Inv-2225

INTERSTATE COMMERCE COMMISSION

WASHINGTON

REPORT OF THE DIRECTOR

BUREAU OF SAFETY

ACCIDENT ON THE

NORFOLK & WESTERN RAILWAY

BLUEFIELD, VA.

NOVEMBER 20, 1937

INVESTIGATION NO. 2225

SUMMARY

Inv-2225

Railroad:	Norfolk & Western
Date:	November 20, 1937
Location:	Bluefield, Va.
Kind of accident:	Derailment
Train involved:	Passenger
Train number:	24
Engine number:	133
Consist:	5 cars
Speed:	35-40 m.p.h.
Track:	7°7' curve right
Time:	9:00 a.m.
Weather:	Light snowfall
Casualties:	2 killed; 72 injured
Cause:	Not definitely determined but probably due to distortion of track alignment resulting from the movement of bridge spans on their piers.

Inv-2225

December 27, 1937.

To the Commission:

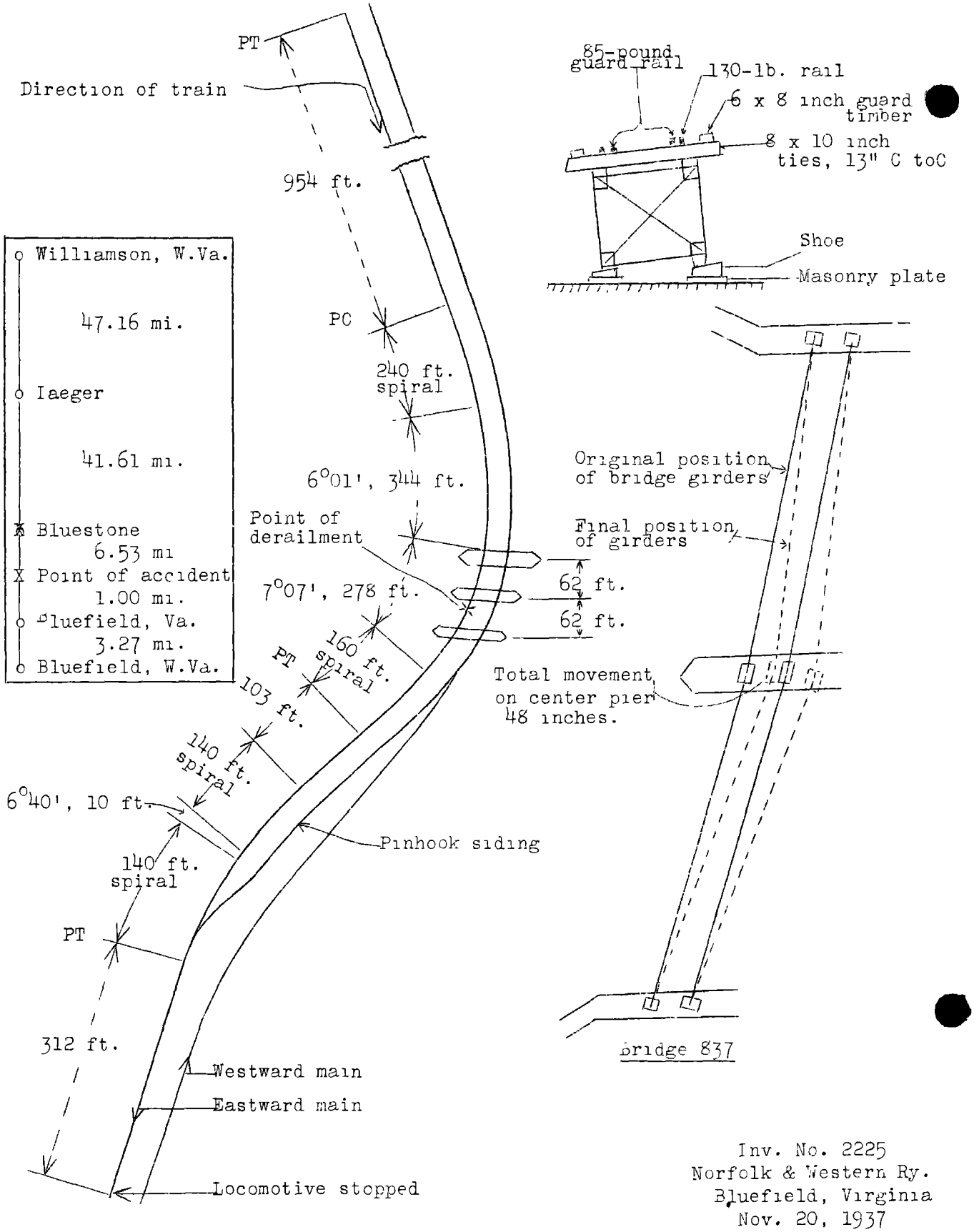
On November 20, 1937, there was a derailment of a passenger train on the Norfolk & Western Railway, near Bluefield, Va., which resulted in the death of 2 passengers, and the injury of 70 passengers and 2 employees.

Location and method of operation

This accident occurred on that part of the Pocahontas Division which extends between Williamson, W. Va., and Bluefield, W. Va., a distance of 93.57 miles. In the vicinity of the point of accident this is a double track line over which trains are operated by timetable, train orders and an automatic block-signal system. Both electric and steam power are used for propulsion in this vicinity; the train involved in this accident was being hauled by a steam engine. The point of initial derailment was on Bridge 837, about 12 feet east of the middle of this bridge which is located approximately 1 mile west of Bluefield, Va.; the general derailment occurred about 250 feet farther east at the west end of Pinhook Siding which is in effect a cross-over about 550 feet long connecting the eastward and westward main tracks. In this vicinity the tracks lie generally north and south but timetable directions are used in this report. The maximum authorized speed for passenger trains is 40 miles per hour.

Approaching the point of accident from the west the eastward main track is tangent for 954 feet to a compound curve to the right consisting of a 290 foot spiral, 344 feet of 6° 1' curve, 278 feet of 7° 7' curve and a 160 foot spiral; this curve is followed by 103 feet of tangent track and a compound curve to the left consisting of a 140 foot spiral, 10 feet of 6° 40' curve and another 140 foot spiral, after which the track is tangent for 312 feet. The west end of the 7° 7' curve is at the west end of Bridge 837. The grade is 0.18 percent ascending for east-bound trains.

Bridge 837 spans the Bluestone River; separate steel structures are provided for each main track and these are supported by common stone abutments at the east and west ends, and a common stone center pier. On the eastward track the bridge is an open deck plate girder bridge consisting of two spans each approximately 62 feet long. This bridge was erected in 1912 and was designed to withstand a load of five 55,000 pound axles spaced 5 feet center to center and preceded and followed by a



Inv. No. 2225
Norfolk & Western Ry.
Bluefield, Virginia
Nov. 20, 1937

uniform load of 5,500 pounds per lineal foot. The unit tensile strength used in the design was 15,000 pounds per square inch. The rating of this bridge corresponds to Cooper's loading E-56. When the bridge was originally installed the girders were tilted to provide the necessary superelevation of the outer rail. The girders were supported by tapered steel castings; the sole plate was riveted to the bottom flange angles of the girders and the castings and masonry plates were secured to the masonry by anchor bolts. Both the top and the bottom lateral systems of each span consisted of a single independent diagonal lateral brace at each end of each span and a single lacing of 9 diagonal braces set at angles of approximately 45° to the girders. Additional bracing was provided by 4 internal cross braces to each span. The bridge ties are 8 inches by 8 inches by 10 inches and are spaced 13 inches center to center; they are dapt 3/8 to 3/4 inch where they rest upon the girders and each fourth tie is secured to the girders with an anchor bolt. Timber guard rails 13 inches outside of the track rails are anchored to the ties with drift bolts. Steel guard rails of second hand 85-pound rail are single spiked 8 inches inside the track rails. The masonry plates on the center pier are common to the abutting girders; the south plate is 5 feet 8 inches by 30 inches while the north plate is 5 feet 7 inches long and 33 inches wide.

About five years ago, due to the application of additional ballast to the roadbed, the level of the bridge was raised by placing 8 inch by 10 inch oak timbers between the masonry and the masonry plate; the steel structure was not anchored to the blocking or to the masonry and has remained unanchored since that time.

The track is laid with 130-pound rail on the elevated side of curves and 131-pound rail on the low side of curves and on tangent track. The rail is in 39 foot lengths and is provided with four-hole continuous type rail joints and ten rail anchors to the rail length. The track is fully tie-plated and double spiked, and except on the bridge it is laid on an average of 24 treated ties per rail length in crushed stone ballast about 24 inches deep. Track maintenance is excellent and the rail was not appreciably curve-worn.

There was a light snow fall at the time of accident which occurred about 9:00 a.m.

The locomotive involved in this accident is of the 4-8-2 type having a total weight in working order of 352,000 pounds exclusive of the tender. The distribution of weight is as follows:

Engine truck	51,500 pounds
No. 1 driving axle	59,500 "
No. 2 " "	61,600 "
No. 3 " "	60,900 "
No. 4 " "	61,000 "
Trailer truck	57 300 "

The driving axles are spaced 73 inches apart, the engine truck wheels are spaced 86 inches apart and the rear engine truck wheel center is 55 inches from the center of the No. 1 driving axle. The distance between the center of the No. 4 driving axle and the center of the trailer truck axle is 120 inches. The tender has a loaded weight of 271,200 pounds and a wheel base of 31 feet 11¾ inches. The trucks are of the six wheel type with articulated side frames. The wheels are spaced 4 feet 6 inches center to center in each truck and the distance between the center of the No. 3 axle to the center of the No. 4 axle is 13 feet 11¾ inches.

Description

No. 24, an east-bound passenger train, consisted of one storage mail car, one express car, one combination express and baggage car, and two coaches, in the order named, of all-steel construction, hauled by engine 133, and was in charge of Conductor Godfrey and Engineman Shelton. This train departed from Bluestone, W. Va., the last open telegraph office, located 6.5 miles west of Bridge 837, at 8:47 a.m., 46 minutes late, according to the train sheet, and was derailed at Bridge 837 while traveling at a speed estimated at 40 miles per hour.

The engine and tender remained coupled to the head car and stopped 1,019 feet east of the bridge with the forward tender truck off center and derailed to the south. The head car was not derailed; the second car stopped on its left side across the side track, about 350 feet west of the rear end of the head car. The third and fourth cars were derailed and stopped upright, parallel to each other, about 250 feet west of the second car, off from their trucks. The rear car was derailed; the body left the trucks, turned over down an embankment about 18 feet high and stopped on its right side parallel to and about 50 feet south of the main track, slightly west of the preceding cars in the train. The trucks of the derailed cars were so badly scattered that it was impossible to determine to which cars they belonged.

The employees injured were the conductor and flagman.

Summary of evidence

Engineman Shelton stated that the air brakes were tested at Williamson and functioned properly en route. The riding qualities of the engine were good and the maximum speed of 40 miles per hour was not exceeded at any time. Approaching Bridge 837 the speed was about 40 miles per hour and no brake application was necessary to control the train at that place. The throttle was open sufficiently to haul the train at the maximum authorized speed, and the brake valve was in running position. His first knowledge of the derailment came when the front tender truck struck the cross-over frog, making an unusual noise. He immediately closed the throttle and moved the brake valve to emergency position but no exhaust of air occurred. He was not aware of any application of the brakes prior to the time he moved the brake valve to emergency position and attributed this to the fact that after the train broke in two the engine was hauling one car with the brake applied. While his engine was passing over the bridge he did not feel any movement of the bridge and there was no indication that the track was out of line. At the time of the derailment the tender was about one-fourth full of water and there was about two-thirds of a tank of coal. After the accident he could find nothing about the front tender truck that would have caused the derailment.

Fireman Rhudy stated that the maximum speed of 40 miles per hour was not exceeded between Bluestone and the point of accident and it was not necessary to reduce the speed of the train for the curve on which the accident occurred. Approaching Bridge 837 he did not see anything to indicate that the track was out of line, and there was no abnormal movement of the engine while on the bridge. Just as the engine was leaving the bridge he felt a peculiar jerk and the engine gave a lunge. He looked across the cab and saw the engineman close the throttle and reach for the brake valve. At this time the engine was about one-third of the distance between the bridge and the west end of the cross-over. Prior to this time he had not noticed any application of the brake.

Conductor Godfrey stated that he was in the fourth car when the derailment occurred; the car was derailed as it left the bridge. The train was running smoothly at about 40 miles per hour and there was no unusual movement of the coach before it was derailed. He fixed the time of the accident as between 8:55 and 9:00 a.m.

Brakeman Keeler was also in the fourth car; he noticed no unusual movement of the train as it moved over the bridge, and estimated the speed as between 35 and 40 miles per hour just

prior to the derailment.

Assistant Road Foreman of Engines Jackson stated that he boarded No. 24 at Iaeger, 41 miles west of Bridge 837, and went to the rear coach. Because the train was late he paid particular attention to the speed and noted that the 40 miles per hour speed limit was not exceeded and that movement on the curves was not uncomfortable. No. 24 left Bluestone about 8:48 a.m. His first intimation of derailment came when the coach started swaying and bumping as it was leaving the bridge; the front end gradually eased southward and then the car rolled down the embankment. He did not notice any application of the brakes just prior to the derailment, and there was no run-in, surge or jerk at that time.

Conductor Douthat of train No. 84 stated that his train passed over Bridge 837 at a speed of 25 to 30 miles per hour about 30 minutes ahead of No. 24. He was in the cupola of the caboose at the time and did not notice anything indicating that the bridge or track was out of line.

Chief Chemical and Test Engineer Coddington stated that when he arrived at the scene of the accident the engine, tender and head car had not been moved. The front truck of the tender was completely derailed to the south with the leading wheels about 14 inches away from the rails, and was off center to the right of and about 2½ or 3 feet back of its proper position. Absence of ballast in the deep pockets of the cast steel side frames indicated that this truck had not been a great distance from the rails. The rear truck of the tender and the leading truck of the head car had not been derailed and this car was still coupled to the tender, with air and steam heat connections intact. The rear truck of the head car was about 2 feet off center and there was evidence that it had been derailed and had plowed deeply into the ballast on the north side of the track, but had been rerailed at the frog of the east crossover. His inspection of the front tender truck at the scene of the accident, and later at Bluefield accompanied by the Commission's Inspectors, revealed that the flanges of all six wheels were well within the normal limits of wear as determined by the A.A.R. standard gauge. Back to back measurement of the No. 1 and No. 2 pairs of wheels showed no variation; there was a variation of 1/8th inch in the No. 3 pair. The brake rigging on the front wheels was torn loose. A portion of the brake shoe had been broken from the left No. 1 brake head, and the brake shoe was entirely missing from the right No. 1 brake head but the key was still in place and the brake head was not worn. The No. 1 pair of wheels were out of position to the right. The tie bar between the left No. 1 journal box and the side frame was knocked loose at the point

where it had been attached to the side frame lug by 2-7/8ths inch rivets and the rivets were missing. The front end of the journal box was badly crushed and together with the box bolts was bent backward. The centering boss on the truck bolster was broken off and the fracture appeared to be old. The top surfaces of the side bearings and that of the female center casting were polished and showed uniform wear. In his opinion the variation in the back to back measurement of the No. 3 wheels did not constitute an unsafe condition; the front of the left No. 1 journal box was crushed inward and the tie bar rivets sheared off when the box struck the cross-over frog; and the broken centering boss could not have contributed to the cause of the derailment because the male portion of the center casting would be guided by the female portion which is 1-7/8ths inches in height.

Master Mechanic Brown stated that he made a thorough inspection of the engine, its tender and the passenger cars on the morning of the derailment. There were no broken or missing parts on the locomotive. Neither the coupling bar between the engine and tender nor the coupler on the rear of the tender showed any evidence of twisting. There were no broken or burned journals in any of the passenger car trucks nor was there any other evidence that a failed truck had contributed to the cause of the accident. The side bearing blocks, the broken portion of the centering boss, and the tie bar rivets from the front tender truck were found on the eastward main track within a short distance of the east cross-over switch. The fracture of the boss was apparently old. His opinion regarding the damage done to the left No. 1 tender truck box and its tie bar agreed with that of Test Engineer Coddington, and the location of the centering boss and side bearings after the derailment led him to believe that the truck was forced off center at the east cross-over switch.

Section Foreman Peery stated that the superelevation on the curve involved is maintained at 5 inches and a speed of 40 to 45 miles per hour is safe. He made a general inspection of the bridge and checked the gauge and elevation about a week before the accident and found everything in good condition. He passed over the bridge on November 17 and it appeared to be all right at that time.

Roadmaster Clifton stated that he made an inspection immediately after the accident and found that the entire bridge together with the track had been pushed to the north but the rails had not moved from their location on the ties. The track immediately west of the bridge was in proper alignment and fit for use. Two broken rails were found, one on the high side and one

on the low side of the curve at points 119 feet 8 inches, and 78 feet, respectively, east of the east end of the bridge. Three of the exposed surfaces were clean new fractures but one showed some discoloration, apparently grease. None of the broken ends showed evidence of having been struck. He had inspected the track in this vicinity within about three weeks prior to the accident and found it to be in proper alignment.

Assistant Superintendent Burton stated that he arrived at the scene of the accident about 10:00 a.m., and immediately inspected the track. The ends of the girders on the center pier were shifted to the north 48 inches and there had been a slight movement of the bridge at its east and west ends. From a point 20 feet east of the initial marks of derailment westward the rails had not moved from their original location on the bridge ties and the track west of the bridge was not disturbed. He gauged the track on the bridge at once and found the gauge good. The bridge spans were then moved by jacks to their former locations on the center pier; the blocking between the masonry and the masonry plate was not changed. The east and west ends of the bridge returned to their former location during this operation. He inspected the track west of the point of derailment but could find no marks on the rails or roadbed. Badly damaged ties on both the eastward and westward tracks a short distance east of the marks of initial derailment led him to believe that a truck or trucks had become fouled between the two tracks at the east back wall of the bridge and the momentum of the train had then shifted the bridge to the north.

J. R. Derrick, Assistant to the General Manager, stated that he arrived at the scene of the accident about 1:45 p.m. At a point about 12 feet east of the center pier he found two marks 4 or 5 inches apart on the high rail, and at a point about 5 feet farther east he found two similar marks about 4 or 5 inches apart on the same rail. These were made by wheel flanges crossing the rail, and on the north side of the high rail there were flange marks on the ties. From this point to the east end of the bridge the steel guard rail along the south rail was ripped up. Eastward from the bridge the track was knocked slightly out of line for about 50 feet and then for a distance of 150 to 175 feet the track was thrown off the roadway, after which it was badly out of line to the point where the locomotive stopped but excepting the lead rails and switch points of the east cross-over switch it was not torn up. He thought the tender truck was the first to be derailed and the marks on the rail and ties of the bridge indicated that it had been derailed to the north; however, when he inspected the truck where it stopped he found it derailed to the south. He then examined the crossover frog and found marks on the wing rail

of the frog which indicated that the wheels had moved to the south side of the rails while passing over the frog.

C. P. Russell, Supervisor of Bridges and Buildings, stated that the annual inspection of this bridge was made on October 14, 1937, and it was found to be in good condition. On October 18 he passed over the bridge on the rear of a train and noticed nothing wrong with the alignment. His inspection of the bridge shortly after the derailment disclosed that the ends of the girders of both spans had moved northward on the center pier about 48 inches. On the south side the girders were still on the blocking but on the north side the girders were off the blocking, and on that side the shoes under the girders had slipped off the masonry plate and the end of the masonry plate was inclined so that the ends of the girders were unsupported. The blocking on the south side had moved about 30 inches but on the north side the blocking had remained intact and the masonry plate had slipped over it. On the west abutment the girders had moved 4 inches northward, and on the east abutment they had moved about 4 inches southward. The track was thrown to the north and was somewhat kinked. Fifty ties were damaged, and seven guard rails and five lateral braces were broken, all of the latter in the west span. He stated that in bridges where no blocking is used the girders are anchored to the masonry, and in some cases where blocking is used they are anchored. The recent practice in placing blocking under bridges is to anchor it to the masonry. There are other bridges which are blocked in the same manner as Bridge 837 and occasionally these bridges are found slightly out of line. He was of the opinion that anchorage of the girders of Bridge 837 was unnecessary and that normal conditions of train movement would not cause movement of the bridge. He thought that the movement of the bridge was caused by internal impact in the train due to sudden retardation of the head end during the derailment, and that if any part of the train had passed over the center pier while the ends of the girders were unsupported by the blocking collapse of the bridge would have resulted.

Bridge Engineer Stone described the method used to raise Bridge 837 to meet the new track level resulting from the application of additional ballast to the roadbed. He stated that when this was done no anchor bolts were used to secure the bridge to the blocking or to the masonry, and because of this the factor of safety may have been slightly reduced. His examination of the bridge some time after the accident showed that the ends of the girders had moved about 48 inches northward on the center pier; that both spans had moved was due to the fact that the spans were tied together by the rails which constituted a continuous band along the entire structure. He thought that any

force which would be exerted by the normal operation of a train would be insufficient to cause a movement of the girders on the blocking and that in order to produce such a force a speed of between 65 and 70 miles per hour would be necessary; at such a speed there would have been a likelihood of the train turning over. The force produced by the angling of derailed trucks on cars which were being kept in motion by the pulling of the locomotive might be sufficient to cause movement of the structure. In his opinion the movement of this bridge was the result of the derailment rather than a cause of it, and the fact that the ends of the north girders had moved entirely off the blocking on the center pier and were thus placed in suspension indicated that the final movement of the bridge took place after the last car had passed that point. Had this not been true the bridge would have collapsed. He was also of the opinion that the breakage of five bottom lateral trusses in the west span was caused by the horizontal movement of the bridge which put the laterals under a compressive stress, causing them to buckle.

R. G. Henley, Superintendent of Motive Power, reported that a test of the rails which were broken during the derailment revealed no inherent defects which would have caused fracture.

Observations of the Commission's Inspectors

Examination of the track disclosed marks and other evidences of derailment as described by the various officials and employees except that the scars on top of the north rail of the bridge had been obliterated by traffic, and that the flange marks on the outside of the north rail continued to the end of the bridge and for 20 feet beyond on the abutting roadbed. About 30 bridge ties had been renewed on the eastward track near the east end of the bridge; except for these renewals there was no evidence of any repairs having been made anywhere on the bridge.

An inspection of the front tender truck, the derailed cars, the broken rails and the locomotive developed nothing in addition to the information contained in the statements made by railway officials and employees.

Discussion

Investigation disclosed that this derailment occurred on a bridge, on a 7° 7' curve on which the superelevation of the outer rail was 5 inches, the speed of the train at the time of derailment being approximately 40 miles per hour, which is the maximum authorized speed for passenger trains at this point. The engine was not derailed; the forward tender truck was derailed; the rear tender truck and the forward truck of the first car were not derailed; the rear truck of the first car apparently had been derailed but had been rerailed at the crossover frog east of the

bridge. The second, third, fourth and fifth cars were entirely derailed. It therefore appears that there were separate derailments at two points in this train, first the forward tender truck, and secondly the rear truck of the first car or the forward truck of the second car which was succeeded by the derailment of all following trucks. Apparently all of the derailed wheels left the rails within a very short span. Two flange marks crossing the high rail appeared about 12 feet east of the bridge center pier, and about 5 feet farther east two other similar marks were found. From these points eastward, bridge ties, guard timbers and guard rails bore marks of derailed equipment. The fireman felt a jerk just as the engine was leaving the bridge; other employees in the third and fourth cars noticed no preliminary swaying or swerving, the derailment occurring just as they were passing off from the bridge; the assistant road foreman said there was violent swaying and bumping of the rear car as it was leaving the bridge.

Following the accident no defective condition of wheels or trucks could be found which would account for this accident. The forward tender truck was badly damaged but so far as could be determined this damage was a result and not the cause of the derailment. Car trucks were widely scattered, but no defect was discovered which could be assigned as the probable cause of the accident.

There is no evidence that this accident was caused by excessive speed. All of the employees estimated the speed prior to derailment at or near the maximum authorized rate, 40 miles per hour, and the position of equipment following derailment does not indicate excessive speed.

After the accident there were two broken rails, one 78 feet and the other 119 feet 8 inches east of the east end of the bridge; however, the broken ends did not show any indication of having been struck or run over by car wheels, and the location of these fractures indicates that they were a result rather than the cause of the derailment.

After the accident the bridge and track were considerably out of line. The bridge girders on the center pier, together with the track, were shifted to the north 48 inches, and at the opposite ends a few inches to the south. However, the evidence indicates that this condition was at least for the most part a result of the derailment. The forward part of the train passed over the bridge without any abnormal movement; after the accident the ends of the north girders were unsupported, and both the Supervisor of Bridges and the Bridge Engineer stated that had

any part of the train passed over this point when this condition existed collapse of the bridge would have resulted. Breakage of lateral trusses also appeared to be the result of movement of the bridge structure after derailment.

The steel structure of this bridge was not anchored to the blocking or to the masonry; this condition had existed for a period of about five years, since the level of the bridge was raised to conform to the changed level of the roadbed due to the application of additional ballast. Other bridges which are blocked in the same manner are occasionally found slightly out of line and under present practice on this road blocking placed under bridges is anchored to the masonry.

The results of this investigation point to the probability that the bridge, or the alignment of the track on the bridge, was slightly distorted by the engine of this train, or be preceding trains, sufficiently to cause derailment of the forward tender truck wheels and some of the wheels of following cars, and that the derailed wheels and the momentum of the train set up forces in the track and bridge which forced the bridge out of position and broke the rails east of the bridge.

Conclusion

It is believed that this accident was caused by the failure of a bridge.

Respectfully submitted,

W. J. PATTERSON,

Director.