(Continued from Page 84.)
up and set off empties on the Salisbury Branch, and in considering the failure of this rail this point should be carefully borne in mind.

The pieces were not carried any distance, with the exception of the longer ones, and this condition would naturally lead to the conclusion that the breaks were caused by the downward pressure of the engine passing over the rail ends.

A chemical analysis of the rail showed the following:

	Chemical Analysis.	Specifications Called for.
Carbon	.48	.43 to .53
Sulphur	.77	....
Phosphorus	.108	Not to exceed .10
Manganese	1.10	.80

This analysis shows the composition to be rather high in phosphorus, with manganese closely approaching the upper allowable limit. While either one in itself would not be a serious matter, the combination would tend to make a somewhat brittle rail, even though the phosphorus is no higher than is found in many good rails.

In making physical tests of this rail a weight of tup of 1,640 pounds was used, this being the only drop available in the Test Bureau. Supports were placed 3 ft. apart, and when the test piece was placed in the machine with the head up the tup was allowed to fall 10 ft., and when the test piece was placed in the machine with the head down, the tup was allowed to fall 8 ft. It was the intention to so select the height of the drop that the number of blows would show a comparison of the different rails; that is, it was so arranged that the drop would not break a rail which had been in service and was not defective, while it might break a rail which was burnt. Under these conditions the following results were secured. These conditions do not conform to those usually specified, but other rails were tested under same conditions in direct comparison:

Rail Causing Derailment at Salisbury Junction.

	—Deflection in Inches— Head Up in Supports 10-ft. Drop.	Head Down in Supports 8-ft. Drop.
1st Blow	.65	broke
2nd Blow	1.20	......
3rd Blow	1.80	......
4th Blow	2.25	......
5th Blow	2.75	......
6th Blow	broke	......

The rail placed with head up broke with fine crystalline fracture, near supports. Rail with head down broke near center, on first blow, with a fine crystalline fracture.

Rail of Maryland Steel Company Tested for Comparison With Above.

	—Deflection in Inches— Head Up in Supports 10-ft. Drop.	Head Down in Supports 8-ft. Drop.
1st Blow	.61	.62
2nd Blow	1.30	1.06
3rd Blow	1.80	1.44
4th Blow	2.22	broke
5th Blow	2.75	......
6th Blow	3.25	......
7th Blow	broke	......

This rail was perfect so far as known, but had seen service in track. With head up the test piece broke near support with a fine crystalline fracture. With head down it broke near the center with similar surface appearance.

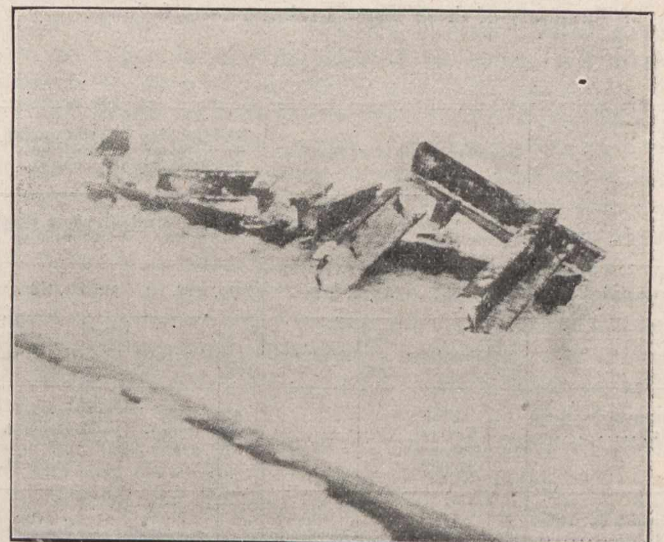
A further comparative test of rail of the Cambria Steel Company's manufacture showed the following:

	Head Down in Supports 8-ft. Drop.
1st Blow	.73
2nd Blow	1.28
3rd Blow	1.74
4th Blow	2.22
5th Blow	2.58
6th Blow	broke

This rail also broke near center with fine crystalline fracture. A common and noticeable feature of all these breaks is that with head up they break near supports, while with head down they break near the center, but the burnt rail broke under a much less number of blows whichever way it was placed, and with a very much less final deflection.

The second instance in which any extended test was made of the chemical and physical properties of the failed rail occurred at Shenandoah Junction, as a westbound passenger train was pulling out from the station. This rail broke into five pieces and had been, evidently, badly burnt by slipping of the drivers as the engine started the train up a quite heavy grade from the station. The brittleness of this rail was further indicated by its breaking at one point while it was being cut at another by the section foreman.

This rail was rolled by the Carnegie Steel Company in 1896, of A. S. C. E. section, 85 pounds per yard. There was no surface indication of defect in the rail, and roadbed conditions were good and not contributary causes to this failure. Track was fully ballasted with stone and had good drainage, and the ties were in good condition and properly spaced. No undue strains were brought to bear on the rail by longer supports between ties or by any unusually flexible ballast.



Views Showing Pieces of Rail which Broke at Salisbury Junction.

The curve at this point was 4° 30′ and had an elevation of 3½ in., with gauge ¾-in. wide at the point of failure, caused by wear of rail over the standard gauge of 4 ft. 8½ in. on this degree of curvature. The grade was 0.75 per cent. ascending, westbound. The chemical analysis of this rail showed the following:

Rail Causing Derailment at Shenandoah Junction.

	Chemical Analysis.	Specifications Called for.
Carbon	.48	.43 to .53
Sulphur	.027	....
Phosphorus	.095	Not to exceed .10
Manganese	.76	.80

The chemical composition of this rail is apparently good, but microscopical examination showed small cracks in the head, which may have been produced by slipping of the drivers, since these surfaces of the metal at the crack showed the characteristic blue color due to heating.