

Table IV.—Fifteen Principal British Railways, Ten Years' Maintenance and Renewal of Permanent Way Expenditure (1897 to 1906). Equivalent Mileage Annually Worn-out and Renewed.

Year.	Miles Open.	Wages.	Per Mile Open.	Materials.	Per Mile Open.	Total Expenditure.	Total Expenditure per Mile Open.		Equivalent Miles worn out.
							Per Annum.	In Thirty Past Years.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Col. 7.
	£	£	£	£	£	£	£	£	Col. 9.
1897	14,609	2,208,558	151.22	1,520,225	104.09	3,728,783	255.31	7659.30	486.83
1898	14,778	2,279,977	154.34	7,784,453	120.79	4,064,430	275.14	8254.20	492.43
1899	14,811	2,333,775	157.57	1,843,111	124.44	4,176,886	282.01	8460.30	493.70
1900	14,900	2,429,384	163.04	1,794,345	120.42	4,223,729	283.46	8503.80	496.67
1901	15,043	2,434,552	161.84	1,935,507	128.66	4,370,059	290.50	8715.00	501.43
1902	15,095	2,532,418	167.76	1,983,618	131.41	4,516,036	299.17	8975.10	503.17
1903	15,264	2,587,784	169.54	2,021,299	132.42	4,609,083	301.96	9058.80	508.80
1904	15,350	2,586,205	168.44	2,085,832	135.88	4,672,037	304.36	9130.80	511.67
1905	15,527	2,586,584	166.59	2,063,201	132.88	4,649,785	299.47	8984.10	517.56
1906	15,809	2,644,859	167.30	2,102,586	133.00	4,747,445	300.30	9009.00	526.96
Totals and Averages ..	151,186	24,624,096	161.89	19,134,177	126.58	43,758,273	289.47	8684.10	5039.22

serviceable life of the permanent way except in its entirety and considered as a whole. Considered, however, in that sense, the average annual expenditure in maintenance and renewals of the permanent way, in terms per mile of railway, whether it consists of double or single lines, during a sufficiently long period of years, is in reality the real equivalent of the annual death-rate of all classes of the perishable materials which constitute the permanent way of any railway. By way of illustration a period of thirty years may be fixed as a sufficient interval of time to obtain average and reliable results of the destructive effects of the wear and tear of traffic, and of the natural decay and exceptional causes necessitating complete renewal of the materials of all kinds. As will be seen from reference to the figures in Table IV., of the results obtained in the case of the fifteen principal British railways during the last ten years, means are afforded of determining very approximately the equivalent number of miles of permanent way and works of all descriptions which have become worn out and have been required to be renewed, so as to have enabled the permanent way of the particular railway to have been maintained in a thorough condition of efficiency for continuing the ceaseless and constantly increasing traffic of British railways. All, in fact, that is required—with the data now available of the actual annual expenditure per mile of railway of these fifteen railways during the past long period of years in question, taking thirty years as a definite and reasonable maximum limit of serviceable life of all classes of materials, subject to the destructive effects of wear and tear and of decay—is to multiply each year's annual cost of renewals per mile of railway by the past thirty years' fixed period, and to divide the total amount of renewals expenditure during the last ten years by it, and we get the equivalent number of miles of railway—whether double lines or more, or partly double and single, or exclusively single lines, of each of the fifteen railways. In the aggregate this amounts in ten years to 5,039 miles of railway—or, roundly, 504 miles annually—which have become worn out and have been replaced in most, if not all, cases with stronger and better materials, and as the traffic on these railways is still rapidly increasing, it may be satisfactory to the steel-rail manufacturers in this country to know that at least that quantity of worn-out steel rails will have to be simultaneously renewed during a similar period in the future. The permanent way of a railway—in fact, in its entirety, as has already been stated—has perpetual life, and it follows that every portion of it must necessarily share it also.

The late Sir John Hawkshaw, during the discussion on the author's paper in 1866 referred to, admitted that the improvements in the permanent way had not kept pace with the requirements of the rapid growth of railway traffic. It has since certainly been greatly improved and better maintained, and renewed with stronger and better materials, but on those portions of the main lines where there are junctions, and at all intermediate stations over which trains pass at high speeds without stopping, there are the knife-edged facing points and the main line rail crossings, more especially those known as the obtuse or diamond crossings, at all of which there is a gap in the main line rail, and they are all of the primitive types of crossing and switches as at the time Sir John Hawkshaw alluded to the permanent way in 1866. It is notoriously the fact that at these main line junctions and crossings, as the published records testify, some of the most terrible railway accidents have occurred. The recent very calamitous accidents at Salisbury and Shrewsbury junctions have since directed attention to great defects and risks at junctions when trains are travelling at the high speed now attained, and to the need in such places for curves of greater radius; but that involves the adoption of longer and much more attenuated knife-edges, facing points or switch tongues, sharper-angled crossings, and bigger gaps in the main lines. A method has been devised for dispensing with the gaps in the main lines and of rolling much stronger and larger and tapered facing points, which have been highly approved of by eminent engineers, amongst others notably by the late Sir Benjamin Baker and Sir Alexander Rendel, and especially by the late Sir Henry Bessemer; the only objection made is the greater expense, and that the present types can be more cheaply constructed. With railway expenses at nearly two-thirds of the gross railway revenue, economy is most desirable, but where risk of accident and danger to life can be avoided, saving of expense, as Sir John Hawkshaw said on the occasion referred to, is false economy, to say the very least of it.

In conclusion, the author trusts that the fact that it is the business of members of this Institute to supply by far the greater portion of the material required for the renewal of the permanent way and of locomotive and wagon stock, the expenditure of which has amounted in the short period of ten years to nearly £129,000,000, may be considered some justification for drawing attention to the subject of the permanent way of British railways.