# Reasons for Building the B. \& O. Magnolia Cut-off ${ }^{*}$ 

Low Grade Double Track Line 12 Miles Long Costing $\$ 6,000,000$ Relieves a Serious Operating Problem

During the period of 17 years in which the construction of the original line of the Baltimore \& Ohio between Harper's Ferry, W. Va., and Cumberland, Md., was under consideration, many routes were surveyed on both sides of the Potomac river. On account of a lapse in the company's Virginia charter and a provision in the law extending the charter, that the route must lie in the state of Virginia, the company was forced to adopt a line south of the river. This location had other decided advantages, however, as it reached the fertile valleys bordering on the tributaries of the Potomac, avoided interference with the Chesapeake \& Ohio canal then far advanced in its construction, and was cheaper than a line north of the river by $\$ 2,625,000$. The final location of this line was made in September, 1839, and the road opened to Cumberland in November, 1842. On account of the necessity for avoiding heavy construction work a line with heavier grade but shorter than the circuitous route following the river was adopted. The original line included three tunnels, all
branch, and ascending a 0.3 per cent grade to the foot of a 20 mile helper grade of 0.75 per cent at a point 8 miles west of Pinkerton on the Connellsville division. The estimates show that it would require approximately $\$ 17,755,000$ to construct a new line and revise the present one on such a basis. At the summit of the mountain the 1.23 per cent line through Sand Patch tunnel could be replaced by one commencing at Garrett, Pa., having a 0.3 per cent eastbound grade with a tunnel 13,500 ft . long. This revision would cost $\$ 4,312,000$. These new lines and revisions would permit operation on a 0.3 per cent basis from the Fairmont coal fields eastbound to the summit of the Allegheny mountains with a helper grade of 20 miles.

On the east side of the summit the grade is descending eastbound until the location of the recent Magnolia improvement is reached. At this point the completion of this work provides a 0.1 per cent eastbound grade to Cherry Run, where a 0.3 per cent helper grade has been established eastward to Hedgesville. From


Map of the Baltimore \& Ohio System Showing Location of the "Neck" Between Cumberland and Brunswick in Which the Magnolia Cut-Off Improvement Is Located
of which have now been eliminated, the last being a part of the Magnoiia cut-off improvement.

## handling coal to tidewater

In January, 1844, the new road was offered a contrect for hauling 175 tons of coal. pig iron and bar iron for 300 days in the year at a rate of $11 / 3$ cents per ton mile. From this beginning the semi-bituminous coal trade on the Baltimore \& Ohio has grown to $30,000,000$ tons a year, the gross revenue from which is 0.4 cents per ton mile. If a new project were considered for handling this traffic from the Maryland, West Virginia and Pennsylvania fields to tidewater, undoubtedly a line with grades against eastbound traffic not exceeding 0.2 per cent could be built over these ridges with a tidewater terminal located at some point on the Potomac river.
During the growth of this business the question of more economical operation has been constantly studied and many surveys have been made covering various lines from the Fairmont, W. Va., region to tidewater. It has been found possible in these surveys to establish an eastbound low grade line beginning at Van Voorhis on the Fairmont, Morgantown \& Pittsburgh

[^0]Hedgesville to Harper's Ferry surveys have been completed which show that for $\$ 3,500,000$ a low grade line can be constructed, having a maximum eastbound grade of 0.1 per cent. These surveys have been made looking toward the future when it is thought the eastbound tonnage will have grown to such proportions that more economical operation will be necessary and the large expenditures will be justified.

## EAST END of CUMberland division

The congestion on the 102 -mile freight division between Cumberland and Brunswick was serious as early as 1900 , and various improvements were considered, including the Magnolia cut-off. Owing principally to the heavy expenditures necessary to add to the track facilities along the Potomac river, however, they were postponed from time to time. At Cumberland, two double-track lines, one from Pittsburgh and Chicago, and the other from Cincinnati and St. Louis, meet and form the main line east. At Patterson Creek, 8.1 miles east of Cumberland, a freight cut-off joins the main line from the Cincinnati-St. Louis line, which eliminates handling this freight through Cumberland. These two double-track lines merge into a three-track road from Patterson Creek to Little Cacapon, 13.9 miles, at which point there is a westbound passing siding. From the latter point to Magnolia, 7.5 miles, there are but two tracks with a westbound siding
at Magnolia. An additional freight running track is provided from Magnolia to Hansrote, 9.5 miles, at the foot of the helper grade. From Hansrote to Orleans Road, 4.7 miles, there are two tracks on an 0.8 per cent grade. eastbound, against the
follows: 14 per cent fast freight. 84 per cent slow freight, 2 per cent package local. The average daily movement on the east end of the Cumberland division for a 10 -day period, ending March 10. 1914, is shown in the following table:
ruling movement from Hansrote to the summit at Doe Gully tumel. l'rom Orleans Read to Cherry Kum, 25.3 miles, there are three tracks with a four-track section from Sir John's Run to Hancock. 5.1 miles. It Cherry Kinn the main line which is double track. ascends an 0.8 per cent grade for a distance of 7 miles to the summit at North Mountain. From Cherry Run to Cumbo there is a low-grade, easthound double-track freight line, 14 miles long. which passes around Nerth Motintain and joins the main line asain at the latter point. From (umbo to Fawer, 3 miles, there is a double-track line and from Fawrer to Opequon, the foot of a helper grade, there are three tracks, the third being the eastbound rumning track, and an 0.8 per cent ascending grade begins at ()iequon. which continues to the summit at Hobbs, 7.3 miles. Irom this point to Engles, near Harper's Ferry, 5.8 miles, there is a double-track line with an 0.8 per cent descending grade and a westbound third track. From Engles to Weverton, 6.2 miles, there is a double-track line. Brunswick yard, the east end of the freight division, is situated just east of Weverton.

The division is operated for a general grade of 0.3 per cent. easthound, using helper engines over the two 0.8 per cent grades. With the completion of the Magnolia cut-off. helper engines at Hansrote will be climinated, which will permit a continuous movement of freight trains between Cumberland and Martinsburg. the part of the road of greatest tratfic density. From Martinshurg east over the third summit, the use of helper engines will be continued until the low-grade line between Martinsburg and Harper's Ferry will have been built. The elimination of the 2r-mile helper grade at Hansrote was delayed on account of the very rough country and the circuitous route of the river. pending a decision in regard to a general change which would shorten the !ine and reduce the curvature in addition to eliminating the helper grade.

## THE TR MFFIC AND RESTILTNG CONGESTION

A diversified husiness is handled over this line, the preponderance of which is soft coal. There are three points of interchange with other roads, at Cumberland with the Pennsylvania, the Cumberland \& Pennsylvania, the Georges Creek \& Cumberland and the Western Maryland, at Cherry Run with the Western Maryland, and at Martinsburg with the Cumberland Valley. At the latter two points. 47 and 71 miles respectively east of Patterson Creek. 43 per cent of the easthound freight leaves the B. \& O. for castern Pennsylvania and New England delivery, coal being the principal commodity diverted. The Cumberland Valley is also the route of the Central States Despatch.

The greatest density of traffic on the B. \& O. system, that is, the number of trains handled as well as the ton miles per mile of road, obtains between Patterson Creek and Martinsburg. There have been handled annually $20,000,000$ net tons of freight per mile of road hetween these points and an average of $15.000,000$ net tons per mile of road over the entire freight division between (umberlend and Brunswick. This traftic is divided as

As shown in the table, the heaviest tonnage is handled between Patterson Creck and Cherry lun, the number of trains being approximately the same in each direction. The eastbound gross tonnage amounted to 08.1 per cent of the total, consisting of 97.5 per cent loaded, and 2.5 per cent empty cars, while the westbound freight movement comprised 23.8 per cent loaded and 76.2 per cent empty cars. Of the total cars operated, 97 per cent carried full rated tonnage, which is a very high average. The highest average miles per car per day for the system obtains on this division for two reasons, first. because of the through movement and the large number of cars handled and second, because of the small amome of busines originating in this territory.

The most serious congestion in handling this heavy traffic was, of course, on the helper grade between Hansrote and the summit at Doe Gully tunnel. Six or seven eastbound freight trains were always in the vicinity of this helper grade, either moving or waiting for track and on account of the helper engines having to use the westhound track down the grade, the westbound traffic was frequently delayed and the delay to helper engines. in turn, delayed eastbound trains.

## impronement in oper.ition 1910-1914

The congestion in this portion of the line, referred to as the "neck of the bottle." hecame so serious in the latter part of 1910 that conditions were given particular study with a view to taking care of the business offered at that time, as well as to provide for increased business. Had a revision of grade and line been worked out and decided upon at that time. and the money appropriated. the completion of the work could not have been accomplished in time to take care of the business offered, as it would have required at least 18 months to two years to complete any scheme presented for the Magnolia cut-off, and from four to six months to get any relief whatever from third track along other portions of the division. It was therefore necessary to do something at once and existing financial conditions demanded exceptoonal care in making expenditures.

In order to secure immediate results it was decided to order Mikado locomotives for immediate delivery, to construct additional automatic signals, and build third tracks where they could be laid on that portion of the line not affected by the proposed Magnolia cut-off. establish signal indications for the operation of trains, and provide more and better supervision. The Mikado locomotives ordered for this division weigh 284.500 lb ., and have $55,000 \mathrm{lb}$. tractive power with 26.2 per cent greater hauling capacity than the consolidation locomotives previously used. A vigorous campaign was also started for a better carload, a decrease in the number of cars hauled, and an increase in the number of revenue tons per train.

The various passing sidings and freight tracks both east and west of the 17 -mile section of road which was to be improved by the Magnolia cut-off, were coupled and extended, therehy securing maximum freight running trackage for a considerable
distance at each end of the proposed improvement. Interlocking towers were placed five miles apart and crossovers constructed between tracks to permit of parallel movements. In this threetrack layout, the middle track was equipped with automatic signals to permit movements in both directions and the operation of all trains in this district was placed under signal indication, eliminating train order movements, the third-track system particularly lending itself to increased efficiency because of its flexibility in permitting almost four-track operation. No 16 frogs were installed in crossovers, which, when used, were covered by upper-quadrant, low-speed signal blades. A main-track coaling tipple, ash pits and water facilities were placed at Sir John's Run, half way on the freight run east from Cumberland, which resulted in a reduction in the cost of operation. Additional supervision was secured by placing well-trained men both on the road and in the superintendent's office. Particular attention was given to following the makeup of trains to reduce the num-

| Gross ton miles | 266,271 | 8 | 0,737 | 12.2 |
| :---: | :---: | :---: | :---: | :---: |
| Pass. car miles per locomotive | 34.500 | 31,870 | 2,630 | 7.6 |
| Pass. car mi. per mi. main track | 18,630 | 19,540 | 910 | 4.9 |
| Net ton miles. | ,997,887,181 | 2,316,743,150 | 318,855,969 | 16.0 |
| Revenue train | 2,826,043 | 2,165,716 | 660,327 | 23.4 |
| Freight engine mile | 3,117,261 | 2,318,263 | 798,998 | 25.6 |
| Loaded freight car m | 68,539,339 | 69,990,517 | 1,451,178 | 2.1 |
| Empty freight car m | 39,899,356 | 43,752,856 | 3,853,500 | 9.7 |
| Total car | 108,438,695 | 113,743,373 | 5,304,678 | 4.9 |
| Percent loaded to | 63.18 | 61.53 | 1.65 | 2.6 |
| Type of freight loco | Saturated Hand-fired Consol. | $\left.\begin{array}{c}\text { Superheater } \\ \text { Stoker } \\ \text { Mikado }\end{array}\right\}$ |  |  |
| Avg. number of freight locos. | 72.9 | 84.1 | 11.2 | 15.4 |
| Trac. power of freight locos. | 3,054,510 | 4,448,890 | 1,394,380 | 45.6 |
| Avg. trac. power per frt. loco. | 41,875 | 52,831 | 10,956 | 26.2 |
| Avg. mileage per frt. loco. | 42,800 | 27.600 | 15,200 | 35.5 |
| Gross ton mi. per mi. of road | 33,970,000 | $38,130,000$ | 4,160,000 | 12.2 |
| Gross ton miles per mile of main track | 11,540,000 | 12,080,000 | 540,000 | 4.7 |
| Gross ton miles per frt. loco. | 54,650,000 | 53,000,000 | 1,650;000 | 3.0 |
| Gross ton miles per $1,000 \mathrm{lb}$. tractive power | 1,302,000 | 1,003,000 | 299,000 | 23.0 |
| Train load-Gross | 1,408 | 2,060 | 652 | 46.3 |



Track Diagram and Profile of the East End of the Cumberland Division Showing Location of the Magnolia Cut-off and Proposed Improvements Between Cumbo and Harper's Ferry
ber of breaks-in-two to a minimum, and further to see that each train was given its full tonnage rating. Inspectors were also placed in the coal region to see that each car was loaded to its capacity.

During the four years 1910-14 the average carload on this division increased 13.4 per cent, the increase in average capacity of system cars during the same period being 5 tons, or 13.5 per cent. As an indication of the results secured by these measures the following table shows a comparison of operating statistics for this division between the fiscal years 1910 and 1914, indicating a considerably increased volume of business and a marked increase in efficiency:

| Description | Statistics |  | Increase or decrease | $\begin{gathered} \text { Per } \\ \text { cent } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
|  | $\sim$ Fiscal years |  |  |  |
|  | 1910 |  |  |  |
| Miles of road. | 117.00 | 117.00 |  |  |
| Miles of main track. | 344.47 | 369.75 | 25.26 | 7.3 |
| Miles main track and sidings | 468.07 | 504.27 | 36.20 | 7.7 |
| Passenger train miles. | 778,198 | 997,152 | 218,954 | 28.1 |
| Passenger car miles. | 6,413.969 | 7.227.397 | 813,428 | 12.7 |
| Avg. trac. power per pass. loco. | Light Pacific | Heavy Pacific |  |  |
| Avg. mileage per pass. loco.. | 15.5 | 18.9 | 3.4 | 21.9 |
| Cars per train... | 456,625 | 760,060 | 303,435 | 66.5 |
| Type of passenger locomotive | 29,500 | 40.200 | 10,700 | 36.3 |
| Avg. number of pass. locos.. | 4,310 | 4.475 | 165 | 3.8 |
| Tractive power of pass. locos. | 8.25 | 7.25 | 1.00 | 12.1 |
| Pass. car miles per mi. of road | 54.800 | 61,800 | 7,000 | 12.8 |


| Train load—Net $\ldots \ldots \ldots \ldots$ | 707 | 1,070 | 363 | 51.3 |
| :--- | ---: | ---: | ---: | ---: |
| Engine load-Gross $\ldots \ldots \ldots$ | 1,276 | 1,927 | 651 | 51.0 |
| Engine load—Net $\ldots \ldots \ldots$ | 641 | 1,000 | 359 | 56.0 |
| Car load-Net $\ldots \ldots \ldots \ldots$ | 29.2 | 33.1 | 3.9 | 13.4 |

In the four years ended June 30,1914 , the revenue train load increased 51.3 per cent with a decrease in the freight train mileage of 23.4 per cent. The following table shows the decrease in number of trains run in that period and the increase in the net ton mileage:

## Comparisons of Car and Ton Miles

 Number of freight trains run in 1914......................................28,527

Per cent decrease. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
Total freight car miles in 1910........................................ 108,438,695
Total freight car miles in 1914..........................................113,743,373
Increase
$5,304,678$
Per cent increase
4.9

Net ton miles in 1914..............................................2,316,743,150

A comparison of the freight movements in this territory for 1914 and 1910 is shown in the table on the following page.


These improvements in operation made it possible to take care of a rapidly increasing business, postpone for three years the construction of the Magnolia improvement, thereby saving the interest on a large sum of money that would otherwise have been expended immediately, and to provide additional time for studies of the contemplated line revision.

## CHANGES IN LINE AND GRADE

The various studies that have been made as to improvements in the operation of the east end of the Cumberland division have shown that it is possible to obtain grades of 0.1 per cent or 0.2

Before the adopted line of the Magnolia cut-off was located and construction commenced, the studies included locations of both 0.1 per cent and 0.2 per cent lines, as it would be possible to obtain either of these grades on the Cumbo-Harper's Ferry lines. The present 0.3 per cent grade line from Cherry Run to Cumbo will have to be operated with a light helping engine on either 0.1 per cent or 0.2 per cent grades. The completion of the Cumbo-Harper's Ferry lines and the Magnolia cut-off would leave very little additional grade reduction necessary to obtain a 0.1 per cent grade against eastbound movement and a 0.15 per cent grade against westbound traffic, especially if it is considered necessary to revise on that basis only one track for slow freight in each direction.

## CONSIDERATIONS IN LOCATING MAGNOLIA CUT-OFF

In taking up the study of the Magnolia cut-off improvement, an investigation covering several years was made of the train movement and tonnage handled, motive power, probable future locomotive tractive power and train loads. The relation of loaded eastbound movement to empty westbound movement being also carefully studied. It was finally decided that an eastbound grade of 0.1 per cent was possible, which would permit the most economical operation, and that a westbound 0.4 per cent


Location of Fomr Routes Considered for the Magnolia Improvement and Profile of the Adopted Line
per cent against eastbound traffic which is the loaded and ruling movement, and of 0.15 per cent against westbound traffic with 0.4 per cent helper grades on certain sections. The various studies pointed clearly to the fact that a 0.1 per cent grade is justified as compared with either a 0.2 per cent grade or the present method of operation. This grade would permit a maximum eastbound train load, based on the most economical operation, and the maintenance of a proper balance of power between eastbound and westbound movements. The general proposition to obtain better gradients over the entire division will necessitate the building of a low grade line along the river from Cumbo yard to Harper's Ferry, in addition to the Magnolia cut-off. The former line has been investigated and the recommendation made that any future construction of additional tracks between North Mountain and Harper's Ferry should be along this route.
grade would take care of the balance of traffic in that direction.
The question as to the construction of a new two or four-track line was also given a great amount of study. Four possible propositions were considered; first, a temporary third track alone, the present line retaining the eastbound helper grade; second, two additional tracks along the present line, retaining the helper grade ; third, a four-track low grade cut-off abandoning the present line; and, fourth, a two-track eastbound low grade cut-off using the present line for westbound movements. Before the final decision was reached a total of 29 propositions covering various grades and alinements were covered, following practically three routes. These various studies included plans for building the new line in parts over a term of years, and the estimated cost of the lines varied from $\$ 1,425,000$ to $\$ 15,575,000$. The following table shows the estimated cost of a few of these
lines; also the ammal operating costs, with and without interest, for the present traffic and for double that tratfic:
pprating standpoint that the new line can be better operated by using both new tracks for castbound freight trains and the pres-


The following taile shows the saving in distance and curvature for the four principal routes considered:

| Easthound |  |  |  | Ng in | STANC | Wenthound |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Line | $\overbrace{\substack{\text { Mist. } \\ \text { Miles }}}$ | Saving Miles | Curvature les. | $\operatorname{Sining}_{\substack{\text { aveg. } \\ \text { lock }}}$ | $\begin{aligned} & \text { Dist. } \\ & \text { Miles } \end{aligned}$ | Saving <br> Miles | $\begin{gathered} \text { C:uvature } \\ \text { bek. } \end{gathered}$ | $\begin{gathered} \text { saviag } \\ \text { DCg. } \end{gathered}$ |
| No. 1. | 20.8 | ... | 2.130 | ..... | 20.6 | ... | $\therefore 130$ |  |
| ㅅ.. ${ }^{\text {a }}$. | 20.8 | $\ldots$ | 2.130 |  | 20.8 | $\because$ | 2.130 |  |
| No. 3. | 12.5 | 8.3 | 495 | 1,635 | $1 \therefore .1$ | 8.7 | 305 | 1.8 .5 |
| No. 4. | 15.2 | 5.6 | 1,3*0 | 750 | 20.8 | ... | 2,130 |  |

The recommended line No. 4, which was tinally adopted and built at an estmated cost of $\$ 6,000,000$, is a double track line. using the present operated tracks for westbound traffic. This has made it possible to secure a four-track line and derive the benefit from a low grade with the least expenditure. Furthermore, it is believed that the following important characteristics have been secured. First, a minimum grade both eastbound and westbound which will permit the most economical operation; second, a 0.1 per cent grade eastbound, possible over the entire freight division, which will fit in with a general grade revision scheme from the coal fields to tide water; third, a 0.4 per cent grade for westbound business which is practically justified by the probable balance of future traffic; fourth, a four-track system between Little Cacapon and Orleans Road, which will take care of a largely increased volume of business and probably take care of the traffic over the division for a great many years. This section is the first portion of a four-track system, which will gradually be extended from Patterson Creck to Brunswick, a distance of 95 miles.

The Magnolia cut-off was more essential to the development of the Baltimore \& Ohio as a system than is shown by the advantages to be gained by economies in operation. In view, however, of the heavy expenditure necessary to provide the additional tracks for the purpose of climinating congestion that has heretofore existed in the handling of traffic over the east end of the Cumberland division, particularly this 17 -mile section, it is reasonable to expect a reduction in the operating costs. Some of the direct savings that may be expected are as follows:

| Flimination of Hansrote Ifelping Station- <br> Operation of helping engines................. . $\leqslant 35.000$ |  |  |
| :---: | :---: | :---: |
| Water station facilities | 2.000 |  |
| Jnterlocking tower | 3.000 |  |
| Overtime account of facilitated mo | $\begin{array}{lr} \ldots & \$ 40.000 \\ \ldots . & 20,000 \end{array}$ |  |
| Train mileage, increased tonnage. wages, fue including proportion of locomotives and | $\begin{aligned} & \text { pplies. } \\ & \text { airs... } 125.000 \end{aligned}$ |  |
| Less mileage allowance to crew. | 20.000 |  |
| Total direct saving per ann:m |  | \$205.000 |
| Trital direct saving per month. |  | 17,080 |

The flexibility in operation brought about by the elimination of the cause of congestion will result in a saving equivalent to the cost of operating eight road and two helper engines. It also will avoid had situations heyond the improved section which will be beneficial in the coal regions where the traffic is assemhed, as well as at points of destination, especially tidewater, pormitting a quicker movement of traffic over the entire system. Conservatively estimated on the basis of the present business this saving should amount to approximately $\$ 500,000$ a year.

While it has not been definitely decided, it seems from an
colt main tracks and third track for cast and westhound passenger trains and all westbound freight trams. Although the line is shorter by the new route, this advantage from the standpoint of passenger traffic is offset by the old line having no tunnels and being along the lotomac river for the entire distance. Facilities for handling passenger traffic will, however, be greatly improved by the elimination of the helper stations and the removal of the easthound fast and slow freight trains from the old line.

## WESTERN RATE ADVANCE HEARING

Testimony of the representatives of shippers and of the western state railway commessoners against the proposed advances in freight rates on fresh meats and packinghouse products occtpied the hearing iefore (ommissioner D)aniels at (hicago this week in the western rate advance case. This is to be followed by testimony on the livestock rates from May 1 to May 5. Testimony on the advances on fruit and vegetalle rates and on rice and rice products was heard on April 22. 23 and 24. The testimony on grain and grain products was not completed in the time allotted for it in the schedule on April 21, although several night sessions have been held, and supplemental testimony will be presented on the days allotted for unfinished evidence at the end of the hearing.

One of the witnesses for the shippers of grain and grain products was W. J. Thompson of the Einited States Department of Agriculture, who introduced exhibits to prove that the farming industry is unprofitable and in too weak a condition to stand the proposed advance of one cent per 100 lb . in the grain rates. He presented figures based upon returns from 273 farms to show that the net return only averaged 3 r. per cent on the value of the property used. Under cross-examination by T. J. Norton. general attorney of the Atchison, Topeka \& Santa Fe, Mr. Thompson said that he had not taken into consideration the fact that the farmer gets a living for himself and his family, and that he had not included money the farmers receive for hutter, eggs and other similar products. Mr. Norton entered objection to the entire testimony as being irrelevant. Commissioner Daniels ruled that the question of whether the shipper was making a profit or a loss had nothing to do with the reasonableness of a freight rate, but said that since the question of returns had been raised he would admit the testimony for what it was worth, although he was not strongly persuaded, he said, that the average farmer keeps cost accounts.
C. W. Hillman and Jean Paul Muller testified as expert accountants for the shippers and the state commissions as to the cost of handling grain traffic. Mr. Hillman presented an extended analysis of the operating revenues and expenses of the Chicago $\&$ North Western to show the margin between the cost of moving grain and the revenue received by the railroad per car for the month of November, 1914. He divided the operating revenues and operating expenses of the road between freight and passenger service, and then attempted to separate the expenses of handling the wheat, other grain and grain products traffic. The result was to show that the cost of carrying a car of wheat into Chicago from Sioux City, Iowa. 526 miles,


[^0]:    *Abstracted from a naper presented before the Engineers' Society of Western Pennsylvania. November 24, and published in the December, 1914, Proceedings. A descrintion of the interesting construction features of thi

