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PREFACE.

LIGHT RAILWAYS postulate greater facilities for promotion, cheaper construction, simpler working, and more lenient conditions generally than are applied to ordinary or standard railways; but, as pointed out in Chapter I., light and standard railways only differ from each other in degree, and no sharp line can be drawn between them. We are all feeling our way in the matter of light railways, and the treatment of a subject which is more or less unformed and undefined presents peculiar difficulties. The late Mr Corrie L. Thompson's *Catalogue of Books, Reports, Papers, and Articles relating to Light Railways*, 1895, was a most useful guide to a literature which is necessarily scattered and incomplete. To sift this information, and to collect and arrange useful matter in a convenient and readable form was the result I aimed at.

In Chapter II. I have tried to give the general reader some idea of the principles which govern the classification of goods and the application of rates. Passenger fares may vary directly as the mileage, but not, as a rule, goods rates. Of all the factors which affect the cost of goods service, distance is often the least important. It will usually pay a railway better to carry properly packed foreign produce right through from port to market than small home consignments picked up at intermediate stations. Not only, however, is it generally impracticable to lower local rates to the level of import rates, but attempts to satisfy the home producer by raising the import rates have sometimes merely resulted in forcing the foreign produce to find a cheaper way to the market by sea. The British agriculturist's ultimate remedy lies, not in requiring the railways to "boycott" the foreigner, but in adopting better methods of packing, in combining to make up larger consignments, and in the development of light railways under the Act of 1896. Why—as Mr W. M. Acworth once asked—if light railways are useful to foreign farmers, must they be useless to English farmers? In the writing of this

chapter I am indebted to Acworth's *The Railways and the Traders*, to Grierson's *Railway Rates*, to Hadley's *Railroad Transportation*, and to a course of three lectures on *Railway Management* (Calcutta, Bengal Secretariat Press, 1896) delivered at the Sibpur Engineering College by S. Finney, Manager (under whom I held the post of Deputy Manager) of the Eastern Bengal State Railway.

What other European countries have done towards the development of light railways has been briefly described in Chapters III.-VI. No system, in regard to its organization and results, offers to those interested in light railways so instructive a field for study as that of Belgian Light Railways. They owe their development to the foundation in 1885—with the express object of enabling agriculturists to compete with foreign producers—of the National Society of Local Railways, which holds the monopoly of light railway concessions, determines the contributions of the State, provinces, communes, and private individuals (a small proportion), and distributes the profits. Under the Act of 1896 we have, at last, secured equal facilities and as simplified a procedure; but, as our Light Railway Commissioners simply deal with applications made to them for an order authorizing a light railway, State aid is practically unknown, financial assistance from local authorities is seldom sought, and private enterprise is still the mainspring. A close parallel has been traced in some detail between the cost of Belgian Light Railways and light lines on the same (metre) gauge in India. In France the direct control of the light railways is placed in the hands of the Prefects, and the tendency is for the departments to construct the lines and to lease the working of them. This raises the question of a traffic formula which shall induce the lessee to work the light railway in the interests of the public, by making the amount of his subsidy depend upon his doing so. The Belgian and Noblemaire's formulæ, Considère's formula, and Colson's modification of it come under brief review. The consideration of these and of MM. Considère's and Colson's controversy on the claims which light railways have, not only upon local but upon national support, as well as upon the most generous treatment by the main lines which they feed, cannot be without interest, and even practical value, to all who are interested in the light-railway question. The development of Italian tramways (which are—as in Belgium, France, and Holland—light railways on roads) shows that it is far more effective, in the long-run, to offer private enterprise a fair field, unhampered by harassing restrictions, than to afford direct pecuniary assistance in the form of Government subsidies. In Prussia the pro-

vincial and district authorities, but not the Central Government, may support the undertakings of other local bodies or of private persons. Light railways on roads are far more frequent on the Continent than they are likely to be in England.

In our Colonies and in the United States, uniform adherence to a standard of perfection has not been required, and, consequently, the necessity of making light railways a distinct class seldom arises. As will be seen in Chapter VII., these countries offer suggestive examples of the cheap construction of pioneer lines in undeveloped districts.

Facilities for the acquisition of land, and the early recognition of light-railway principles, wherever the utmost economy was essential, have already added a considerable mileage to our Indian railway system (Chapter VIII.). The "Branch Line Terms of 1896" and the near prospect of a stable exchange should attract British capital to the development of light railways in India.

Unlike England and Scotland, Ireland (Chapter IX.) is no stranger to State aid; and, apart from mere figures, the construction of light railways with State assistance has been a great boon to poor and remote districts. The Irish Act of 1896 is in line with the English Act of the same year.

Chapter X. devotes a brief space to traction engines, road locomotives, and other means of road transport which offer themselves as possible alternatives to light railways in certain cases; and their recent relief from certain disabilities which restricted their use has been described.

The interpretation of the Light Railways Act of 1896 is dealt with in Chapter XI.

The notion that a light railway must be a narrow-gauge railway is far too common. Light axle-loads and low speeds, not gauge, are the first conditions of cheap construction and economical working. Gauge is quite a secondary factor, the effect of which is very often exaggerated by the advocates of narrow gauges. Its influence on the cost of different items of expenditure is discussed in Chapter XII. Unless there are very special reasons to the contrary, light railways in England—short in length and making contact with the main lines—should be on the 4 ft. 8½ in. gauge. It is many years too late to wish that in India 4 ft. 8½ in. were the standard gauge, with the 2 ft. 6 in. gauge to fall back upon for those light railways which could not or need not make physical connection with the main lines in order to carry standard-gauge goods stock. *All the world over there ought to be two gauges only, the 4 ft. 8½ in. and the 2 ft. 6 in.*

Chapter XIII. on "Construction and Working" and Chapter XIV. on "Locomotives and Rolling-Stock" (and this explanation applies to the other chapters also) were not designed to form portions of a technical text-book on "Light Railways." That would necessarily include so much information regarding the construction, equipment, and working of ordinary, as well as of light railways—information regarding which is within the knowledge of railway engineers and within the reach of all—that I have simply endeavoured in those chapters to suggest or to recall the various details which admit of simpler and more economical treatment in the case of light railways. In no branch of expenditure is there more scope for economy in working than in the organization of the revenue staff—by employing cheaper servants than would be required on ordinary railways, by making the duties of the subordinate staff interchangeable, and by combining the supervision and administration of several departments under one head—and yet, in Chapter XIII., this important question is confined to one (the concluding) paragraph. The conditions of light-railway working must vary so greatly that suggestions for reducing establishment charges are best sought and considered in connection with the particular systems where such economies have actually been applied (see *Index*—"Economies in Construction and Working").

More precise illustrations of economical construction, equipment, and working are given in Chapter XV. (on "Light Railways in England, Scotland, and Wales"), which contains short studies of three light railways constructed before the Act—the Wisbech and Upwell Tramway, the Three Horse-Shoes and Benwick (Goods) Line, and the Easingwold Railway. Through the kindness of Col. G. F. O. Boughey, R.E., C.S.I. (one of Her Majesty's Light Railway Commissioners), I have been able to bring my information regarding light railways which come under the Act of 1896 as nearly up to date as possible.

Finally, my thanks are due to the General Manager, Locomotive Superintendent, and Mr Sherlock of the Great Eastern Railway, to the Honorary Secretary of the Easingwold Railway, to Messrs John Fowler & Co., to Messrs Kitson & Co., to the Leeds Forge Co., to Mr Everard R. Calthrop, to the representatives of the Colonies in London, to Mr A. S. Jameson (Locomotive Superintendent, E.B.S.R., India), and to many others, who have kindly placed information at my disposal.

W. H. C.

January 1899.

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PREFACE.

IN this work the Locomotive Engine is looked at chiefly from the point of view of the Designer or Locomotive Draughtsman, and the scope and treatment have been mainly determined with reference to his needs. The requirements of the Engineer generally, who may desire to ascertain the practice of the Locomotive Engineer, and the needs of the Student have, however, also been kept steadily in view.

The aim has been not only to set out the most successful and generally approved modern practice, but to set it out in such manner as to aid in its intelligent adaptation, in accordance with general mechanical principles, to changed conditions or to further development. At the same time the book is intended to be of a thoroughly practical nature; and the calculations which it has been necessary to employ are accordingly suited, as far as possible, for every day use in the Engineer's Drawing Office.

There is given, after a brief historical introduction, an enumeration of particulars concerning the leading types and classes of locomotives at present in use in this country, both simple and compound. This is followed by a description of the methods of determining those factors or elements in the design of a locomotive which in large measure furnish the data for the subsequent working out of detail, but which themselves arise immediately from the conditions as to speed, loads, character of the roads, and so forth, prescribed, it may almost be said, to the Locomotive Engineer from without. The detailed construction and design of the various parts and fittings of the modern locomotive are then dealt with in a series of chapters ending with the eighteenth, and material for a comparison between British and foreign practice is also afforded by the chapter on American and Continental locomotives.

The operations of the workshop, and questions of cost, fall in general outside the scope of such a work as the present. They are, however, it will be seen, touched upon to some extent wherever they bear immediately on the design or maintenance of the locomotive—as, for example, in respect to the application of steel in boiler construction in Chapter xiii., and in regard to repairs and renewals in Chapter xxii.

A record and analysis of a series of experimental runs form the subject of Chapter xix. This chapter it is hoped will be found to afford some useful data for the Designer, and to give exact information as to the capabilities of the modern British express locomotive. An account of these trials has previously appeared in the *Proceedings of the Institution of Civil Engineers*. Thanks are due to the Institution for permission to reproduce the paper here.

The work is largely based upon experience gained in the drawing office and workshops under some of the leading locomotive engineers in this country, supplemented by information kindly furnished by the locomotive departments of the various Railway Companies. The large comparative Table forming Appendix B is compiled from information thus supplied.

The Author's best thanks are due especially to the following locomotive engineers for particulars concerning engines designed by them:—Messrs. W. Adams, J. A. F. Aspinall, F. W. Webb, J. Holden, W. Kirtley, Jas. Stirling, W. Worsdell, H. Pryce, H. A. Ivatt, J. McIntosh, D. Jones, T. F. Clark, and G. Estall, and to Mr. T. Coates for drawings of the Rocket and other old engines. Thanks are also due to Mr. A. F. Ravenshear for assistance in the final preparation for the press, and to Messrs. G. R. Sisterson, L. Gates, and E. Sharples for preparing details, diagrams, and for other aid.

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A Manual of Locomotive Engineering by W.F.

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(True Extract)

A. Edgington
for Chief Secretary.

18
26/4/89

TO

Messrs. Baker and Company.

The Public Works Department, Railway Branch.

" Accountant-General, Madras.

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of my letter No: 457 RM of 21: April 1899,
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