1903, 1904, and 1905. In 1908 the method from this cause is only about 40% of the number removed in an equal time of the 1906 wheels and less than 20% of the corresponding number for the wheels made in

FIG. 6—MANUFACTURER. A.

Year Cast	Wheels Cast	1st Year W F	1st Year S F.	2nd Year W. F.	2nd Year S. F.	3rd Year W. F.	3rd Year S. F.	4th Year W. F	4th Year S. F.	5th Year W. F.	5th Year S. F.	6th Year W. F.	6th Year S. F.	7th Year W. F.	7th Year S. F.	Lbs.
1912	24975	.03	.11													625 & 645
1911	19527	.03	.28	.12	1.46											645
1910	8950	—	.39	.10	1.97	.41	5.27									"
1909	8614	—	.37	.07	1.47	.26	3.28	.70	4.70							"
1908	23018	.02	.19	.08	2.07	.20	3.59	.66	5.03	1.46	6.02					"
1907	14000	.04	.31	.14	1.59	.43	2.98	1.20	4.32	2.29	5.13	3.66	5.82			600
1906	1800		.78	.17	1.50	.34	2.22	1.12	3.44	1.90	4.44	2.96	4.82	3.35	5.26	"
							MA	NUFA	CTUR	ER.	B.					
1907	4000		.05		.90	.02	.313	.10	5.53	.52	6.55	1.79	7.73			600
							MA	NUFA	CTUR	ER.	C.					
1907	4000		.05	.02	.68	.02	2.15	.52	4.10	.87	5.32	2.34	6.77			600

worn flanges, slid flat, and removed from tenders. These diagrams illustrate the statement that a group of wheels that show up well in the first two years will show correspondingly good results throughout later years. They are also interesting as showing the great difference between various groups of wheels and the improvement that took place in 1908 and subsequent years. Figs. 11, 12, 13, and 14 show the wheels removed for worn flange, slid flat, broken or chipped flange and broken wheels for the C. P. R. 600 lbs. wheel, for which statements were given in figs. 3 and 4, and illustrate in an interesting way the numerical results which have been referred to.

Reference has been made throughout this paper to the revision of the C. P. R. foundry methods in 1908 and to the results obtained since that date, which evidently show a considerable improvement. Prior to that date the mixture had been handled by

of taping was carefully gone into and the work carried on with greater care, so it would appear that the proper carrying out of this work is most important to avoid injury to wheels from worn flanges. To the end of the 4th year the 1909 wheels are even better, so that the 1908 results were not simply accidental, but the consequence of greater care and better methods.

Fig. 4, showing broken and chipped flanges and broken wheels, is also instructive. Unfortunately no distribution is made between broken and chipped flanges, but two facts are certainly shown. The most important is that broken and chipped flanges have been greatly reduced since 1908, and since there seems no reason for any change in the chipped flanges, it is to be hoped that the broken flanges have been largely eliminated. The second is that broken wheels are a most unimportant factor, the number rarely amounting to one tenth of 1% in 10 years. These facts are of the greatest interest as showing the excellent service that may be obtained from a well made chilled wheel.

Figs, 5, 6, 7, show similar statements for the wheels supplied by three separate manufacturers, giving the same information for the same weight of wheel as figs. 2, 3, and 4. It will be seen in fig. 5 that 1907 wheels from manufacturer A compare very closely with the 1908 C. P. R. wheels on the percentage removed for foundry causes, but that for the balance of the groups of wheels, poorer results are shown. In fig. 6 the removal of wheels for worn flanges from manufacturer B is exceedingly small, while the number removed from other manufacturers compare with the later C. P. R. results. Wheels from manufacturers B and C were received under new cars, so that it would appear that in the case of B particular care was taken with the taping. In fig. 7 there is a peculiar circumstance. The broken and chipped

FIG. 7—MANUFACTURER. A.

Year Cast	No. Wheels Cast	1st Year B. F.	1st Year B. W.	2nd Year B. F.	2nd Year B. W.	3rd Year B. F.	3rd Year B. W.	4th Year B. F.	4th Year B. W.	5th Year B. F.	5th Year .B W.	6th Year B. F.	6th Year B.W.	7th Year B. F.	7th Year B.W.	Lbs.
1912	24975	.02														645
1911	19527	.02		.07	.01											"
1910	8950	.03		.18		.26	.01									"
1909	8614	.03		.23		.42		.58								"
1908	23018	.03		.11		.19		.32		.42						"
1907	14000	.01		.11		.17		.31		.38		.42				600
1906	1800	.11		.17		.34		.40		.46		.57		.68		"
							MAN	UFAC	TURE	R. B.						
1907	4000						MAN	UFAC	TURE	R. C.		.02		.02		600
1907	4000			.08		.16		21		.29		.31	.05			600

plotted records for a number of different from C. P. R. 1908 and 1909 wheels, but there are practically no broken flanges and no broken wheels from manufacturer B. This question is being investigated, but without any reason being so far obtained.

Before leaving this description of these records it is interesting to note that they

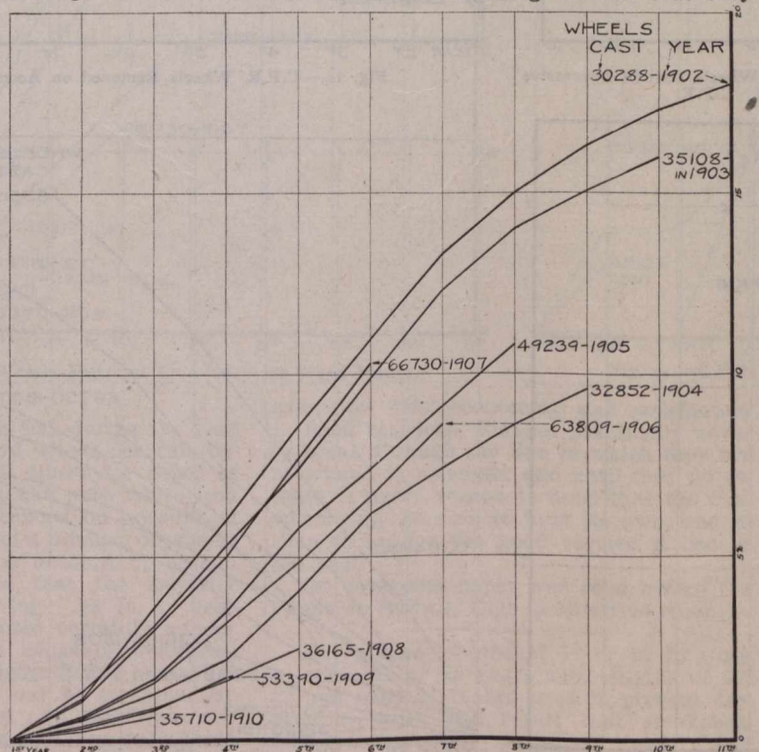

Fig. 8.—Failures Caused by Manufacturers' Defects on Wheels Cast in Successive Years for 60,000 lbs. Capacity Cars for C.P.R.

may be easily plotted and figs. 8 to 14 show weights of wheels of C. P. R. make. Figs. 8, 9, and 10 show the percentage of wheels of 600 lbs., 650 lbs., and 700 lbs. weight respectively, removed for causes other than

brands and numbers and as the records show in some years very good wheels were made and in others the results were not as good.

In 1906 and 1907, considerable trouble arose, a large number of failures occurring in service, caused, as was subsequently discovered, chiefly by iron of widely varying silicon content, but of the same brand, being used indiscriminately. The system of inspection was not sufficiently thorough to reject all wheels of improper quality, and while the records in use at that time did not indicate anything unusual, sufficient trouble developed in service to draw attention to the irregularity in the wheels. Ira B. Lesh was engaged to organize the manufacture on a basis in which the mixtures would be accurately determined by chemical analysis and the inspection effective to reject any of the product that was not of the proper quality. A proper mixture is of course only one of the factors entering into the manufacture of a satisfactory wheel and considerable attention was paid to other points as well with the results that obvious defects disappeared while the records show that a permanent improvement was obtained.

It is not the intention to make this paper one of the manufacture of chilled cast iron wheels, but in view of the enormous importance of the subject, it is interesting to describe the lines on which the C. P. R. practice has been developed and discuss the opportunities for improvement.

The writer considers one of the most important factors in obtaining good wheels is that of inspection. Absolutely uniform and perfect foundry practice is of course the great thing to obtain and the most difficult, but that is the portion of the subject which would be better described by some competent wheel manufacturer. Inspection should detect those wheels which for any reason depart from the accepted quality, and for this purpose the wheels to be tested should be selected with care and sufficient wheels broken from any days run to en-