INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE PENNSYLVANIA RAILROAD AT MOCANAQUA, PA., ON MAY 19, 1930.

August 6, 1930.

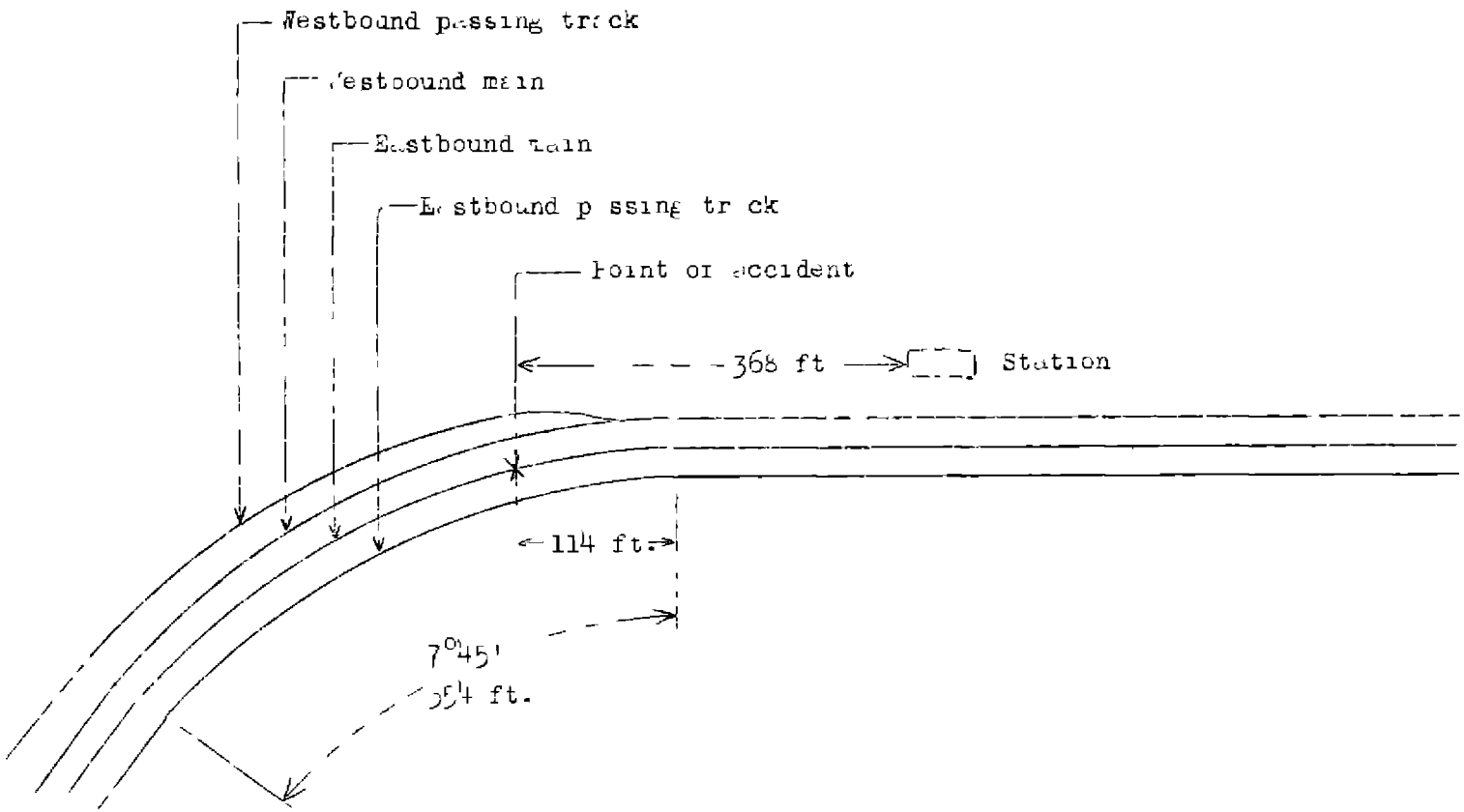
To the Commission

On May 19, 1930, there was a derailment of a passenger train on the Pennsylvania Railroad at Mocanaqua, Pa., which resulted in the death of 2 employees, and the injury of 28 passengers, 4 employees, and 3 persons who were in a building adjacent to track which was struck by the derailed engine. This investigation was made in conjunction with the Public Service Commission of Pennsylvania.

Location and method of operation

This accident occurred on that part of the Sunbury Division extending between Kase and Wilkes Barre, Pa., a distance of 62.8 miles. In the vicinity of the point of accident this is a double-track line, over which trains are operated by time-table, train orders and a manual block-signal system. The accident occurred on the eastbound track at a point 368 feet west of the station. Approaching the point of accident from the west the track is tangent for a distance of 800 feet, followed by a spiral curve to the right 554 feet in length, having a maximum curvature of 7°45', and then tangent track, the accident occurring on the curve at a point 114 feet from its eastern end. The grade is practically level. The main tracks are paralleled on the south by an eastbound passing track and on the north by a westbound passing track, the east switch of the westbound passing track is located at the eastern end of the curve.

In the vicinity of the point of accident the track involved is on a fill varying from 6 to 9 feet in height on the north side and from 3 to 6 feet on the south side, and there is a concrete underpass-crossing located about 30 feet west of the point of derailment. The track is laid with 130-pound rails, varying from 29 to 39 feet in length, averaging approximately 18 ties to the 33 ft. rail, single-spiked, fully tie-plated and ballasted with crushed lime



Inv No 1641
Pennsylvania Railroad
Mocanaqua, Pa
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stone to a depth of about 14 inches. The line and surface of the track are good and the track is well maintained The maximum speed permitted by time-table on the curve involved is 40 miles per hour

It was dark at the time of the accident, which occurred at 11 41 or 11.42 p m

Description

Eastbound passenger train extra 3011, consisting of four coaches and one baggage car, of all steel construction, with the baggage car in the rear, hauled by engine 3011, was in charge of Conductor Kniss and Engineman Cleaver. This train was a special train on its return trip from Harrisburg. It departed from Sunbury, Pa., 47.3 miles west of Mocanaqua, at 10.41 p. m., passed Wren Tower, the last open office, 4,723 feet west of Mocanaqua, at 11.40 p. m , and was derailed at Mocanaqua while traveling at a speed estimated by members of the train crew to have been about 40 per hour

The entire train was derailed, the engine turned over on its left side and skidded along over the rails of the westbound main track to a point 490 feet beyond the initial point of derailment, knocking down a steel signal pole located 160 feet east of the first marks of derailment and 5 feet north of the westbound track, and badly damaging the basement wall of a hotel located 60 feet beyond the signal pole and 8 feet north of the track. The tender came to rest upright, but in reverse position, between the main tracks, near the engine, and the rear tender truck came to rest in a diagonal position on the eastbound track 80 feet beyond the tender. The left forward tender wheel was broken, the axle had been pushed through the web of the wheel and the wheel was hanging on the axle between the broken hub and the opposite wheel. The break was about half way between the hub and the tread, and was irregular, varying from 10 to 11 3/4 inches from tread of wheel The first car came to rest on the eastbound passing and main tracks with its rear end against the pilot of the engine; the remaining cars were derailed in a general line along the eastbound track. The employees killed were the engineman and fireman

Summary of evidence

Road Foreman of Engines Warren stated that he rode on the engine of extra 3011 from Sunbury to the point of accident and during the entire trip he noticed no unusual condition that gave him any warning that anything was wrong until approaching the station at Mocanaqua when the engine ran over something that seemed like heavy sanded rail and caused the fire to fly from the driving and engine truck wheels higher than the running board and it felt as if the engine dropped down and broke in two. He stated that before leaving Sunbury the brakes were properly tested and he assisted the engineman in inspecting the engine which was found in excellent condition. The air brakes were applied several times en route, working properly at all times; and at Nescopeck, their last stop, he commended the crew for the excellent manner in which the train was being handled. Upon approaching Wren the train was traveling at a speed of between 50 and 55 miles per hour when the engineman reduced the speed slightly. After passing Wren he further reduced speed until after sounding the whistle for a road crossing, located about 300 feet west of the point of derailment, when he opened the throttle slightly to give the engine more steam, and he thought it was traveling at a speed not in excess of from 38 to 42 miles per hour when the derailment occurred. He later qualified this statement by saying he was positive that this estimate was within 5 miles per hour of the speed of the train at the time of the derailment. Road Foreman of Engines Warren said that the throttle was not closed by the engineman nor the air brakes applied at the time the engine was derailed.

The statements of Conductor Keiss corroborated those of Road Foreman of Engines Warren as to the satisfactory operation of the train from Sunbury to the point of accident. Conductor Keiss was riding in the fifth car and upon approaching the curve west of Mocanaqua he felt an application of the air brakes, as his car reached the sharp point of the curve he said the brakes applied in emergency. He estimated the speed of the train at the time of the accident to have been 40 miles per hour, and previous to the service application it had been traveling at about 50 miles per hour.

Brakeman Schirmel and Car Inspector Lewis, who also were riding in the fifth car, stated that they noticed a service application of the air brakes before reaching the curve on which the accident occurred, and they felt an

emergency application while rounding the curve, the derailment occurring almost immediately thereafter. Brakeman Schimmel estimated the speed of the train to have been 50 miles per hour before the service application of the air brakes was made. Car Inspector Lewis had been assigned to ride this train from Wilkes Barre to Sunbury and return to look after the air brakes, and he stated that the brakes were tested and that they worked properly en route.

Assistant Road Foreman of Engines Geasey stated that he arrived at the scene of the accident about 1 o. c. and his inspection of the engine upon his arrival, as well as after it had been placed on its wheels, disclosed nothing that could have contributed to the cause of the accident. There was no indication of bent axles, the flanges were gauged, the wheels were trammed and measured correctly face to face, and there was no excessive lateral. His inspection of the track disclosed some heavy dust spots on the high rails of the curve, these rails having been turned over. These dust spots appeared to be crushed stone ballast, there were four or five spots, each from 4 to 8 inches in length and probably 4 to 6 feet apart. He looked for corresponding marks on the wheels of the engines, but could not find any, nor did he see any on the opposite rails. It was his opinion that the engine was derailed at the point these spots were found, and that the pressure of the derailed wheels against the north rail turned it over.

Superintendent Grissitt stated that on the morning of May 19 he was on this train from Nescopeck to Sunbury, riding in one of the coaches, and it was in charge of the same crew as on the return trip when the accident occurred. He observed the handling of the train and it was in all respects satisfactory as to uniformity of speed and observation of speed restrictions. At several points he checked the speed by mile posts, and did not find the speed exceeded at any time. Subsequently, in examining the track and equipment to ascertain the cause of the derailment he could find nothing on the engine or tender that would seem to contribute to the accident. There was one broken wheel on the rear truck of the tender, showing a complete break around the hub. This was the left leading wheel of the rear truck, but the condition of the truck was such that it was clearly established in his mind that this was a result of the accident rather than having had anything to do with the cause of the accident. The fracture appeared entirely new, no flaws being visible and he saw no signs of the wheel continuing to turn after the

fracture He thought that the fracture occurred close to where the truck came to rest. His examination of the track brought out nothing additional to that disclosed by Assistant Road Foreman of Engines Geasey Superintendent Grissitt said that it was his opinion that the derailment resulted from ballast on the high rail of the curve.

Track Supervisor Whisler stated that the track in the vicinity of the point of accident was in good condition. On several occasions within the last two months reports had been received of obstructions on the track approximately 1 mile east of the point of accident; several nuts that would fit a 1 1/8 inch bolt were found on the rail head about 20 feet apart, switch lamps had been found broken, and stones and tree limbs had been found on the track, but the guilty persons in this latter case were apprehended and convicted.

Edward Miller stated that he was walking between the westbound main and passing tracks when extra 3011 approached and as he reached a highway crossing located about 300 feet from curve the train passed him and he saw big flames around the wheels as the train neared the subgrade, and he then heard a crash. Just before the crash he had been thinking that the train would never make that curve due to its high rate of speed.

Marion Yarrish stated that he was at a store located about 1 block west of the crossing when the train passed, and he noticed it was traveling fast and thought that it was the regular train trying to make up time

Joe Gersh, who was standing in the doorway of a hotel on the north side of the track about 600 feet west of the curve, stated that when extra 3011 passed it was traveling at a pretty high rate of speed and he saw sparks flying from the brakes of the cars.

As a result of the accident two rails were turned over, and two others were partly turned over, these rails were the high or north rails of the eastbound track The first mark of derailment was a flange mark found on the 4th tie, 6 feet east of the receiving end of the first rail involved, which was partially overturned, designated as rail "0", and 6½ inches from the base of the south rail on the low side of the curve The number of the flange marks gradually increased to 7 on the 36th tie, ranging from 13 to 24½ inches from the base of the south rail The track was badly torn up beyond that point for a distance of 300 feet. The first mark of derailment outside of the north rail appeared on the 14th tie from the tie on which the

first mark was found. It was scarred 7½ inches outside of and north of the base of the rail, apparently having been made before the rail was turned over. The next marks appeared on the 31st tie, a scratch and a flange mark 5 3/4 inches and 7½ inches, respectively, from the base of the rail, flange marks then appeared on a number of the following ties until the 32nd tie, on which there were 6 flange marks ranging from 6½ to 16½ inches from the base of the rail, there also being scratches and gashes between the 31st and 32nd ties, apparently made by some object dragging, the ends of the 31st to 36th ties were badly battered and crushed, and there were sharp jagged cuts across the ends of the 35th and 36th ties. Flange marks were found on the tops of the first three overturned rails which show the wheels passed over the tops of these rails before they were overturned. There was a scarred line on the top of the rail head 12 feet from the receiving end of rail "C", about 1/32 inch deep or wide, which ran along on the head ½ inch from the gauge side to a point 6 feet from the leaving end of the rail where it then crossed the head and ran off the leaving end of the rail 2 inches from the gauge side and continued on over the head of the second rail or rail "A", running off the outside edge of this rail 26 inches from the receiving end. This mark was made by some object dragging, or being carried partially suspended, and was probably made by the same object that cut, scratched and scarred the ends of the ties north of the north rail. There were, however, two distinct flange marks varying in length on the heads of both rails "A" and "B". The first flange mark started from the gauge side of rail "A", 15 feet 9 inches from its receiving end, the second mark started from the gauge side 25 feet 6 inches from the receiving end, the third and fourth flange marks started from the gauge side of rail "B" 14 feet 6 inches and 22 feet, respectively, from the receiving end. Marks of flanges were found on the inside web of rails "C" and "A" which showed clearly that the rails turned over under moving wheels. There were found on the top surface of rails "A" and "B" areas which were covered with powder of crushed limestone. Analysis made of this powder showed it to be of the same composition as pieces of crushed stone ballast taken from the track in the vicinity of the point of accident. On rail "A" these areas were from 6 to 10

inches in length and were located 4 feet 8 inches, 6 feet 4 inches, 13 feet 9 inches, 16 feet and 28 feet, respectively, from the receiving end of the rail. On rail "B" the areas were almost continuous from one end of the rail to the other and indicate that pieces of ballast were crushed on the rail at intervals of about every two feet for the length of the rail. These deposits of limestone dust were dry and adhered to the surface of the rail only from the effect of the pressure of wheels, the powder could be blown off or dusted off easily From the nature of the deposits it does not appear that many wheels could have passed over the rail after the limestone was crushed on the rail.

Engine 3011 is of the 4-4-2 type, having a total weight, engine and tender, of 348,500 pounds. Inspection of this engine after the accident disclosed no defect which could have caused or contributed to the cause of the accident. The wedges were all free, there were no bent axles, flanges had not been worn below the condemning limit, the forward truck showed no defect The clearance between the driving box and frame were less than normal, but this was due to a broken frame which resulted from the accident The spring rigging was intact, the engine appeared to have been well equalized, and all measurements were within the required limits Engine 3011 was last given monthly boilerwash on May 17th, at which time the wheels were whitewashed and an inspection made for wheel defects, the wheels were, however, not whitewashed near enough to the hubs to have aided in the detection of a flaw at the place where the left No. 3 wheel of the tender was broken, it not being the practice to look for defects so near to the hub. The tender is equipped with four-wheel pedestal trucks, the wheels were made by the Standard Steel Works Company and are 36 inch, wrought steel with 7/8 inch web, the axles are No. 7 and the journal 5½ inches by 10 inches. The left No wheel, which was broken, has the following markings; Wheel number 437, heat 827459, and the date 10-29-24. This wheel was carefully examined following the accident but no evidence of old flaws could be found. The break was a circular break around the hub, varying from 10 inches to 11 3/4 inches from the hub, the edges of the break showed that the strain which broke the wheel had been exerted laterally by the axle and that at the moment the wheel broke, the hub pushed through the break, and the rim of the wheel dropped down on the inside of the hub on the axle There are battered spots on the hub and axle which were made by the rim of the wheel and the peculiarities of these marks show clearly

that the axle made a number of revolutions after the break occurred, and that the axle was turning faster and within the broken rim. There were no marks on the wheel to indicate that the wheel had received a sharp blow. The axle was true and the flanges gauged well within the limit. Examination and analysis was made by the railroad's engineer of tests. His report indicated that the failure occurred by the entire breaking out of the hub, the cracked face containing all sudden ruptures. Examination of the wheel at the fracture showed the plate to be approximately 1/16" below the required thickness of 7/8" minimum. The material in this wheel was of good quality and the only abnormal condition existing was the slight undersize of the plate. This deficiency, however, was not considered to have dangerously impaired the strength of the plate under ordinary service conditions. From the sudden character of the fracture and the results of the examination, the railroad company's engineer of tests thought the failure of this wheel was a result of an abnormal shock incident to the wreck, rather than due to any defective condition in the wheel itself.

The curve on which the accident occurred is a spiraled curve 554 feet in length, and has been rated as a 5°30' curve, and the maximum speed permitted for all trains over the curve has been 40 miles per hour. A check of the curvature since the accident at 11 foot stations, showed the average curvature for 242 feet just west of the point where the track was first distorted as a result of the accident to be 6° 12'. At seven of the stations the curvature varies from 7° to 7°45'. The superelevation for the same section of track varies from 3.8 inches to 4.8 inches, with an average of 4.3 inches. In accordance with the tables of velocity and superelevations on curves, as approved by the American Railway Engineering Association, and as shown in the Pennsylvania Railroad Manual for the Guidance of Maintenance of Way Employees, the velocity for the curve on which the accident occurred should not be in excess of 50 miles per hour.

Conclusions

It is believed that this accident was caused by speed on a curve in excess of the rate for which sufficient superelevation was provided in combination with pieces of stone ballast on the outer rail of the curve, it could not be definitely determined whether a broken tender wheel was a contributing cause or a result of the accident

The track conditions existing at this point did not afford an adequate margin of safety for a speed of 40 miles per hour The track was in good alignment, surface and gauge, the elevation, however, was insufficient for the maximum rate of speed permitted. According to the railroad company's manual for guidance of maintenance of way employees with an elevation of 4 3 inches, the maximum speed allowed should be 30 miles per hour, instead of 40 miles which was permitted by rule. On a 5° 30' curve, 6 inches elevation should have been provided to warrant a maximum speed limit f 40 miles per hour, and on a 7° 45' curve more than 7 inches elevation would have been required Furthermore, the weight of evidence of those who witnessed the passage of the train just before the occurrence of the derailment, the position in which the engine and cars came to rest, and the damaged condition of the track resulting from the derailment, indicate that the speed of this train at the time of the accident was in excess of 40 miles per hour

The evidence which points to obstruction on one of the rails as contributing to the cause of the derailment consists of areas of powdered ballast, flange marks of wheels on top of the heads of rails "A" and "B", and the statement of Road Engineer of Engines Warren to the effect that the engine received something that seemed like a heavy sanded rail and fire flew from the engine truck and driving wheels higher than the running board The receiving end of rail "A" is 33 feet east of the tie on which the first marks of derailment were found Rail "B", the next rail east, and rail "A" were turned over almost immediately, as it appeared that no other wheels than those of the engine and tender had passed over them. The powder and flange marks on the heads of these rails could not have been made after the accident occurred and the flange marks are unquestionably the marks of the wheels of the engine or tender. The first flange mark takes off directly from an area of powdered limestone, 16 feet from the receiving end of the rail

Following the accident patches of limestone powder were placed on the rails and after the passage of an engine and ten cars the patches were almost obliterated by the grinding effect of the wheels and the air currents, after the passage of an engine and tender the density of the spots was comparable to that of the spots found on rails "A" and "B". It was found by other tests that on impact with pieces of the ballast laid on the rail, the treads of wheels were slightly raised from the rail head, sufficiently to indicate that pieces of ballast on the top of the high rail of a curve created a tendency toward derailment.

It does not appear that the rate of speed alone was adequate to cause the derailment as the train had traveled a distance of 440 feet around the curve before the derailment occurred. However, in view of the curvature and superelevation as well as the rate of speed when this train was rounding the curve, there could have been but a very narrow margin between probable safe passage and probable derailment of the train. Under such conditions it appears that pieces of ballast on the rails which would not ordinarily form dangerous obstructions could introduce an added factor of sufficient consequence to effect derailment. That there were such obstructions on the rail is clearly established, how they came to be there was not ascertained except that uniform spacing indicates that pieces of stone were placed on the rails.

It is conceivable that the failure of the tender wheel might have caused this derailment, although this theory did not appear probable when no evidence of old flaws could be found in the broken wheel. The circular break around the hub about half way between the axle and the tread is such a break as might be expected to result while extreme lateral pressure was suddenly exerted by the axle against the center of wheel and with the resistance against this thrust falling on the rapidly turning flange held back by the rail head. The point of greatest strain, under such conditions, would fall somewhere about halfway between the hub and the wheel tread and this point of strain would constantly be moving around the hub, as the wheel turned. Under such a combination of stresses, a fracture, once developing in the web of the wheel, would progress into a circular break around the hub and finally allow the hub to push through the web of the wheel in the manner in which it did occur in this instance. As a result of the excessive speed for the curvature and elevation of the track there was an extreme lateral thrust communicated through the axles to the wheels and against the inside head of the high rail as the train took the curve. Some of the scars, scratches, and cuts on the ties, which have not otherwise been accounted for, could have been made by the jagged edges of the broken hub. Scarred marks on the inside of the hub, and on the axle of the broken wheel, made by the jagged edges of the rim of the wheel, clearly show that the axle continued to turn after the break occurred. An examination of the rear truck frame established that after the wheel had broken the truck had continued to move for some distance in a direct line. The strap extending under the journal from pedestal to pedestal had been scoured from sliding over the rail ties, or ballast, and there were straight line scratches

and scars on the bottom side of the strap, parallel with the side frame of the truck. These marks were made after the wheel dropped and show that the wheel broken before the truck was deflected from its course, but it could not be determined whether this occurred before, at the time of, or after the initial derailment

The emergency application of the brakes which members of the train crew noted just prior to the accident evidently occurred as a result of a break in the brake pipe and was probably a result and not a cause of the derailment

All the employees involved were experienced men, and at the time of the accident none of them had been on duty in violation of any of the provisions of the hours of service law

Respectfully submitted,

W. P BORLAND,

Director.