

ALFRED WATSON MEMORIAL LECTURE

THE PLACE OF FIGURES IN INLAND TRANSPORT ADMINISTRATION

THE following is the full text of the fourth Alfred Watson Memorial Lecture which was delivered on 1 May 1950 by **Mr R. H. Wilson**, B.Com., C.A., Comptroller, British Transport Commission.

I. INTRODUCTORY

1. My aim in this paper is to consider, in general terms, how transport administration at the various levels is dependent on figure processes for its information, its controls, and ultimately for its policy, and how in their turn the figures make practicable, and even shape, the different forms of administration.

2. When I talk of figures I draw no great distinction between financial accountings, statistical analyses, costing statements, budgetary controls, and similar aids to the establishing of fact or probability. For example, the higher accounting may be regarded as substantially a form of specialized Statistics or, if you will, the statistics may be regarded in a wider sense as a form of Account. To my mind all these figure processes are inter-dependent. They must be related to each other, and the specialists in each art and discipline of numbering have all their part to play in assisting the processes of administration, whether internal management or public control, and whether at the level of the individual units or of groups of units or at the national level.

3. I should perhaps remind you that only the public system of transport is being dealt with. This excludes private coaches and lorries used for a trader's own purposes. Nor is air transport being dealt with, though much that is said might apply to it.

II. THE BASIC UNITS

Road passenger services

4. If we start at the bottom, and with the easiest and smallest unit of transport, we find the bus operator with five vehicles, or less, doing public stage-carriage work.

5. He needs no figures. Even though he is a monopolist, protected from competition by law, he still needs no figures worth the name. A few statistics about miles run and fuel consumed plus a note of gross receipts and passengers carried are the main statutory requirements. And he has few of his own. His bank pass-book shows him his position, especially if he finances his business on the hire-purchase basis, he knows each vehicle by its own number-plate, as it were, and the staff are probably all members of the family.

6. This picture may be a trifle overdrawn, but not much. Figures play little part in the current administration of his business, and virtually none in the determination of policy. The small operator takes the traffics that offer, and expands when he can.

7. However, over 90% of the regular road passenger services are carried on, not by the numerous small fry around the fringe, but by a hard core of really large units. The middle-sized operator is significantly scarce. Out of some 11½ thousand million passenger journeys—estimated from the last return, 1947/48—about 10½ were made in vehicles belonging to undertakings with 50 vehicles and upwards. The typical size of the larger bus unit varies between a few hundred and a thousand vehicles, according to the nature of the services and the geography of the area. Excluding the municipalities and London Transport, there were only 83 undertakings with fleets of 50 vehicles or more, but they owned about 25,000 buses.

8. These few score giants who, excluding London Transport and the municipalities, divide the largest part of the country between them, have greatly developed the use of figures, at any rate in one direction. Unlike the small operator, these big undertakings need elaborate controls to ensure that the gains of working on a large scale are not lost by reason of the absence of personal incentive and individual initiative. In general, however, there is no question of budgeting ahead financially, of long-term plans, of market analysis, of difficult decisions about heavy investments in fixed capital, or of close costing research; the main elaboration of the figures is in the direction of expenditure statistics, and in the control of takings route by route.

9. The form of these figure-controls is dominated by the fact that transport—every kind of transport—buys time but sells distance, the fares and charges being normally based on miles. Another vital fact is that the output is a service and not a physical product, as in most undertakings; moreover, the output cannot be stored, even for a moment. If not sold when produced, the seat-miles provided by the operator have no value. The economics of bus operation depend largely, then, on three groups of ratios: first, the rate of conversion of hours of vehicle-and-drivers time into miles; secondly, the cost per mile of fuel and maintenance; and last, but most important of all, the proportion of passengers to seats.

10. For the first group—the ratio between hours paid for and miles obtained—the more important tests are set out in Appendix A and relate the paying-mileage run (a) to the fleet licensed and (b) to the hours and money paid to the platform staff, i.e. the drivers and conductors.

11. The second group of ratios—the fuel, tyre, and maintenance statistics—are of the obvious kind and I will not dilate upon them, except to make the point that the workshops are on a comparatively small scale. They exist only for repairs and periodical overhauls; vehicles are normally purchased complete from the manufacturers.

12. The last group of ratios—the bus loadings—are expressed mainly in terms of gross receipts per bus-mile on each route. This is the figure for which all busmen inquire. Particular sections of route, however, must be separately and specially investigated, where desired, on the basis of *ad hoc* returns filled in by the platform staff, very unwillingly as a rule. Nor do these undertakings normally possess regular figure-studies of the categories of passengers carried and tickets sold, of the variations in load factor between peaks and valleys of demand and from point to point, and of the speed with which the supply of seat-miles is adjusted to the demand. Such things are still, largely, a matter of physical observation followed by personal decision.

13. It should be added, perhaps, that on many routes the takings per mile have almost doubled since the war. That is, the load factor has vastly improved, and in consequence the fares have not needed to rise in the same ratio as the expenditure. The better loading may have tried the patience of the public, with the constant queues (an admirable loading device from the operator's point of view), the standing passengers, the less frequent service, and so forth, but the public cannot have it both ways. Of all the things the public does not understand about transport, one of the most important is that a fare of a penny a mile for an adequate ten-minute service must, for the same number of travellers, be two-pence* a mile if they demand a five-minute service. Demands for early, late and off-peak services must also be reflected in the fares ultimately. In other words, not even the level of fares, let alone the profit and loss account, is a safe index of operational efficiency—a consideration which can hardly be over-stressed.

14. The area covered by each undertaking is too small, and the vehicles and routes too similar, to produce great variations in the average costs per bus-mile, except where the special congestion of a big city slows down the cost-pattern entirely; the value of a route can thus be sufficiently estimated, normally, by looking at the *gross* receipts from it. Nor, beyond the rather meagre financial accounts, is there much else in the way of figure-processes, for the general plan of campaign remains hardly more complicated than the plan of the small operator, viz. to increase remunerative mileage, to adjust the worst of the 'thin' services (subject to permission of the licensing authority) and to reduce the average cost per bus-mile.

15. In my view the figures compiled are sufficient to serve their particular purposes remarkably well. Provided the management has a good general acquaintance with the potentialities of its vehicles, the character of its men and the nature of the various routes and traffics, the big bus unit appears to be able, largely as a result of these figure controls, to operate each vehicle over each mile with a greater efficiency than the small and personally owned undertaking. No doubt the business of bus operation is relatively uncomplicated and the work itself is reduced, by the existence of the bus time-table, to a pre-determined schedule which exactly sets the pace—a factor of crucial importance. Again, the figure ratios commonly used are direct and simple and most of them can be expressed ultimately in the standard denominator of money. The fact remains that we have here an unusually good example, I think, of the way in which figures can be used to control the detail of day-to-day operations.

Road Haulage

16. Turning next to the road haulier, we find that he, also, enjoys the protection of a public licensing system. An extension of the necessary licences can be obtained only if the Licensing Authority is satisfied, after hearing evidence from established hauliers (including the railways) and from potential customers, about the need for the extra vehicles. The haulier's public obligations are less. It is only the vehicle which is licensed, not a defined or regular service, and the haulier may go where he will, carry what and when he will, and charge what he will. Nor are regular statistics required of him except in connexion with fuel rationing.

* The fare would be somewhat less than double in actual practice because certain overheads would not increase proportionately.

17. A change is taking place, of course, as the units of long-distance haulage become gradually absorbed into the British Transport Commission. About 2500 units are involved and some 40,000 vehicles, or about a quarter of the public carrying vehicles licensed at 31 December 1948.

18. The typical long-distance unit was quite small. The individual haulier tended to regard each piece of transport carried out as a separate 'job'. In general he made a separate quotation to the customer for each job, and this quotation was based more on what he thought he could get than on any study of the cost. An instinct born of long experience told him whether certain jobs at certain rates could be regarded as worth having, and this instinct also told him that the homeward journey should be regarded as costing less than the outward journey, whatever accountants might say. No doubt he was right for his own purposes, but in such circumstances figures played little part in the planning of services, fixing of revenue, or control of costs. Indeed, the control of costs depended mainly on knowing the drivers individually and on personal knowledge of each type of job and the time it should take, though the technical journals would assist the haulier by publishing periodical studies of standard operating costs for each main size and type of vehicle. The general aim of the haulier was, of course, to make each vehicle earn as much freight as possible, and to get a 'back' load at a rate which would at least cover the drivers' wages and fuel costs for the journey.

19. Mention should perhaps be made of the existence of freight-clearing houses in some of the main cities. These houses provided commercial representation in places where operators had no offices of their own, and the main function was to provide (usually on a sub-contracting basis) back-loads for vehicles returning to base. I am not aware that figure studies were ever made of the activities of these clearing houses, or of the amount of empty running eliminated, or of time saved in finding a return load, but their activities were considerable; many traders entrusted all their road haulage traffic to them to be handled by the many haulier clients of the clearing houses.

20. It is interesting to speculate upon the reasons for the failure of road haulage to develop the well-organized and dominating units which characterize public bus-transport. One of the main factors, perhaps, is the absence of the regular time-table service and the fixed charge. Without these, there is insufficient basis for the type of figure-control so effectively used, in large-scale bus operation, as a substitute for control by continuous personal observation, and, since there are limits to the area that can be covered by physical supervision, the haulage unit usually remained small.

21. With the coming of organization on a large scale, accompanied by definite schedules of service at definite tariffs and by a drive to eliminate empty running and other waste, this freedom from statistics and figures of all kinds must, I fear, disappear.

Railways

22. When we pass to railways, the figure-control of motive-power is much the same as for the bus, though the locomotive is a much larger and costlier prime-mover than the bus, and more emphasis must therefore be laid on the use of the locomotive's time. However, the governing ratio is still the distance run divided by the hours of men and machines, for each main type of service, as will be seen from the summary in Appendix B. The total train-miles run (i.e. engine-miles

run with passenger or freight trains attached) by the 20,000 locomotives and 2000 rail-motors on British Railways are now of the order of 380 million a year, and the wages and salary cost was over £50 million in 1948. However, these enormous totals are merely an aggregation of the operating figures which emerge district by district. The sixty odd districts are each of manageable size, and it is the district figures which are used for the purpose of detailed local control, on the spot, by the superintendents of the districts. The conditions from district to district vary much more than in normal bus operation, and it is the trend within a given district, not the absolute size of the figures, which affords the plainest clue to what is happening.

23. In the world of railways, unlike the bus world, the measurement of work done is complicated by variations in the weight and length of the trains behind the prime-mover, especially freight trains. To deal with the changes in train-size, and indeed to enable the freight trains to be marshalled at all in economical fashion, figures of the kind shown in Appendix B are required about the work of the 40,000 passenger coaches and 1.1 million wagons. The way in which these figures are used at all levels is of great interest and importance, but a subject so complicated cannot be encompassed in this lecture. For those who would like to pursue the matter a little further, a brief outline appears in Appendix C. Obviously, many interesting ratios can be derived from the basic figures, but the best single over-all indication of efficient operation is probably the net ton-miles per engine-hour—the raw material being engine-hours and the ultimate product, for which the railways are paid, being weight and distance moved. Incidentally, measured on this basis the present performance is at least one-fifth better than in 1938.

24. Fuel is an important item on the railways, and it is carefully checked by statistical records and investigations of various kinds, local and general. Consumption is usually expressed in weight of coal, etc., per engine-mile, but if this average figure is the only one available it hides too many variable factors, such as quality of fuel and size and speed of trains, to be the almost automatic form of control which exists in road transport.

25. The railway workshops are very large and the maintenance bill very heavy, partly because the assets are so long-lived. Also, the railways manufacture considerable parts of their own capital equipment. The control of the workshops is therefore of great importance, and figure processes of many kinds must be called in to assist, though there is little to distinguish railway workshops in this respect, perhaps, from other large repair establishments. There is the same attempt, and the same partial failure, to find common units in which to measure performance; the same setting of time schedules where possible; the same move towards fixing standards of pre-determined and agreed costs, for each shop or section, in terms which exclude the effect of disturbances or variations beyond the control of that particular workshop or section (e.g. fluctuations in the price of materials used); the same forms of detailed costings; and the same statistical research into production incentives and into production lay-out and methods generally. But however valuable these figure processes may be, efficiency in the workshop will still depend mainly on successful local supervision and on other such imponderables, which may well be lost when the unit of workshop organization becomes too big.

26. The railways have heavy track and terminal activities. No matter how prompt the figures, a given portion of track cannot be temporarily 'de-licensed'

like a road vehicle, but careful figure-controls are great aids to reducing the cost of track maintenance, since it can be standardized, localized, and measured in units of length, grade and work involved. Expenditures at terminals and marshalling yards are more like workshop costs in that it is difficult to find a satisfactory unit of measurement by which they can be controlled. However, detailed statistics exist which show, for example, the number of tons of goods handled per man-hour and the cost per ton at each point, or the number of wagons shunted per engine-hour, and close records are kept of the maintenance expenditure in money on stations and workshops. In total, the cost of the terminal and marshalling services really represents, of course, the price paid for the high economy of the long train once it is in motion over a fair distance at good speeds with a reasonable load.

27. When to all the foregoing heads of expenditure are added the general expenses, we have a complete picture of the railway expenditure in money. To these accounts must be added the voluminous records connected with stores, debtors, and assets generally, both in money and in quantities. All these financial and statistical records, which are both detailed and elaborate, are intended to culminate in a prescribed form of Annual Accounts which was something of a *tour de force* when it was evolved many years ago. Though this standard form has proved most useful for comparing and collating the results of the individual companies, evil can come out of good; and the statutory requirements may have acted like a strait jacket, restricting the natural growth and development of railway financial accounting. At all events, the financial records may conceivably play a more active role in the internal administrations of the future.

28. The process of *ad hoc* investigation into particular questions, as contrasted with the process of regular financial reporting, plays a large part in railway administration. The technique of sampling is also highly developed, and can be a great saver of time and cost, though with modern tabulating and counting machines this is no longer so true as it was. Much information, such as staff statistics, can now be made to flow naturally from the normal day's work, and will thereby cost little or nothing more, and prove more accurate. Nevertheless, there will always remain, especially in the railway world, a considerable field where the special and difficult techniques of *ad hoc* statistical investigation are appropriate.

29. Mention must be made of some of the processes of general budgetary control, which are of necessity highly developed, if only because mistakes of planning result in far greater damage, and are much less easily adjusted, than in the world of road transport. For example, there is usually a forecast of the traffic receipts week by week for the year ahead, and of the total expenditures month by month; these forecasts are based on traffics expected and on the train-miles planned in consequence, plus the programmes intended for maintenance, and it is extraordinary how accurate the forecasts can be as a result of long experience of the sources of error. Then there are the programmes of capital expenditure, which are costed in great detail to ascertain not only the total cost but also the probable economic result of the expenditure.

30. It will be observed that none of the regular figure processes described in the foregoing paragraphs will provide information about the relative profitability of rail transport in different areas. To divide the earnings and costs between the parts of any system much further figuring is required. The railway statistics of gross earnings are devised to show, not the takings of each route, but the facts

about the total traffic load on the network as a whole—its points of origin, its composition, the length of haul, the size of consignments, the time of transit, the terminal delay to wagons, and so forth, culminating in the receipts per passenger-train-mile, per passenger-mile, and per originating passenger by categories of ticket (ordinary, workmen, seasons, etc.), and per ton-mile in each main classification of freight. This is a quite different approach from the busman's. The railwayman has been influenced by the facts that the network of line is fixed, that 'all is traffic that comes to it', that the train timetables (at least for passengers) are highly complicated affairs which cannot be readily adjusted to loadings for reasons connected with the customer as well as for reasons of internal operation, and that the tradition of 'maintaining the service' has been enforced by a hundred years of public watchfulness. There is 'balanced operating' to consider, and also the matter of 'through-running'. Loadings which seem uneconomic in one district may yet, when joined with similar loadings from other districts, produce a highly paying traffic on a main route elsewhere. The local sector of line therefore contributes to the total profitability of the whole line, even though the local sector, if separately accounted for, would show a loss by reason of its poor loadings. It is significant, in this connexion, that even before the war some 75 % of the main line company takings were subject to wide pooling arrangements of various kinds.

31. In order to localize the relative expenditures, the running and maintenance costs of the ubiquitous wagons and passenger coaches would have to be charged to each separate part of the system on some arbitrary formula based on user, and many other internal adjustments would also be necessary. But would such processes have been worth while? In the past the railwayman tended to avoid any regular subdivision of money costs between the lines or districts of his own particular system. He was prevented by statute from varying his charges to the public in conformity with local variations in cost; and the penalties in money and hostile agitation involved in closing an unremunerative line are very great. What he needed was the best and quickest operational statistics, district by district, and not an academic and theoretical financial comparison between revenues and costs in each area. There was also the problem of 'contributory value' as explained above. Whether in today's conditions these localizations of net revenues or net deficits are equally irrelevant is a matter to be touched on later.

32. It is also impossible to compare localized total expenditures with some unit of localized total output because, unfortunately, the unit of total output does not exist. Ton-miles and passenger-miles cannot really be added together (though some countries do so without turning a hair). The types of ton-miles vary vastly among themselves, and the average length of haul enters into the equation. A ton-mile of general merchandise may be the equivalent, in terms of work entailed, of several ton-miles of coal. Or it may not. So there can be no total of standard output with which the total expenditure in money, or some particular section of staff, can be compared.

33. This upsets the public, and even some economists, who think it ought to be possible to summarize a whole world in one statistical ratio. However, for those who will look carefully at the many different and sometimes conflicting indices which actually exist and are published, there is available a mine of information unequalled for any other large industry, public or private, in the United Kingdom.

34. The figures exist because, as already implied, a modern railway could not be operated without them. But they exist also for two other main reasons. First, even the smallest of railways, when it was built, had heavy capital outlays to finance; the iron road had to be made and the rolling stock was expensive and had a relatively long life; a big capital was therefore required and joint stock ownership was the rule, with all its consequences in the sphere of control. Secondly, the railway could not be built without parliamentary powers and Parliament took care, when granting the monopoly, to see that there was some form of public accountability. At least it must be allowed to the age of political liberalism that, where large-scale or monopolistic power was tolerated for certain purposes, it was controlled with all the figure processes available. The railways were not even born free, and everywhere still heavier chains were slowly and effectively loaded upon them. There are the controls over safety and adequacy of service, the onerous legal obligations and discriminations, the prohibition of undue preference, the compulsory concessions in charges, and so forth; there are the published accounts and operating statistics referred to above, and the periodical inquests into costs and efficiency; and the charges made to the public are, of course, under rigid control by the independent Tribunal set up for the purpose—a central one, be it noted, and not a series of local ones. I stress this matter, not by way of objection, but because it is all too little realized, and because of the irony inherent in the fact that the controls became heaviest and most paralysing just at an epoch when the monopoly was about to disappear and a new and unfettered competitor was coming on the scene. The 20,000 route-miles of railway are now largely paralleled by road services, though the 180,000 miles of road are not, of course, paralleled by railway; nor do the road passenger services compete among themselves to any marked degree so far as stage-carriage or express services are concerned.

Canals

35. Of the canals there is little to say, except that most canal undertakings are owners of the waterway rather than operators of craft, the two functions being thus distinct. On the canal-owning side, which corresponds with the track of the railway, as it were, there has never been much in the shape of figures to assist the administrations which, with a few notable exceptions like the Manchester Ship Canal, were local, small and unprogressive. They could see the state of each waterway for themselves, and knew their staff personally. On the carrying side, the craft are mostly in the hands of individual owners or minor companies, and no figure apparatus of control has been necessary, though the entry of the Docks and Inland Waterways Executive into this business will result in better operating statistics in due course.

36. There were certain statutory statistics required from canal-owning undertakings, such as total traffics by categories. The figures were primitive, however, as were some of the published accounts. Until it was unfeelingly dispatched from this world under the Transport Act, there was one ancient company which was under no obligation to publish a balance sheet, but only an account of income and expenditure; the capital expenditures of a hundred and fifty years and more had always been decently and rapidly interred in the charges to revenue, and in this sense the account must have possessed an accuracy and a wisdom only rarely achieved in these days!

III. THE GROUPS

37. The basic operating units in transport have tended, with the exception of road haulage, to collect together into a few major groups, and this tendency is really nothing more than a natural development of a technical and economic character. What distinguishes the functions of a group from the functions of the units? To some extent the distinction must be arbitrary, but the function of 'comparing' the unit-managements with each other, as distinct from the function of management itself, can be identified. I would include, also, research of a type beneficial to all units, and the common study of common problems. The achieving of economy by standardizing engineering specifications, by substituting scientific methods for rule-of-thumb procedures, by concentrating the administrative services, by pooling the stores and other resources, and by other such means, is another typical group function. Above all, policy is made on a wider basis and on a longer term.

38. It is these distinguishing functions which determine the type of figures provided, but in actual fact there is little new in the figures themselves; the difference lies in the use made of them, and inevitably they become more standardized. Whether the groups begin as mere investments, or loose trade associations, or as conscious acts of public policy, the urge to increase profitability or the emergence of common problems will lead to comparative studies of the available facts, which itself leads to standardization of the accounts and statistics. In this there is the usual danger of stifling natural development, but the issue has to be faced. The main remedy would appear to be constant review of the standard basis itself, and this suggests that the details should not be prescribed by law.

39. If the standard forms are well devised, and not too rigidly prescribed, it should be possible so to organize matters that the targets are set by the best performances of all units within the group. The services of men of figures are therefore much in demand, not so much for setting the targets, perhaps, as for judging performance. In this connexion I would mention the danger of allowing accountants and statisticians to work in isolation from the actual happenings which the figures purport to record. Whatever may be possible in the world of pure science, in a day-to-day world like transport the men employed must have considerable and frequent contacts with the subjects they are attempting to measure. There is no greater set of sinners, in my view, than the gifted men of figures who draw exceedingly interesting but highly erroneous conclusions from an examination of figure material which, by reason of lack of knowledge of the complicated background, they are not really in a position to handle.

40. However that may be, one result of comparisons is research into the causes of differences, and it is here that fresh statistical analysis has much to contribute. The subject of investigation will not be some particular unit or some particular sphere of personal responsibility; it will be some particular happening or some particular 'job' which runs right through the group. This 'job' will be pursued beyond the boundaries of departmental responsibility and the boundaries of the individual units will be ignored. An example is the investigation of relative locomotive efficiency recently carried out by the Railway Executive—a process never really practicable before. Processes of this kind, which must be approached in a scientific fashion by a combination of fresh minds and practical experience, are perhaps a form of that so-called operational research which is so much dis-

cussed today, and it is essential that men with an understanding of figures shall be prominently associated with such investigations.

41. Control over working capital in relation to turnover, the study of capital developments and of the finance required for them, general financial forecasts and other such contributions made by figures to the working of the group are not peculiar to the transport world and I will not say anything about them, in spite of their importance.

42. There is, however, one matter of considerable interest to which I wish to refer. The studies or surveys of the passenger problem made by London Transport are well known, and the *London Travel Survey* published recently is probably unparalleled elsewhere. It reviews the kind of household concerned, the type of travel undertaken, the normal working journey, the time involved and the cost to the traveller—all with a wealth of statistical detail. Inquiries of this kind are no doubt essential to the London Transport Executive in the proper execution of their functions, as also are the studies they make of population trends, town-planning developments and other matters on which modern statistical techniques can be employed, but it may be asked why London Transport is further advanced with these studies than most other public transport undertakings in the United Kingdom. In part this may be due to the pressing nature of the problems which face London Transport, and in part to the differences in personnel. But it is due also, I think, to the fact that in the London Area there is a 'total' responsibility for a defined function.

43. We are, indeed, when we look at London Transport, looking at one of the first examples of the constructive integration of differing means of transport.

IV. THE NATIONAL LEVEL

Limitations of figure material

44. The transport figures produced at the national level are legion, as is shown by the interesting paper recently produced on *Rail and Road Statistics* by Mr F. A. A. Menzler (*J.R.S.S.* Vol. CXIII, p. 352). However, the purpose of many of these figures must be classed as propaganda or education, and it seems necessary to mention only the figure-work carried out on behalf of the Ministry of Transport and by the British Transport Commission. And I exclude, of course, the figure-work carried out to enable the authorities to ration scarce materials, and to control capital extension. Incidentally, it is the comprehensive service of figure-controls available in a nationalized utility, coupled with concentration of ownership, which makes possible the much more effective rationing of such undertakings.

45. Before the Transport Commission was set up the functions of the Ministry in this field included the publication of certain statistical material bearing on transport; they still include the exercise of certain statutory duties in connexion with charges tribunals, for example, with licences for goods and passenger vehicles, and with the maintenance and development of the road system. Whereas during the war there was a more direct control of railways and canals, the figures normally furnished to the Minister were for information of the public rather than for purposes of control. I have already referred to the voluminous returns

produced in relation to railway transport, and, with an annual summary of the reports of the road licensing authorities, the Minister publishes consolidated figures for the earnings and expenditures of passenger vehicle operators with over five vehicles, though the figures are not statistically related to operational performance or to standard bases of fares, and are tenuous in other respects also. The Road Fund Accounts show the costs of road maintenance by class, and a census of traffic passing on the roads has been taken from time to time, but the only regular figures available in respect of road haulage as a whole are the statistics of Road Fund Licences issued for mechanically propelled road vehicles. Indeed, with the emergence of road transport as an important factor, the country is no longer in possession of the comprehensive indices of total transport activity which existed, in the shape of railway statistics, so long as railways had a monopoly of fast or long-distance transport.

46. Without the facts, policy cannot or should not be made, and it is the figures which provide and weight the facts. However, with the advent of the British Transport Commission figures are once again becoming available to show the pattern and volume and true cost of the many different activities which make up inland public transport as a whole, subject only to the exclusion of the short-distance road vehicles in the hands of independent hauliers. The opportunity will be afforded to measure the public transport system according to the qualities expected of it, which in the Transport Act are defined, by implication, as efficiency, adequacy, economy and integration of service.

Adequacy of facilities

47. What is meant by 'adequacy' depends upon the point of view. Suppose we consider first the concept of the physical adequacy of the system, and the related question of physical 'over-adequacy'. The railway figures can be used to show that the net ton-miles per route-mile per working day in each district, and other such ratios, are much less than during the war, when the high degree of utilization of the railway system, whether track or rolling stock or staff, was an important factor in the final victory. The degree of utilization of the roads must, on the other hand, be left largely to personal observation, though the fitness of the road system to bear the heavier and newer types of vehicle, and the great cost of constructing or reconstructing the roads where necessary, can doubtless be reduced to less subjective forms of measurement. Also, in congested areas like London, where traffic can only make progress by road because the road is assisted by underground railways, considerable studies have been made on the basis of figures of various kinds which, if not accurate, at least illustrate the order of magnitude of the problems. Leaving the 'way' and coming to the 'equipment', the statistics available are reasonably complete except as between empty running and full running. The figures show a steady rise in the number of road passenger vehicles and, though the railways are short of passenger stock, in general the passenger traffic of the country is now carried in reasonable comfort, subject to the impossible 'peak' demands in London and elsewhere. Nor is there any great shortage of equipment to move the freight traffics of the country. Whether the equipment is adequate in the sense of being economic, or of the type most demanded, is a different matter, the answer to which lies chiefly in the realm of cost, however defined.

48. In relation to adequacy in the sense of frequency of service or the timing of service, statistics normally play a restricted role. It is possible, of

course, to map out in lines of varying thickness the figures of trailing gross ton-miles on each route of railway, or of seat-miles provided by buses, and indeed such route-maps are constructed when transport plans are being worked out. It is useful to know, also, for example, that the bus service between London and Edinburgh carries only 3 % of the total passengers conveyed between the two points by railway, or that three lorries every minute of the day and night might be required to carry the freight traffic through Carlisle if the railways were closed.

49. Adequacy can be used in still other senses. The trader in particular requires rapid shipment, and various other advantages such as freedom from breakage, and up to a point he is prepared to pay for these additional elements of service: but he may want 'cheap transport' before all else.

Efficiency

50. Efficiency is a quality never exactly defined or measured except in relation to purely mechanical matters such as the thermal efficiency of the electricity generating station. Economists tend to talk of something which is called 'social efficiency'. This is measured, apparently, by a 'social accounting'. A particular undertaking may be in receipt of a subsidy, open or concealed; or it may be working to a short-term instead of a long-term policy; or it may be obtaining business efficiency regardless of social consequences. The costs as they appear from the books of an individual industry must therefore—or so runs the theory—be corrected in all kinds of ways to reflect the true social cost in relation to the social output. I fear that we shall be crying for the moon if we ask for scientific figures as a basis for comparative accountings of this character.

51. Neither has anything useful come out of the frequent attempts to find an over-all index of comparative efficiency for the railways of different countries. This was so even before the complications caused by the present chaos of exchange rates. The legal and industrial frameworks within which the railways operate have always differed from country to country. One railway received its land free and another paid high prices for it. One has onerous pension obligations while for another the State bears the pensions. In one country the lines run over mountains and in another they can be laid almost straight on to the ground. Still more difficult, however, is the fact that the nature of the traffics differs fundamentally, as do the services offered. In one country there will be a big percentage of light merchandise traffic carried at high speeds, whereas in the other there will be mainly bulk commodities carried for economic reasons at low speed. And even if punctuality can perhaps be measured in figures, the other qualities of service normally elude this form of measurement. To rely on any general international index of transport efficiency is therefore absurd.

52. Even within one and the same country there are similar difficulties in attempting to assess the differing 'social costs' involved in the differing forms of transport. Attempts have been made, for example, to compare the total number of men required to transport a certain number of tons or passengers a certain distance by rail and by road. Though such comparisons may be interesting and thought-provoking as a purely internal exercise, they could not be adequately defended under detailed cross-examination. The real difficulty is, first, that there is no reliable way of measuring in man-hours the assistance received from the capital equipment and, secondly, that the common unit of output simply does not exist. Road and rail services compete with each other, in fact, over a limited

area only, but in so far as they do offer similar services, the only way of comparing their efficiency in figures is to abandon the interesting speculations of social accounting or of productivity indices, and to deal with the facts as we have them. We come down, in other words, to the hard question of money cost, which includes the question of economy.

Economy

53. This is more familiar territory and figures are once again of great value. Admitting all the defects of money as a common denominator of measurement, it is the only one we really possess, and it upsets many a statistical house of cards where one assumption could otherwise be piled on another with little possibility of checking the ultimate answer.

54. It is obviously the duty of the Transport Commission to ensure that the various Executives entrusted with running the different forms or areas of transport are reasonably efficient. For this purpose the figures of costs and cost ratios must be available, and partly with their complex and sometimes doubtful aid a continuous form of what is sometimes called 'efficiency audit' is in progress. The special position of the Commission in this respect is all too little understood. Unlike many other public boards, the Commission was so constituted as to be reasonably separate from the day-to-day or functional managements; this special form of structure was no accident, and one of the prime functions of the Commission is to protect the public interest against inefficiency or lack of economy. This is the constitutional structure; yet it seems to be forgotten in a welter of demands for other commissions or committees or authorities to exercise a running supervision over the figures and the cost of public transport. I find it difficult to see how such a function could be successfully exercised except by a body which is permanent and which, like the Commission, is non-specialist and free from managerial cares, yet which is intimately acquainted with the intricacies of the position, critical but sympathetic, publicly responsible but sufficiently 'of the family' to be accorded, without reserve, the necessary access to persons and to facts.

55. The efficiency of the managements, as shown in their costs and by other indications, is only one of the cares of the Commission. There is also the shaping of policy in its broader aspects. If it is wasteful for the cobbler to weave his own clothes and for the weaver to cobble his own shoes, then it is wasteful for one form of transport to be doing items of work that can be much better done by one of the other forms. But when we talk about forms of transport as separate entities we beg the whole question. It is no use comparing in total the costs of one form of transport with the costs of another. The totals or averages conceal vast variations. As well talk about the average cost of fruit as talk about the average cost of a form of transport. It follows that generalizations about one form of transport being more efficient or more economic than another can usually be written down as uninformed assumption or even as prejudice.

56. The cost to the individual customer, i.e. what he pays for a particular haul under the public railway tariffs as compared with the special quotation of a haulier (or with the customer's own selected vehicle), is another matter, but the answer of the figures to the burning question whether in general road transport costs less than rail, even before adjustments have been made for inequalities in social obligation and statutory burden, is that there are a hundred answers. Once again, therefore, we shall dissatisfy those who think that life owes them easy

and sweeping solutions. There are, of course, some definite and unarguable cases at the extremes: on the one hand, for example, a full trainload of coal on a long, unbroken haul and with no empty wagons to return; on the other a few hundred-weights of fragile merchandise on a cross-country train journey which entails handling several times. But more often the hard fact is that only the closest of figure investigations, backed by a good deal of commercial 'feel' and experience, and a complete knowledge of the ancillary circumstances, will indicate whether any particular traffic can be carried more cheaply on one form of transport than on another, or on one route or in one area than another. And then the 'circumstances' may fluctuate. The most important is usually the comparative load factor, which may itself be the result of differential alterations in the level of fares and charges, which themselves affect the nature and cost of the traffic operations required.

57. Nevertheless, the figure processes must be called to aid wherever possible. A hypothetical if over-simplified example may be of interest. Suppose we estimate, subject to reservations of many kinds, that the cost attributable to a certain long-distance bus route works out at the order of three farthings a seat-mile, and that for the same journey by rail the cost of a seat-mile may be of the order of a halfpenny. But we find that the bus service carries only a tiny fraction of the total traffic between the two points, and has for this very limited service an assured and steady clientele who book long in advance. The result is that its available seat-miles are 95 % occupied by passengers, and the fare need therefore be little higher than three farthings a mile. The train, on the other hand, must provide the bulk service for all comers, most of whom expect to be able to travel without notice. The peaks of demand must be met and the valleys carried. In consequence the load factor of the train may be only 40 % and the cost per passenger two-and-a-half times the cost of the seat—say a penny farthing a mile. That is, the rail service turns out more expensive after all, but only so long as the bus service keeps to its limited proportions and obligations. The position would be very different if the railway provided the restricted and pre-booked accommodation, and left the duty of carrying the general public to a greatly augmented bus service—which incidentally would mean a bus every minute or two of daylight. This is not an argument in favour of the railway and against the road; the flexibility of a small unit like the bus has other consequences to recommend it. There is, obviously, a large area of operation where the bus is the cheaper.

58. It is not the business of figures to solve the issues of policy thus raised. The figures are needed to establish the facts as aids to the development of policy. Comparative studies of transport costs in varying circumstances are, of course, being undertaken by the Commission. The principles adopted are first to analyse the rail and road costs under convenient comparative headings, e.g. vehicle operation, stabling and servicing, marshalling, terminal, documentation, track and signalling, and licence duties; and then to ascertain under each heading a range of cost according to the principal factors which cause a variation in the cost of the service provided—e.g. speed, frequency and density of service, length of haul, physical characteristics of freight traffic, train loading, etc.—for the long-distance, medium, and local passenger traffics separately. As a result of the number of assumptions involved in such calculations, and the exceeding variety of circumstances, the individual answers produced in any one case will not normally rank as indisputable fact, but there will gradually be built up, by the accumulation of cases, a much clearer general picture of the true economics and uses of the differing forms of present-day transport.

Integration

59. This brings us, finally, to integration, which can be defined as a long-term and never-ending process of organization and change intended to secure that the public transport instruments most suitable in each particular case are given a proper opportunity of meeting the public transport requirements of this country's inhabitants. No doubt 'suitability' will, in less abnormal times, be more closely related to 'cheapness', from the point of view of the customer as well as of the provider. It is often argued that fares and charges should be based strictly on cost. Unfortunately, cost is a very vague concept in this connexion, and if the chaos of separate, fluctuating and undetermined charges for each of the million and one transport jobs carried out by the public transport system is to be avoided—and certainty in advance about service and price are the essence of a public system—then we must accept the fact that, in one sense, the price charged for each job will be either greater or less than the actual cost. It costs more to transport a passenger on Sunday, for example, than on a weekday; and it costs more to transport him in some areas than in others. Likewise the cost of hauling goods for a distance of 102 miles might be much larger than the cost of hauling them for 100 miles if a shunting operation is entailed at the hundredth mile. In this sense each job, or season, or area of the public transport system will be subsidizing the others from time to time. But the process of averaging is essential and the question is what the area of average should be, whether by type of customer, type of commodity, type of haul, area of operation or any other basis which can be envisaged. With London Transport, for example, the basis of averaging is not the form of transport but the categories of passenger in the area concerned.

60. The place of figures in internal work of this kind need not be elaborated. It will remain an impossibility, however, for accountants to solve the old problem of dividing main line railway costs as a whole between passenger traffic and freight traffic with a view to showing the 'profit and loss' on each traffic. There are too many costs in common and, whatever may be done by way of sample studies into the economics of operation, it is impossible, as a book-keeping process, to divide all the costs between the two traffics except on a highly arbitrary basis which can have little significance. How can the cost of breeding a sheep be divided between the cost of growing the wool and the cost of producing the mutton?

61. So far as public figures are concerned, a first example of their role under an integrated system is to be found in the accounts of the Commission for the year 1948. These contained 240 pages of financial and statistical material, and there is, therefore, no justification for the fear expressed in some quarters that all the public would receive would be a large and indiscriminate matching of receipts and expenditure and an indivisible bulk of accounts and statistics and costs which would defeat all attempts at public understanding of the results of the various transport operations. Perhaps I should also mention the volume of *Transport Statistics* which is published every four weeks by the Commission.

V. THE FIGURE-PRODUCERS

62. Figures do not produce themselves, nor do they interpret themselves, and the part they play in administration depends in great measure on the position, capacity and training of the human beings who are responsible for the figures.

63. It is said that the world may be divided into those who understand figures and those who do not. Because figures are essential in modern administration there may have been an undue tendency, during the last generation, to place in power those who understand them. Of course, ability to deal with figures is a great advantage in top-level administration, which is a form of governance, but this ability is no substitute for imagination, courage and other such attributes, not to mention the capacity to be lucky. It is surely better to support the administrator with men of figures, if this is necessary, than to put a man of figures in supreme control and to hope that his subordinates will supply the missing qualities.

64. It is time, perhaps, to explode the myth of the Great Mind in control of a gigantic undertaking with the help of a panel of statistical light-bulbs, and time, also, to dispose of the idea that squads of 'back-room boys' can plan the progress of mighty affairs merely by plotting the curves of elaborate relationships on logarithmic paper.

65. Having said this, however, it is proper to add that the place of figure-men is fairly close to the seats of power. It is part of their duty to see that the organization as a whole, and the administrators concerned, are sufficiently figure-minded. The ways in which this can be done, and the pill of stodgy figures coated with the sugar of easy presentation, would take a long time to describe.

66. 'Figure-mindedness' must happen not merely at top level, but at every level of administration. In consequence the keepers of the figure processes should not be centralized. They must be distributed to each point where management goes on. Moreover, so far as is reasonably possible, having regard to economy, each local unit should have its own figure apparatus; no branch or section of an undertaking will take the same interest in figures prepared by some central figure-factory as in the figures it prepares for itself; and the man in charge of the apparatus should be one of the chief servants and advisers of the local management. That a functional link is needed between the figure-men at the various points will go without saying, and if circumstances are unpropitious there may even have to be a direct chain of command down from the higher levels.

67. So much, briefly, for the place of those responsible for the figures. As already remarked, there is a certain affinity of mind between all those who are able to work in figures—the language of size. There is much in common between the accountant, the statistician, the cost expert, and even, if I may say so, the actuary. No doubt they are, at the middle levels, concerned with separate aspects of figure-work, but their figurings start from the same original sources at the bottom, whether guards' journals, engine logs, staff records or other such basic records, and, in the same way, the results of their work come together at the top. It is important, therefore, that the senior figure-administrators should have at least some acquaintance with each of the techniques, and a complete grasp of one of them.

68. I have refrained from calling these techniques by the name of 'science', though statistics is often claimed to be a science in its own right. What they have in common with the recognized sciences, however, are the inquiring approach and the disciplines, and in this respect they can provide an exceedingly valuable training, not only for jobs connected with figures, but also for administrative responsibility generally. The danger is that specialist work on figures can also be very narrow, especially where there is no direct and living contact with the actual

operations or happenings which the figures record. The problem of training young men in the use of figures, and of promoting them to senior posts while they are still young, becomes increasingly difficult as the number of reasonably sized undertakings diminishes. This, however, is a subject in itself.

VI. CONCLUSION

69. In conclusion I will attempt to draw together the threads of thought which run through this lecture.

(a) Figures are a vital aspect of the administrative work at the operating levels, where their chief objective is to control operating efficiency, the pattern of expenditure control being much alike for all forms of transport. In respect of gross earnings however, the objectives of the figure-work have differed, because the responsibilities of each form of transport have differed. What is important about all these figures is that they should be available for local application by persons with a close knowledge of the background of the figures. They cannot be used by some statistical genius sitting in isolation to determine 'what is wrong with transport' or where the relative inefficiencies exist. Still less can the levels of fares and charges, or the balances on profit and loss accounts, be used for this purpose.

(b) However, the detailed statistics and accounts can be added together on a national scale to provide, if not a detailed critique of comparative efficiencies, at least a valuable general picture of the trend of operations, subject to current incompleteness in relation to road haulage.

(c) A national policy for transport depends, nevertheless, chiefly on figures of a very different character, in which the relative load factors, whether of the services provided in relation to the size of the system, or of the services *used* in relation to the size of the services *provided*, play a significant part. Just as the operating figures cannot be properly interpreted at the national level without a good deal of expert guidance, so the loading and comparative cost studies needed for an integrated administration of public transport as a whole will not be adequately constructed or interpreted at the level of the individual operators. Nor can the complicated interplay between these figures and the variations in price policy (e.g. the basis of fares) be studied in an impartial manner except at the national level, or something almost equivalent thereto. Figure studies on all these matters provide the facts, as near as we can get to them in a highly unstandardized world like transport, and without the facts policy ought not to be made. And policy, incidentally, is not something static and fixed for all time. It must vary as conditions vary, and a continual service of figures is therefore essential.

(d) Lastly, though the figures are of great importance, their limitations must be kept in mind; they are the servants of policy rather than its master. Also, they can be exceedingly dangerous tools in the hands of irresponsible or untrained persons. The training of the men-of-figures, and their placing within the organization, is therefore a matter of considerable moment.

70. It was Lord Kelvin who remarked, in relation to physical science, that if you can measure something in numbers you have the beginning of knowledge, whereas without this form of measurement your knowledge must be meagre and unsatisfactory. This is true even outside the physical sciences. Figures are bound to play an increasing and indeed essential part in any shaping of the modern

world, including the world of transport, and I would suggest to you that professional societies like your own, and your members individually, have an important role to play not only in preventing the abuse of figures and in the training of young men in the use of figures, but also in giving positive assistance in the field of practical figure-administration.

APPENDIX A

EXAMPLES OF STATISTICS PREPARED BY LARGER BUS COMPANIES

(excluding London Transport and Municipalities)

A. Mile and Time Statistics

1. Standard timings for each service scheduled.
2. Miles lost on schedule; miles run per mile lost.
3. Miles run in passenger service and empty.
4. Miles per driver's hour paid; miles per driver's hour worked.
5. Vehicles owned by type (single deck, double deck, coach) and by fuel (petrol, diesel oil).
6. Miles run per vehicle owned;
per vehicle licensed;
per route.
7. Average earnings of drivers and conductors.
8. Cost of (7) in pence per vehicle-mile.

B. Fuel and Maintenance Statistics

1. Gallons of fuel used (petrol, diesel oil).
2. Miles per gallon by fuel and by type of vehicle.
3. Miles per breakdown.
4. Number of vehicles under and awaiting repair. Number available for traffic.

C. Loading Statistics

1. Number of seats in fleet: maximum number licensed any one day per period.
2. Number of passengers carried.
3. Receipts per vehicle owned or licensed;
per vehicle-mile;
per service (stage, express, tours, etc.);
per route and per vehicle-mile for route.

APPENDIX B

EXAMPLES OF STATISTICS PREPARED BY MAIN LINE RAILWAYS

A. Mile and Time Statistics

1. Rolling stock owned and in use—engines, passenger carriages, freight wagons—and by type in each case.

2. Mileage of engines—passenger and freight separately—divided into train, shunting, assisting required, assisting not required and light running with total for passenger and freight. Also departmental miles (e.g. engines working break-down trains) and total engine miles.

3. Mileage of trains: (a) passenger (steam and electric separately) loaded and empty; (b) freight loaded and empty.

4. Mileage of wagons—loaded divided into three main groups of traffic (merchandise, minerals, coal and coke) and loaded and empty.

5. Hours of engines in traffic—as for mileage of engines except that assisting, assisting not required and light running are grouped as 'other'.

6. Movement: (a) train-miles per train-engine-hour, passenger (divided between steam and electric) and freight; (b) wagon miles per train-engine-hour, per engine-shunting-hour and per total-engine-hour; (c) net ton-miles per train-engine-hour, per engine-shunting-hour and per total engine-hour.

7. Wages cost per engine-hour or -mile.

B. Fuel and Maintenance Statistics

1. Tons of coal, units of electricity, gallons of diesel oil consumed.

2. Pounds of coal per engine-mile. Units of electricity per electric-carriage-mile (or car-mile). Gallons of diesel oil per engine-mile.

3. Number of vehicles—engines, carriages, wagons—under and awaiting repair.

4. Number available for traffic—engines, carriages, wagons.

5. Number of classified repairs carried out—engines (divided between workshop and motive power depots), carriages, wagons.

C. Loading Statistics

1. Number of passenger journeys and passenger-miles, and passenger-miles per loaded-passenger-train-mile.

2. Number of tons carried—three main groups of traffic and also livestock.

3. Loaded wagons forwarded—three main groups of traffic.

4. Average starting wagon load and throughout—three main groups.

5. Net ton-miles (excluding weight of wagon)—three main groups.

6. Average length of haul—three main groups.

7. Number of wagons per train—loaded, empty, and total.

8. Net ton-miles per total train-mile—train-load in tons of traffic.

9. Receipts—passengers, parcels, etc. and freight by three main groups. Average receipts per loaded-train-mile, passenger and freight separately. Average receipts per passenger journey and mile. Average receipts per ton, net ton-mile, loaded wagon, wagon-mile (three main groups).

APPENDIX C

NET TON-MILES PER ENGINE-HOUR

The road haulage unit tended to remain small because the industry depended largely on visual supervision, from the lorry driver looking after his load to the owner knowing and seeing his men and lorries. The railways on the other hand were very large, and a system of non-visual control and supervision had to be devised. An elaborate system of control became necessary because the method of operation demanded it. The locomotive as the prime mover takes the place of the bus or lorry, but it requires trailers for the conveyance of the payload, whether carriages for passengers or wagons for freight. Let us examine rapidly the figure processes needed by the million odd railway freight wagons available for use on British Railways.

There are over 6400 stations and several thousand private sidings at which freight is loaded and unloaded into and out of railway wagons. These terminal points vary from the farm siding, in use only for seasonal traffics, to coal-mines, steel-works, large city stations and ports where the turnover of wagons may run into thousands daily. Wagon control starts with the station wagon return on which a forecast of tomorrow's situation is built up from an estimate of the loaded wagons on hand and expected during the day, unloadings expected and probable demands for wagons, and from these latter two items the expected surplus or shortage. The station wagon forecasts have to be built up for each of the main classes of wagons, of which there are, for wagon-control purposes, about a score. They are summarized by wagon distribution centres and district wagon-control offices. Many of the surpluses and shortages cancel themselves out at this level, but there are others which go up to the regional wagon controls and some to the Executive level. Movement of empty wagons has to be arranged within districts, between districts within regions, and between regions; the mileage run by empty wagons is compiled and published in the Commission's periodical and annual statistics. Last year it was over twelve hundred and seventy million miles, rather more than a quarter of the total loaded and empty wagon mileage. Railwaymen watch the percentage of empty to total wagon-miles. It has fallen from 33% in 1938 to 27% today, a substantial saving in train and vehicle operating costs. The abolition, seventy years too late, of the several thousands of separate ownerships in the wagon fleet has contributed greatly to this saving.

When the empty wagon is ready to receive its load, another statistic makes its appearance—the average wagon load at starting-point. The improvement compared with pre-war is notable, and is due partly to the increased size of wagons and partly to heavier traffics and better loading. After loading comes the marshalling into trains. The throughput of marshalling yards is measured in various ways such as, for example, the number of wagons detached per shunting-engine-hour. Freight engines spend, on shunting, more than half the total freight-engine-hours; any reduction in the proportion of the time spent on shunting and a corresponding increase in time spent on train movement represents a gain in efficiency. The rate of movement of freight trains has been steadily rising since the war-time trough, but has not yet reached the pre-war level.

The number of wagons per train multiplied by the rate of movement gives the number of wagon-miles per train-engine-hour and this is calculated for sections of line, districts, regions and for the country as a whole. The trains are conveying more traffic and the net ton-miles (traffic multiplied by distance) per train-engine-hour and also per total-engine-hour last year were the highest yet recorded in this country.