RAILROAD GAZETTE

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Contributions

What is a Rational Basis for Accident Statistics?

Chicago, Feb. 15. 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your review February 12 of my recent pamphlet on Railway Accidents in the United States and Europe you reject the conclusion of its comparisons because you think that some other unit than mileage should be employed as the basis of such comparisons. To use your own words the average casualties per mile of road "is entirely worthless, for the reason that density of traffic—not miles of road—must be the main factor in the computation of any average that is to be a true index of the danger or safety of railroad travel."

No one can be more conscious than I am that mere mileage is an unscientific and not wholly satisfactory basis for such comparisons as I sought to make. But a close study of the subject and extensive inquiry among men who have devoted more years than I have months to practical railway affairs, convince me that there was no other single basis, common to railways the world over, upon which an approach to satisfactory computation could be made. You suggest "density of traffic" as the main factor, and when you come to apply that factor you ignore length of haul, weight of cars and trains, physical and climatic conditions and a score of other things that render anything like a scientific comparison of railway accidents impracticable and unconvincing.

But because we are denied the possibility of a scientific basis is no reason why we should not arrive at some rational basis, and one that would not be wholly and palpably unfair to American railways. There is no excuse, in my opinion, for persistently prejudicing the American side of the comparison by ignoring the fact that we have nine times the British mileage, and, I believe, nine times the actual basis or opportunities for railway casualties. So far as the returns show, here are the accepted facts or approximations:

	United States, year to June 30, 1902.	United Kingdom, year 1902.
Track, single, miles	202,471	22,152
Track, double, miles	13,720	11,329
Track, three, miles	1,204	194
Track, four or more, miles	895	827
Track, yard and sidings, miles	58,220	....
Total track	276,510	34,502
Employees (U. S., 1903)	1,333,000	575,834
Passenger traffic—		
[1]Number carried, millions	711	1,320
[1]Number carried one mile, millions	21,543	9,140
*Train mileage, millions	407	227
*Average journey per passenger, miles	30.30	7
Freight traffic—		
[1]Tons carried, millions	1,363	437
[1]Tons carried one mile, millions	178,680	17,494
*Train mileage, millions	500	170
*Average haul per ton, miles	131	40

* U. S. Report, 1902. [1] 1903.

Out of the crucible into which all these factors must be cast in order to arrive at an approach to a rational basis for comparative analysis we can pluck these three salient facts:

While British railway passengers outnumber American nearly two to one, so short is their ride that in passengers carried one mile the American roads surpass them 2 1/2 times.

While American roads carry a little over three times as many tons of freight as the British, so much longer is the average American haul that the tons carried one mile are over ten times as many.

The American railroad employees outnumber the British 2 1/2 times, despite the fact that thousands are classed as railroad employees there who are not here.

Now it is a question whether these decisive factors should be added together or multiplied to arrive at the average unit of opportunity of railway casualties in the respective countries. Merely considering them as cumulative factors, we arrived at a total of nearly 15 units of chance for an accident on American roads to one on British.

And yet the *Railroad Gazette* says that my averages are "entirely worthless," because I have based them on the mileage unit and not on density of traffic, where the ratio is only 9 instead of 15 to 1.

Passenger and train mileage are the most pertinent factors in these statistics, but they are incomplete as furnishing a working basis without employee mileage, especially as trainmen furnish 80 per cent. of the victims of train accidents among employees.

As it would be even more impracticable to follow the comparisons through the varied and incomplete railroad statistics of other European countries I adopted a mileage basis common to all countries and, as the above statistics demonstrate, erring if at all in leniency to foreign railroads.

You say that if season ticket passengers were counted on the English roads as in American statistics the English total would be increased "to perhaps 1,500 millions." They were counted in 1902 for the first time and found to be 592,570, and their number of journeys approximated at 132,000,000, making the total as given above.

Your assumption as to my figures of Chicago roads embracing "a larger proportion of 'thin' lines than would be the case with roads further east" is not warranted. But if it were it would not apply to those comparisons in which I include all the great roads running out of New York, with one exception.

The error in my statement of the loss and damages on British roads was due to a slip in writing 1902 for the 1901, to which all my foreign figures refer, and this you correct by giving the loss for 1902 while retaining the mileage for 1901. [Mileage increased 1/2 of 1 per cent. that year.—EDITOR.] The comparison was equally illuminating whether the British loss was $4,258,080, as it was in 1901, or $3,847,000, as it was in 1902; since nine times the latter figures yields a loss nearly 40 per cent. greater per mile than on American roads.

In regard to the instances I gave of "disastrous train accidents occurring" in spite of the block signal system, the statements were taken from and credited to the bulletins of the Interstate Commerce Commission and bore direct or internal evidence to the fact that they occurred on roads protected by that system. Therefore, they were pertinent to show that something besides signals was necessary to the safety of railroad travel in America.

As for the ancient myth "that the railroads of England run many more fast trains than do those of this country, I am surprised at the *Gazette* reviving it in the presence of Mr. George G. Tunell's demonstration of "the overwhelming superiority at every point of the American train service." Unless my eyes and memory have deceived me the *Gazette* itself has taken an effective hand in the same demonstration.

Thanking you for your courtesy and space, I am, etc.,

SLASON THOMPSON.

[Putting figures into a crucible never clarifies them; it converts them into pi; and plucking figures out of pi, either before or after the crucible is heated, never does any good. The trouble seems to be the difference between facts and assumed facts. In what publication does Mr. Thompson find the total mileage of passengers on the British railroads? We do not know it, and Mr. Thompson should not assume it. The "belief" that there are nine times as many opportunities for railroad casualties in America as in Britain is unscientific, as Mr. Thompson agrees. It is also irrational, for the reasons which we gave. Length of haul is taken into account in computing density of traffic. As the number of season-ticket passengers reported by the British roads must be multiplied by 626, the number of trips for which such a passenger pays in a year, that class of mileage would be nearly 371 millions, not 132 millions. As we read the Interstate Commerce Commission Bulletin the records of collisions cited by Mr. Thompson and referred to by us bear direct or internal evidence that they were not on railroads using the block system. "The overwhelming superiority" which characterizes American train service in some particulars does not modify the fact that leading English roads run numerous fast trains where leading American roads run but a moderate number. There need be no fear, however, that this fact will afford any real comfort to the wicked persons who are persistently prejudicing the American side of the comparison. We forbear to take the reader's time to consider ton miles, or weight of cars, or climatic conditions; for the mileage of trains, which we did consider, is a more nearly scientific basis than all of these other factors put together. Employees' mileage, if it could be had, would afford no appreciable information beyond what is already available in the statistics of train mileage. We print the figures given above by Mr. Thompson because we do not like to abridge his letter; but he makes no use of them except in connection with assumed figures of English passenger mileage and ton mileage, and, therefore, we do not analyze them. It remains true that men employed, passengers carried, and train miles are essential factors in any fair comparison of casualties; and that to compare on an even basis 23,000 miles of road having a given density of traffic with 23,000 miles where the density is far different is misleading.—EDITOR.]

Performance of Automatic Signals in Cold Weather.

BY H. S. BALLIET,

Assistant Engineer of Signals, Lehigh Valley Railroad.

The principal railroads which have in service automatic block signals report that the weather conditions during January, 1904, were the most severe since the signals have been in use. Snow storms and blizzards were frequent. Generally speaking, the snowfall was the heaviest in years, 14 inches being a common depth. The thermometer on the coldest days recorded from zero to 42 deg. F. below. The period of extreme cold lasted about 30 hours each time and on several occasions the temperature moderated from 20 deg. to 40 deg. within a few hours. These sudden rises were closely followed by lower temperature. In one case the record shows 40 deg. decline within five hours. This decline occurred after the thermometer registered 35 deg. above zero.

The performance of automatic block signals under such adverse weather conditions has been, on the whole, admirable. Care, skill and forethought have been exercised to anticipate interruptions to satisfactory working. There are, however, several details which might be improved. It is the intention to confine this article to the more important failures which have been observed during the above-named period.

A number of cells of gravity or bluestone track battery were found frozen into a solid mass of ice. Most of these cells were in chutes constructed of 2-in. lumber and about 8 ft. in depth, or in cast-iron chutes of sufficient length so as to bring the lower cell about 7 ft. below the surface of the ground. Careful inspection indicates that most of these cells were frozen in consequence of the improper filling in of earth when the chutes were set. As a rule, too many stones are used to fill up and not enough earth. The best practice is to fill in with earth or, preferably, ashes. Chutes are sometimes set too close to stone walls. In extremely difficult places mineral wool should be used to protect 12 or 15 inches of the chute where it enters the ground as well as to make an additional cover for the top of the chute.

Gravity battery used for other than track circuits is always placed in wood or iron wells from 5 ft. to 8 ft. deep. These batteries were frozen in but few cases and then the trouble was apparently due to the absence of "frost breakers"—doors in the well some distance below the outside cover. Like track battery chutes, these wells need earth or ash protection up to the top covering.

Some batteries operating motor signals and their controlling electro magnets are kept above the ground line in the base of iron signal poles. In this situation many cells made up of a water solution of caustic potash were frozen solid. Where the cells were surrounded by newspapers, mineral wool or hair insulator, their e.m.f. was reduced because the cells chilled; but where these batteries were underground they delivered current uninterruptedly.

Batteries having a water solution of caustic soda which were above ground (in the base of iron poles) without further protection, or in shallow wood wells set on the surface of the ground, gave no indication either of reduction of e.m.f. or of freezing. A number of storage battery cells located in unprotected places delivered current without any decrease in e.m.f. and there was no apparent inclination to freeze. At 34 deg. below zero in a fairly well protected wood case, but in close proximity to a river, several cells of dry battery were unaffected and performed their function without any apparent decrease in e.m.f.

A great many relay points both normally open and normally closed were affected by the intense cold, quantities of frost, moisture and ice being deposited on them. In some cases the interruption to the passage of the current was temporary, while in others the signal continued to fail until the obstruction was removed by the repairman. Relays with platinum contacts were affected more quickly than those having a carbon contact. These interruptions were not confined to what is known as the open relay, they were also observed on relays with sealed glass covers. The steady cold did not appear to do the harm; it was the rise in temperature followed within a short time by a decline, which caused the moisture which was deposited to freeze and form frost or ice, depending upon the quantity of moisture. In a few instances, the change was so extreme as to cause sufficient moisture to be deposited so the armatures were frozen into whatever position they occupied. It is only fair to state that the major portion of relay contact failures occurred where the relays were enclosed in the cases at the bases of iron signal poles, or in iron relay cases. Where wood relay cases were in service, a small percentage of frost failures caused interruption, although many were found with a deposit of moisture. Where the wood cases were located on the shady side of a post no moisture or frost was traceable.

The accumulation of frost and ice was not confined to

relays alone; the mechanisms and controlling parts were also affected. These conditions were noted in all designs of automatic block signals. Apparatus enclosed in iron cases without ventilation appear to have suffered most; iron cases with ventilation not so much, and iron poles with whole or partial wood lining appear to have had about the same interruption as those with ventilation.

Where the mechanisms were enclosed in cases built principally of wood but few interruptions were noted.

The use of oil lamps kept burning continually to keep the air dry, has met with but little success. The most effective preventive of moisture troubles that has been found is ventilation. This is generally accomplished by having a number of openings cut into the side of the cases, allowing the air to circulate freely; but even this has been ineffective in many instances. The circulation can be maintained by means of an electric fan within the case or enclosure.

The accumulation of frost and ice is confined to localities where the air is moist. The area of moisture-charged air is not well defined. There are cases where this area extends from 25 to 40 miles on either side of large bodies of fresh water; again it reaches but a few miles inland from a river, creek or swamp.

Extraordinary precautions have been taken to protect motor commutators against frost by enclosing them in felt, flannel, glass, celluloid and brass; but no positive relief seems to have been accomplished.

On certain signals within 2,000 ft. of salt water electric motors have been in operation for several years without interruption or a trace of frost or ice, and no covering of any description is or has been used to prevent it.

Some interruptions have been reported due to the breaking of line wires on account of sudden contraction. These breaks appear to be confined to iron wire exclusively, except in cases where copper has been strung a second time, the breaks occurring where kinks were introduced by handling.

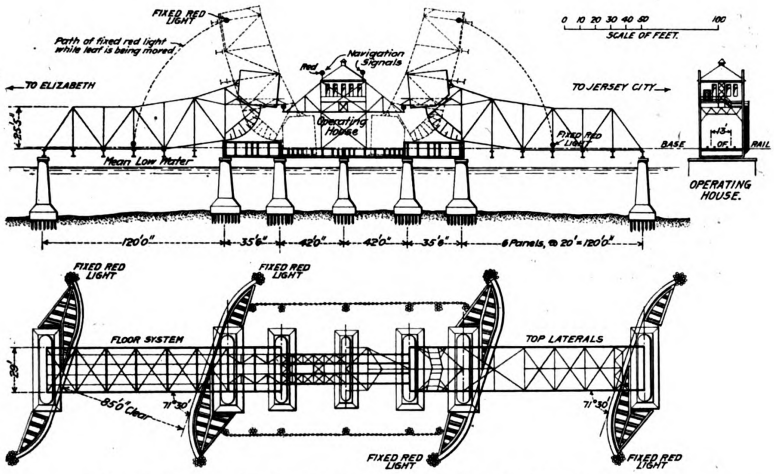
A close study of the various designs of apparatus develops the lesson that more margin should be allowed for moving parts, *i. e.*, more air gap should be allowed. If applied, this would mean a slight increase in maintenance, because it would involve the application of more voltage on each circuit.

The experience of this winter seems to have demonstrated that the power to operate automatic block signals should in all cases be located at the signal post. Under such a system, the failures are confined to a few signals. Where a series of signals is operated from a common point, a break, or interruption in the main, causes the failure of a number of signals. A few such cases have occurred during the month under review.

Scherzer Rolling Lift Bridge Over Newark Bay.

The double-track main line of the Central Railroad of New Jersey enters Jersey City over a pile and timber trestle, 1½ miles long, across the lower end of Newark Bay. The opening at the dredged channel, a short distance east of the center of the trestle, is spanned by a steel center-pier swing draw which has been in use for a number of years but which some time ago was found to be unsuited to accommodate the very heavy freight and suburban traffic which passes over it. This line is used for the numerous suburban trains of the Jersey Central and for all the through trains of the Philadelphia & Reading and the Baltimore & Ohio to Philadelphia and the South. During the morning and evening rush hours trains pass over it at intervals sometimes as close as two minutes. There are always large numbers of vessels passing through the channel to and from Newark and other cities on the Passaic and Hackensack rivers, a majority of which are barges and tugs. Owing to the swift and uncertain tides vesselmen are compelled to pass through the draw at times when the tide is favorable regardless of the interruption of train service over the bridge and with the present type of draw it requires the same opening to allow a barge to pass as to allow a masted vessel to go through, inasmuch as the tops of the rails are only 11 ft. above mean tide water.

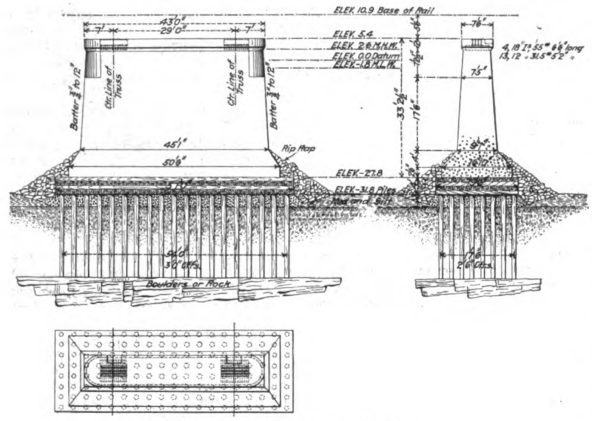
It was decided to replace the present span with a modern type of bridge and careful studies were made of the cost and adaptability of the different types of movable bridges to meet the existing conditions and the requirements for future expansion. It was essential that the new bridge should readily permit the building of additional tracks and drawbridges at some future time should the necessity arise. Four tracks are now used on both sides of the bay and the possibility of extending them across the trestle was of course taken into consideration. The maintenance of an uninterrupted train service during the erection of the new span and the dismantling of the old was another important point. In building a new center pier swing bridge on the site of the old span it would have been necessary to erect a temporary trestle and draw to one side of the present structure and divert all trains over it. It would also have been necessary, in order to provide for future tracks across the bay, to have erected a four-track bridge at the present time, although only two tracks are now needed; for, if only a double-track swing bridge was put in it would have to be discarded and replaced by another of greater capacity as soon as it was decided to increase the number of tracks crossing the trestle. A four-track swing bridge would also have increased the height of the tracks above the water on account of the heavy drums and rollers required and this would require the elevation of the entire trestle for a considerable distance on each side of the opening and the consequent introduction of undesirable grades.



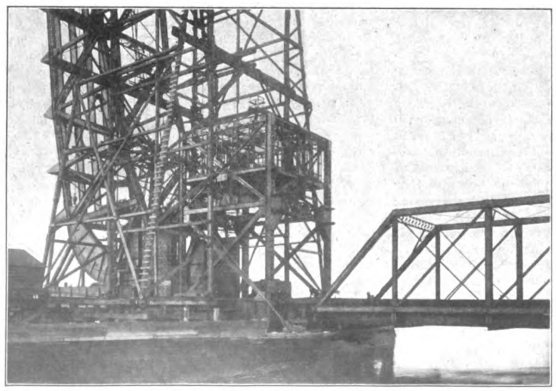
General Plan and Elevation of Scherzer Rolling Lift Bridge Over Newark Bay.

After a careful consideration of all the types of movable bridges and consultation with the War Department it was decided to put in a Scherzer rolling lift bridge as meeting most satisfactorily the conditions of present and future traffic. A provision of the charter of the railroad company required that two channels should be maintained for navigation and plans were therefore drawn for two double-track single-leaf, Scherzer lifts, placed back to back and each bridge independent of the other in its operation. Work was begun on the foundations about a year ago, and on Sunday morning, Feb. 14, the completed west leaf was lowered into place on its supports from the upright position in which it was erected. Regular train movements had been maintained throughout the erection without changing the alinement or grade of the tracks and was only interrupted for a few hours while the bridge was lowered for the first time. Trains were run over the Newark branch during that time.

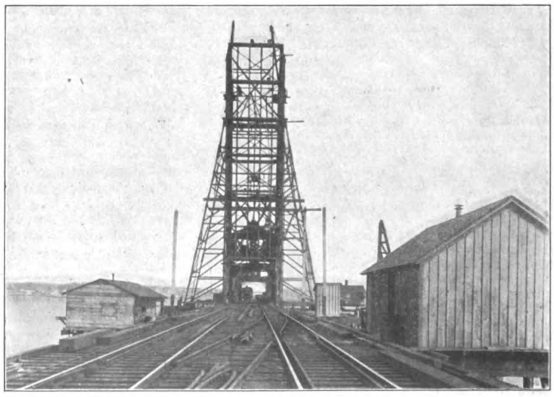
The accompanying drawings show the general outlines of the new bridge and the details of one of the piers. The dredged channel at this point makes an angle of 71 deg. 30 min. with the center line of track, and in order to preserve the clear channel openings of 85 ft. fixed by the War Department, the two spans were each made 120 ft. long. The center pier of the present swing draw, which has openings of 70 ft. and 75 ft., stands about in the middle of the east channel. Seven piers were sunk for



Detail of Foundation for Pier No. 3.



Scherzer Lift Bridge During Construction, Showing Old Draw Span.



End View of Bridge Showing Train Running Under.