REPORT OF THE CHIEF OF THE BUREAU OF SAFETY REGARDING INVESTIGATION OF AN ACCIDENT ON THE NEW YORK CENTRAL RAILROAD NEAR SOUTH BYRON, N Y, ON JANUARY 12, 1919.

MARCH 4, 1919.

To the COMMISSION

On January 12, 1919, there was a rear-end collision between two passenger trains on the New York Central Railroad near South Byron, N Y., which resulted in the death of 21 passengers and one Pullman porter and the injury of 71 passengers Investigation of this accident was held in conjunction with the Public Service Commission of New York, second district, a hearing being held at Syracuse, N. Y., on January 14, 1919 As a result of this investigation the following report is submitted.

The trains involved in this accident were westbound passenger train second No 17, known as The Wolverine, en route from Syracuse to Buffalo, and westbound passenger train No 11, known as the South Western Limited, operating between the same points

Train No 17 consisted of one Pullman club car and six standard Pullman sleeping cars, all of steel construction, hauled by locomotive 3364, and was in charge of Conductor Starr and Engineman Gibbons It left Rochester, the last regular stop before reaching point of accident, and 25 miles east of South Byron, at 2 54 a. m , 1 hour and 31 minutes late, passed tower SS 35, 6 miles east of point of accident, at 3 25 a m, and at 3 35 a m reached tower SS 37, at South Byron, where the train was brought to a stop on account of the engine not steaming properly. Engineman Gibbons went into the tower and asked for an engine to help move his train, and engine 3088 was about to be coupled to the train when the rear end of the train was struck by train No 11 at 3 42 a. m

Train No 11 consisted of 1 Pullman club car, 6 standard Pullman sleeping cars, and 2 day coaches, all of steel construction, hauled by locomotive 3340, and was in charge of Conductor Stewart and Engineman Friedley It left Rochester at 3 07 a m, 2 hours and 44 minutes late, passed tower SS 35 at 3 35 a m, and collided with the rear end of train No. 17 while running at a speed of approximately 50 miles per hour

The force of the collision drove train No 17 forward a distance of about 250 feet, including the space gained by the telescoping of the two rear cars The rear car, the sleeping car Canfield, was forced under the car ahead of it and was telescoped by that car nearly its full length, or within 15 feet of its rear end, within which space the bodies of all the occupants of the car were found. The rear end of the third car from the rear was derailed and considerably damaged. Two or three other cars in train No. 17 were slightly damaged, while the first car in train No 11 was derailed. Considerable damage was sustained by engine 3340. Illustration No 1 is a view of the rear of the Canfield, from the south side, with the Croton Falls inside of it Illustration No 2 is a view of the opposite end from the same side.

The Syracuse division of the New York Central Railroad, upon which this accident occurred, is a four-track road over which train movements are governed by automatic block signals The tracks extend east and west, and, beginning with the south track, they are numbered 2, 1, 3, and 4 Track 2 is used for eastbound passenger and fast freight trains, track 1 for westbound passenger and fast freight trains, and tracks 3 and 4 are generally used for eastbound and westbound freight trains The accident occurred on track No. 1, at a point about 900 feet east of the home interlocking signal at South Byron, and 3,400 feet west of signal 39461, the rear home signal The next signal to the rear, No. 39361, was nearly 5,000 feet east of signal 39461. The track approaching the point of accident is straight for about 3 miles, and practically level The weather was clear and cold.

The signals on this division of the New York Central Railroad are of the upper quadrant, three-position type, with red, yellow, and green lights as night indications for stop, caution, and clear. Interlocking signals have three arms, with the lights in a vertical row; automatic block signals have two arms, with staggered lights, the lower, to the left of the mast, being a fixed red light. The signals operate on the normal danger system, and so long as the lever in an interlocking station is left reversed a signal controlled by a lever acts as an automatic signal, clearing on the approach of a train and assuming the stop position after it passes. The first signal in rear of a home interlocking signal is known as the "rear home signal," and is controlled by a lever in the tower, although its indications are the same as those of a purely automatic signal. Signals for inside tracks are located on bridges above the tracks which they govern. The average length of blocks is a little less than one mile Electric current to operate the signals, as well as for the track circuits, is provided by storage batteries, charged from a power line.

At Signal Station 37 there is a mechanical interlocking plant operating the crossovers between the main tracks and the switches connecting the middle track with tracks 3 and 4. The station contains a 56-lever machine, with 14 spare levers and 7 spare spaces. The main-track signals are electrically operated and are semi-automatic. The westbound home signal for track 1 is on a bridge 60 feet east of the tower; this signal has three arms; the upper arm (55), electrically operated through signal lever 55, governs through movements; the middle arm is inoperative; and the lower arm, which is mechanically operated by signal lever 54, is a "calling-on" arm, to be used when the upper arm can not be cleared due to failure or because of an occupied block Illustration No. 3 is a view of the signal bridge at SS 37, looking west, and shows the home signals governing tracks 1 and 3 The light engine on the right is standing on the middle track Signal lever 56 controls the rear home signal, No 39461, located on a bridge 4,317 feet east of the home signal Illustration No 4 is a view of the rear home signals governing movements on tracks 1 and 3. The next automatic signal east of No 39461 is 39361, 4,954 feet distant, which acts as a distant signal for the rear home signal.

The home-signal levers are provided with circuit controllers located in the lower part of the tower, and with electric locks which prevent a lever from being latched in its normal position unless the home signal has assumed the stop position and the distant signal the caution position. Approach indicators in the tower show when a train passes the third automatic signal in the rear of the home signal; the control circuit of the approach indicator passes through the front contacts of all intervening track relays up to the point where the section locking is effective. This same circuit also controls a bell to announce the approach of the train. Section locking takes effect when the rear home signal is passed by the head end of a train A screw release, requiring practically one minute to operate, is provided for each track in order that the route may be changed if necessary after having been locked up by an approaching train.

At Signal Station 37, when a westbound train on track 1 passes the distant signal, No. 39361, with the track ahead clear and signal levers 55 and 56 in the tower reversed, both the home signal 55 and the rear home signal 39461 assume the clear position automatically. This is accomplished in the following manner A circuit is completed from battery through the back contact of the track relay for the track circuit west of signal 39361, to the coils of the home-signal relay in the tower, thence through front contacts of track relays for the track sections west of home signal 55, through switch boxes, to common The home-signal relay therefore picks up if the track ahead is clear and the main-track route is lined up When the front contacts of the home relay are closed, a local circuit is formed through the coils of the distant or 90° relay controlling home signal 55, contact on lever 55, and thence to the next signal to the west on track 1, signal No

39701; therefore, when the home-signal relay is picked up and the lever is reversed, a circuit is completed through the slot coils of the motor. The picking up of the home-signal relay also closes a circuit to the 90° slot coils of the rear home automatic signal 39461. When both the home and distant relays for signal 55 are energized, then both slot coils are energized and home-interlocking signal 55 goes to the 90° position. By this arrangement of circuits, with the track ahead clear, the lever must be reversed for both home and rear home before those signals will clear The rear home signal clears only when lever 56 is reversed and a train has entered the approach circuit at the second automatic signal east of it.

Towerman Palmer, on duty at Signal Station 37 at South Byron, stated that train second No 17 arrived at his station at 3 35 a. m., the engineman sounding one long and three short blasts on the whistle as the train stopped He then came to the tower and asked for a helper as far as Batavia At this time there were two helper engines, Nos. 3088 and 3120, standing on the middle track, this middle track being located between tracks 3 and 4. After getting the necessary authority for the movement from the train dispatcher, the towerman gave the engineman of the first helper, No 3088, the signal to come out and cross the eastbound track to track 1 After the movement had been made, and signals and switches on the eastbound track restored to their normal positions, he gave the helper a dwarf signal to back up and couple to train No. 17 He thought about 6½ minutes elapsed between the time train No. 17 first stopped and the time the helper started to back up and couple to it. The collision occurred just as the coupling was about to be made, at 3.42 a. m. Towerman Palmer said that when he first noticed train No. 11 approaching, apparently about 40 car lengths distant, he saw a flagman or some one with red and white lanterns standing a few car lengths back from the rear end of train No. 17. As train No 11 approached, these lanterns were swung across the track once or twice, then stopped for a few seconds and then were again swung twice, and as the second swing was completed the train passed them. He did not see any fusee or hear a torpedo; neither did he hear the engineman of train No. 11 answer the flagman's signals. He also said that when he first saw train No 11, he looked at the signal repeater and it showed the signal in rear of train No. 17, No. 39461, to be in the danger position.

Engineman Moynihan, of helper engine 3120, said that his engine was on the middle track at a point about three car lengths from the rear of train No. 17. About two or three minutes after that train stopped he looked out of the window on his side and saw a headlight in the distance, but paid no attention to it until his fireman told him that he thought it was on track 1. This was about threefourths of a minute after he had first noticed it, and at about this time he saw the flagman of train No. 17 going back. From his position on the right side of his engine, which was facing west, he had to look around the rear of his tender, and he thought the flagman must have been 15 or 20 car lengths away when he was first able to see him. The flagman's lanterns did not seem to be in motion, and he continued to watch him. He seemed to go slowly and then when the approaching train was almost upon him, he gave a couple of swings with his white lantern Engineman Moynihan said that the red lantern was not swung at all, and he though it was upon the ground, as the two lanterns were so far apart He did not see any fusee.

Fireman Jasper, of helper No 3120, stated that about 2 or 3 minutes after train No. 17 stopped he opened the cab window and saw the flagman with red and white lanterns about 4 or 5 car lengths from the rear of the train. At this time he also saw the headlight of train No. 11 approaching some distance away. The flagman was going back and he saw him swing his lantern once before steam obscured his view. He did not see any fusee or hear the explosion of a torpedo. He said that his view at this time was more or less obscured by steam, but he thought the flagman was back a distance of about 12 car lengths at the time train No. 11 passed him.

Flagman McMahon, of helper 3120, stated that he stood in the doorway of the flagman's shanty, on the right side of the tracks, east of the signal bridge, and saw the flagman of train No 17 going back to flag He did not know how long this was after train No. 17 had stopped, saying that he saw train No 11 approaching at the time he saw the flagman Train No 11 was then east of the rear home signal. The flagman's lanterns were swinging, but apparently not enough to be giving stop signals, thus giving him the impression that it was just the natural motion of the flagman's arms as he walked along, and he therefore supposed that the approaching train was on another track He estimated the flagman to have been back about 15 car lengths when train No. 11 passed him. He did not see any fusee.

Engineman Gibbons, of train second No. 17, stated that he stopped his train east of the signal bridge at South Byron on account of low steam, and at once sounded the signal for the flagman to go out. He did not at any time see anything of the flagman. All of the signals approaching South Byron were clear and the lamps were burning brightly when his train passed them, as was also the case with the signals on the bridge at SS 37 The statements of the fireman added nothing to those of the engineman

Conductor Starr stated that he was riding in the first car of the train when it stopped, and that the engineman immediately signaled back the flagman. When he got off the car he saw the flagman going back on the right side of the train After the accident the flagman told him that he had been back 20 or 25 passenger-car lengths and that he had put down one torpedo and lighted a fusee when he saw train No. 11 coming. Conductor Starr stated that he himself did not hear train No. 11 approaching or hear the explosion of any torpedo.

Flagman Groves stated that as soon as his train stopped he got off and started back. As soon as he started he saw the headlight of train No. 11, apparently about 3 miles away, and he ran back, stopping only to put down two torpedoes at a point about 20 car lengths from the rear of his train He then continued to run back, lighting a red fusee as he ran and dropping it between the rails. He thought that at the time he lit this fusee train No. 11 was about half a mile distant He continued running back, swinging both lanterns, and had reached a point about 25 passenger-car lengths from the rear of his train when train No 11 passed him. He estimated that the rear end of train No 11 stopped about 10 passenger-car lengths beyond him, or about 6 or 8 car lengths beyond his red fusee. He said the engineman did not answer his signals and that he did not shut off steam until after passing him, at which time he noticed fire flying from the wheels Flagman Groves stated that he continued back in order to protect train No. 11, going to a point near rear home signal No 39461. He was about 150 feet west of this signal when the flagman of train No. 11 came back, and the two of them walked to a point east of the signal and looked up at the signal indications, finding both of them red. He also stated that while he was on his way back to flag he looked at the markers on the rear of his train a couple of times and found them to be burning brightly. Flagman Groves subsequently modified his statement by saying that at the time he lit the fusee train No 11 was about one-fourth mile distant, and that he ran toward the train on track 3, giving stop signals; also that the rear end of train No 11 was only four car lengths beyond him when it stopped

Engineman Friedley, of train No. 11, stated that the rear home signal was green, indicating clear. When about 10 car lengths beyond it he first saw the lanterns of the flagman, these apparently being about 12 telegraph poles distant and resting on the ground. They seemed to be only five or six car lengths from the rear of train No 17 When he first saw these lanterns he was not sure whether they were on track 1. the track on which his train was runing, or track 3, and when he got closer he sounded the whistle a couple of times and shut off steam, but the lanterns did not move. As his train approached it looked to him as if the lanterns were inside of the right rail on his track, and he said that up to this time he had not noticed the markers on train No. 17, his mind being occupied with the lanterns He did no know whether or not they were moved before he ran over them, and said that he did not see the flagman or any sign of a fusee. After passing the lanterns he began looking for the next block signal and saw the rear end of train No. 17. He at once applied the air brakes in emergency and at about the same time passed over one torpedo. Engineman Friedley was positive that all of the automatic signal indications approaching the point of accident were clear He stated that about 10 or 15 minutes after the accident he walked back to the last signal passed by his train and found it to be red. While looking at it he saw the flagman of train No 11, and the latter told him that when he got off his train after the collision he found the flagman of train No 17 standing near it. The flagman from train No. 11 also said that when he got off he saw a fusee on the track, but did not know whether the flagman of train No 17 had put it there before or after the accident. He did not see the signal on the bridge immediately in front of train No. 17 on account of it being obscured by smoke from the engines. The evidence of other witnesses indicated, however, that this signal at the time was in the danger position. Engineman Friedley said that on the night before he went on duty, Friday night, he went to bed at 10 p. m and got up at about 10 Saturday morning. He registered on duty at 2 25 Saturday afternoon and registered off duty at Syracuse at about 8.10 that evening. He registered on duty for the return trip to Buffalo at 9 53 p. m, but on account of the train being late did not actually leave Syracuse until 1 32 a. m. At the time of the collision, 3.42 a. m., 13 hours and 17 minutes had elapsed since he first registered on duty at Buffalo, and a total of about 18 hours since he had had any rest. He stated. however, that he did not feel drowsy or tired in any way, and was absolutely wide awake all of the time, also that there was nothing the matter with his engine which would draw his attention away from proper observance of signal indications

Fireman Brill stated that when his train passed the second signal in rear of train No 17, No. 39361, he called it clear and then started putting in a fire He thought Engineman Friedley called this signal first and he remembered distinctly that the engineman called the next signal clear. At this time he had just finished working on the fire and had seated himself on his seat, and he called the block just before the engine passed under it. He then started to work on the fire and did not see anything of the flagman. As he was finishing his work he felt the air brakes being applied, and as he got on his seat to look out of the window the collision occurred. He did not hear any torpedo or see the reflection of a fusee.

Conductor Stewart was riding in the first car when he felt the brakes being applied in emergency. The interval between this time and the time of the collision was not more than 10 seconds; he said that he only had time to stand up and brace himself for an instant. As soon as he got off he went back to see that his own train was protected by flag, and as he approached the rear of it, he saw someone carrying a fusee down the track and he learned afterwards that his flagman had it in his hand. He was positive that he did not see the glare of a fusee when he first got off his train, and said that there was nothing to obscure his view of it if one had been burning at that time.

Flagman Babcock stated that he was seated in the rear car three or four seats from the door, while his coat, with fusees in the pockets, was hanging beside the door. When he felt the brakes applied, he got up and had just gotten to where he could reach the fusees when the collision occurred He picked himself up, took his lanterns and went out on the platform. He then saw a burning fusee on track 1, about 15 or 20 passenger-car lengths beyond his train. When he passed it, he picked it up and carried it back with him until it burned out He said that when he reached this fusee, he saw the flagman of train No 17, about 25 passenger-car lengths, beyond. This would have put the flagman of train No 17 a distance of 40 or 45 passenger-car lengths beyond the rear of train No. 11 He overtook this flagman near the road crossing immediately east of the rear home signal, but did not have much conversation with him, the flagman merely telling him that the engineman did not acknowledge his signals The two of them walked back and put torpedoes on the rail about 20 or 25 car lengths east of the rear home signal. The signals on this bridge were both red when they passed them Flagman Babcock also stated that the fusee picked up by him was a five-minute fusee and was about half burned. He denied having told Engineman Freidley that when he got off the rear of his train he found the flagman of train No. 17 near it; neither did he say anything to the engineman about fusees

During the investigation of the accident the rear home and distant signals were tested and carefully examined They were found to be in good condition and working freely. The track circuits were shunted and the signals assumed the stop position properly The screw release in the tower controlling the circuits on track 1 was tested, and its average time of operation was about 1 minute. The operation of the signals from the tower was noted and the indicators checked with the position of the signal. The mechanical locking between the home signal and the back-up dwarf signal on track 1 was checked and found correct. As the approach locking had taken effect at the time train No. 17 was waiting for the helper, it was necessary to operate the screw release in order to throw the switches to let the helper engine out upon the main track from the middle track, where it was standing By the circuit arrangement, the home signal could not be restored until the rear home had assumed the caution position.

Nothing was discovered which could in any way have prevented the proper operation of the signals at the time train No. 11 approached South Byron, while the testimony indicates that the signals functioned properly when train No. 17 arrived at that point, and they were found to show the proper indication when members of the train crews of the two trains looked at them immediately after the accident In view of the evidence developed in connection with the investigation, it is believed that Engineman Friedley of train No. 11 did not see the block-signal indications. Notwithstanding his failure to see these signals, had Engineman Friedley taken proper precautions to bring his train under control at the time he himself says he saw the flagman's lanterns, instead of allowing his train to approach them rapidly without any application of the air brakes being made, this accident would not have occurred Engineman Friedley's failure to see the markers of train No 17 until after he had passed the flagman's lanterns can not be explained. By careful observations made at night on January 16, with the conditions which existed at the time of the accident duplicated as nearly as possible, it was found to be impossible to look through the "peep hole" or clear-vision window in the front cab window and see the lanterns on the ground without seeing the markers of the train In fact, Engineman Friedley's failure to apply the brakes until his engine exploded the torpedo arouses a strong suspicion that he had fallen asleep for a brief period, or else his attention was in some manner distracted from observance of the signals. The evidence also indicates that 7 minutes elapsed between the time train No 17 stopped at South Byron and the time of the collision, train No. 11 being 6 miles distant when train No 17 stopped. If Flagman Groves is correct in his statement that he saw the headlight of train No. 11 as soon as he started back to flag, it is apparent that he was delayed 2 or 3 minutes in starting. There is also a question as to whether he went back as far as he could have gone in the time at his disposal At the hearing he stated that he was back 25 passenger-car lengths when train No 11 passed him, but other witnesses estimate the distance to have been much less, and at a subsequent hearing Flagman Groves modified his original statement to the extent of saying that when train No 11 stopped after the collision its rear end was only 4 car lengths beyond him His statement that he lighted a fusee before train No. 11 passed him is disputed, and the weight of evidence is that such was not the case.

This accident was caused by the failure of Engineman Friedley of train No. 11 properly to observe and be governed by automatic block-signal indications. A contributing cause was the failure of Flagman Groves to go back a sufficient distance properly to protect his train, and to display lighted fusees as required by rule

Engineman Friedley was employed as a water boy in 1873, promoted to fireman in 1876, and in 1885 was promoted to engineman. In January, 1906, he was dismissed for using the main track without flag protection, being reinstated in November of the same year.

Flagman Groves was employed as brakeman in 1891. In 1907, he was suspended for 15 days for not protecting his train by flag when it remained at a regular stopping point longer than usual. None of the employees involved had been on duty in violation of any of the provisions of the hours-of-service law.

The evidence indicates that all of the signal appliances intended to prevent an accident of this character worked properly, its occurrence being due solely to human error.

In answer to a question as to what he would suggest for the prevention of accidents of this character, Signal Engineer Elliott said that the only remedy would be an automatic train-control system In his 25 years' experience as signal engineer he had made tests of three different types of train control, starting in 1893 Eight years ago a former president of the New York Central Railroad appointed a committee of four signal engineers from that system to investigate such devices and recommend one for trial. If this could not be done they were to devise one themselves. Up to the present time the work of this committee is uncompleted. Mr. Elliott stated that one of the principal objections to the use of an automatic train-control device was the idea of taking away from the engineman the control of his train, the belief being that such a practice, under stormy weather conditions, for example, would cause the engineman to take chances and to depend upon the train-control device. If it should fail under such circumstances and an accident should result then the railroad company would be in a very undesirable position. The committee felt that an automatic train-control system was not intended for such dependence as would be placed upon it by enginemen, and that it would be better not to have it unless it could work with the same degree of reliability as the signal system Another objection was the expense. Mr. Elliott stated that after careful investigation it seemed to this committee that greater protection would be afforded by spending an equal amount of money in installing automatic signals on the parts of the road not so equipped than by putting a train-control device into use on lines already equipped with automatic block signals. Mr. Elliott said that a device of the mechanical trip type was in use in the tunnels and subways of New York and was giving good service, but its use in open country where it would be exposed to snow and ice and to gravel or stone which might be dumped along the roadway had not proved a success, the result being that often there would be no application of the brakes when there should have been, or else there would be many stops when none was called for. Difficulties were also presented on steam roads operated in the open on account of the different types of trains operated over them at greatly varying rates of speed. Mr. Elliott further stated that with one possible exception no device has been developed in which the objections from an operating and engineering standpoint were sufficiently overcome to warrant going ahead with such devices He said, however, that a device can be had, but that everyone had been dodging it on account of the expense.

Few, if any, of the large railroad systems of this country have their lines completely equipped with automatic block signals. Instead of developing and installing automatic train-control devices a greater increase in safety may be provided by using available funds to extend automatic block signal installations and to construct and install interlocking plants, or for other means for safeguarding normal train operation, the value and efficiency of which not only as safety measures, but also for increasing capacity and facilitating traffic, have been amply demonstrated in practical service But this in substance is merely an argument for utilizing available funds so as to secure immediate returns and results; it can not properly be considered an argument against the development and use of an automatic train-control system, although it may temporarily serve as an excuse or reason for indefinite postponement of the consideration of that subject and of the practical development of automatic train-control devices.

As has frequently been pointed out in previous reports of this bureau, the proper field for an automatic train-control system is for use in connection with automatic block signals, and the function of automatic train-control apparatus is primarily to compel obedience to fixed signal indications. The record of railroad accidents during the past several years shows that a comparatively large percentage of the most serious and disastrous railroad accidents have resulted from the failure of enginemen to observe and heed automatic block signal indications; while in some instances other causes have contributed, a considerable number of the most harrowing accidents have been attributable to that one cause alone.

Although numerous suggestions have been made and a number of them put into effect for the purpose of bringing about an improvement of railroad operating conditions, the automatic train-control system is the only fundamental and comprehensive remedy which has been advanced to meet the conditions producing such accidents, and it possesses reasonable promise of successful application for at least reducing such accidents to a minimum Mr. Elliott himself stated that a device of this kind can be had.

The objections to automatic train-control devices other than expense, which were outlined by Mr. Elliott, have been well known and understood for a number of years, and while many of the problems to be met and solved are serious and the vision of the difficulties to be encountered has been allowed to obstruct the constructive development of automatic train-control devices by railroad companies, these difficulties are not considered insurmountable. In its Fourth Annual Report in 1911, the Block Signal and Train Control Board in a discussion of this matter stated

> * * * the board has no hesitancy in saying that had the railroads directed the same effort toward the development of automatic train-control apparatus that has been devoted to the development of interlocking and block-signaling apparatus, we should now have adequate installations of automatic train-control devices which would permit an engineman to handle his train without interference as long as he did it properly but would intervene to stop his train if he disregarded a stop signal or ran at excessive speed where speed restriction was prescribed

It would be very undesirable, of course, as stated by Mr. Elliott, for an automatic train-control device to take away from the engineman the control of his train under normal operating conditions and to reduce his sense of responsibility for the safety of his train But the proper function of an automatic train-control system is to control the train only when the engineman has, through inadvertence or incapacity, failed to perform his required duties The startling recurrence of accidents resulting from the failure of enginemen to observe and heed signal indications calls attention with great emphasis to the fact that the sense of responsibility for safety of their trains which is almost universally felt by enginemen is not always effective with present safeguards to prevent collisions.

It is to be hoped that the investigations now in progress by the Automatic Train Control Committee of the Railroad Administration will result in the constructive development of one or several of the automatic train-control systems available, and eventually the practical use of devices of this character for the purpose of preventing accidents such as that described in this report

The Canfield was a Pullman sleeping car of all-steel construction, built in 1911, having a weight of about 75 tons and length of 81 feet 10 inches It was equipped with Commonwealth combined steel platforms and double-body bolsters, without any antitelescoping devices other than that afforded by the framework When the collision occurred the rear end of the Canfield was raised by the locomotive hauling train No 11, the forward end being lowered sufficiently to allow it to go under the underframe of the car immediately ahead of it, the Croton Falls The sides of the Canfield were then pushed outward and the car forced forward under the Croton Falls nearly its entire length. In view of the fact that the telescoping of the cars was nearly identical, attention is called to the commission's report covering its investigation of the accident which occurred on the

Pennsylvania Railroad at Mount Union, Pa., on February 27, 1917, in which the following statements were made:

Importance attaches to the method of end construction in steel cars—that is, for the portion above the sills or floor line. Under the usual conditions of service the tractive forces are applied and transmitted in the plane or nearly in the plane of the sills. Under reversed conditions, compressive stresses are resisted in substantially the same planes.

In the Railway Mail Service, specifications require a static resistance in the underframe members of 400,000 pounds, the several structural parts to act as a unit, the stresses being restricted to 16,000 pounds per square inch. It is further stipulated that the ends shall be proportioned to resist horizontal forces applied at a distance of 18 inches above the floor line. The latter provision is for the purpose of providing strength to resist telescoping.

It is recognized in the construction of mail cars that in case of emergency the forces to be resisted will not always be directed in the plane of the sills, and end strength is provided to meet the condition when the sills of adjacent cars are not in the same plane.

Shearing forces of great magnitude are present in cases of collision when the sills of one car are raised above those of its neighbor, tending to strip the superstructure of the adjacent car, or by wedge action separating the sides of the adjacent car. A superstructure which affords shelter but not strength virtually leaves the vehicle a flat car in cases of emergency, not adapted to resist exceptional stresses received above the sills.

There are two features of prominence pertaining to end construction of cars with particular reference to passenger service in order to ameliorate the shocks of collision. The end construction must be adequate to prevent telescoping—that is, prevention of the penetration of one car into another, and for the further safety of the passengers there must be some shock-absorbing feature in the construction of the car. In order to meet the latter consideration, collapsible vestibules have been proposed.

The practicability of providing shock-absorbing features is governed by the speeds involved, also the masses which are to be put into motion, or, on the other hand, the motion of which is to be destroyed. Colliding bodies may have such velocities that they become virtually projectiles, as in ordnance and gunnery. With increased speed of trains the tendency is toward such a result.

Covering certain ranges in speeds and intervals within which shocks may be absorbed, the use of cars of strong end construction and with collapsible vestibules would be expected to lessen the severity of collisions.

In the present case the inadequacy of the end construction of the car which was telescoped is clearly shown. It possessed but little strength in a comparative sense against telescoping, while its horrible shock-absorbing feature was the mass of humanity forced from all parts of its length into its extreme end.

Types of construction have been proposed, and cars are in service which offer greater resistance than the car which was telescoped and in which all of the occupants were killed. The features of adequate strength in end construction and collapsibility of vestibules as the means of lessening the dangers of collisions demand serious consideration.

Respectfully submitted.

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Chief, Bureau of Safety.

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