
tank engines, electric locomotives, total.

Percentage { General merchandise,
 { Coal, coke, & patent fuel.

Other minerals.

of total tons and ton-miles.

Average wagon load -

General merchandise.

Coal, coke & patent fuel.

Other minerals.

Total.

AVERAGE TRAIN LOAD:

Net ton-miles per train-engine-hour
(including assisting & light).

Net ton-miles per shunting-hour (By train-engines
& shunting-engines.)

Net ton-miles per engine-hour.

Ton-miles per route-mile per working day.

WAGONS PER TRAIN.

Loaded.

Empty.

Total.

Wagon-miles per train-engine-hour.

" " " Shunting-hour"

" " " engine-hour.

Average number of miles run per wagon per week. :-

Loaded.

Empty.

Total.

Average time per day wagons were --

In transit.

Shunting, standing under, & waiting repair.

Coal consumed, steam locomotives.

Lbs. per engine mile, goods service.

Coal consumed, shunting, by shunting engine.

Lubricating oil used, steam locomotives.

Pints per 100 engine-miles goods service.

" " " " " Shunting by shunting-engines.

Steam & electric locomotives, steam & petrol rail motors
(shown separately)

(a) Average number in stock.

(b) " stock available for use.

Number per cent of stock.

- (c) Average number in use (All services)
Number per cent of stock, per cent of
average number available.
- (d) Maximum number in use (All services)
on any one day, number per cent of
stock, per cent of average number
available.
- (e) Engine-hours in traffic per day.
Per engine in stock.
" " " use.
- (f) Engine-miles per day.
Per engine in stock.
" " " use.
-

U. S. A. (Interstate Commerce Commission)PASSENGER STATISTICS.REVENUE STATISTICS.

Number of revenue passengers carried -

Commutation.

All others.

Total.

Passenger revenue -

Commutation.

All others.

Total.

Number of revenue passengers carried

one mile -

Commutation.

All others.

Total.

Revenue per passenger.

Miles per passenger.

Revenue per passenger-mile.

Revenue passengers per train.

Revenue passengers per car.

Passenger service train, revenue per train-mile.

Passenger service train, revenue per mile or road.

Passenger-miles, revenue per mile of road.

Passenger revenue per car-mile.

TRAIN MILES.

Passenger.

Mixed.

Special.

PASSENGER TRAIN MILES.

Mixed train-miles.	}	Per mile of road & per
Special train-miles.		locomotive-mile.

LOCOMOTIVE MILES.

Principal.

Helper.

Light.

Total.

under passenger, mixed train & special
separately.

Train switching.

Yard switching.

AVERAGES ETC.

Net tons of coal consumed.

Lbs. per passenger train car-mile.

Passenger train car-miles.

Passenger cars.

Sleeping, parlour & observation cars.

Dining cars.

Other passenger train cars.

Total passenger train cars.

Passenger cars per train.

Passenger train cars per train.

Average miles of road operated.

Average miles of all tracks operated.

Cars Miles:

Freight loaded.

Freight empty.

2 Caboose.

Passenger.

Sleeping, parlour & observation.

Dining.

Other passenger cars.

Total,

under mixed & special trains separately.

Car-miles per mile of road.

Cars per train under passenger & mixed, separately.

Car-miles per locomotive-mile under passenger, mixed
& special separately.

GOODS STATISTICS.REVENUE STATISTICS.

Number of tons carried:

Revenue.

Non revenue.

Total.

TON MILES.

Revenue.

Non-revenue.

Total.

Freight revenue.

Revenue per ton.

Revenue per ton-mile.

MILES HAULED.

Revenue freight.

Non-revenue freight.

All freight.

Gross ton-miles including locomotives & tenders.

Gross ton-miles excluding locomotives & tenders

Freight revenue per train-mile.

Freight revenue per mile of road.

Freight revenue per loaded car-mile.

Ton-miles revenue freight car-mile.

Ton-miles all freight car-miles.

Revenue freight originating on respondents road.

Revenue freight received from connecting carriers.

Total

Showing number of car loads & tons every
quarter under 70 commodities.

TRAIN MILES.

Ordinary.

Light.

Total.

Work service.

Freight train-miles per mile of road.

Work train-miles per mile of road.

Freight train-miles per locomotive-mile.

LOCOMOTIVE MILES.

Yard switching.

Work service.

Principal.

Helper.

Light.

Total.

Locomotive-miles, transportation per mile of road.

ENGINE HOURS.

Train-hours.

CAR MILES.

Car-miles loaded east.

" " " west.

" " " total.

" " empty east.

" " " west.

" " " total.

Car-miles loaded east.

" " " west.

" " grand total east & west.

" " caboose east.

" " " west.

" " grand total including caboose.

AVERAGES.

Train-miles per train-hour.

Net tons per loaded car.

Net tons per train.

Gross tons per train.

Net ton-miles per train-hour.

Gross ton-miles " " "

Net ton-miles per car-day.

Net ton-miles per mile of road per day.

Per cent loaded of total car-miles.

Per cent east bound of total loaded car-miles.

Per cent east bound of total car-miles.

Cars per train.

Cars-miles work service.

" " per mile of road.

Cars per train.

Loaded.

Empty.

under freight & mixed, separately.

Car-miles per car-day.

Net tons of coal consumed.

Lbs. of coal per 1000 gross ton-miles (including
Locomotive & tenders).

Average number of freight cars on line daily.

Serviceable, home.

" foreign.

" total.

Unserviceable, home.

" foreign.

" total.

Grand total serviceable & unserviceable.

Total home.

Total foreign.

Number of cars stored.

" " owned cars.

Per cent unserviceable of total cars on hire.

" " of owned cars on line.

" " cars on line of total owned cars.

ROLLING STOCK STATISTICS.

Locomotives serviceable.

Locomotives unserviceable.

Locomotives total on line daily.

Per cent unserviceable of total locomotives.

Miles per locomotive-day.

I N D I A. (Railway Board.)PASSENGER STATISTICS.REVENUE STATISTICS.

Number of revenue passenger s originating by classes.

Number of and total earnings from revenue passengers carried by classes.

Number of revenue passengers carried one mile by classes.

Total parcel earnings.

Total miscellaneous coaching earnings.

Total coaching earnings.

Earnings per passenger.

Earnings per passenger-mile.

Miles per passenger.

TRAIN MILES.

Passenger.

Mixed.

Total passenger and proportion of mixed.

SHUNTING MILES.

Shunting-engines.

Train-engines.

Total.

ENGINE MILES.

Assisting required.

Assisting not required.

Light.

Total "other".

ENGINE HOURS.

Passenger train.

Mixed train.

Shunting.

"Others."

AVERAGES, ETC.

Train-miles per train-engine-hour.

" " " engine-hour (passenger with proportion.
mixed.).

Shunting-miles per 100 train-miles.

Light engine-miles per 100 train-miles.

Net tons of coal consumed (Passenger and mixed.)

Lbs. per engine-mile.

Net pints of oil consumed.

Pints per 100 engine-miles.

GOODS STATISTICS.REVENUE STATISTICS.

Number of tons forwarded.

" " " carried.

Net ton-miles.

Average haul.

Total earnings.

Total other goods earnings.

Total goods earnings.

Earnings per ton.

Earnings per mile%.

Tons originating over home lines, whether local
or foreign.

Tons of other traffic.

Total tons carried.

Total earnings under 25 commodities.

TRAIN MILES.SHUNTING MILES.

Shunting engines.

Train engines.

ENGINE MILES.

Assisting required.

Assisting not required.

Light.

Total "Other".

Siding.

Departmental.

ENGINE HOURS.

Train.

Shunting.

Other.

Siding.

Departmental.

WAGON MILES.

Loaded.

Empty.

Total.

Percentage loaded of total.

AVERAGES, ETC.

Train-miles per train-hour.

" " " engine-hour.

Shunting engine-miles per 100 train-miles.

Light engine-miles per 100 train-miles.

Net ton-miles per loaded wagon-mile.

Net ton-miles per goods train-mile.

Gross ton-miles per goods train-mile.

Net ton-miles per shunting engine-hour.

" " " " wagon-day.

" " " " locomotive-day.

" " " " engine-hour.

Gross ton-miles per engine-hour.

Net ton-miles per running-track mile per day.

Passenger miles per running-track mile per day.

WAGONS PER TRAIN.

Loaded.

Empty.

Total.

Wagon miles per shunting engine-hour.

" " " engine-hour.

" " " wagon-day.

Net tons of coal consumed.

Lbs. " " per engine-mile.

Total pints of lubricating oil consumed.

Pints per 100 engine-miles.

WAGONS.

Number owned.

Average number on line daily.

Per cent unserviceable to average.

Number of line daily.

LOCOMOTIVES.

- (a) Average number in stock.
- (b) Average number under or awaiting repair
per cent of stock.
- (c) Average number available for use per cent
of stock.
- (d) Average number in good repair stored.
- (e) Average number in use daily on - ordinary
passenger service (including mixed.)
Special service.
Goods "
Departmental.
Shunting.

(f) Maximum number in use on any one day.

Engine-miles per passenger engine used per day.

Engine-miles per goods engine used per day.

Engine-miles per day per engine in use.

Engine-miles per day per engine in stock.
