THE BALTIMORE AND OHIO RAILROAD COMPANY
Engineering DEPARTMENT

THE HOLLOW HEADED RAIL FOUND ON HARSHMAN SIDING

THREE MILES NORTHEAST OF DAYTON, O.

(From "The Miami Conservancy Bulletin"
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Old Hollow Headed Rail Found on Harshman Siding

Interesting Pear-Shaped Sections Rolled Before Steel Came Into Use.

An interesting circumstance in connection with the wrecking of the old Big Four R. R. line, following the relocation, was the discovery of two pieces of "prehistoric" rail in use in the Harshman Siding, three miles northeast of Dayton. This siding served an old mill, still standing, dating back into the fifties of the last century. Near the end of the siding a few short lengths of light rail were found with a pear-shaped head instead of the T head now in use. Inspection showed that in addition to its peculiar shape, one of these old rails had a hollow head, as shown in Fig. 282. This picture is taken from a "sulphur print," kindly furnished by the Hunt Inspection Bureau of Chicago, who were good enough to make an examination and analysis of a section of the old rail sent them. The end of the rail was polished. A piece of photographic paper was then dipped in a dilute solution of sulphuric acid and laid on the polished face of the rail for a short time (the period being usually about one minute). The parts of the steel higher in sulphur left a darker impression on the photographic paper than those parts lower in sulphur. Thus the "sulphur print" shows in a rough way the distribution of sulphur in the specimen, this element being one of the most deleterious impurities. This action shows plainly in Fig. 282, the base and web of the rail appearing much darker than the head, indicating that the latter, which in service took the wear, was of much purer matter. Besides furnishing the sulphur print, the rail was analyzed chemically.

The etching and analysis both show that the pear-headed rail is of iron and dates back to the old days before steel had taken the place of the earlier used material. The transition began about 1865 and was due to the better wearing qualities of steel under the increasing severity of the hammering and mashing action of car wheels on the rail head; this being due in turn to the steadily increasing weight of locomotives and cars.

Thus the chemical analysis carries the date of the rail back to 1865 or earlier. The shape carries it still further back, to 1859 or 1860. This is shown by records of the Cambria Iron Company, at Johnstown, Pa., given in the upper part of Fig. 283. This series shows the shapes of the successive grooves of the rolls through which the redhot iron "bloom" or billet was passed in the mill to bring it to the final rail shape. These successive grooves are numbered "1, 2, 3, 4, 5," the last showing the identical pear-shaped hollow head found in the Harshman Siding. The date of the record is 1859.

This information was furnished by Mr. G. B. Waterhouse, Metallurgical and Inspecting Engineer for the Lackawanna Steel Company of Buffalo, N. Y., to whom also sections both of the solid and hollow-headed rail were sent.

The lower set of shapes in Fig. 283, also kindly furnished by Mr. Waterhouse, show the successive rail shapes used on American railways, from the beginning (on horse-drawn tram lines) in 1808, up to the present time. Development in size is shown as well as in shape, the rail at the right (1910 model) being 6½ inches high. The hollow pear head appears in this series, dated 1860.

It is interesting to note in this development that by 1831 the T-headed, broad-based rail, in practi-

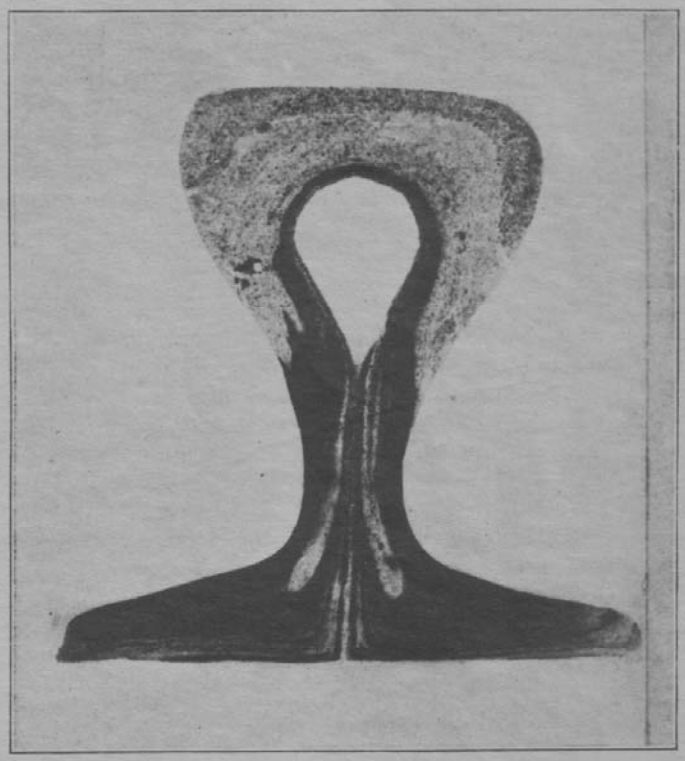

FIG. 282—SULPHUR PRINT OF OLD RAIL, DEC. 1920

This curious hollow-headed old rail was taken from the Harshman Siding of the Big Four R. R. near Dayton, where it was probably originally laid about 1860. It was rolled by the Cambria Iron Works of Pennsylvania, as roll records in their mill show, the metal being iron instead of steel, the latter metal not coming into use till 1865. The head was rolled hollow to save about 10 per cent in metal. The pear-shaped head is to reinforce the web of the rail against its tendency to bend, and thus permit one side of the head to lop down. **See page 124.**

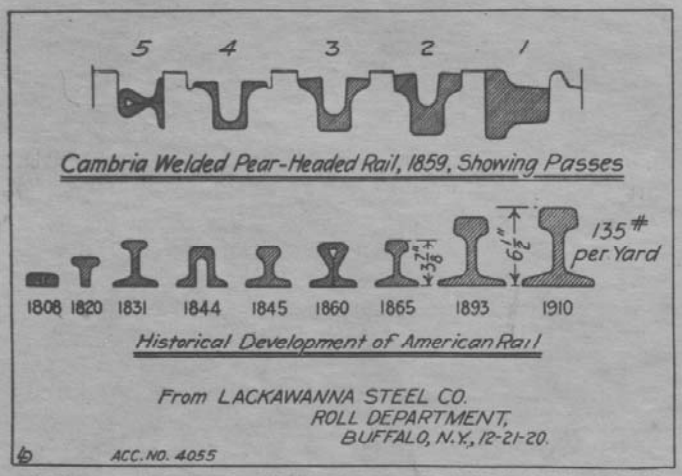

FIG. 283—PASSES USED IN ROLLING OLD RAIL

cally its present shape, had been already reached. The U-shaped and pear shaped sections, competing "Darwinian variations" which sprang up later, went to the wall in the struggle for existence where only the fittest survive. The reason for both the U-shape and the pear shape was evidently to support the edges of the rail head against the tendency to buckle or mash down under pressure of the car wheel tread. With iron, which is much softer than steel, this support was necessary, as all the sections in Fig. 283 between 1831 and 1865 show. In all these we see the broad supporting base and the somewhat narrower head, connected by a shape built stiffer than the present narrow vertical web. With the coming in of steel, a more rigid material, in 1865, these stiffer shapes were no longer necessary and to save metal were discarded.

It is interesting to note that the use of the hollow head, as in the Harshman rail, was also to save metal, the amount saved being about 10 per cent. The metal was saved at some excess labor cost for rolling the rail head hollow, indicating a relatively low labor cost at this period of manufacture.

It will be understood that the historical development shown in Fig. 283, gives dates of introduction of the several shapes. In actual use, of course, the older forms survived many years (as in the Harshman siding), gradually disappearing, and finally becoming extinct.

The Bulletin wishes to acknowledge, in addition to those mentioned, the kindness of Mr. E. T. Howson, Western Editor of The Railway Age, of Mr. C. W. Sennet, Jr., of the C. W. Hunt Co., of Mr. A. J. Sebastian of the Cincinnati Iron & Steel Co., and of Messrs. Albert Larsen, Division Engineer, and Fowler S. Smith, Purchasing Agent, of The Miami Conservancy District, in securing the information here presented.

We append Mr. Waterhouse's letter as giving some additional interesting technical matter.

The two specimens of old rails taken from a switch leading from the Mad River (Miami Conservancy District, Dayton, Ohio,) have been carefully examined.

One is a solid pear-shaped rail, and in its present condition weighs 57.6 lbs. per yard, the other is a hollow pear-shaped section and weighs 54.6 lbs. per yard.

Both rails proved to be made of wrought iron, and so are of the class of material in general use before Bessemer steel rails were made. The results of analysis were:

	Carbon	Manganese	Phosphorus	Sulphur	Silicon
Solid Rail	0.04%	0.025%	0.552%	0.067%	0.212%
Hollow Rail	0.03	0.013	0.254	0.209	0.184
Hollow Rail*	0.005	0.085	0.49		

In order to show the difference between this and present day material, below are given typical analyses of Bessemer and Open Hearth steel, such as would be used in a 60-lb. rail.

	Carbon	Manganese	Phosphorus	Sulphur	Silicon
Open Hearth	0.57%	0.75%	0.035%	0.055%	0.12%
Bessemer	0.42	0.95	0.10	0.070	0.12

Our Roll Shop Department has investigated the rolling of these two sections. The hollow pear-shaped rail was undoubtedly rolled by the Cambria Iron Company at Johnstown, Pa., about 1860. A sketch of the roll grooves for this section, as found among the old records at Cambria, is given on the accompanying blue print. There is a tradition that this hollow-headed rail was rolled at a time when the size of rail, and not the weight, was specified. The hollow place reduced the amount of metal by about 10 per cent.

The solid rail is a good example of the pear-shaped iron rails rolled at a number of places in this country from 1845 to about 1860. The so-called strap rails were discontinued about 1844. The first T-rails were designed by Robert L. Stevens, Chief Engineer, Camden and Amboy Railroad. They were 36 and 40 lbs. per yard, and rails of this kind were apparently first rolled in 1845 at the Montour Rolling Mill, Danville, Pa. The pear shape was used because it provided metal to support the sides of the head, and prevent them breaking down. The use of steel in place of iron for rails commenced about 1865, and the new design of rails from which our present sections were developed was worked out by Mr. Ashbel in 1866.

Steel became necessary because the iron rails gave very poor service as traffic and the weight of rolling stock increased. Because of lack of homogeneous material and uniformity the iron rails scaled, splintered, laminated or else disintegrated and mashed down in spots before they wore out. A brief historical development of rails in this country is shown on the same blue print as the roll passes for the old hollow rail.

* This third line shows the analysis of the hollow headed rail by C.W.Hunt & Co., the metal in this case being taken from the head of the rail, the upper analyses being of metal taken over the entire rail section. The difference corroborates the testimony of the sulphur print in indicating that the head of the rail is of purer metal.