Inv-2313

INTERSTATE COMMERCE COMMISSION

WASHINGTON

REPORT OF THE DIRECTOR

BUREAU OF SAFETY

ACCIDENT ON THE

WESTERN PACIFIC RAILROAD

OROVILLE, CALIF.

NOVEMBER 30, 1938

INVESTIGATION NO. 2313

SUMMARY

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Railroad:	Western Pacific
Date:	November 30, 1938
Location:	Oroville, Calif.
Kind of accident:	Derailment
Train involved:	Passenger
Train number:	2
Engine number:	171
Consist:	8 cars
Speed:	45-55 m.p.h.
Operation:	Timetable and train orders
Track:	Single; 6° right curve; 0.082 percent descending grade eastward
Weather:	Cloudy
Time:	3:49 p. m.
Casualties:	4 injured
Cause:	Excessive speed on sharp curve; possibly a broken engine driving spring was a contributing cause.

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January 27, 1939.

To the Commission:

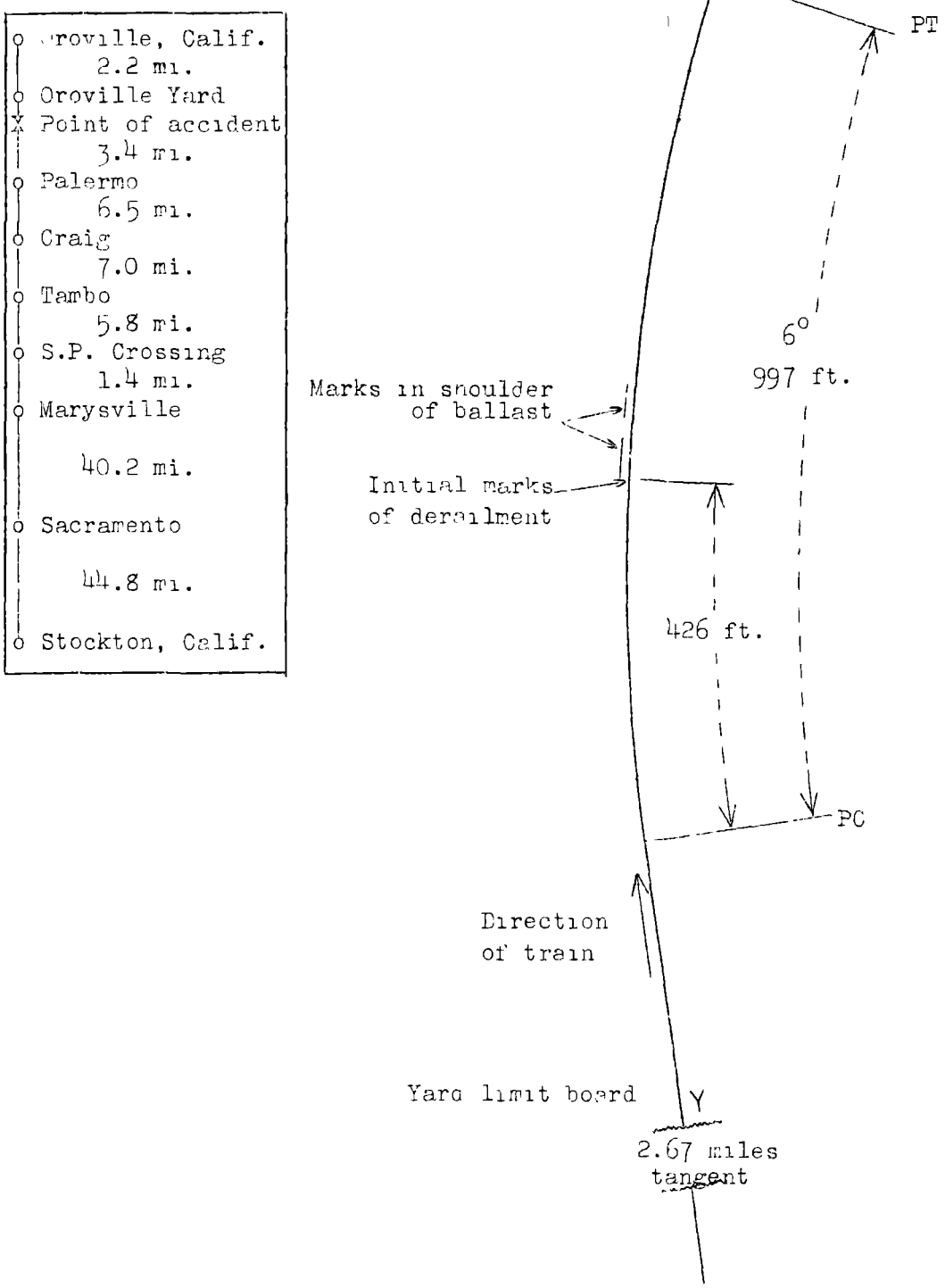
On November 30, 1938, there was a derailment of a passenger train on the Western Pacific Railroad at Oroville, Calif., which resulted in the injury of one railway mail clerk and three railroad employees. This accident was investigated in conjunction with the Railroad Commission of California.

Location and Method of Operation

This accident occurred on that part of the Western Division designated as the Second Subdivision which extends between Stockton and Oroville, Calif., a distance of 111.3 miles. In the vicinity of the point of accident this is a single-track line over which trains are operated by timetable and train orders, no block system being in use. Timetable directions are used in this report. The accident occurred within yard limits at a point 726 feet east of the west yard-limit board at Oroville; approaching from the west the track is tangent 2.67 miles, followed by a 6° curve to the right 997 feet long, including spirals; the accident occurred on this curve at a point about 426 feet from its western end. Each spiral is 154 feet long; the superelevation on the simple curve is 5 inches and the run-off is $1\frac{1}{2}$ inches per 100 feet. Eastward from the curve involved there is a tangent 377 feet long, which is followed by a $1^{\circ}40'$ curve to the left 2,689 feet long. The grade eastward is 0.4 percent ascending 2.33 miles, then there is a vertical curve 1,000 feet long, followed by about 1,000 feet of 0.082 percent descending grade to the point of accident and about 1,500 feet beyond.

Approaching from the west the track passes through a cut approximately 4,500 feet long and emerges therefrom at about the point of accident, beyond which it follows along the side of a hill with a cut on the south side and a fill on the north side of the track. At the point of accident there is a ditch 2 feet deep and 2 feet wide along the north side of the track; beyond the ditch there is an embankment sloping to 2 feet above the top of the ties at a point 20 feet from the track and from this point the embankment slopes downward to a point below the track level.

The track structure consists of 85-pound rail, 33 feet in length, laid on 20 treated ties to the rail length; it is fully tieplated with canted plates, double-spiked, equipped with



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four-hole angle bars fully bolted with bolt heads staggered and also with three rail anchors per rail in each direction; it is ballasted with crushed stone to a depth of 12 or more inches below the ties and is well maintained. The maximum speed for passenger trains in this territory is 60 miles per hour, and speed on the curve involved is restricted to 50 miles per hour.

The weather was cloudy at the time of the accident, which occurred about 3:49 p. m.

Description

No. 2, an east-bound passenger train, consisted of one mail car, one baggage car, one coach, one diner, two tourist cars, one Pullman car and one observation car, in the order named, all of all-steel construction, hauled by engine 171, of the 4-8-2 type, and was in charge of Conductor Murphy and Engineman Patterson. This train left Stockton at 12:55 p. m., according to the train sheet, on time, made various stops en route, and shortly after entering the yard limits at Oroville it was derailed while rounding a curve at a speed estimated to have been from 45 to 55 miles per hour.

Engine 171 and its tender stopped to the north or outside of the curve on their sides about 86 feet from the track, with the front end of the engine about 500 feet east of the initial mark of derailment which was a scrape mark in the shoulder of the ballast on the outside of the curve. The first car made a complete side revolution and stopped upright between the engine and the track. The second car stopped upside down 80 feet east of the engine, 15½ feet north of the track and almost at right angles thereto. The forward truck of the third car was derailed but remained on the ties and stopped 1,228 feet east of the initial mark of derailment, the rear five cars remaining coupled to the third car. The employees injured were the engineman, the fireman and the express-baggageman.

Summary of Evidence

Engineman Patterson stated that he made an inspection of the engine before leaving Oakland, located 90.3 miles west of Stockton, and everything appeared to be all right. A proper air-brake test was made leaving Oakland Pier. The mail car was picked up at Sacramento, 44.8 miles east of Stockton, and a running test of the air brakes was made when leaving that point; after this several stops were made en route, the last stop being at Binney Junction, 21.68 miles west of the point of accident, where a delay of five minutes was occasioned by a Southern Pacific train. While passing Palermo, about 2.4 miles west of the point of accident, at a speed of about 55

miles per hour, he glanced at his watch and thought it read 3:47 or 3:48, and he estimated that his train would arrive at Oroville about 8 or 10 minutes late, but he made no effort to recover lost time. Steam was worked up the hill to Oroville Yard but the engine gradually slowed down. He eased off the throttle when he saw the top of the hill and making a light air-brake application started through the cut planning to enter the curve at a speed between 45 and 50 miles per hour. When rounding the curve he made a light brake application and without warning the engine suddenly lurched, slumped down on the left front end, then started to turn over, at which time he estimated the speed to have been about 48 miles per hour; steam was being worked as he did not have time to close the throttle. Prior to the accident the engine rode well and he did not notice anything wrong with its condition, and at no time between Marysville and the point of accident was a speed of 60 miles per hour exceeded. There was no obstruction on the track. This was the second trip he had made as passenger engineman eastward into Oroville, the trip prior thereto having been made about four months previously; however, about half of the time since 1923 he had acted as fireman between Oakland and Oroville. He qualified as passenger engineman about October, 1937. About four months previous to the accident he made four round trips as fireman between Oakland and Oroville on an engine of the same type as the one involved in the accident. He considered himself familiar with all conditions between Oakland and Oroville, and understood the operation of engines of the type involved. He operated the engine according to what he thought the curve would stand, and stated that he had fired for enginemen who entered the curve the same way. He did not know what caused the accident.

Fireman Sanford was interrogated in a hospital; he had been on this subdivision before, but this was only his second trip in passenger service. The engine rode well en route and he did not notice anything unusual about its condition. The speed was reduced at a point several miles west of the point of accident and then increased to about 60 miles per hour. Approaching the curve involved he thought the speed was excessive, about 50 or 55 miles per hour, and he anticipated that the engineman would slow down, but no air-brake application was made prior to reaching the curve. He said he was standing and shutting off the steam-heat valve when the engine turned over and that no lurch occurred before it turned over.

Conductor Murphy stated that nothing unusual transpired on the trip prior to the accident. After leaving Binney Junction no stops were made; he was in the rear end of the third car. While rounding the curve involved at a speed of about 50 miles per hour there was a severe jolt but he did not feel any air-

brake application. He stated that he did not recall any time en route when the speed exceeded 60 miles per hour. After the accident he did not notice any obstruction on the rail or track. He could not say what actually caused the accident, unless it was because the engine was top heavy.

Head Brakeman Washburn did not notice any change in the speed after leaving Binney Junction. He was in the head end of the smoker and as the train entered the curve involved at a speed of about 50 miles per hour he felt a light air-brake application being made, about the same time that a jolt was felt. He stated that some time was made up between Binney Junction and the point of derailment.

Flagman Gould stated that after leaving Binney Junction he thought that time was made up; he was in the vestibule of the lounge car when the accident occurred and he did not notice anything unusual between Binney Junction and the point of accident. He did not notice any air-brake application or any reduction in speed after entering the curve involved.

Telegrapher Ford, at Oroville, stated that the wires failed at 3:49 p. m., the telephone line circuit being broken as a result of the derailment.

Division Engineer Williams arrived at the scene of the accident about 6:30 a. m., December 1. A chart revised January 11, 1937, showing A.R.E.A. superelevation table for this railroad on a 6° curve with a superelevation of 5 inches, prescribed 36 miles per hour as the equilibrium speed, 45 miles per hour as the comfortable speed, 51 miles per hour as the safe speed and 78 miles per hour as the overturning speed. The chart carries a recommendation that the comfortable speed should not be exceeded by steam trains. He furnished a print which indicated that the left cylinder of the engine first scraped the shoulder of the ballast on the outside of the curve at a point 419 feet from the western end of the curve; this mark paralleled the track and extended eastward 49 feet, then apparently the engine straightened up a distance of 19 feet, at which point the mark reappeared. At this point the first tie mark was 14 inches outside of the north rail, apparently made by the tender step or the cylinder cock, then the ends of the ties were broken off and the ballast shoulder was again scraped; the scrape mark extended 36 feet in a tangent away from the track. Opposite this latter point marks which were not flange marks appeared on the ties between the rails extending toward the outside of the curve, and at a point 48 feet beyond the engine hit the side of the cut and started sliding on its side. Check of the curve showed the superelevation and the run-offs to be practically uniform, with only three joints 1/8 and $\frac{1}{4}$

inch out of proper surface. The gage was from ¼ inch to ½ inch wide. There were no marks on the rail or ties west of the initial point of derailment to indicate dragging equipment or any obstruction on the rail that would cause the derailment. The engine did not climb the rail; it turned over on its side; the pony trucks and the trailer trucks remained attached to the engine. There was nothing wrong with the track or engine. No previous derailment had occurred on this curve. He thought the curve was safe for a speed of 50 miles per hour as a factor of safety was provided up to 55 or 58 miles per hour, and said that he would not make any recommendation for a change of speed limit around this curve. He attributed the accident to excessive speed.

Trainmaster Duggan examined the track and equipment at the scene of the accident; he had no definite opinion as to the cause of the accident, but he thought excessive speed was not involved, saying that Engineman Patterson had worked under his supervision off and on for about two years and he considered him a careful employee, not having been involved in any previous trouble.

Road Foreman of Engines Stapp stated that engines of the type of engine 171 are equipped with a tripper-device whereby the air brakes will be automatically applied in emergency if the engine truck becomes derailed. Judging from the marks on the shoulder of the ballast he thought that the engine leaned over sufficiently to permit the left cylinder to scrape the ballast, then rolled back to the south rail when the engine trucks were derailed and then the engine turned over on the north rail. The wetness and firmness of the ground contributed to the distance that the engine slid, and he did not think that the speed was in excess of 50 miles per hour at the time of the accident. Examination of the engine showed the flanges to be in good condition and no flat spots were on the tires. There was no top-heavy condition of the engine to his knowledge. He did not have any definite opinion as to what caused the accident.

Master Mechanic Caffrey stated that his opinion as to conditions agreed in substance with that of Road Foreman of Engines Stapp; he said that engines of the type involved were unusually good curving engines at all speeds up to 75 miles per hour. The indications were that the speed in this instance was not more than 50 or 55 miles per hour; he did not think that the air brakes became applied until the baggage car broke off. He gave no opinion as to the cause of the accident.

Roundhouse Foreman Studt stated it was his opinion that the left front tank step made the scrape marks in the shoulder

of the ballast outside the north or high rail of the curve; apparently there was some obstruction on the rail at the crossing, which is located on the spiral and 60 feet east of the western end of the curve, which started the tank rolling, causing the first tank step to drag and mark the ballast, then the tank righted itself and the next time it swayed it pulled the engine off and caused it to go down in front; he did not think that any of the wheels of the engine or tender ever touched the ties.

Road Foreman of Engines Muhl examined engine 171 at the scene of the accident. Everything appeared to be intact, flanges were all right and no gravel or dirt was on the brake rigging. Engines of this type ride comfortably and curve well, and there is no top heavy condition about them. He would not say that a speed limit of 50 miles per hour on the curve involved was unsafe, but he did think that it was a little too high, saying that when he used to operate fast trains as a matter of extra precaution he always made a brake application before going into this curve and reduced the speed to about 40 or 45 miles per hour. In his opinion the accident was caused by excessive speed, probably a speed of 55 miles per hour, basing his judgment on the manner in which the derailed equipment stopped and the distance that the rear portion of the train traveled after the accident.

Engineman Davis had operated engines in passenger service over this territory for many years. He did not consider this curve good for a speed of 50 miles per hour, but thought that it was safe for 40 miles per hour, which latter speed he preferred, saying that he always made it a point to reduce to the latter speed when entering the curve from either direction.

Roadmaster Connelly stated that new ties were placed in the track at the point of accident during May, 1938. On October 18 the track was surfaced. No ballast had been placed there during the last 60 days. He was over the track involved on a motor-car two days prior to the accident, and on a train the day before it occurred. Examination of the track after the accident failed to disclose anything wrong. He thought the speed limit of 50 miles per hour on the curve was not too high, and he would not recommend any change, saying that he had ridden with enginemen around this curve at a speed he thought to be 50 miles per hour and that the engines rode comfortably. The distance the derailed engine traveled, the manner in which it and other derailed equipment stopped, the fact that the ground was wet and slippery, and the distance that the rear six cars traveled with the forward pair of wheels of the first truck of the leading car derailed, indicated to him that the speed of

the train at the time of the derailment was between 55 and 60 miles per hour. In his opinion the accident was caused by speed in excess of the 50 mile-per-hour limit placed on the curve.

Section Foreman Korojohn passed in both directions over the track involved on a track motor-car during the morning of the day of the accident and found the track to be in good condition. During his 14 years of service no previous derailment had occurred on this curve.

Assistant Superintendent of Motive Power Gleason stated that after engine 171 was removed from the scene of the accident to the Oroville roundhouse an inspection which was made on December 7 developed that the left front driving spring had been broken in the center. He said that this may have occurred before the locomotive left the rails, or after it left the rails and while it was coming to a stop on the ground, or during the rerailing operations while it was being dragged back to the right-of-way and rolled and dropped upright on its wheels. This spring is composed of 15 plates held together by a band 4 inches wide. The working length is 40 inches center to center of the hangers; it has a maximum fiber stress of 77,930 pounds per square inch and the load is 22,950 pounds. The plates which are 7/16 inch thick and 6 inches wide, four of which are full length, are numbered 1 to 15, starting at the bottom, for identification purposes. All plates were broken almost in the center of the plates and under the center of the spring band, except the two bottom plates which were broken in front of and outside of the band. Plate 1 had a 90 percent old fracture slightly under the front end of the band; plate 2 had a 100 percent new fracture about $\frac{1}{4}$ inch in front of the band; plate 3 had a 100 percent old fracture about $\frac{3}{4}$ inch in front of the band and a 100 percent old fracture under the center of the band; plates 4 to 11, inclusive, had 100 percent new fractures under the center of the band; plates 12 to 15, inclusive, the full length plates, had 100 percent old fractures under the center of the band. All old fractures were obscured from view by the band and the spring saddle in such manner that ordinary inspection could not reveal the defective condition. The broken spring was not detected until after the engine had been taken to the roundhouse. He said that a spring with four broke main leaves could not be considered as entirely safe. The fact that the left front driving spring when found at the roundhouse had all broken leaves of the back half of the spring lying loosely on top of the engine frame with the outer ends of the plates merely resting loosely in the back stirrup hanger indicated to him that the spring was not broken when the locomotive was sliding on its side for if it had been the loose leaves would

have fallen out of place. The band was not loose or shifted as was evidenced by the fact that the band held half the broken leaves firmly together even after all the broken leaves of one-half the spring had been pulled out of the band. The band was tight and firmly holding all plates in place, even those plates that had old fractures being rigidly held in place, and the spring was able to carry a large part of its load in this broken condition until some extreme overload or shock was imposed. It was his opinion that even if the left front driver spring did fail at some time before the engine left the rails, which he believed was not the case, the left side of the engine could only lower or list approximately 2½ inches at the front before the top of the left No. 1 driving box would contact the underside of the frame and before the end of the equalizer between Nos. 1 and 2 drivers would strike the frame and prevent further listing. In his opinion the failure of the spring under this condition could only be considered as a minor contributing factor in the cause of the derailment. Due to centrifugal action the stress on all driving and other springs on the left side of the engine would be somewhat increased when the curve was entered; probably the additional stress due to the centrifugal force would first be introduced on the left front spring, then immediately equalized through the entire spring rigging arrangement. It was his opinion that if the spring broke when the engine reached the curve the ends of the spring would have pulled out of the band.

The total weight of engine 171 is 313,000 pounds, distributed as follows: drivers, 210,500 pounds; engine truck, 53,500 pounds; trailing truck, 49,000 pounds. The tender is of the rectangular type and has two four-wheel trucks; its capacity is 4,000 gallons of oil and 10,000 gallons of water; it is equipped with splash plates that run vertically and extend the full distance between top and bottom of tank. The weight of tender loaded is 202,000 pounds. The drivers are 73 inches high and the driving-wheel base is 19 feet 7 inches long; the total wheel base of engine and tender is 77 feet, and the overall length is 87 feet 7/8 inch; the overall height is 15 feet 3/8 inch.

According to the records of the Southern Pacific Company office at Binney Junction, No. 2 left that point at 3:26 p. m.; the train dispatcher's record of the Western Pacific Railroad shows that the wires failed at 3:49 p. m. According to these figures the train traveled approximately 21.63 miles, the distance between Binney Junction and the point of derailment, in 23 minutes, or at an average speed of 56.55 miles per hour.

Observations of the Commission's Inspectors

Inspection of the engine and of track conditions by the Commission's inspectors disclosed them to be practically the same as described by the witnesses. The front half of the broken left front driving spring remained in the band and the forward and was attached to the hanger.

Discussion

Before leaving Oakland the engineman inspected the engine and everything appeared to be all right. The air brakes were tested and they functioned properly en route. This was the second trip for the engineman as an engineman in passenger service on this line, although he was familiar with conditions over this subdivision, having served as both engineman and fireman in freight service. There was a delay of several minutes at Binney Junction but the engineman maintained that he did not make any effort to recover lost time; however, the head brakeman and the flagman thought that time was made up. The maximum authorized speed for passenger trains in this locality is 60 miles per hour, but the timetable places a speed limit of 50 miles per hour on the curve involved. The train traveled approximately 21.68 miles, the distance between Binney Junction and the point of the derailment, in 23 minutes, or at an average speed of 56.55 miles per hour. The engineman said that he eased off on the throttle when he saw the top of the hill and that he made a light air-brake application entering the cut and planned to round the curve at a speed of between 45 and 50 miles per hour. Members of the crew estimated the speed to have been from 48 to 55 miles per hour while rounding the curve. The engineman made a light air-brake application while on the curve and without warning the engine suddenly lurched, slumped forward and down on the left front end, and turned over, at which time steam was being worked and he did not have time to close the throttle.

Scrape marks appeared at two locations in the shoulder of the ballast outside the north or high rail of the curve; they were the initial marks of derailment and were made by either the left cylinder of the engine or the left front tender step. One witness thought that the tender was the first to leave the rails, and that it pulled the engine off the track without any of the wheels of the engine or the tender touching the ties; however, all other evidence was to the effect that the engine was the first to leave the track.

Inspection revealed that there was no indication of dragging equipment or any obstruction on the rails. The track was well maintained and it was not disturbed as a result of the

accident, and track conditions were definitely eliminated as a factor in the derailment. No previous derailment had occurred on this curve. There was no indication that the engine wheels climbed the rail and all flanges were found to be in good condition and there were no flat spots on the tires.

According to the superelevation table for a 6° curve with a superelevation of 5 inches in effect on this railroad, the equilibrium speed prescribed is 36 miles per hour; the comfortable speed, 45 miles per hour; the safe speed, 51 miles per hour; and the overturning speed, 78 miles per hour. This table carries a recommendation that the comfortable speed should not be exceeded by steam trains.

One week after the accident an inspection was made of engine 171 at Oroville roundhouse and it developed that the left front driving spring had been broken in the center and under the band. The bottom plate of this spring showed a 90 percent old break, while plates Nos. 3, 12, 13, 14 and 15 showed 100 percent old breaks and the remaining 9 plates showed 100 percent new breaks. According to the evidence a spring with four broken main leaves was not considered entirely safe. It could not be definitely determined whether complete failure of this spring occurred before the engine left the rails, or at the time the engine started to turn over, after it left the rails and slid along the ground, or while it was being rerailed; however, since the broken spring was on the left side of the engine which was on the outside of the curve it is apparent that if the spring became broken before the derailment the engine would list toward the outside of the curve and thus tend to counteract the benefit of the superelevation on the curve.

Some witnesses thought that the curve was safe for the speed limit of 50 miles per hour, and said no recommendation for a change was anticipated; others would not say that this figure was unsafe but thought that it was too high. As a matter of precaution it was the practice of some employees in passenger service to make air-brake applications and reduce speed to about 40 or 45 miles per hour before reaching the curve. Some could not advance any reason for the occurrence of the accident, some did not think that excessive speed was the cause, and others were of the opinion that it was responsible for the derailment. Indications at the point of derailment were that the engine turned over as a result of centrifugal force. The distance the derailed engine, tender and first two cars traveled and the manner in which they stopped, and the distance the rear six cars of the train traveled around and beyond the curve involved, with the front pair of wheels of the lead truck of the forward car derailed, indicated that the accident was caused by excessive speed

in view of the existing curvature and elevation coupled with the possibility of the engine listing to the left due to a broken driving spring.

Conclusion

It is believed that this accident was caused by excessive speed on a sharp curve; possibly a broken engine driving spring was a contributing cause.

Respectfully submitted,

W. J. PATTERSON

Director.