of types B and C, it being a 1:3:6 mixture. The thicknesses of the lining, as given in the engraving, are the minimum dimensions that are allowable, and these are increased as occasion may demand. In this section refuge niches 3 ft. wide with circular tops are provided every 200 ft. on each side and staggered so as to provide a refuge at half that interval throughout the whole length of the tunnel. Weep holes are also provided, leading from the sides to cross drains, as local conditions may require. The space between the concrete and the material on all sides is packed with a layer of 6 in. of spalls. In this section the excavation exceeds that of any

Ingleside Tunnel; Tidewater Railway.

of the others, it being 18.537 yds. per lineal foot, with 1.955 cu. yds. of concrete masonry in the arch and 3.085 cu. yds. in the side walls.

The E section is used in yielding material, and is a timbered tunnel lined with concrete; the dimensions of the latter corresponding with those of the D section, though a richer or 1:2:4 mixture is used. The timbering is of the same character as that used in the C section, except that it is carried down the sides instead of being confined to the roof. This section requires 21.82 cu. yds of excavation and 489 ft. board measure of timbering per lineal foot. The masonry for the same distance consists of 1.955 cu. yds. in the arch and 4.323 cu. yds. in the side walls.

In driving these tunnels various methods have been employed in the detail of the work. Sometimes it has been from shafts

Portal of Tunnel at Mile Post 58; Deepwater Railway.

sunk from above with a heading driven in each direction, though usually the work has been by approach from the two ends. In a number of cases elaborate preparations had to be made in the way of building roads, sometimes laying rails on them for the transportation of material and supplies, and in many instances this also involved the erection of expensive compressor plants to supply air to the drills.

A very complete system of progress charts was also provided by which the condition of the work could be exactly determined at any time. This was quite essential to a proper supervision from headquarters since, in the distance between mileposts 103 and 362, there are twenty tunnels with a total length of 18,786.3 ft., the longest being the one at the summit crossing the Alleghany mountains, with a length of 5,139 ft., and the shortest at milepost 291, which is but 450 ft. long. The system by which the reports of progress were kept consisted of a blueprint upon which there was a longitudinal section of the tunnel divided vertically by lines 50 ft. apart on the scale and by a horizontal line to separate the bench from the heading. Two sets of these prints were provided, one for the week ending and one for the month. These were colored red and yellow, as directed, and sent to the office of the chief engineer at the end of each week and month by the resident engineer, with the other data called for. In this way a complete record was obtained of the number of men employed and the material removed as called for on the blank. The two blanks are identical in every particular, except that one is for the month and the other for the week.

It is this portion of the work that will probably fix the time for the opening of the road, and the tunnel that will be the last to be completed will undoubtedly be that at the summit of the Alleghanies, and this is now being pushed as rapidly as possible.

The prosecution of this work may be taken as a sample of that done elsewhere, though it is on a larger scale than is ordinarily required. The contractors have installed a very complete power plant near the opening of the shaft that is about midway between the two portals, besides having built a standard gage railroad from a connection with a local mining road up to the power-house. In this way a direct connection is made with the Norfolk & Western and all supplies are brought in over the line, which is about 2½ miles long. Four headings are being driven, and the advance is at the rate of about 380 ft. per month, through rock.

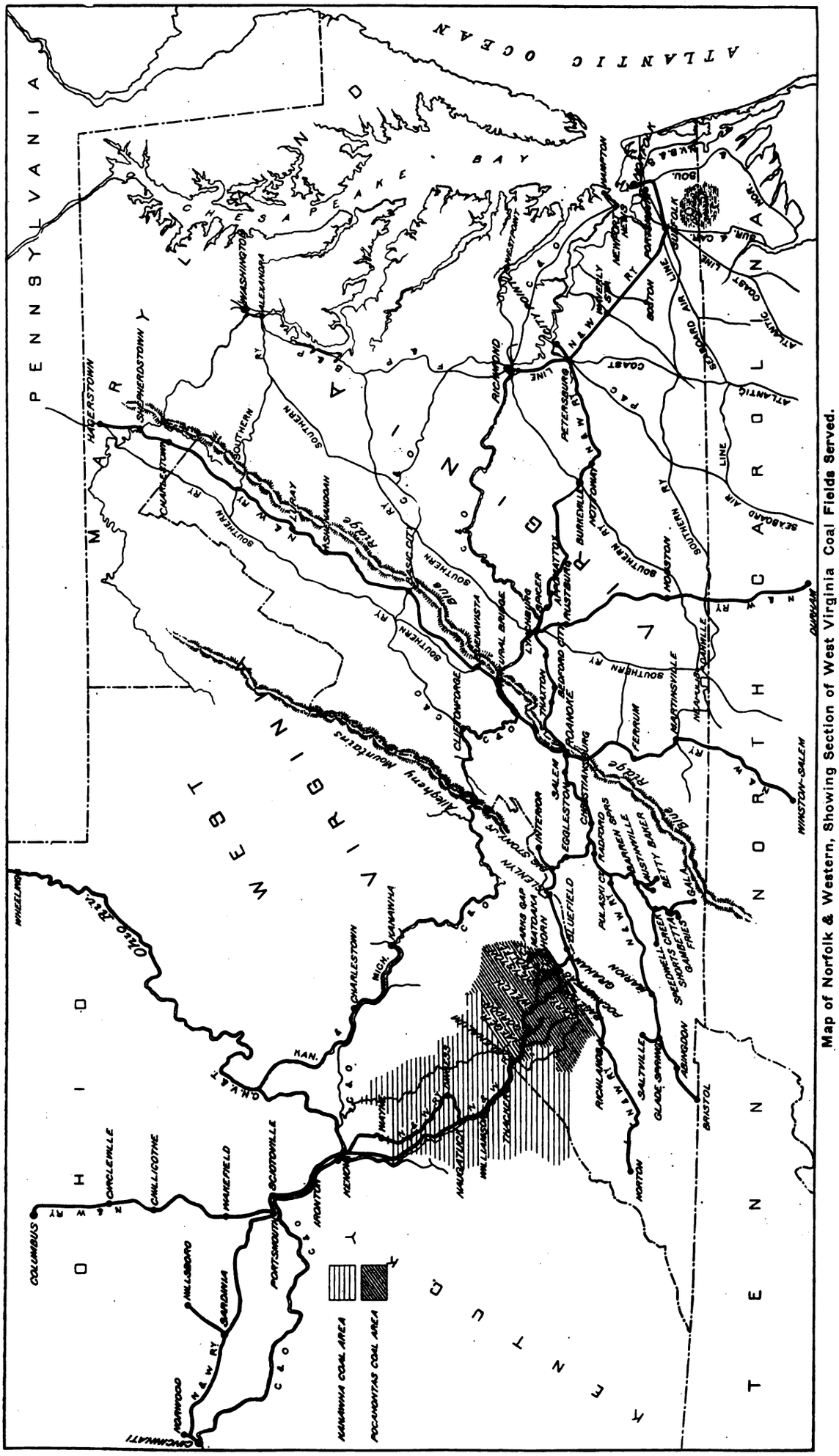
Norfolk & Western Improvement Work.

BY GEORGE L. FOWLER,
Associate Editor of the *Railroad Gazette*.

GENERAL FEATURES AND IMPROVEMENTS.

In the issues of the *Railroad Gazette* for July 3, July 24, September 25, and October 2, 1903, there was published a series of articles relating to the physical and operating conditions of the Norfolk & Western Railway as they existed at that time. The coal traffic from the Pocahontas and Thacker districts was increasing rapidly and the company found that unless the facilities for handling this traffic were at once increased there would be a congestion which it would be impossible to relieve. Already conditions of this sort had been encountered on the westbound work, which had been relieved by building the Big Sandy line from Naugatuck to Kenova, by which a low-grade track for westbound traffic had been obtained and the distance shortened by about 24 miles. This had not, however, afforded any relief at division points where the yards were too small for the demands made upon them, to say nothing of the requirements of the future. Accordingly, at the time of the publication of the articles referred to the company had planned an elaborate range of improvements in the form of yards at Roanoke, Va.; Bluefield and Williamson, W. Va., and Portsmouth, Ohio, in addition to a straightening of the exceedingly crooked portion of the line lying in the midst of the West Virginia mountains between Vivian and Naugatuck. A considerable proportion of this work has now been completed. But, while none of the yards is entirely finished, the work has been executed to such an extent in all of them that they are in operation, and a great deal of the double-tracking on the mountain portions of the line has been finished or is under contract. Not only has this been done, but much additional work made necessary by increase in traffic has been planned and partially contracted for in double-tracking the main line on improved alinement and grades. The principal part of these additions are to be found in the reconstruction and double tracking of the line on the Norfolk division between Montvale and Forest, a distance of 27 miles, and the construction of a low-grade line on high ground around the city of Lynchburg from Forest to Concord, a distance of about 21 miles, while the distance between these points by the present line is about 23½ miles.

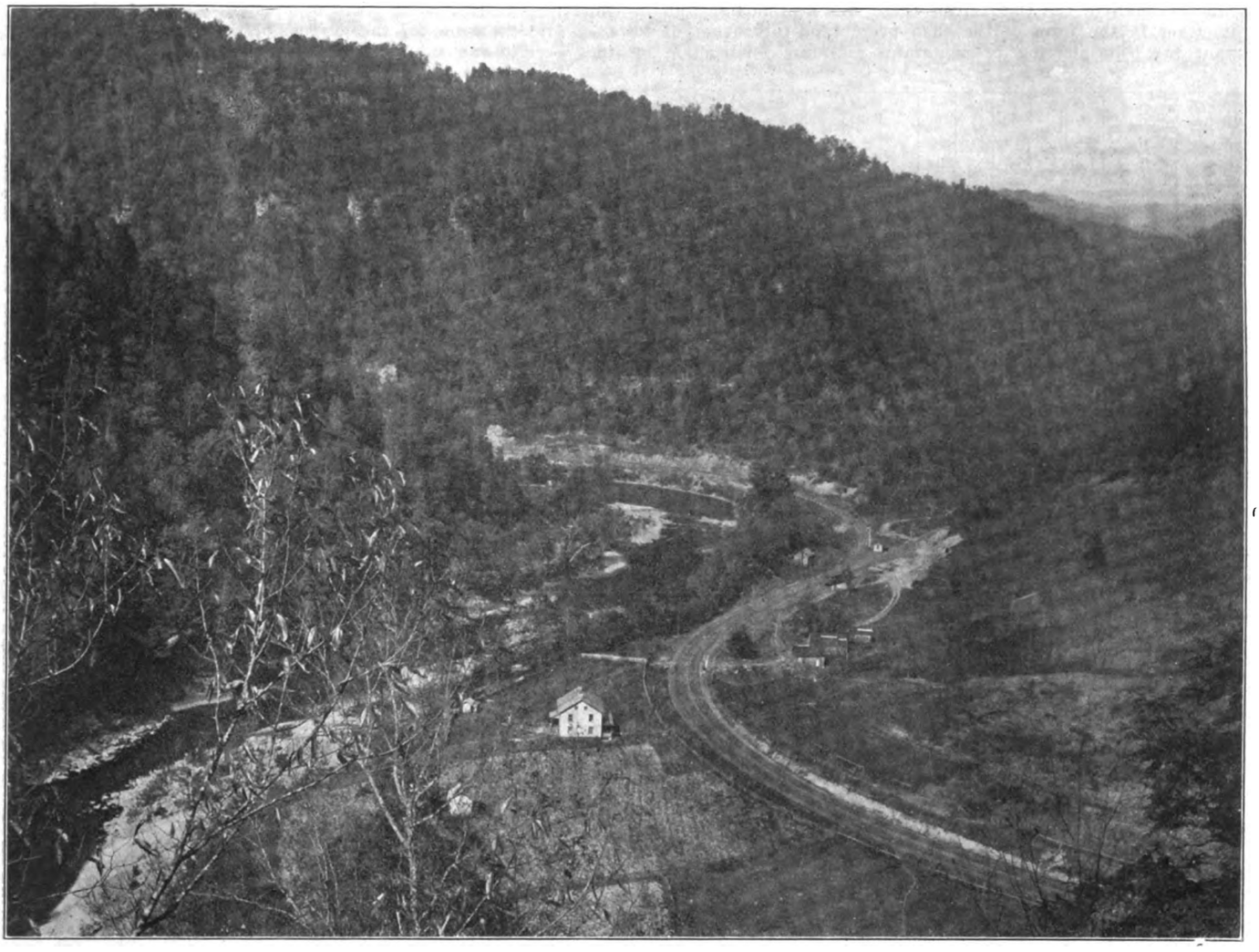
In order to appreciate the true significance of these improvements and why these new alinements were not used in the first place, a few words regarding the general topography of the country



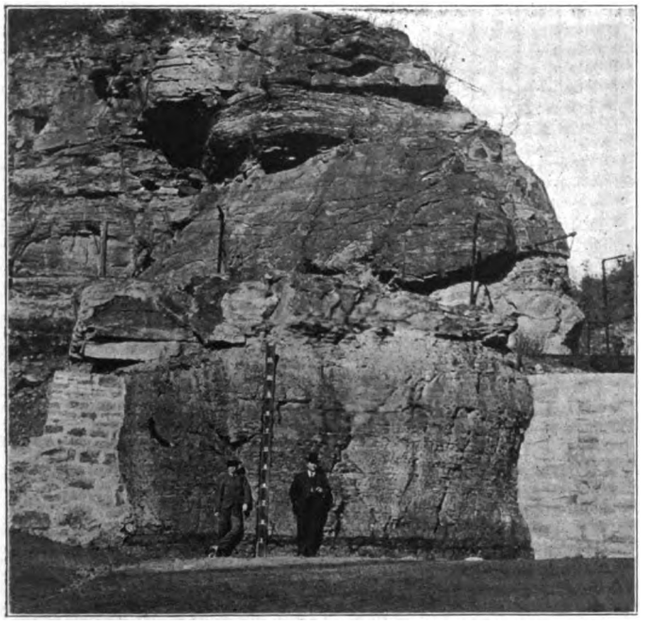
Map of Norfolk & Western, Showing Section of West Virginia Coal Fields Served.

and the conditions governing at the time of construction will be in place.

The Norfolk & Western Railway was not built or even planned in its entirety at the start. It exists as the result of a number of consolidations and extensions that have required nearly 60 years to complete. It did not even start from the seaboard at first. The nucleus of the road lay in the Petersburg Railroad, built from Petersburg to City Point in 1851. A second and disconnected section known as the Virginia & Tennessee Railroad was built from Lynchburg to Liberty, now Bedford, in 1852, and this was extended to Roanoke, then known as Big Lick, in 1855. This was carried on to Bristol, Tenn., in 1858. In 1854 the Norfolk & Petersburg Railroad was opened between those points, and then run on to Burkeville the same year, as the Southside Railroad, and thence to Lynchburg in 1857. The Virginia & Tennessee, the Norfolk & Petersburg and the Southside railroads were consolidated in 1870 as the Atlantic, Mississippi & Ohio Railroad, and, in 1881, when it had 408 miles of main line and 20 miles of branches, the name



View on Norfolk & Western Railway near Glenalum, West Va.



Pocahontas Coal Seam at Pocahontas, Va.

was changed to the Norfolk & Western Railroad, from which time dates the extensions into the coal regions of Virginia and West Virginia. The New River Railroad was acquired in 1882 and opened for business a year later to Pocahontas, Va., where the first development of Pocahontas coal took place. In the next three years, extensions were made into this field on the eastern side of the mountains.

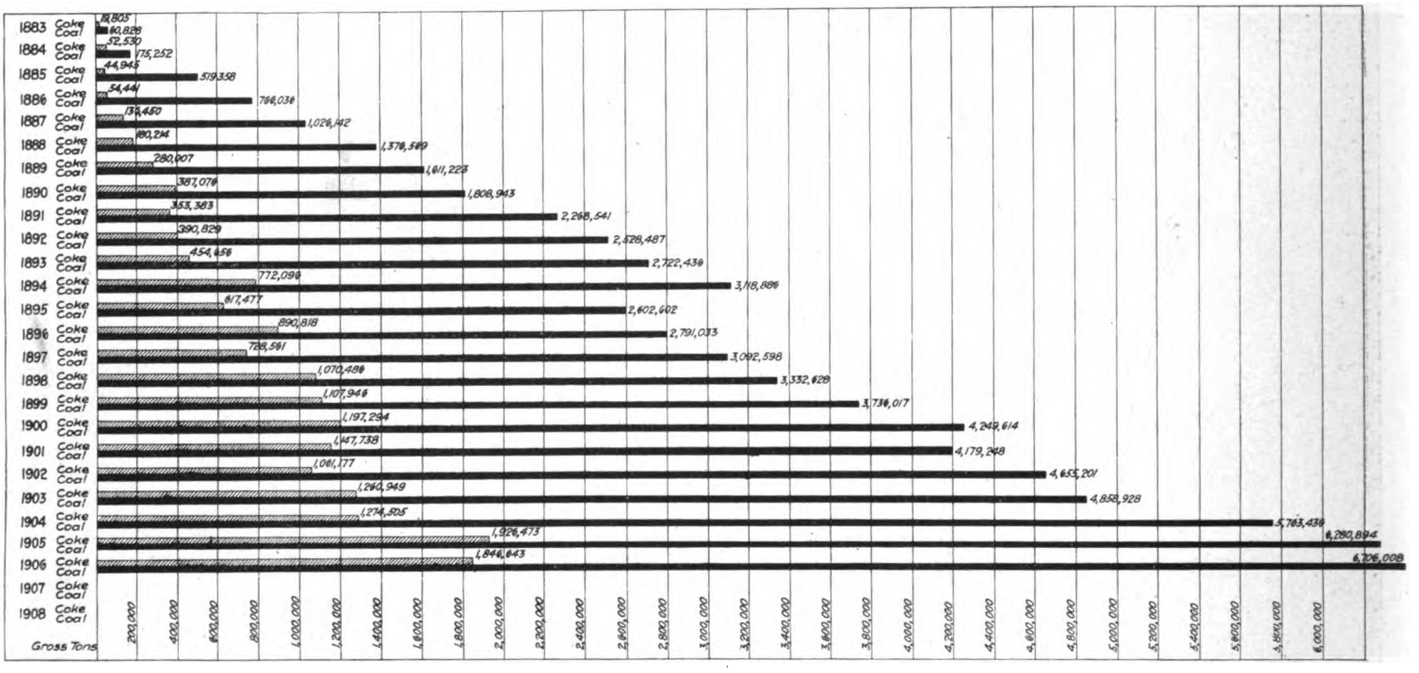
In 1886, the Cripple Creek Extension, from Pulaski, Va., 26 miles to Foster Falls, Va., in the direction of North Carolina, opened a territory of great mineral wealth. In 1887, the Elkhorn tunnel was started through the Flat-Top mountain and the Elkhorn Pocahontas coal field was opened in 1888. This was the initial step toward the route to the Ohio river. The Clinch Valley Extension, affording an outlet via the Louisville & Nashville, through Norton, Va., was finished in 1891. During the same year the Norfolk & Western began building into the Elkhorn Valley. The Shenandoah Valley Railroad, between Roanoke and Hagerstown, Md., was absorbed in 1890, and two years later the Roanoke & Southern, between Roanoke and Winston-Salem, N. C., and the Lynchburg, between Lynchburg and Durham, N. C., were leased.

At the same time the main line was being pushed on to the west until it reached the Ohio river, and then the acquisition of the Scioto Valley Railroad gave a through route from Norfolk to Columbus, by way of Kenova and Portsmouth.

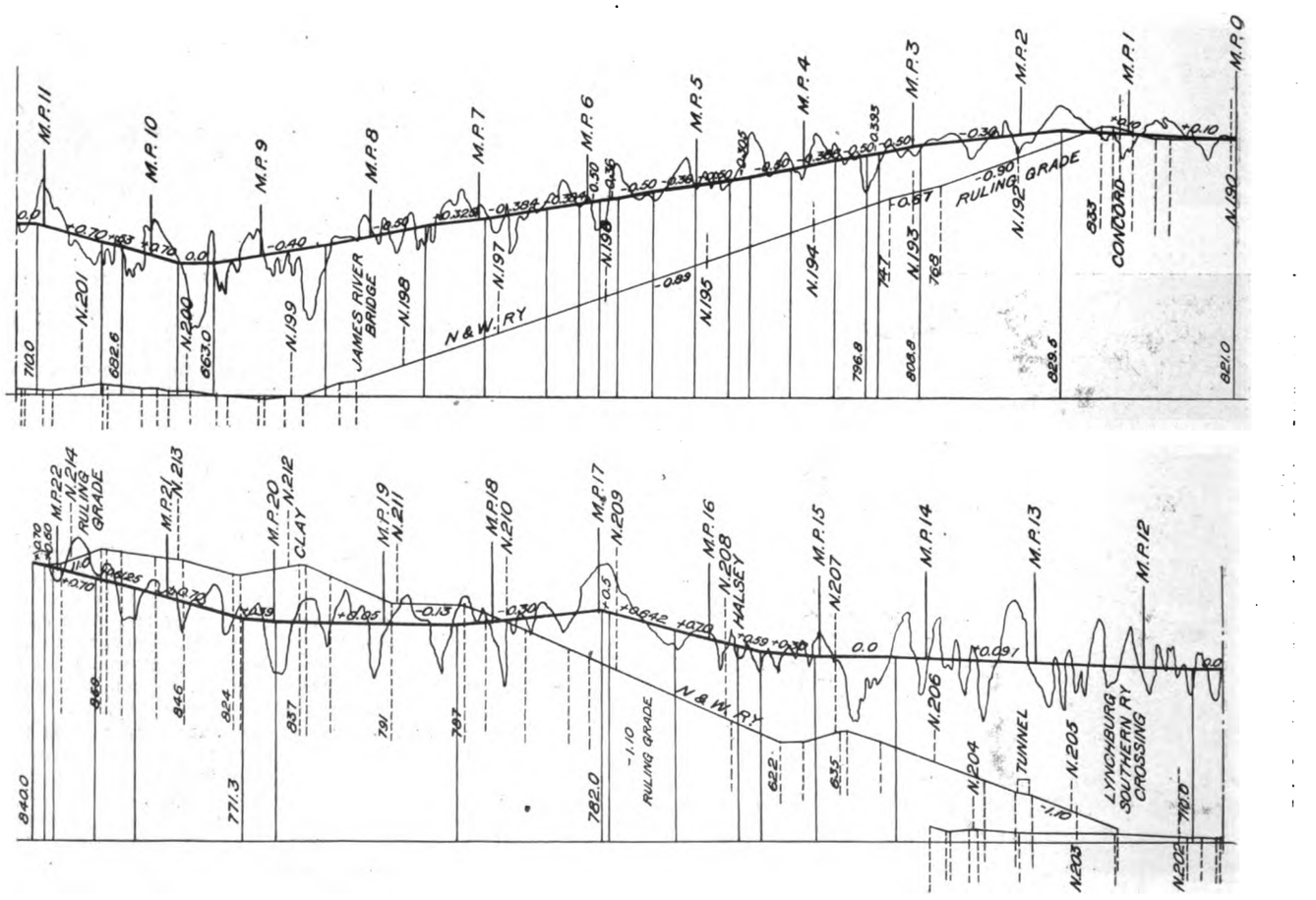
The system, thus built up, was reorganized in 1897 as the Norfolk & Western Railway Co., and now owns more than 1,800 miles of main line and branches.

At the time of the building of the early lines that formed the nucleus of the system there was little or nothing beyond the

purely local traffic to be expected. Nothing specific was known regarding the coal fields of West Virginia, and what was known was not of such a character as to attract capital. Indeed, it is said that, when the Pocahontas fields were first placed upon the market they could not find a buyer, so firm was the conviction that no coal could compete with that from the Pittsburg district. All this had its effect upon the original alinement, which naturally sought the large towns and centers of population. So, after the coal had been brought to the attention of consumers and was found to be of an exceptionally high character, and it was decided to push the line through to the Ohio river, there was still not enough in sight either in the form of the then present or future output to warrant the bold piercing of mountains and the construction of bridges that has recently been undertaken. After entering the mountains and reaching the level of Elkhorn Creek, which is done a short distance beyond the eastern boundary of the Pocahontas field, the natural and economical course to be pursued, both in cost of survey and construction, was to follow the banks of this stream down to its junction with the Ohio, which would give a low-grade, constantly descending line, but one which was exceedingly tortuous, as will be seen by reference to the map of a portion of the alinement where straightening is to be done. This was the course pursued as far west as Naugatuck, 484 miles from Norfolk. At this point there is a detour of the old line running back into the hills, for the purpose of reaching the coal properties that were known to exist and regardless of the extra cost of haul-



Graphical Illustration of Annual Coal and Coke Shipments; Pocahontas Flat-Top Field.



Profile of Lynchburg Belt Line & Connecting Railway and Norfolk & Western Railway.

age, so that it was not until 1904 that it was found to be necessary to add to the facilities and build the low-grade line down the Big Sandy river to the Ohio.

The Norfolk & Western is, then, essentially a coal road and serves a territory in which are located the richest veins of the world. The center of this territory lies in the heart of the mountains of West Virginia, on what is known as the Pocahontas division of the road. It is here that probably 62 per cent. of all of the tonnage hauled by the road originates.

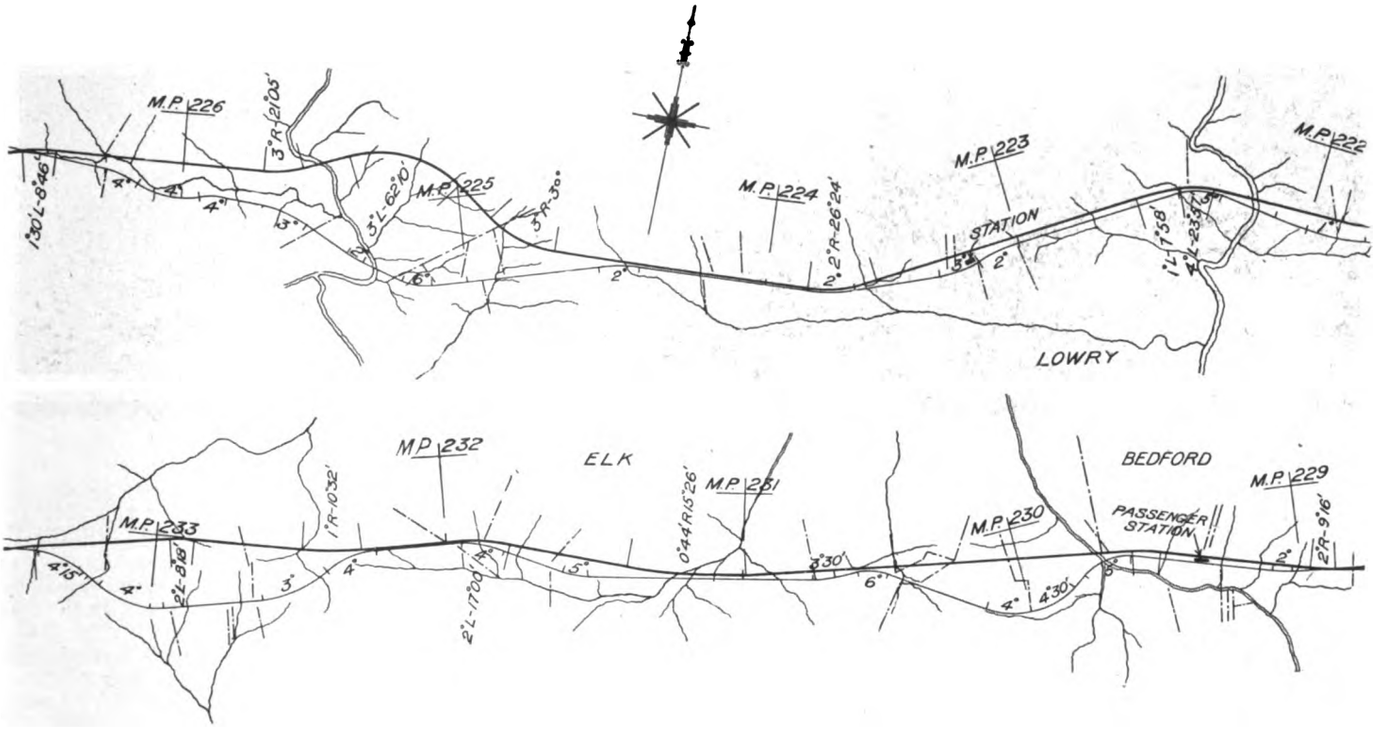
So, too, this particular district stands pre-eminent in coal. Tonnage is obtained all along the line west of Roanoke. There are a few anthracite mines west of that place on the Radford division, with quite a large operation at Christiansburg. There are also a number in the Clinch Valley which really produce a Pocahontas coal. Next to this comes the great Pocahontas field itself, followed by the Tug river, then the Thacker and Kenova, while in Ohio there are two operations.

Divided by districts, the number of operations served by the Norfolk & Western is as follows:

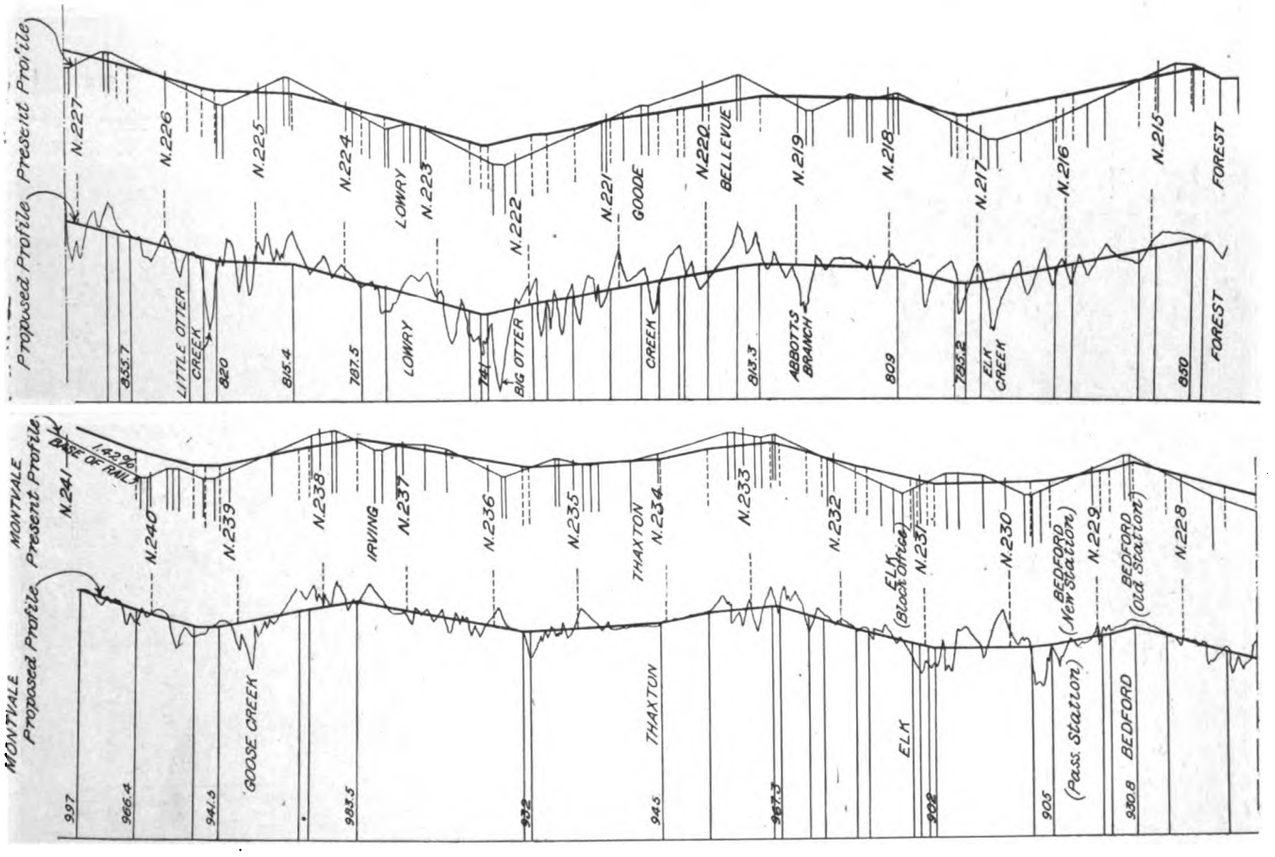
District.	No. of operations.	Shippers of
Radford (Va.)	8	Coal.
Clinch Valley.	28	"
Clinch Valley.	2	" and coke
Pocahontas ..	11	"
Pocahontas ..	51	" and coke
Tug River...	16	"

District.	No. of operations.	Shippers of
Tug River...	1	Coal and coke
Thacker	26	"
Kenova ...	12	"
Scotio (Ohio)	2	"
Total	157	

There are thus 157 mining operations along the line, and as it frequently happens that from one to five or more mines are



Typical Re-location on Forest-Montvale Improvement; Norfolk & Western Railway.



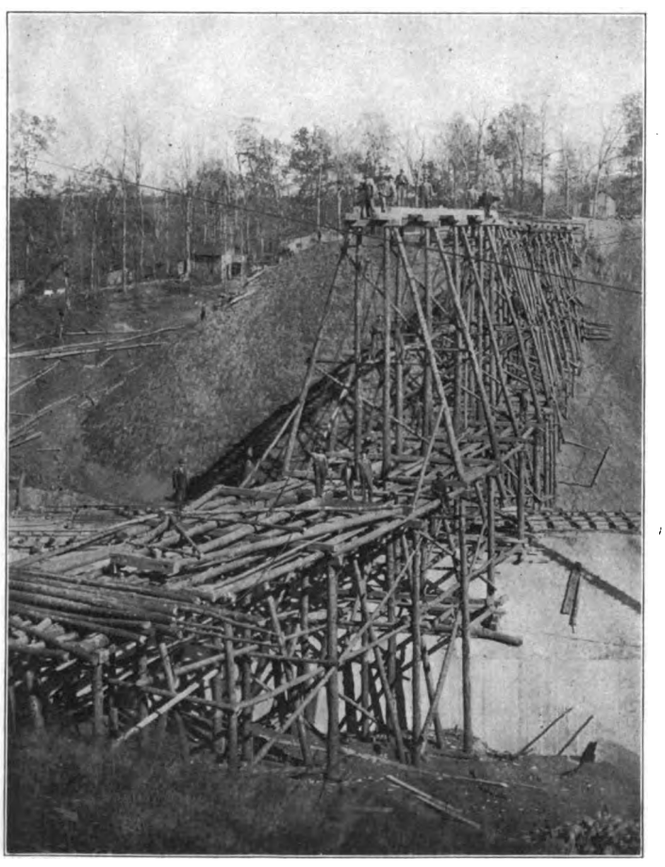
Profile Forest-Montvale Improvement; Norfolk & Western Railway.

Cut near Bedford, Forest-Montvale Improvement; Norfolk & Western.

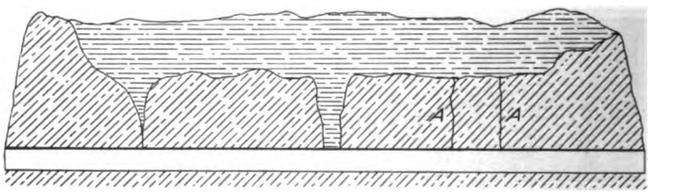
included in a single operation, it will be seen that these are many times greater than the figures given.

That portion of the railroad between Elkhorn tunnel and the Ohio river is within the boundaries of West Virginia, except in one case where it takes a short cut, by way of two bridges and a tunnel, across a bend of the Tug river, and thus runs for a few hundred feet in the state of Kentucky. The mining operations are not, however, wholly confined to West Virginia. From about 437 miles west of Norfolk, or near Glenalum station, the Tug river forms the boundary line between West Virginia and Kentucky, and here a number of operations have been opened along the heights on the Kentucky side. The output of these mines is comparatively small at present, but the properties are good and it is on the increase. Transportation across the river is by means of an aerial tramway reaching from the headhouse on the mountain to the tipple alongside the track, with spans ranging from 1,000 ft. to 1,500 ft.

As for the quality of the coal, it is, as already stated, among the best of the world, and the seams are remarkably free from impurities. The Pocahontas vein proper, or the one that is known



Trestle for Little Otter Creek Fill, Forest-Montvale Improvement; Norfolk & Western.



Typical Section of Rock Along New River; Norfolk & Western.

Tunnel on Laurel Branch, West of Pocahontas.

as the Pocahontas No. 3, is the richest and thickest. It ranges in thickness from 6 ft. to 12 ft., and an analysis shows it to be very high in fixed carbon, with from 15.75 to 19.5 per cent. of volatile matter; very low in phosphorus and sulphur, and with from 2.34 to 9.5 per cent. of ash, with an average of about 6 per cent., and it has a heat content of about 15,000 British thermal units.

The Pocahontas seams are the lowest, geologically speaking, and have a dip of about 50 ft. to the mile. As they disappear below the water the higher strata come to the outcrop to the west, and we find the Tug river and Thacker coals in the western part of the state. There is nothing in these fields that can compare with the great Pocahontas vein. The main Thacker seam runs in thickness from about 4 ft. 6 in. to a little over 5 ft., and is of a remarkable purity, though somewhat inferior chemically to the Pocahontas. An average analysis of this coal would be about as follows:

Moisture	0.41 per cent.
Volatile matter	36.33 "
Fixed carbon	58.09 "
Ash	5.17 "
	100.00 per cent.

There will be about 0.9 per cent. of the whole in sulphur and the heat content will be about 14,700 heat units.

With such coal as this along the line, it follows as a matter of course that the tonnage should be large and rapidly increasing. For the four fiscal years ending June 30, 1906, the total output of the several districts along the line is given in the accompanying table. From which it appears that, in four years, the total tonnage has increased 42.02 per cent. and the coke tonnage 42.25 per cent:

Statement of Coal and Coke Production, N. & W. Ry., by Districts for the Years Ending June 30 (net tons).

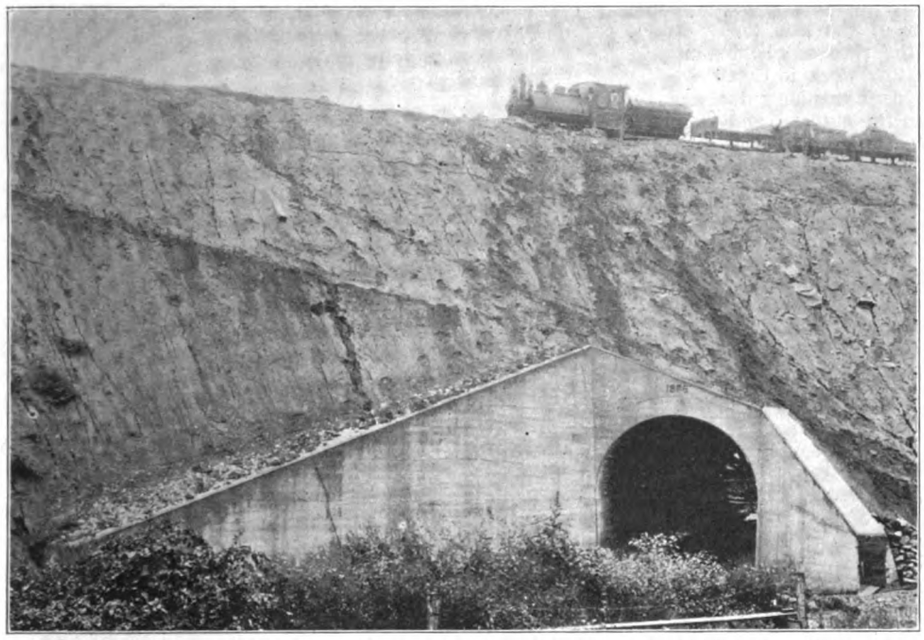
		District					
		Pocahontas.	Tug River.	Thacker.	Kenora.	Clinch Valley.	Total.
1903.	Coal	5,560,735	230,134	884,392	84,099	868,322	7,627,682
	Coke	1,288,307	12,753	.....	.....	341,219	1,642,279
1904.	Coal	5,052,540	394,280	1,267,129	78,809	737,248	8,130,006
	Coke.	1,432,462	6,443	.....	.....	262,417	1,701,322
1905.	Coal.	6,809,887	556,154	1,340,056	190,747	762,193	9,659,037
	Coke.	1,751,877	52	.....	.....	213,221	1,965,150
1906.	Coal.	7,499,523	802,750	1,678,901	368,364	788,501	11,138,039
	Coke.	2,112,268	22	.....	.....	223,917	2,336,207

The total tonnage carried in the year ending June 30, 1906, was 19,266,534, of which 11,875,300 was coal or coke, or about 62 per cent. of the whole. The road has, therefore, a very good reason for its existence; and this is still further emphasized by the graphical representation of the annual coal and coke production of the Pocahontas field from 1883 to 1906, inclusive, as compiled by John J. Lincoln, Chief Engineer of the Crozier Land Co. In this it is shown that the coal production rose from 60,828 to 6,706,008 gross tons, and the coke production from 19,805 to 1,846,643 gross tons, or an increase of more than a hundred-fold.

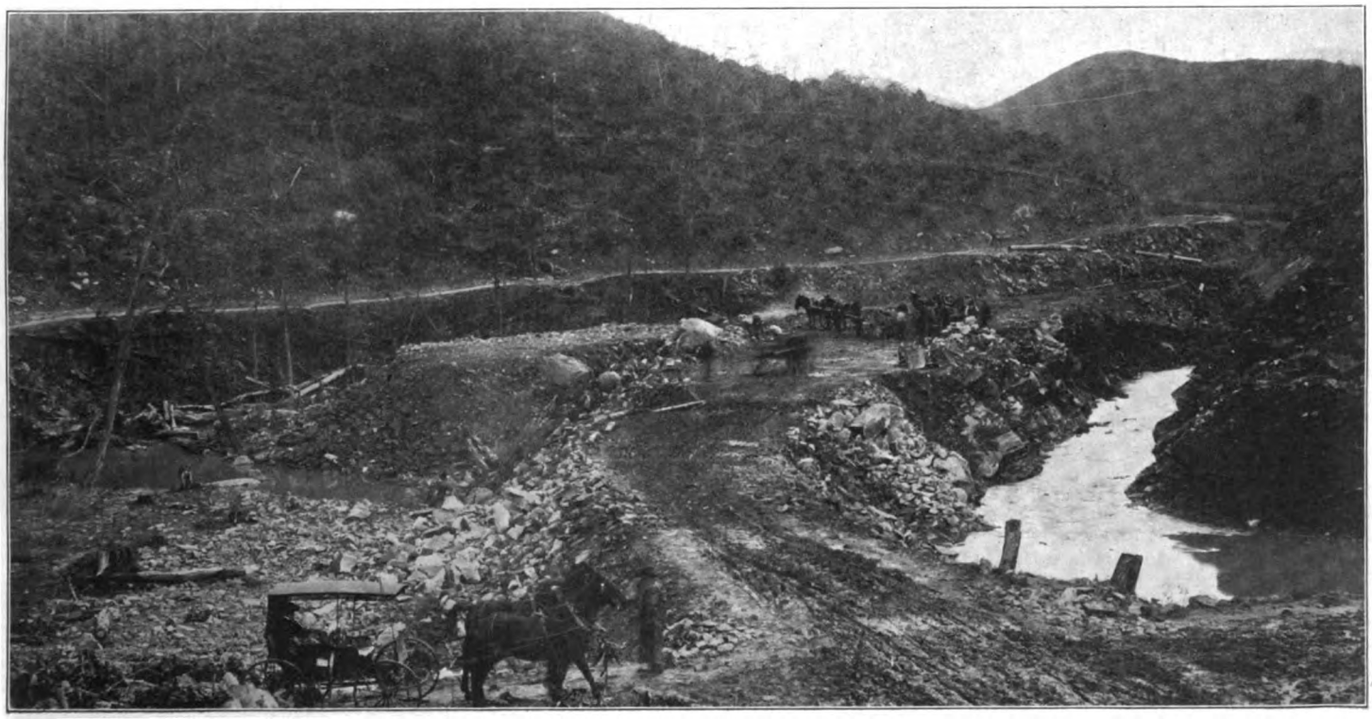
From an engineering standpoint the road traverses a territory as widely different as its products. Starting at sea level it first crosses the northern part of the Great Dismal Swamp and the low ground of eastern Virginia; then rises to a height of about 1,280 ft. in its passage of the Blue Ridge mountains; dropping thence into the valley of the Roanoke and rising again to 2,040 ft. in its passage of the Alleghanies. It then follows the New river for a few miles, and finally plunges into the wilds of West Virginia, where it rises to a height of 2,560 ft. at Bluefield.

The reason for the first location of the road has already been discussed, and the necessity for the improvements that are being made was based upon the inadequacy of the original construction to take care of the constantly increasing traffic that was offered. While not in the chronological order of the work as it was undertaken, it will be convenient to consider what was done on the line from east to west.

At the tidewater terminal we have the Lambert's Point wharves that were described in



Abbott's Creek Arch, Forest-Montvale Improvement; N. & W.

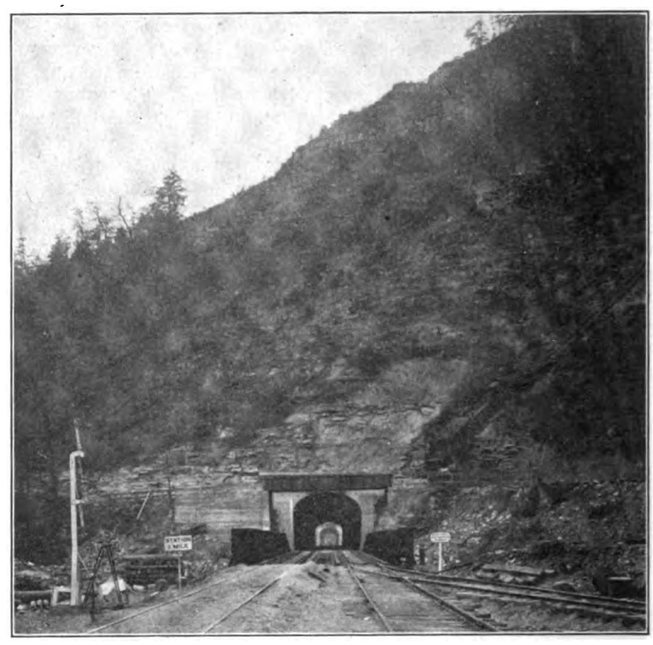


Laurel Branch, near Pocahontas; Change of Creek Bed Saves Two Bridges.

the *Railroad Gazette* for July 24, 1903, to which merely minor improvements have been added since that time. At South Norfolk a large receiving yard is in course of construction, which will be described in another place.

Moving west, the first large undertaking that is encountered is that of the construction of a low-grade line around the south side of the city of Lynchburg, from Concord to Forest. Under the present conditions the single-track line passing through Lynchburg, with the heavy grades upon each side of the city as the road drops down from the heights to the level of the James river, is the limiting point of the traffic and the place where congestion is most apt to occur. In order to meet this difficulty, and, at the same time obtain a better grade and alinement, the detour about the city has been planned and is about 43 per cent. completed.

As already stated, this detour starts from Concord, about 14 miles east of the Lynchburg station, and turning to the south, remains on the high ground until the city is passed, and it reaches the main line again at Forest, about 11 miles west of Lynchburg station, as measured on the present line. On this detour the maximum curvature is fixed at four degrees, and the ruling grade for eastbound traffic will be 0.5 per cent. as against 1.25 per cent., including curve resistance on the present line. For westbound traffic the maximum adverse grade will be 0.7 instead of the 1.45 per cent., including curve resistance of the present line. It will be seen from the profile that is shown of this work, that the excavation required is very great; in fact, for the 22 miles of the line the excavation amounts to 2,625,000 cu. yds., or at the rate of about 120,000 cu. yds. per mile. The greater portion of this work is that which can be done with the steam shovel, but as Lynchburg is approached from the west the rock comes closer to the surface, and where the cutting is more than 15 ft. in depth blasting is required.



Tunnel No. 1 near Welch, W. Va.

Norfolk & Western Railway near Antler, West Va., Showing Old and New Main Lines.

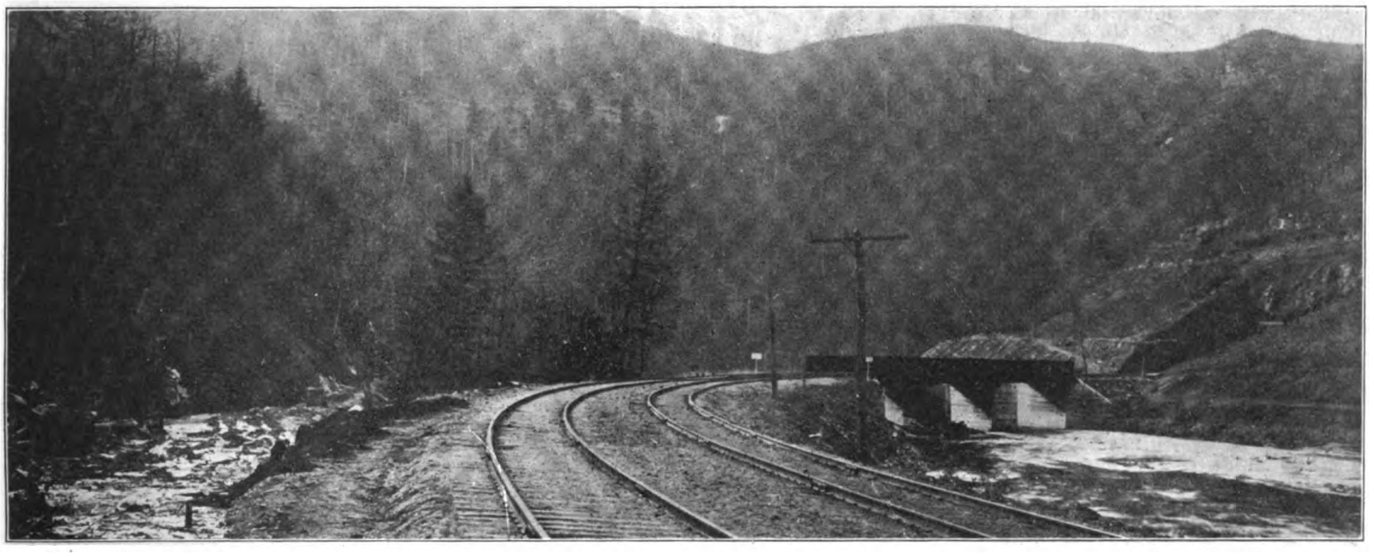
The estimated cost of this portion of the work of improvement is placed at $2,485,000.

The value of such a detour as this can be readily appreciated in that it will afford a low-grade double-track passage around the city of Lynchburg for all freight traffic, and thus not only reduce the cost of haulage, but make it possible to maintain a faster schedule. In this connection the experience of the road in the construction of the Big Sandy line will be of interest.

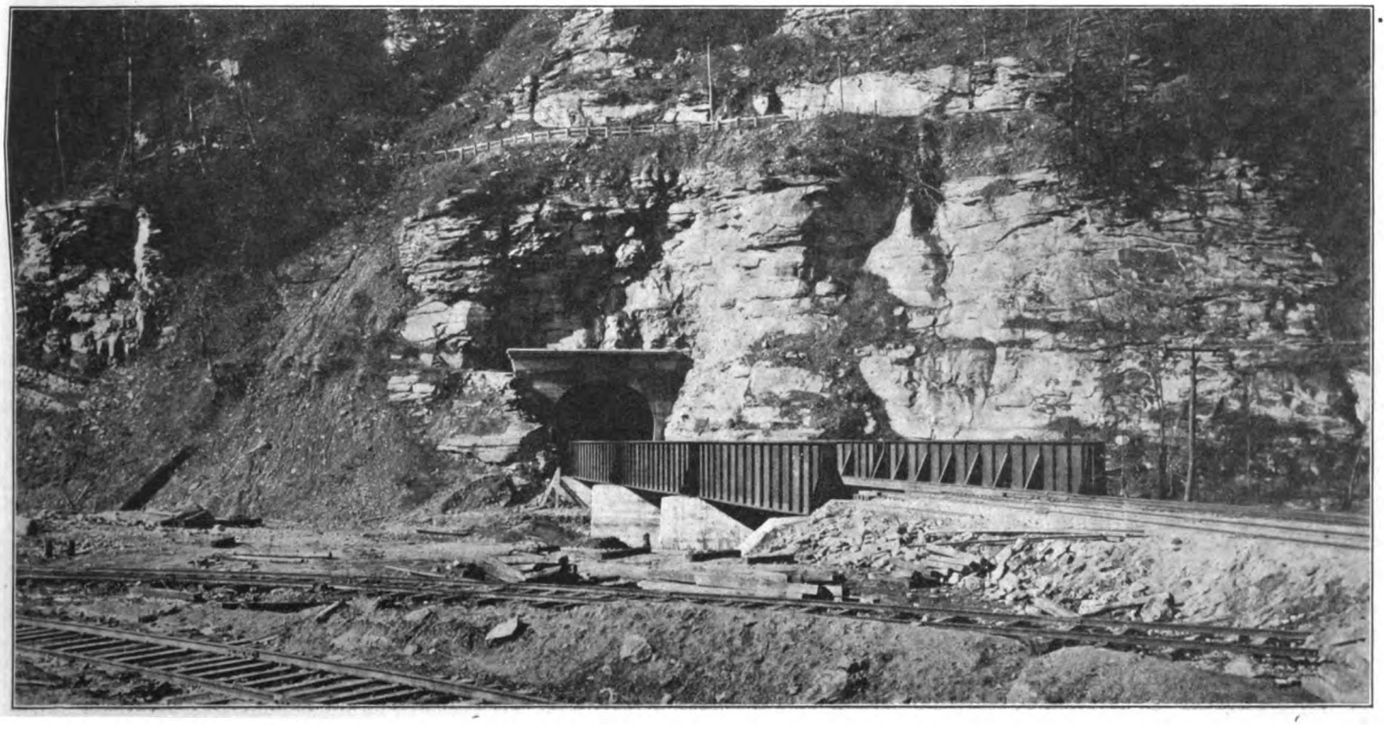
This is built down the banks of the Big Sandy from Naugatuck to the Ohio, and was, as stated, for the purpose of relieving the congestion of traffic on the old line. It was found that at the end of the first year of its operation the saving that it had effected amounted to $237,912, and for 1906 it is estimated that it effected a saving of from $300,000 to $350,000 in comparison with what would have been the cost of hauling the traffic over the old line, even though that could have been done. This line cost $4,939,724, and it has made it possible for the road to handle far more business than could have been done over the old line.

Big Otter Creek Viaduct, Forest-Montvale Improvement; N. & W.

Tunnel No. 2, near Welch, W. Va., Norfolk & Western, Showing Old and New Tracks.



Old and New Main Line at Antler, West Virginia; Norfolk & Western.



Old and New Tracks at Short Creek; Norfolk & Western.

In fact, the relief was so noticeable at first that, shortly after the line had been put in operation, the manager received a call from the representative of the engineers asking for a change in the running arrangements for the men, on the ground that business had fallen off to such an extent that they could not make full time. He was told that not only had business not fallen off, but that it had very perceptibly increased, and that the reason for the apparent fall was that the crews were getting over the road in from ten to twelve hours, instead of twenty.

Immediately west of Forest, where the detour joins the main line, there is a section that is being double-tracked as far west as Montvale, 27 miles. Although this is called double-tracking, it is really the construction of quite a new line, and for the greater portion of the way is of an entirely new location. Sometimes it uses the old right of way, and again it is removed from it some distance. Two characteristic sections of the line are shown in which the old line is represented by a fine, and the new location by a heavy line. In this the maximum curvature is placed at four degrees, and the maximum grade against eastbound traffic is 0.5 per cent. and 0.7 against the westbound, all compensated for curvature, or the same as that maintained on the Lynchburg Belt Line and Connecting Ry. above referred to.

The excavation throughout nearly all of this piece of work is steam shovel work and amounts to 3,277,000 cu. yds., and it is estimated that the cost will be about $2,625,000. In this revision, the shortening of the line will be comparatively slight, but the advantages will lie in the straightening of the alinement by the elimination of sharp curves and the reduction of the opposing grades to east and westbound traffic from about 1.48 per cent. to the figures given. The profile and the photographs of this part of the line, as well as those of the Lynchburg line branch, will give a fair idea of the general character of the work.

With this work completed and a double track down, the capacity of the road will be greatly increased, and the necessity for double-heading through the whole section of which Lynchburg is the center will be entirely avoided. The next point to the west where important improvements are under way is at Roanoke, where the final work is being done on the great yard. This, with the other yards at Bluefield, Williamson and Portsmouth, is a matter of such magnitude that the system of yards for the whole road will be treated separately, and in a future issue.

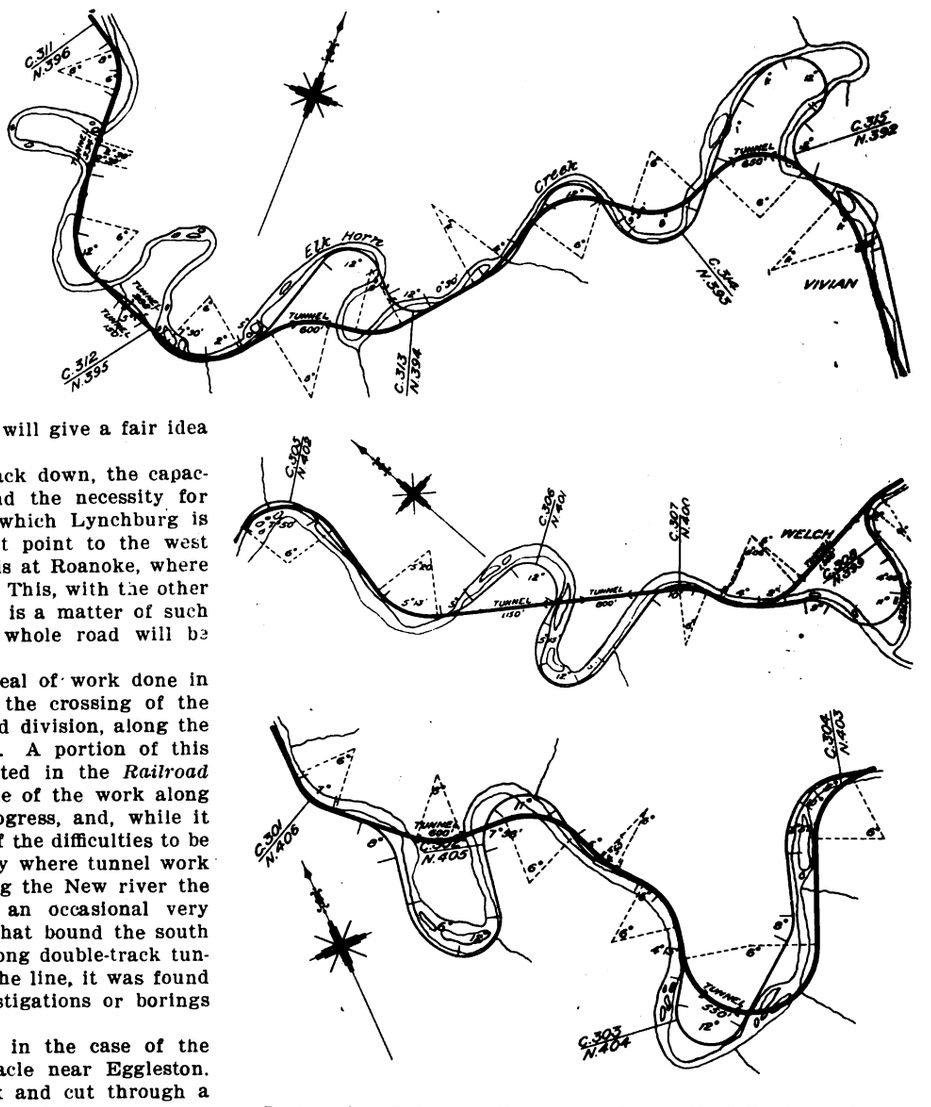
Beyond Roanoke there has been a great deal of work done in the straightening of the line, commencing at the crossing of the Alleghanies and continuing on over the Radford division, along the New river and on the East river to Bluefield. A portion of this work has already been described and illustrated in the *Railroad Gazette* for October 2, 1903. At that time some of the work along the New river was under contract and in progress, and, while it was known to be difficult, the full significance of the difficulties to be encountered was not fully appreciated, especially where tunnel work was concerned. In the original alinement along the New river the banks had been closely followed, with only an occasional very short tunnel through the limestone pinnacles that bound the south side. When it came to driving comparatively long double-track tunnels through this rock in the straightening of the line, it was found that no dependence could be placed upon investigations or borings in the matter of the stability of the cover.

A marked sample of this is to be found in the case of the new tunnel that was driven through a pinnacle near Eggleston. The original line had followed the river bank and cut through a spur by a short tunnel, as shown at the right of the engraving. This has now been abandoned for the one through which the rails are run, and by which a straightening of the line was effected. In the construction of this tunnel, however, unexpected difficulties were encountered. The cover was apparently a considerable thickness of rock, with a hill of earth above, that was practically a series of clay pockets filled in between the ridges and pinnacles of the limestone rock and rising to a height of about 125 ft. above grade. At a short distance back of the western portal, the bore struck the lower part of a pocket and there was a cave-in that crushed all timbering that could be used, and so the material from this funnel-shaped pocket reaching to the top of the hill about 200 ft. across, had to be taken out through the portal.

A similar cave-in, at another tunnel that is being cut a mile or so west of this, has occurred near the center, with only 90 ft. between the ends of the completed tunnel lining at the time of the fall, and this is now being removed by steam shovels from each face and by excavation from above. Again, at Pembroke the whole face of a mountain into which a cut-off tunnel was being driven, came down and buried the portal. The debris was removed and a stone portal built.

The immediate cause of these cave-ins is the seamy character of the rock. This is illustrated by a typical diagram in which a pocket of the earth cover is shown extending nearly down to the tunnel line. Such a pocket as this can, of course, be detected by systematic borings, but such seams or cracks as are shown at A A cannot be found unless a core drill is used and this happens to strike exactly on the line of one of these cracks. The result is that when the heading has been driven into the apparently solid rock between two such defects, the whole roof comes down, and with it the superincumbent water-saturated earth. For mutual protection the contracts for work in these pinnacles along the New river are drawn so as to protect both the contractor and the railroad company for all extra yardage resulting from this disintegration in the form of unavoidable falls, contractors being paid ordinary excavation prices. In these cases the material was used in building high double track fills along the river bank near the tunnels.

While trouble has not been experienced to the same extent in

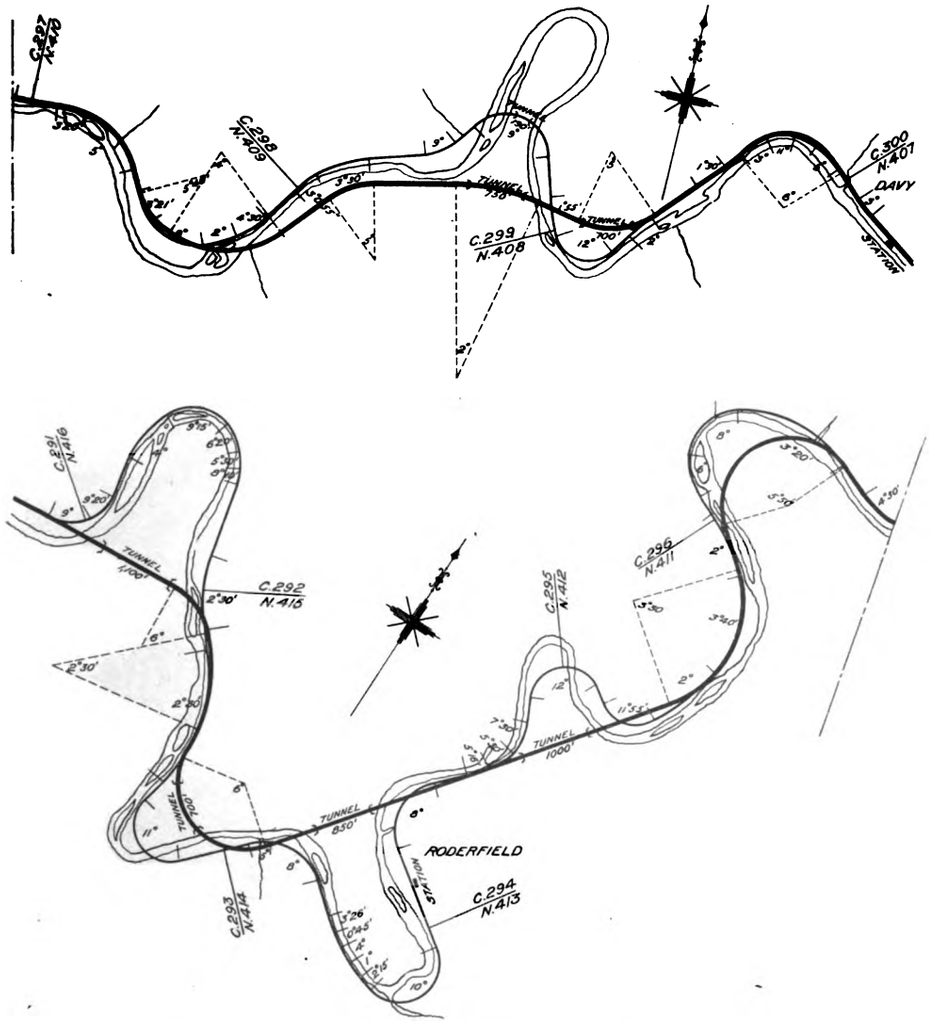


Re-location Between Vivian and Davy; Norfolk & Western.

West Virginia, still all through the mountains the rock is readily disintegrated and comes down in small fragments after a shot. This will be seen by an examination of the reproductions of the photographs of the several pieces of rock work along the line, and is especially noticeable in the case of that of the cut near Keystone, W. Va. The work is a sort of shaly sandstone associated with the coal measures, and while it stands well in cuts, it scales off continually and comes down into the ditches and, in the tunnels, needs lining in order to protect the track; although there is little danger of its coming down in large pieces or quantities, as in the case of the rock along the New river.

The character of the country through the West Virginia mountains is such that the line of cheapest construction, following the banks of Elkhorn and the Tug river down to the junction of the latter with the Big Sandy, is exceedingly crooked. The mountains, while not rising to a great height above the stream, are very steep and are a succession of saw-tooth ridges, separated by narrow valleys or hollows at the bottom of which there is usually a stream. The original alinement followed all the bends

and turns of the river, with only an occasional tunnel, where the curvature would have been so excessively sharp as to exceed working conditions. The grades were easy and in favor of the westbound traffic, which is that predominating west of Welch, or 36 miles west of Bluefield, the assembling point of the eastbound traffic. At about this point the road enters a district of the Thacker coal fields, whose market is mostly in the west, while the greater portion of the Pocahontas coal goes to the seaboard and eastern points. It is a case of traffic following the lines of least resistance, and though large quantities of coal are taken out west of Welch, it is between that point and Bluefield, or rather Bluestone, 11 miles further west, that the center of the coal and coke industry



Re-location of Norfolk & Western Railway Between Davy and Roderfield.

may be said to be located, and from this center it moves in both directions, east and west.

It is along this exceedingly crooked line between Welch and Naugatuck, or rather between Vivian and Naugatuck, a distance of 92 miles, that much of the work of straightening has been done and is in progress, sections of which are shown to illustrate the character of the change of alinement that has been undertaken. In these the heavy line indicates the new and the light line the old alinement.

At Vivian there is an assembling yard for westbound traffic. It is small, and no attempt is made at classification. Starting at this point the old line follows Elkhorn creek in nearly all of its windings down to its union with the Tug river at Welch. The new line, in the first four miles of the distance, will cut across five bends of the creek that are now followed, and in this distance adds two tunnels and shifts the center of a third, and requires five new bridges across the stream. The amount of excavation required, including that for bridges and tunnels, in the 7 miles to Welch, is estimated at 458,000 cu. yds., and the cost is placed at $1,260,000.

At Welch there will be another cut-off, with a tunnel 1,300 ft. long beneath the upper portion of the town, beyond which the line will join the already completed section to Davy, in which there was 722,400 cu. yds. of excavation, and which cost $1,543,000, inclusive of the bridges and tunnels. It will be seen from the map that after leaving Welch the road strikes across two bends of the river on a tangent, upon which there are three bridges and two tunnels, the latter being 800 ft. and 1,150 ft. length, respectively. The curvature for this distance is entirely eliminated, and the new line crosses the old at nearly right angles as it emerges from one tunnel to enter the bridge between the two. This also appears on the reproduction of the photographs. Between Davy and Thacker, a distance of 49 miles, it is estimated that there will be required 1,900,000 cu. yds. of excavation and this double-track will cost $5,140,000. For the greater portion of the way there will be little or no change of alinement, but in certain places the plans call for the construction of practically a new line. An instance of this is shown on the section of the map from Davy to a short distance beyond Roderfield, at milepost 416. In this distance of nine miles there will be six tunnels, with an aggregate length of 5,100 ft. and ten bridges. This is, to all intents and purposes, a new line, and contains at least one repetition of the scheme of the work near Welch, where there is a tangent location near Roderfield involving three bridges and two tunnels of 1,850 ft. total length in a distance of a little more than a mile. To the east of this the line is thrown across the river at a wide divergence from the original, as shown both on the map and the reproduction of the photographs of the work in progress near Antler.

In this distance of 49 miles from Davy to Thacker there will be 16 tunnels with an aggregate length of 13,000 ft. and ten bridges. The bridges will all be in the first nine miles west of Davy and on that portion shown on the engraving. West of Thacker there is no exceptional work as far as Naugatuck, except at Williamson, where the large yard is being built, part of which is already in service. The double track on the improved line is now in operation between Thacker and Naugatuck.

The main object in the expenditure of these large sums of money in securing a change of alinement is to obtain a line upon which passenger trains can be run with safety at high speed and freight trains be handled with less resistance and delay. Very little improvement was possible in grade, nor was this essential, as the descent of the present line is in the direction of loaded traffic; but the amount and rate of curvature has been greatly reduced. On the old line 12-degree curves were in use, and those of eight degrees were quite common, whereas on the new alinement a six-degree curve is the maximum, and in many cases it is much less. With this, train resistance will be greatly lessened, and it will be possible to increase the maximum tonnage rating accordingly. The grade along this section of the road is that of the drop of the Tug river, and averages about 0.40 per cent., with a range of from 0.125 to 1.00 per cent. along the upper portion, and an average of about 0.07 per cent. at the lower, where the grades do not rise above 0.10 per cent.

When this work of improvement was undertaken it was estimated that it would be carried on at an expenditure of about $1,500,000 annually, and that this amount would keep the road up to all of the requirements of its rapidly increasing traffic. But the output of coal and coke has increased so rapidly in recent years, and the facilities for its transportation have been so taxed to the utmost, that it has been necessary to greatly exceed this rate of outlay. In this the object kept constantly in mind has been, not the securing of an immediate relief to meet present necessities, but a permanent betterment of the property, so that what is done shall be final and of such a character as to require the minimum expense for maintenance and place the road to take care economically of whatever traffic may be offered in the future.

(To be continued.)

The Wide-Awake Station Agent.*

Cultivate the power of observation. It may be difficult at first but never let up, no matter where you are. I had a car clerk that could come through the yard sound asleep. At least I could never find out what he knew if awake. I have found it a common failing that new men in this work are prone to look for just one car and see nothing else.

I have in mind, though, a little fellow left to hustle for himself and everlastingly bobbing up around the station in unexpected

*From a paper by C. R. Henderson in the *North-Western Bulletin*.

Norfolk & Western Improvement Work.

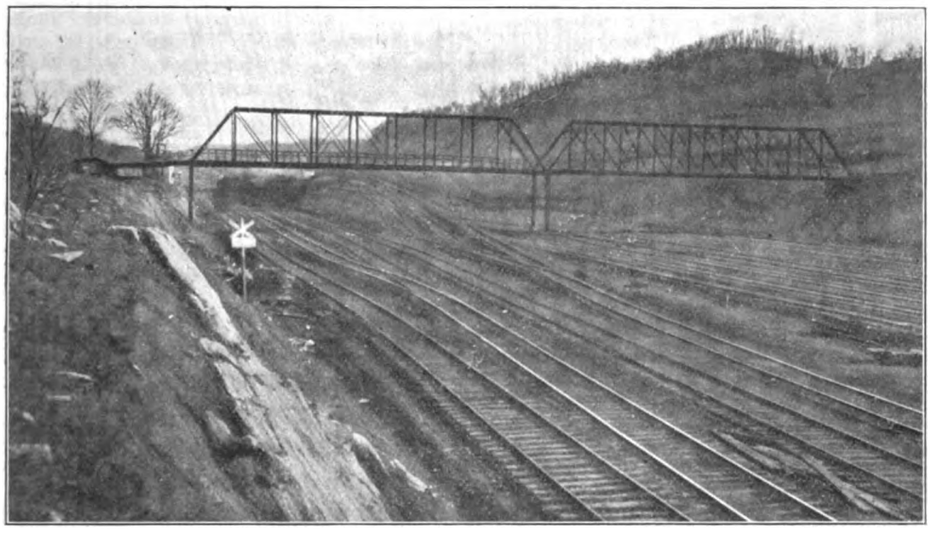
II.

YARDS.

BY GEORGE L. FOWLER.
Associate Editor of the *Railroad Gazette*.

BLUEFIELD YARD.

In a previous article published in the *Railroad Gazette* March 15, the general features of the improvements that are in progress of execution on the Norfolk & Western Railway were passed in review and allusion was made to the large yards that have been built at South Norfolk, Roanoke, Bluefield, Williamson and Portsmouth. While all of them are essential to the satisfactory handling of the traffic of the road and thus become ranking in importance, that at Bluefield is the most interesting in that it serves as the originating point of a very large percentage of the business. Bluefield, West Virginia, is located just east of the great fault in the Pocahontas coal measures, and is a division terminal. It is here that all of the eastbound coal is brought in from the operations in the Pocahontas district and the yard has been built for the purpose of weighing, billing and classifying the shipments. Attention will, therefore, first be turned to the Bluefield yard, after which the others will be described in their physical characteristics, and then the methods of operation of each will be dealt with.



Eastern End of Bluefield Yard.

Bluefield is in West Virginia, but it is not far enough to the west to be in what is properly called the mountain section of the state. This is not reached until after passing Bluestone, nine miles further west. The country is, however, rugged and hilly, with a rock foundation underlying a thin layer of earth. The hills are steep, and cut with numerous gullies and water courses, yet rounded in contour by time so that the country presents an intermediate condition between the rolling foot hills of the Alleghanies and the precipitous ridges and hollows that prevail further west. The rock underlying Bluefield is what is sometimes known as a bastard limestone. Technically it is the bluestone formation, consisting of red and green shale sandstone and impure limestone. Its strata are badly tilted, standing at steep angles that sometimes approach the vertical and often scaling off on a sharp incline where excavations are made, leaving a smooth, unbroken surface. More often, however, it disintegrates badly under a shot, with numerous cracks, afterwards crumbling under the action of water and frost. The location of the road at Bluefield is along a narrow valley, with hills of the character just described rising abruptly upon each side; a valley that serves as a pass between the levels of East river and Bluestone river, both of which are tributaries of New river, at points about 25 miles apart.

Given these physical conditions, the work of building a large receiving and classification yard in such a place involves the removal of large amounts of material and the expenditure of large sums of money. The estimated amount of excavation for the construction of this yard is placed at 1,361,000 cu. yds., and the cost at $1,294,000. The total length of the yard is about 19,000 ft., or 3.6 miles, so that there is about 300,000 cu. yds. of excavation to the mile. At its widest point the yard has a width of about 600 ft. and it is bounded on both sides for almost its entire length by the steep sides of a cut, as shown in the photographs, though even this does not fully show the true significance of what it meant to build such a yard in such a place.

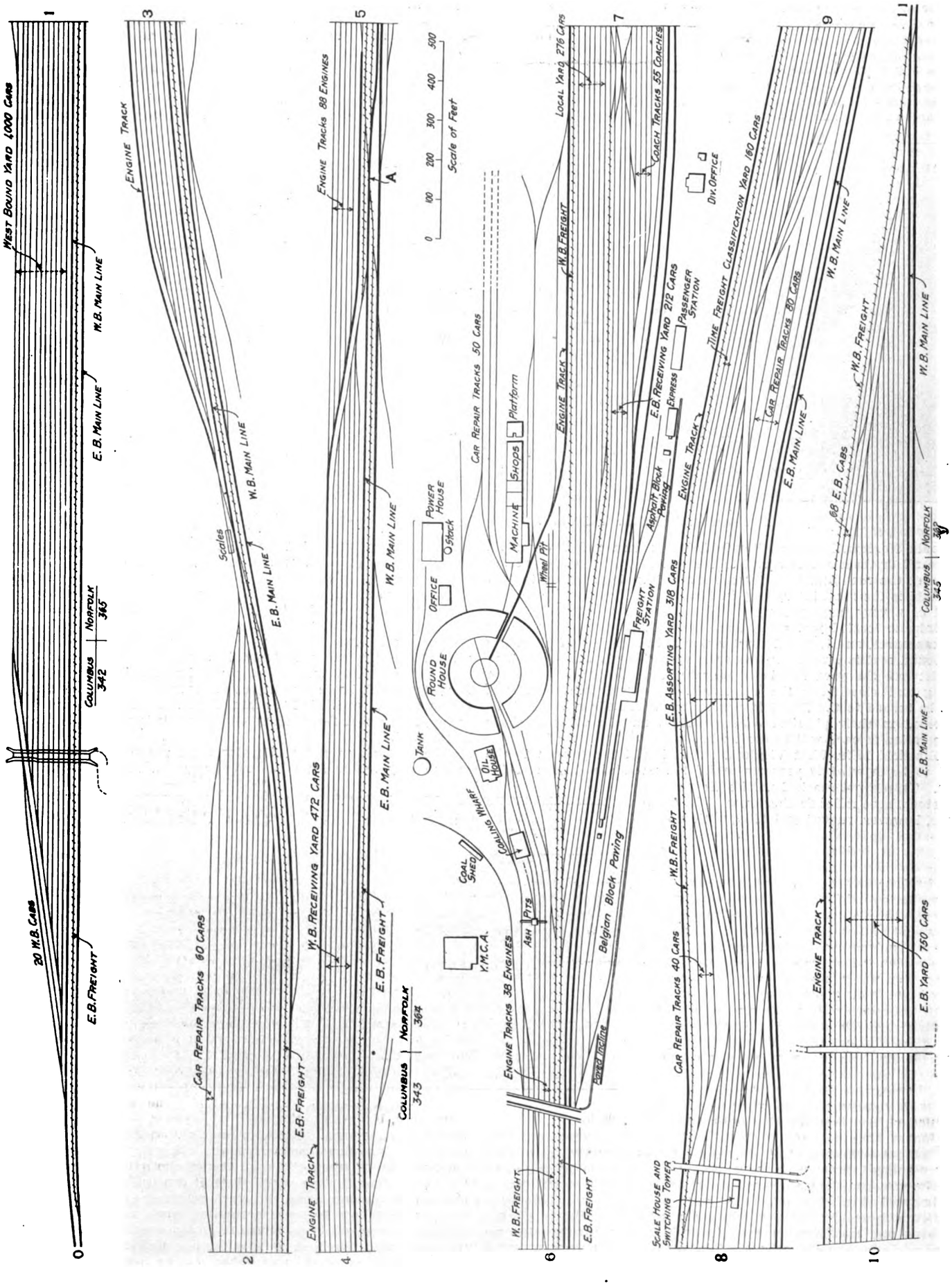
In working out the plans for the large yards at Roanoke and Williamson they have been placed between the two main lines in order to avoid all cross overs; but owing to the configuration of the ground and local conditions at Bluefield, this has been impossible at that point, and the yard has accordingly been placed wholly to the north of the main lines, which are shown by heavy lines. These lie parallel to each other and with the ordinary spacing apart until they reach a point about 2,400 ft. west of the passenger station, when the westbound track is swung to the right to make room for an intermediate third track to be used as a running track for eastbound freight as explained later.

Starting at the eastern end of the yard, the westbound traffic leaves the main track at the extreme end and passes over the special westbound running track that is shown by a hatched line. This track runs along the northern side of the eastbound yards and between them and the running tracks for eastbound engines. At a point about 1,700 ft. from the entrance to the yard, and just before reaching the junction of the engine tracks, the caboose is dropped and falls back to the caboose tracks, at the point indicated for the eastbound cabooses, where they are ready for their trains when the latter are made up. The westbound train then continues its course up the northerly side of the yard between it and the roundhouses and shop, past the neck in which the engine tracks are located and on down to the ladder track at the east end of the westbound receiving yard. The train is there hauled in upon the assigned track and the engine runs through the yard to the west end, where it passes out to the engine track and returns to the roundhouse over the same along the north side of the yard, as indicated by the hatched line. In this, it passes over the engine tracks that have accommodation for 88 engines, and which are served by a ladder track separated from that of the westbound receiving yard. They are all served by a single track that is common to the ash pits. From the ash pits there is a straight run to the coaling wharf, water tanks and roundhouse. From the westbound receiving yard, which has a capacity of 472 cars to the classification yard, the capacity of which is 1,000 cars, there is a direct and easy gravity movement so that the work of classification is practically that of a hump yard.

For outgoing westbound trains there are two routes which the engine may follow from the roundhouse or storage tracks to the west end of the yard. One is to come out on the ladder track, separating the standing tracks from the ash pit tracks, reaching the main westbound track at A, and thence along the latter to the west end of the classification yard, where it can back in to its train and pick up the caboose from the track reserved for them. The other route is to follow the engine running track along the north side of the receiving yard and strike the main westbound track between the two yards. The first route is the one preferred, however, as the engine is thus out of the way of those going toward the roundhouse after leaving a train in the receiving yard.

Bluefield Yard, Looking West.

By following these movements on the engravings, it will be seen that the westbound train clears the main track at the entrance



Plan of Bluefield Yard; Norfolk & Western Railway.

to the yard and, as it is provided with its own running tracks, it does not interfere with nor is it delayed by the work of the eastbound yard. It leaves and enters the main line from the same side and does not cross any of the eastbound freight traffic or the main lines. In this respect it will be seen to resemble the Williamson and Roanoke yards.

The handling of the eastbound traffic is more complicated, not only because of the nature of the shipping and billing, as will be discussed later in connection with the operation of the yard, but because of the amount of traffic originating at this point.

The eastbound trains on entering the yard are run in upon the third track between the two main tracks, as indicated by the hatched line. This track extends the whole length of the westbound yards and then at a point opposite the engine tracks runs upon the westbound main line at A, which it follows for about 150 ft. and then leaves it to enter the eastbound running track as indicated by the hatched line. At a point opposite the ash pits it enters the ladder track of the eastbound receiving yard which has a capacity of 212 cars. This running track extends down through the center of the west end of the receiving yard to a point near the scale house, from which place the cars drop by gravity down to the assorting yard. This assorting yard is needed because of the large amount of coal traffic that originates at Bluefield that must be weighed and billed. The local receiving yard for cars that are already billed has a capacity of 276 cars, and the assorting yard, 318 cars. The receiving yard then delivers direct to the scale tracks, when by way of a split ladder track the cars are run into the eastern assorting yard, and thence on to the classification yard with a capacity of 750 cars, where the trains are finally made up. The eastbound train is thus compelled to haul its caboose into the receiving yard, where it is dropped and hauled back to the caboose tracks at the west end of the yard, by way of the westbound freight running track to the point A, thence along the main track to the extreme end of the yard. From the eastern end of the receiving yard the incoming engines reach the roundhouse by way of a running track lying between the receiving yard tracks, as indicated by the hatched line. On this track the engine reaches the westbound freight running track over which it passes to the storage tracks and ash pits. This causes a minimum delay to any western freight.

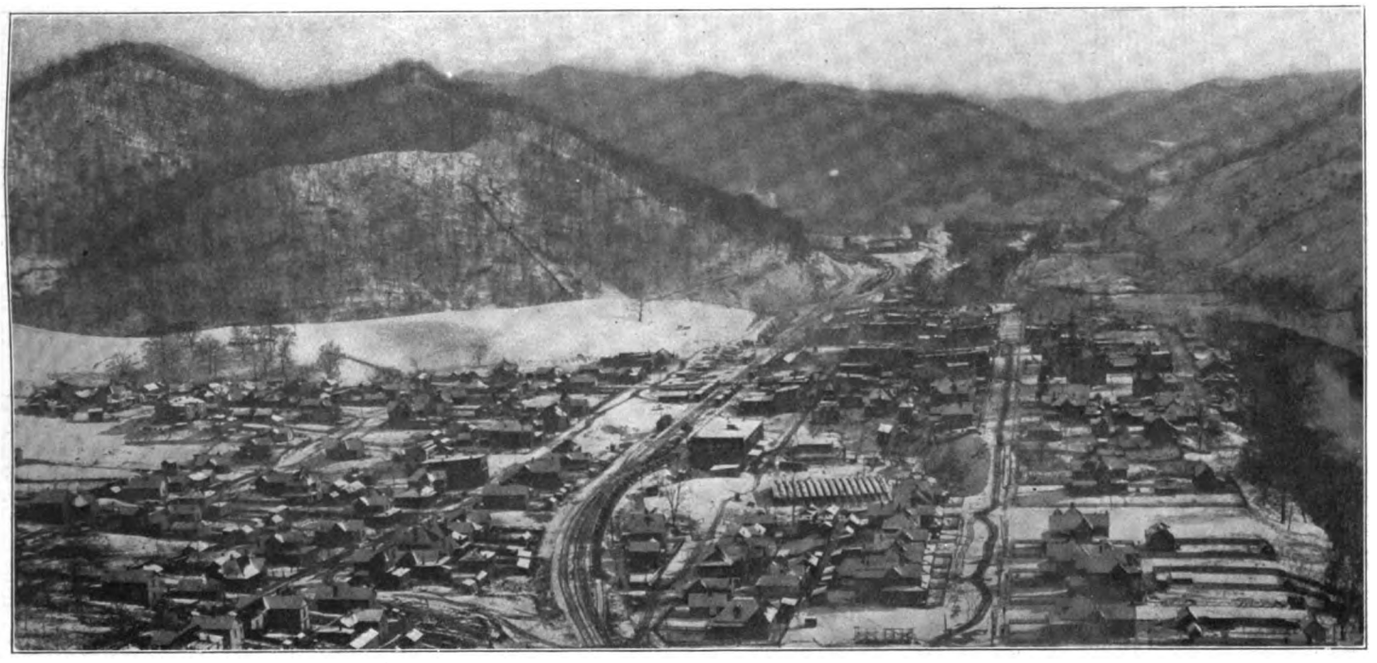
It will be seen from the plan that in order that there may be no delay to engines moving between the roundhouse and the head of eastbound trains, a special engine running track has been provided outside of and to the north of the westbound freight running track. An engine leaving the roundhouse thus skirts the whole of the eastbound yard and, taking its train at the east end, hauls it out beyond the caboose tracks and to the main eastbound track, during which movement the caboose is attached and the train hauled across the westbound to the eastbound track. Even at this point the possibilities of delays are reduced to a minimum, for this eastbound traffic crosses the westbound passenger tracks only, and in no way interferes with the freight whose path is crossed by the empty eastbound engines only. As already stated the principle of yard construction that has been followed in all of the work on the Norfolk & Western is to place the yards between the east and westbound main lines so that the traffic entering the yard will not cross the tracks of that moving in the opposite direction. This has been followed to the letter in some of the yards, but where such an arrangement has not been physically possible on account of topography or for other reasons, as at Bluefield, the same principle of the separation of the tracks to accommodate the yards is followed, in that, as in the case under consideration, the westbound traffic is kept clear of and does not cross the eastbound at all, while its own path is crossed by empty engines only. At the same time the eastbound traffic offers a minimum of interference to westbound passenger traffic, since the tracks of the latter are crossed only by trains that are entering a middle siding that is cleared for their reception or are pulling out prepared for a run over the division.

The track arrangement for eastbound traffic is such that cars can be dropped by gravity from any track in the eastbound receiving yard over either of the two track scales, where they are automatically weighed and recorded. From this point, with slight assistance, they can be dropped by gravity to any track in the eastbound assorting yard. From this yard they may be dropped in cuts by gravity to any track in the main yard.

A brick scale house is placed between the two track scales for the accommodation of the clerks who have the work of weighing and billing in hand, as will be noticed later.

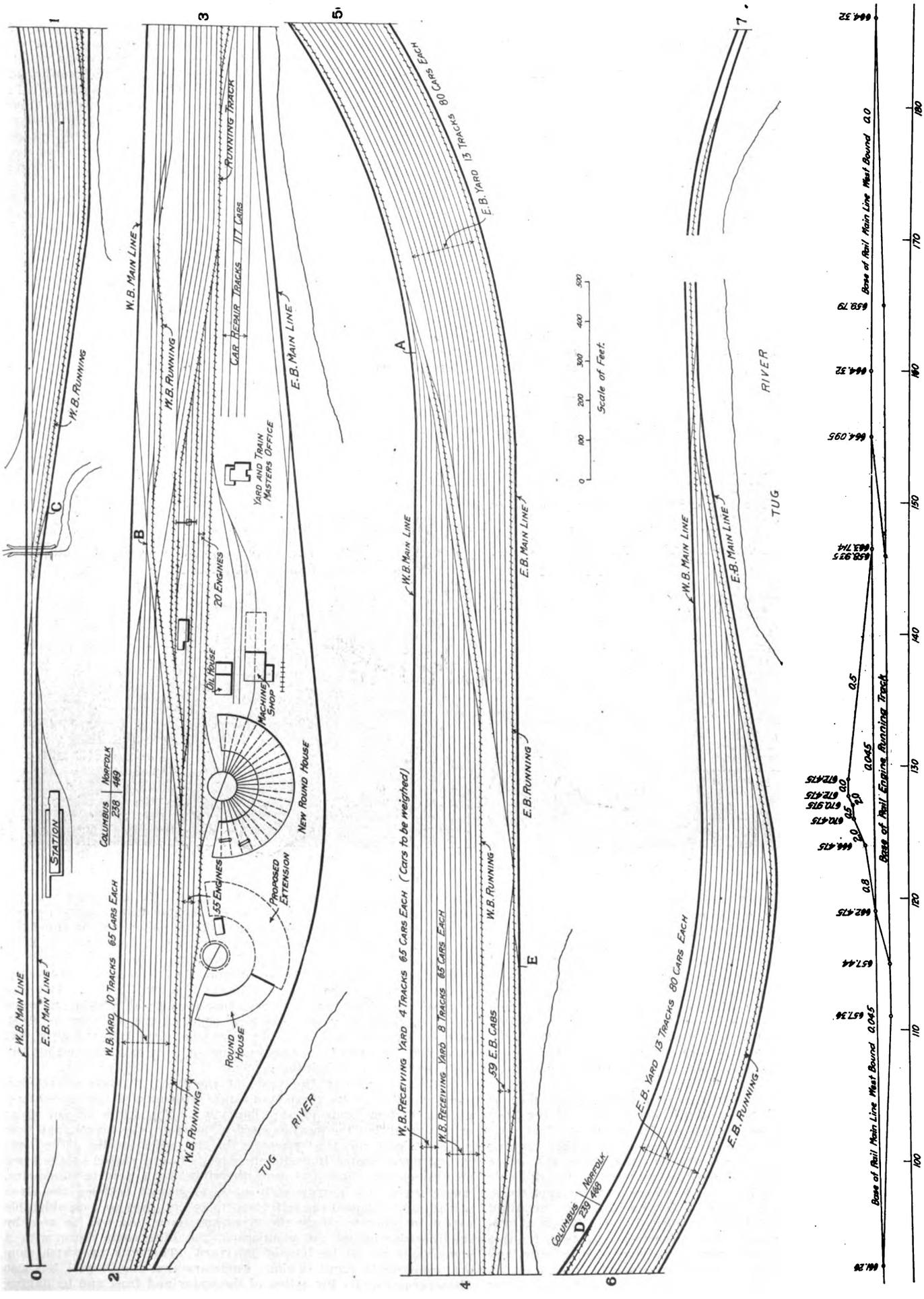
WILLIAMSON YARD.

Williamson is located at the western end of the Pocahontas Division, 105 miles from Bluefield. It is between these two points that the majority of the coal traffic of the road originates. At the eastern end of the division is the Pocahontas field, most of whose output goes east and to the seaboard, being assembled at Bluefield, as we have seen. At the western end there is the Thacker field, with a coal having a somewhat lower fixed carbon, but still of high grade, that is sent west to Columbus, Cincinnati and other points. It is this coal that is handled at Williamson. There is a small assembling yard for westbound traffic at Vivian, 29 miles west of Bluefield on the western edge of the Pocahontas field, where westbound coal and coke from that field is brought in, but this traffic is small in comparison and it is at Williamson that the main westbound assembling is done.



Williamson, West Virginia; Looking Southeast.

Williamson is in the heart of the West Virginia mountains, and is located where there is a slight widening of the exceedingly narrow bottom lands of the Tug river. The width is not great at any point, but the location used is, however, the longest and best piece of land for yard purposes in the entire valley. The next largest piece located immediately west is now occupied by the town of Williamson. The yard was, therefore, built east of this point, where there is a narrow strip of level ground between the river and the hills, though the latter had to be cut away to a considerable extent in order to obtain the necessary room. As will be seen by the reproduction of the photograph, the hills come down with a steep slope to the borders of the yard. The rock of which they are composed is a sort of shaly sandstone that stands well, but also disintegrates under the action of the water and frost and by flaking causes a gradual filling up of the ditches. It is too hard to be handled with a shovel without being first blown down, so that wher-



Plan and Profile of Williamson Yard, Showing Hump; Norfolk & Western Railway.

ever the yard has encroached upon the hills blasting has been needed, with the result that the amount of material moved has amounted to 453,000 cu. yds. and the cost of this part of the improvement has been $580,000.

In this yard the guiding principle, as set forth, of placing the yard between the two lines of the main track, has been followed in its entirety and to this has been added the use of a hump for westbound classification. Like that at Roanoke, as will be seen later, it is so laid out that it can be entered from either direction without crossing any main tracks. The classification yards for each direction are located at the delivery end.

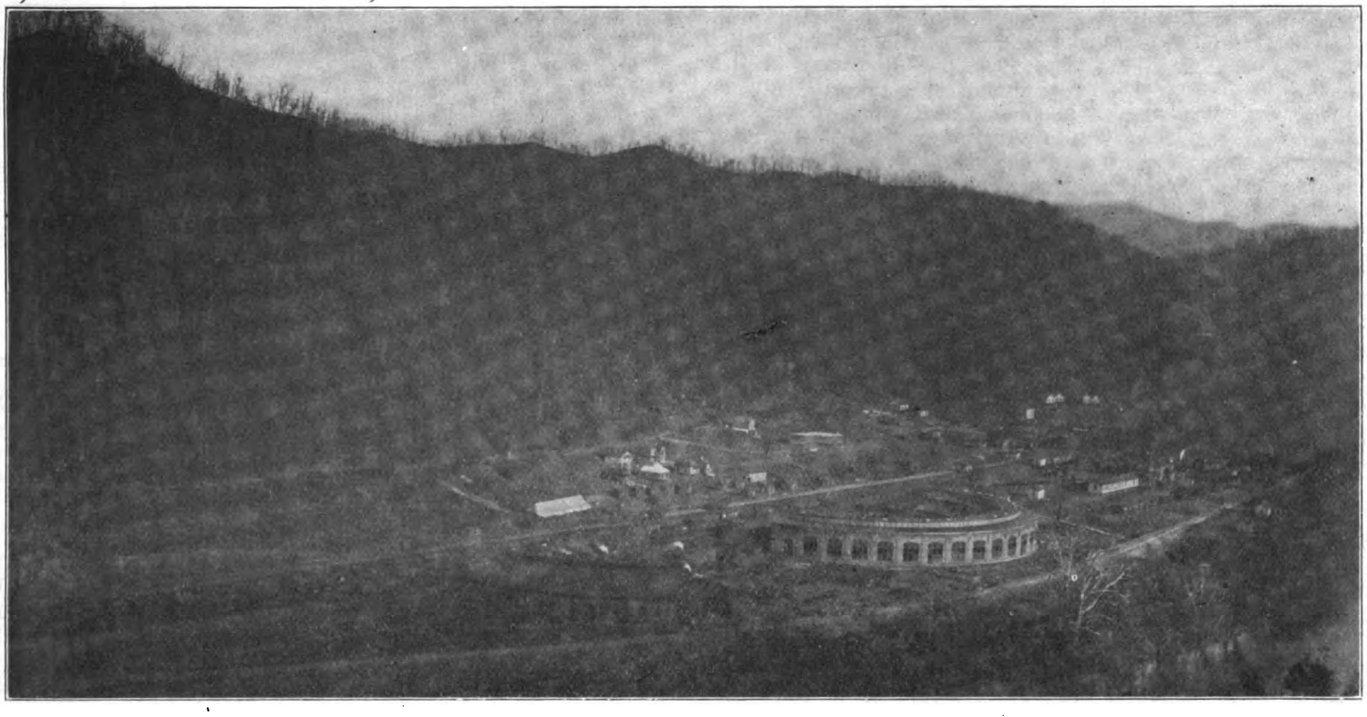
As in the case of the Bluefield yard, the main tracks are indicated by a heavy line and the running tracks by cross hatching. The westbound freight keeps to the main line along the north side of the eastbound yard until it nearly reaches the western end of the latter, when it turns in to a running track at D on which it skirts the northern side of the eastbound yard, over its own running track until its reaches the point A, the entrance to its own receiving yard, which has a capacity of about 780 cars. In this yard the four tracks on the north lead to the hump are the receiving tracks for cars that are to be weighed. The caboose is dropped at the eastern end of the westbound receiving yard and is run down to the caboose tracks over the ladder of the eastbound yard to the caboose tracks. The engine, after leaving its train on the receiving track, passes out at the western end on to one of the cross-over running tracks leading from the westbound ladder track of the same. Leaving the train on one of the tracks of this yard, the engine proceeds to the roundhouse by the engine running track at the south or by the yard track next to the westbound main lines and backs in over the ash pits on its way to the roundhouse.

In the case of an outgoing eastbound locomotive, it leaves the roundhouse on the engine running track south of the ash pits and north of the repair tracks. Then, turning in to the running track next the westbound main line, it crosses the path of the incoming eastbound trains and, skirting the eastbound yard, may turn in upon its eastern ladder track or run to the extreme eastern end before it backs in to its train.

Meantime as it passes the ladder of the caboose tracks it can run in and pick it up and push in over the west ladder track of the eastbound yard to the rear of its train or the caboose may be dropped in to place. In pulling out it can be run out upon the main line at the end of the yard or upon a middle siding where it can stand out of the way of other trains while awaiting orders.

The repair tracks are located near the west end of the westbound receiving yard, and are readily reached over the running tracks from either yard. Direct access to these tracks is obtained over a ladder track that is kept free for this cripple movement.

With this arrangement all engine and train movements can be effected with great facility and without causing the slightest interference with the passenger or through traffic on the main lines. There is a free communication between the yards for the handling



Williamson Yard.

yard to the engine tracks and ash pits from which it goes out upon the eastbound running track and into the roundhouse. There are two entrances to this track, so that the engine can approach the house from either direction, and in this way the tracks are so arranged that the movements in opposite directions for the incoming westbound and outgoing eastbound trains do not interfere with each other in any way.

After the train has been left in the westbound receiving yard any track may be cleared and the cars either pushed over the hump at B and dropped down over the scales into the classification yard, and thus reaches the ladder track of the classification yard. This westbound classification yard has a capacity of 650 cars. When the trains have been made up in this yard, the engine leaves the roundhouse over the engine running tracks that are shown by hatched lines and, skirting the westbound yard, backs into the train that is waiting for it. In pulling out it may pass directly on to the main westbound track and pick up its caboose at the west end of the middle siding that extends on from the end of the engine running track.

Eastbound trains are composed of empties returning to the mines for loads, and through merchandise, which requires little or no classifying at Williamson. Hence there is but one yard for the eastbound traffic which has a capacity of 1,040 cars. These trains follow the main line, and as the caboose reaches the west end of the westbound yard at C, it is dropped and run in upon the center siding. The train then continues on down over the main line to the west end of the eastbound yard at E, where it turns into the of the cars, and engines can be run to and from their trains without in any way interfering with or being delayed by the switching service. The scale tracks are arranged to take care of the westbound traffic only for the reason that much of this is originating coal, while the eastbound consists of empties or of cars that have been previously weighed.

The capacity of the yard is such that about 40 cars per hour can be run over the hump and weighed by a crew of 12 men. At present five day and two night engines are employed. Previous to the construction of the hump all cars had to be spotted on the scales, so that the saving of time is considerable. The traffic passing through the yard now amounts to about 1,500 cars a day or 750 in each direction.

The Williamson yard is the third in importance upon the line, and has a total length of about 14,000 ft. from entrance to entrance. It followed a bend of the Tug river, so that it does not present a straight and unobstructed view from end to end.

(To be continued.)

The number of employees on the 34,132 miles of railroad in the German Empire in 1905 was 606,612, or 17.3 per mile of road, and one out of every 99 inhabitants of the Empire. In this country the same year the 216,973 miles of railroad had 1,382,196 employees, which is 6.37 per mile of road and about one out of every 63 of the population. We had 15 times as much railroad to serve, 45 per cent. more people than Germany.

carry the flowers from Hoboken to the business places of the consignees; it takes such wagons approximately one hour and a half or two hours to transport the flowers from the train to the commission merchant in New York; such commission merchant consignees are grouped in New York City within three or four blocks of each other; the wagons, teams, and men used in such service in no way differ from those used generally in the express business, and these facilities are used throughout the remainder of the day in such general business; the justification advanced by the defendant for the increase in the rate complained of is that the rate previously existing was not remunerative, owing to the expense of the delivery service in New York City; and the United States Express Company employs agents at the points of origin who are, generally speaking, paid for their services in gathering, billing, loading, unloading, and delivering express matter with a percentage of the gross receipts at such offices, which percentages range downward from 20 per cent. It appears that after the rate was raised in 1902 to 50 cents a wagon express began business in the Chatham district, and has continued therein ever since, carrying flowers produced by that district to New York City at a rate of 60 cents; that such wagon express calls at the greenhouses for the flowers and delivers them from one hour to an hour and a quarter earlier in New York City than the rail express, and delivers the empties at the greenhouses on its return trip; that it is a rule of the defendant that its agents shall call for packages to be carried by it within certain prescribed limits from the agents' offices and shall deliver packages within such limits; that such service has not been given to the shippers of flowers complaining, but that no complaint of this failure to obey the rules of the company was made to any of the general officers thereof; that the general merchandise rate for the Chatham district is one-half that on cut flowers; that the rate on meat and vegetables in corrugated paper boxes is 40 cents per 100 lbs.; dry goods, notions, ice cream, etc., 50 cents; beer, ale, mineral waters, etc., 35 cents; berries, fruits etc., 40 cents; millinery, feathers, hats, and cameras (boxed), Saratoga chips, cigar boxes, doll carriages and straw goods, 50 cents.

Report of the Illinois Railroad and Warehouse Commission.

The Railroad and Warehouse Commission of Illinois, in its report just made to the Governor, advises against participation in the widespread movement among the states to reduce passenger fares by legislative action, at least until careful investigation can be made of the conditions which might be considered to justify such action. The report says:

"There seems to be a popular demand for a reduction in passenger fares, and nearly all the states surrounding us are yielding to this demand. What action should be taken by this Commission with reference to the reduction of passenger rates should be determined by a thorough investigation of existing conditions in this state, entirely uninfluenced by the action taken or proposed in adjoining states. Hasty and ill-advised action cannot but operate to the detriment not only of the railroads of the state, but of the people as well. There seems to be a disposition on the part of some to insist upon the presentation of this question to the legislature at its coming session. In the absence of action by that body it will, of course, become the duty of this Commission to make such investigation and enter such order as the facts elicited shall warrant.

"The railroads in the state of Illinois carried 54,757,396 passengers earning revenue during the year covered by this report [ending June 30, 1906,] which was 1,210,086 more than the preceding year. The average amount received from each passenger was $0.54, being 5 cents less per passenger than during the preceding year. The amount of passenger revenue per mile of road was $2,992 as against $3,176 per mile the preceding year, or a decrease in passenger revenue per mile of road of $184. The average distance haul of each passenger was 27.7 miles, a decrease of five miles from the preceding year, and the average amount per passenger per mile was 1.95 cents.

"The total revenue from the movement of passengers in the state of Illinois during the year ending June 30, 1906, was $29,619,969, which was a decrease from the amount received for the same service in 1905 of $2,241,492. This decrease in the passenger earnings is probably accounted for by the fact of the large increase of electric interurban tracks, which in many cases parallel the existing steam railroads. Many more miles of electric line are in process of construction under like conditions, which will absorb a large amount of short distance travel and must of necessity affect the passenger earnings of the steam roads."

Referring to the reduction in freight rates made by the Commission during the year covered by the report, the latter says: "After a long and exhaustive hearing, the Commission ordered a flat reduction of 20 per cent. on the classes numbered one to five inclusive, that is, merchandise classes, on January 1, 1906, and a graduated scale of reduction on classes six to ten inclusive, and commodity rates, commencing with 10 per cent. on the short mileage, effective July 1, 1906. The reduction of 20 per cent. on the first five classes has been in effect for six months at the date of this report, and the predictions of the railroads that it would be ruinous to their business has not materialized. The number of tons of freight hauled earning revenue for the year ending with the date of this report in the state of Illinois was 146,127,775, which was an increase of 22,543,686 tons over the previous year. The average amount received for each ton of freight was $0.73, against $0.75 the preceding year, or a reduction of only two cents, and the freight earnings per mile of road were $7,880 as against $7,086 the preceding year, or an increase of $794 per mile."

The steam railroad mileage in the state on June 30, 1906, was 11,894 miles, an increase of 257 miles; 2,229 miles of second, third and fourth main track, an increase of 146 miles; 6,005 miles of yard tracks and sidings, an increase of 74 miles, and 416.46 miles of industrial tracks, an increase of 0.92 miles. This last is significant, especially when considered in connection with the letter of Russell Harding to the Interstate Commerce Commission published in the *Railroad Gazette* of January 18, in which he asserted that one of the chief causes of the present car shortage and traffic congestion is the lack of sufficient industrial tracks. The total steam road mileage of the state was 20,544 miles, an increase of 478 miles.

Electric roads had a main line and branch mileage of 936 miles, the increase for the year being 173 miles. The total mileage of electric railways, which includes interurban and elevated roads but not street railways, was 1,187 miles, an increase for the year of 205 miles. The street railways are specifically exempted by law from the jurisdiction of the commission and make no report of any kind to any department of the state government. Concerning this the report says: "It would seem to be just and necessary that a public utility enjoying special privileges by courtesy of the state and municipalities, should be required to submit some kind of a statement of its business to some department of the state government for the information of the people who invest in its securities."

The number of accidents on steam roads from movement of trains was 958 killed and 3,636 injured, an increase over the previous year of 66 killed and 546 injured. From causes other than the above there were 18 killed and 1,563 injured, making the total from all causes 976 killed and 5,189 injured.

The interurban and elevated roads killed 48 and injured 468, an increase of 19 and 23 respectively. These roads carried 183,650,979 passengers, an increase of 21,801,904, and 1,277,566 tons of freight, an increase of 641,823 tons.

Norfolk & Western Improvement Work.

BY GEORGE L. FOWLER,
Associate Editor of the *Railroad Gazette*.

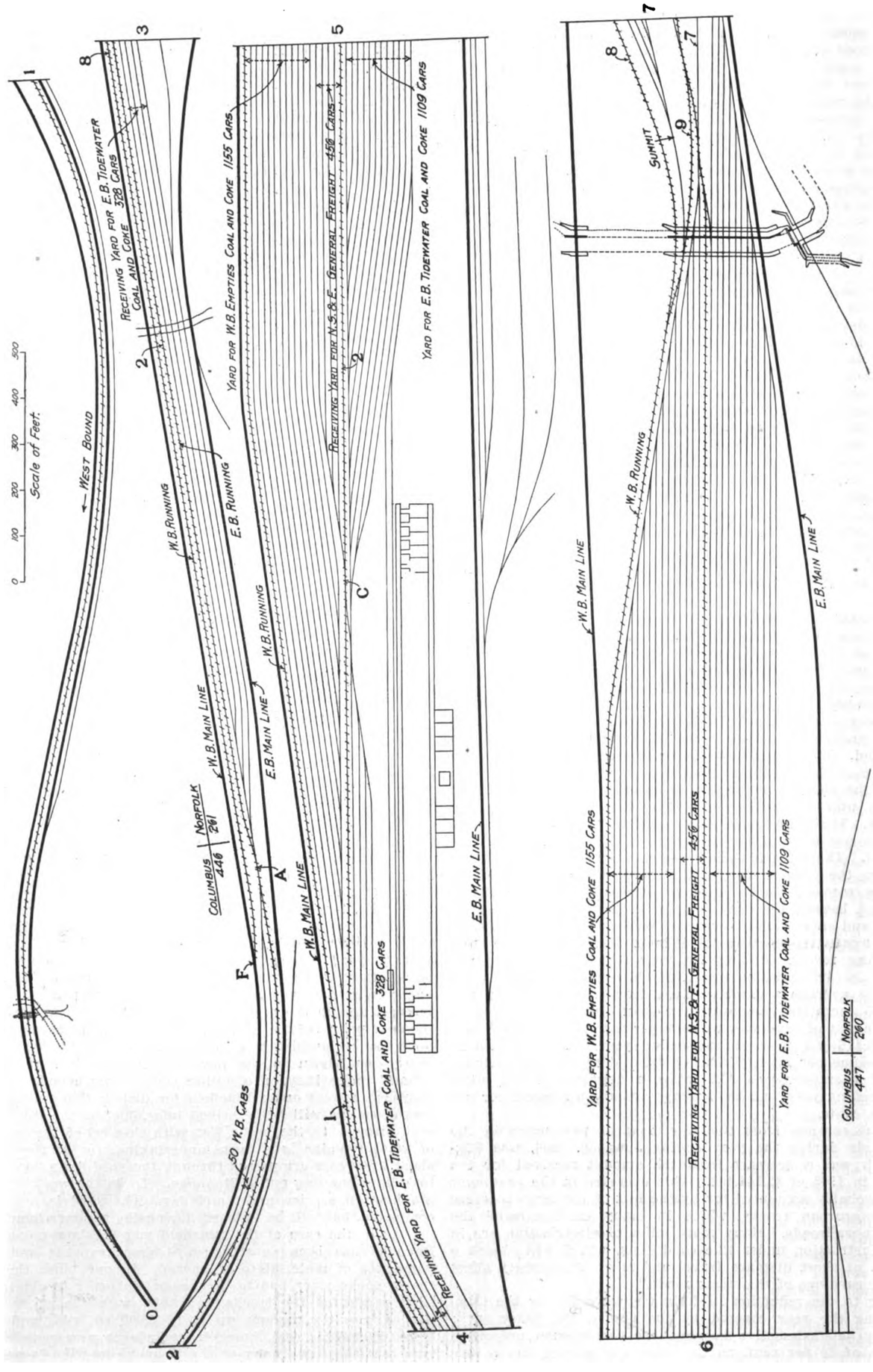
III.

YARDS.

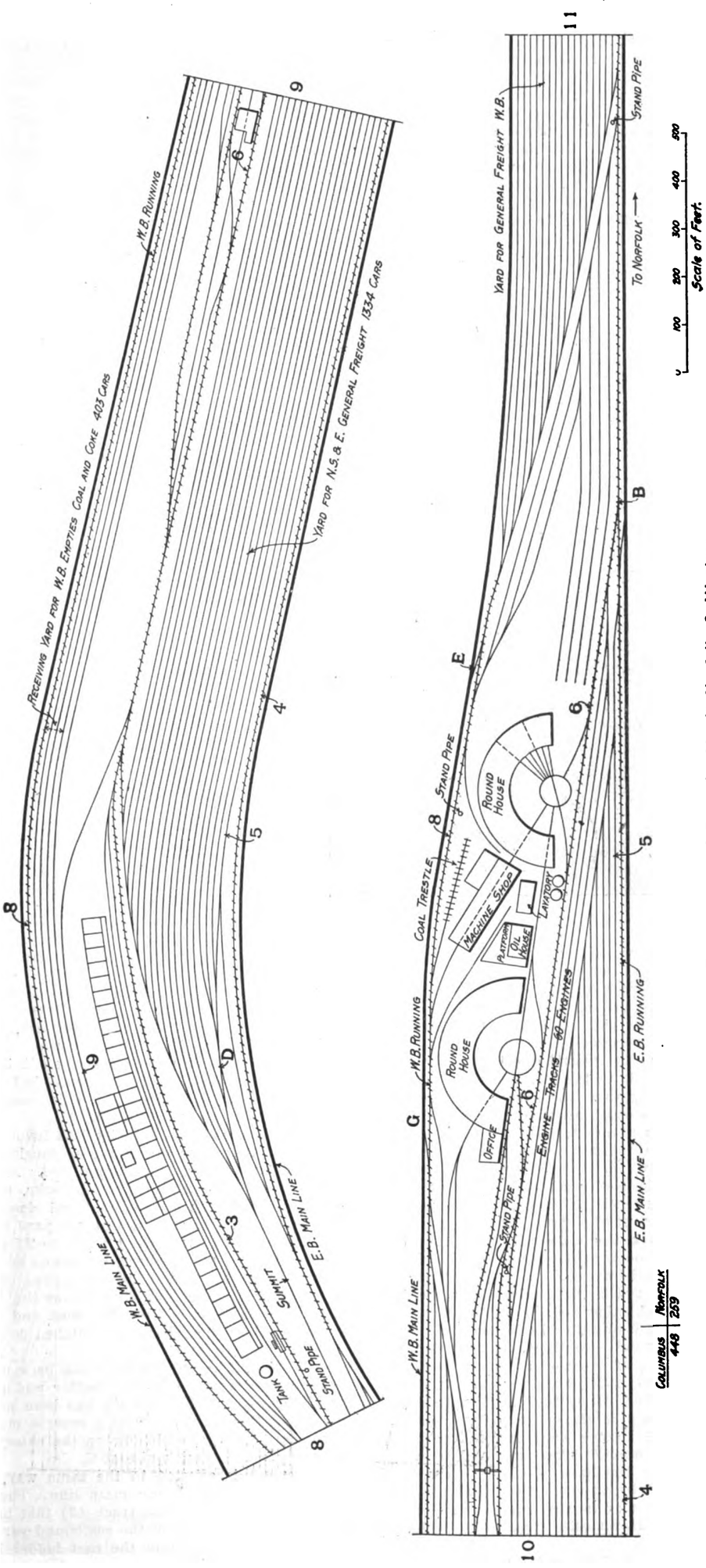
ROANOKE YARD.

Roanoke, Va., is situated at the crossing of the ways. It is the junction point of the main line, extending from tidewater to the mines, and of the north and south divisions running from Hagerstown, Md., to Winston-Salem, N. C. It is not an originating point for any large amount of traffic like Bluefield or Williamson, but it is an important distributing center and the demands are such that a large yard is required. Tidewater coal made up at Bluefield passes through the yard without breaking up, and the new yard has been so designed that this can be done without delay or interference, though the great mass of the general traffic entering from the four points of the compass, and sent out in as many directions, must be reclassified and arranged for distribution. This is, of course, cut down to the lowest possible notch, and there is no general reclassification of either east or westbound coal cars. The empties are sent on to Bluefield for distribution among the several operations, as will be described later, just as the tidewater coal is sent through to the east. Yet with this relief the reclassification of what remains is a large undertaking, for at the present time about 2,500 cars are passed through the yard daily, intended for the four lines running out of Roanoke. To do the work 10 locomotives are kept in service night and day. The yard is not yet entirely completed, but will be finished during the summer months.

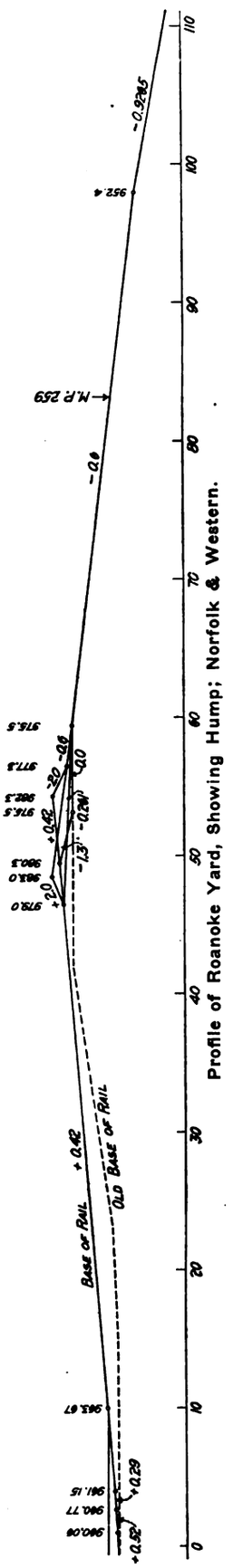
As in the case of the Bluefield and Williamson yards, that at Roanoke has been constructed at great expense and with large quantities of material to be moved. In one place the channel of the Roanoke river had to be changed in order to obtain the necessary width for the tracks and this, with the other excavations needed, run the amount up to 1,385,000 cu. yds., and the cost to $1,240,000. This cost, however, includes a new roundhouse. It is true that the topography of the Roanoke location is not as rugged as it is either at Bluefield or Williamson, still the country is rolling and it has been necessary to level hills of considerable height in order to lay the tracks and, in many places, this leveling has been so accompanied by adjacent filling that when the work has been



Plan of Western End of Roanoke Yard; Norfolk & Western.



Plan of Eastern End of Roanoke Yard; Norfolk & Western.



Profile of Roanoke Yard, Showing Hump; Norfolk & Western.

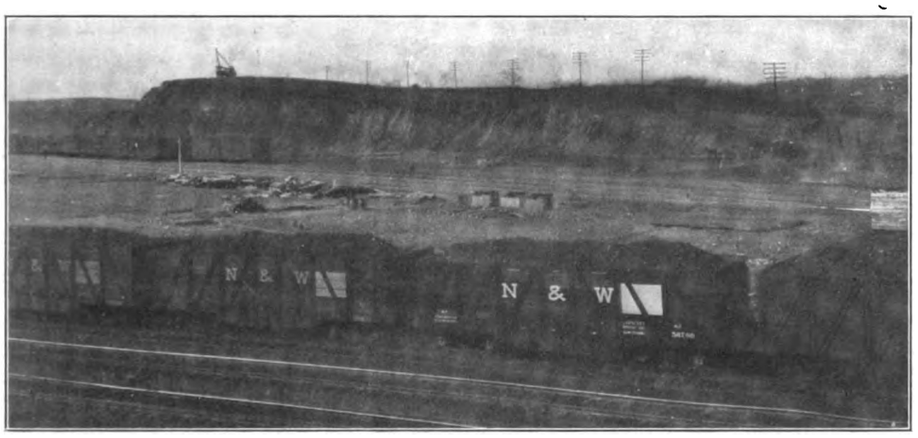
done, there is apparently little to show in corroboration of the figures given for material moved. This yard is, however, nearly all steam shovel work in a hard, shaly sort of clay and sandstone that digs with comparative ease and stands well with little inclination to wash down or slide and fill the ditches.

The yard has a total length of 20,000 ft., is located at the western part of the city, and is the best exemplification of any on the line of the underlying principle of placing the yard between the two main lines of rails. Here it is completely done. The tracks separate at the entrance of the yard and pass along its northern and southern borders, even including the roundhouse and buildings in the swing as at Williamson.

Bearing in mind that the bulk of traffic at Roanoke is eastbound and needs no sorting or classification, we can turn to the physical features of the yard.

As in the case of the westbound traffic at Bluefield, the eastbound freights enter a middle siding that has been cleared for their reception at the west end of the yard and, as this traffic is the most important, the major portion of the yard is devoted to it. These trains then pass over this middle track which, as in the case of all other running tracks, is indicated by a hatched line, until the caboose reaches the point A, where it is cut off and dropped back into one of the tracks reserved for the westbound cabs.

If the train is made up of tidewater coal, it may be run in to one of the three tracks indicated as a receiving yard for that traffic with a capacity of 328 cars, or it may continue on over the running track marked (1) to the yard for eastbound tidewater coal and coke. When the train is left in the first yard the engine is cut off and passes over the running track marked (2) between the yards for general eastbound freight and that for coal and coke to the running track (3) and thence on to the standing tracks or roundhouse.



West End of Roanoke Yard.

If the train is to be sent direct into the tidewater coal and coke yard, it swings away from the receiving yard, and running along the north side of the same, reaches the ladder track at the west end of the main yard. Then, after cutting loose, the engine runs out the east ladder track upon running track (4) and on to the point B whence it backs in to the roundhouse or storage tracks.

Eastbound general freight on reaching the point A swings off directly upon the running track (2) and follows it to the lead of the ladder track of the eastbound freight receiving yard at C, and then swings into that yard. The engine runs out over the eastern ladder upon running track (3) and thence to the roundhouse.

Outgoing tidewater coal and coke, needing no reclassifying, are pulled out of the yard upon running track (4) which they follow to the point B, where they are run out on the main eastbound track.

The general freight, after its reception in the receiving yard, is classified and distributed over the several tracks of the yard for north, south and eastbound general freight, which has a capacity of 1,334 cars, and is thence pulled out over its eastern ladder track to the point B, where it reaches the main eastbound line.

Engines for eastbound general freight can reach the ladder track of the yard from the engine storage tracks at either end. For tidewater coal the engine runs out on track (6) to B and then backs up over track (5), skirting the general eastbound classification yard to D, when it crosses into the ladder track of the coal and coke yard, and thence out as already stated. In both cases, for general freight and for coal, the caboose is picked up at the extreme eastern end of the yard, which is not shown in the engraving. The classification of the general freight is accomplished by means of a hump located at the point marked "summit." The cars are pushed out upon track (7) and thence over the hump from which they drop down into the classification yard by gravity. The eastbound traffic is thus cared for without crossing or in any way conflicting with any engine or train movement in the opposite direction.

The westbound general freight traffic, which is here a light movement, is cared for by a combination of receiving and classification yard having a capacity of 1,107 cars. The trains leave the main line at the entrance to the yard and, moving over the ladder track to one of the 16 tracks forming the yard, are left to be sorted, while the engine is sent out on to the ladder at the west end. The caboose in the meantime has been dropped at the east entrance to the yard and is picked up by the outgoing eastbound train. The engine then passes out over the engine running tracks (8) on the north side of the roundhouse to the west of the standing tracks and roundhouse; backing into the same.

When a westbound train has been made up in the classification yard, the engine takes it and, hauling it to the running track (8), crosses directly to the westbound track at E, or it may continue along the running track (8) between the roundhouse and the westbound track to F, just beyond which point the caboose is coupled on.

In the case of the westbound empties, they drop the caboose as before and then follow the main track beyond the westbound general yard and the roundhouse to the point G, where they turn in and cross the running track to the ladder of the yard for westbound coal and coke empties, which has a capacity of 403 cars. The engine then runs out on the west end ladder and backs over running track (9) to the storage tracks and roundhouse.

From the receiving yard the empties are pushed over a hump located at H and dropped down into the classification yard for empties that has a capacity of 1,155 cars. The engine for westbound empties leaves the roundhouse by running track (6), which it follows to its junction with track (3); thence by way of track (9) it crosses to the westbound running track (8), which it follows along the north side of the yard to the ladder track at I. Backing in on this track it couples to its train and hauls it out over the running tracks (8) to F, where it reaches the main line and takes its caboose at the same point as the general merchandise trains.

The yard is entirely free and independent from that devoted to passenger service as well as that of the shops, and it is made of such size that it will be capable of handling, not only the present traffic but some future increase. In it the east and westbound movements are kept entirely apart. There is no crossing of the traffic, either in the yard or on the main line, and there can be absolutely no interference with the passenger trains. In these particulars this, as well as the yards at Williamson and Bluefield, is deserving of most careful study.

EAST PORTSMOUTH YARD.

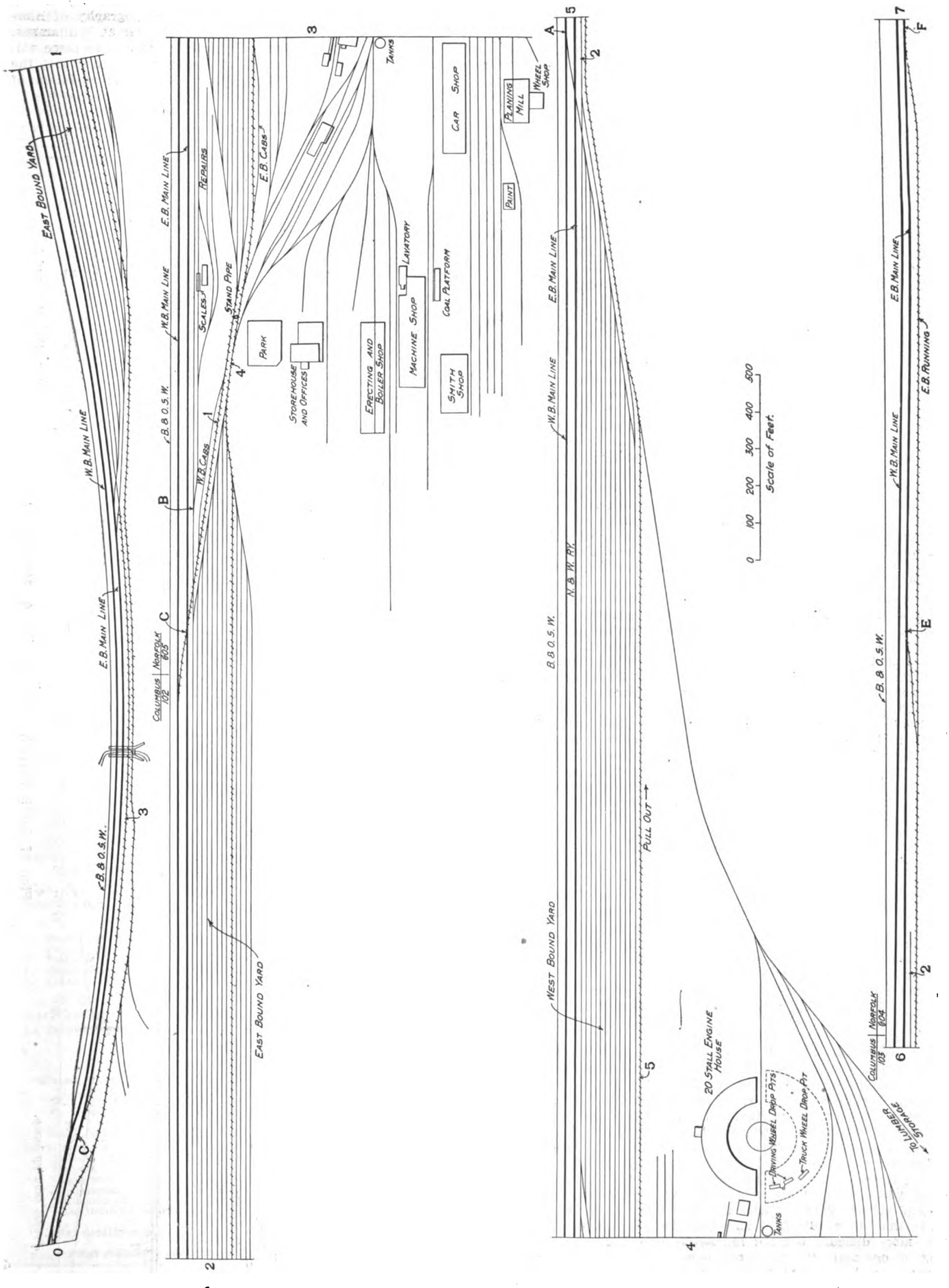
The yard at East Portsmouth, Ohio, on the Ohio river, 138 miles west of Williamson, serves as a receiving and distributing yard at the junction of the three main lines running to Columbus, Cincinnati and Norfolk. At this point the bulk of the loaded traffic is westbound and there is comparatively little that originates between that point and Naugatuck, where the Big Sandy line leaves the original line. Owing to the peculiarities of location it was impossible to place this yard between the main lines. These here run parallel to that of the Baltimore & Ohio Southwestern, and the yard is limited in length by the location of Portsmouth.

The yard is not yet entirely completed, but when it is it will have a length of about 13,000 ft. Although the ground is level near the river considerable filling has been required which amounts to about 500,000 cu. yds., and has cost about $407,000.

As the work to be done at this point is far less involved than at either of the other three, that have thus far been considered, the arrangement of the yard is correspondingly simplified. As in the case of the westbound general freight yard at Roanoke, one yard is made to serve the double purpose of receiving and classification for each direction of movement. On approaching the yard from the east, the trains hold to the main westbound track until reaching the head of the westbound yard at A, where, by means of a crossover they turn directly into the ladder track, crossing the eastbound main line in doing so. The engine then leaves the train in the yard and goes to the roundhouse from the west end by way of the running track (1), while the caboose is switched down upon the cab track.

The classification is effected by pulling the train back upon the tail track (2) and kicking the cars over the ladder and in upon the assigned tracks of the yard. When a train has been made up, the engine reaches it from the roundhouse by a reverse movement and pulls out over running track (1) picking up the caboose at B and crossing the main eastbound track again at C.

The eastbound movement is effected in the same way, except that there is no crossing of the eastbound main line. The trains enter the yard at C and follow the running track (3) that has been cleared for their reception to the ladder of the eastbound yard. The engine passes on to the roundhouse from the east ladder by way of the track (4) and the caboose is brought around the yard and



Plan of East Portsmouth Yard; Norfolk & Western.

put upon the cab track ready for delivery at B. The eastbound engine reaches its trains by a reverse movement and pulls out over the running track (5), picking up the caboose as it passes its siding. It then continues on along the south side of the yard and reaches the main line at E or F, both of which points are beyond the extreme limits of the sorting and poling tracks of the westbound traffic. Provision is made for weighing cars between the two yards, so that they may be run out over the scales and poled back as required. With this arrangement there is no interference between the east and westbound movements as far as the freight work is concerned. The only interference being in the hauling of the westbound freight trains across the eastbound main tracks as they enter and leave the yard, a matter that, owing to the light character of the passenger traffic at this place is of no importance, especially as this crossing is done between the points where the eastbound freight enter and leave the yard.

SOUTH NORFOLK YARD.

The new yard at South Norfolk is intended for the sole purpose of a receiving yard for eastbound traffic in order to relieve a possible congestion at Lambert's Point and the city yards. It is at Lambert's Point that the road has its tidewater terminal from which the coal is delivered to vessels. This terminal was fully described in the *Railroad Gazette* of July 24, 1903. In loading or waiting for vessels it frequently occurs that there will be an accumulation which if run into the terminal would so congest it as to hinder the work. For that reason this yard has been built on the outskirts of Norfolk and the borders of the Dismal Swamp. As already stated, it is intended for eastbound traffic only and has no provision for doing any westbound work. It has a length of about 12,800 ft., and, when completed, will be provided with a hump between the receiving and classification yards.

It is built upon low but firm ground and is raised above the natural surface. Although this natural surface is level, the extent of the yard involved a correspondingly large amount of material to be placed, amounting in all to 120,000 cu. yds., and its cost up to date is $132,000, but the yard is not yet complete.

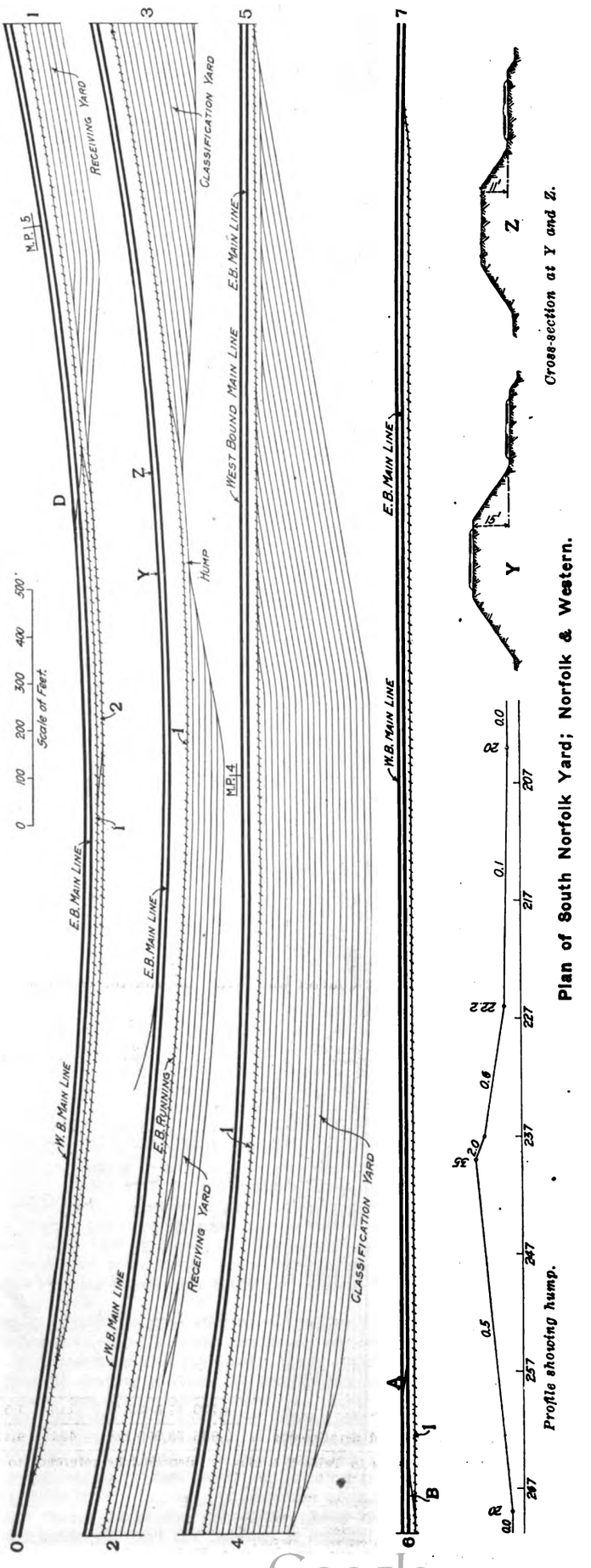
Inasmuch as the yard has to deal with traffic in one direction only, it was unnecessary to place it between the tracks of the main line in order to avoid an interference. It is, therefore, placed outside these lines and to the south of them on the side of the eastbound track which it is intended to serve. Trains approaching it from the west leave the main line at the west entrance and swing off upon running track 1. If the train is to be broken or is intended for the receiving yard it is run in on track 2, which is a westbound continuation of the ladder of the receiving yard. It can then be run direct in upon its proper track. If, however, no work is to be done upon it, it may continue along the main track to the terminal yards.

In the receiving yard there are cross-overs between adjacent tracks, so that one train can be shifted ahead of another whenever it is so desired. The work at the hump is, of course, to be conducted in the ordinary manner. It will be noticed that at the east end of the classification yard there are two ladders serving eight and 10 tracks respectively, and each delivering to running track 1. This is to enable two engines to work at that end of the yard at the same time without interfering with each other.

When a train is ready to be sent to Norfolk an engine is sent out over the westbound track and it can cross to the eastbound at A and back into its train. When pulling out, it may go directly upon the eastbound track at B or continue on down the running track 1, where it may wait for orders and go out on the main line at C. There is also a cross-over from the east to the west line near the western end of the yard at D. In these yard movements the cabooses are pulled out of the receiving yard and sent in to Norfolk over the running track 1 with the engine.

As the movement is all in one direction the detail of all of the yard work is equally simple, both that relating to the movement of the cars and the clerical work attending it as will be shown in a later article.

These yards are shown in this detail because it is the intention to set forth in a later article the methods of operation followed in them in caring for and recording the cars as they pass through and also to show the value of the principle laid down at the outset of so constructing them that there is a free movement of traffic in both directions without the interference of one with the other. Where the whole yard is between the main line tracks, as at Roanoke and Williamson, this is comparatively easy of accomplishment, though study will be required in order to pass one by the other within these limits and still leave free access to roundhouses and storage yards. There the yard must be on one side of the main line, as at Bluefield and East Portsmouth, the problem becomes more difficult, but not impossible of solution with single crossings of one main line track and none in the case of the opposing currents of the freight traffic. Studied independently each of these yards is well worthy of attention, but taken together and with their fundamental principle kept in mind they form a most interesting exemplification of what can be accomplished along lines that have been definitely fixed and still have the flexibility demanded by a widely varying topography. This varies from the flat, open, unobstructed country at Norfolk to the level bottom land that is abruptly bounded by hills at East Portsmouth, to the heavy rolling territory of Roanoke, through the hilly, rough topography of Bluefield, to the narrow, tortuous valley of the Tug river at Williamson. Variations in detail were called for at every point and so there will be needed variations in the detail of operation in order that the traffic may be forwarded without delay. It is this variation of



detail that lends interest to the whole when considered as a unit that has been adapted to the conditions that it has been called upon to meet.

(To be continued.)

Government Accident Bulletin No. 22.*

The Interstate Commerce Commission has issued Accident Bulletin No. 22, containing its report of railroad accidents in the United States during the three months ending December 31, 1906. The number of persons killed in train accidents was 474 and of injured 4,940. Accidents of other kinds bring the total number of casualties up to 20,944 (1,430 killed and 19,514 injured). These reports deal only with (*a*) passengers and (*b*) employees on duty.

TABLE No. 1.—*Casualties to Persons.*

	Passengers.		Employees		Tot'l persons reported	
	Kil'd.	Inj'd.	Kil'd.	Inj'd.	Kil'd.	Inj'd.
Collisions	119	1,630	189	1,330	308	2,960
Derailments	61	892	85	625	146	1,517
Misc. train accidents, inc. boiler explo...	..	26	20	437	20	463
Total train accidents	180	2,548	294	2,392	474	4,940
Coupling or uncoupling	..	...	84	1,083	84	1,083
While doing other work about trains...	..	...	79	4,464	79	4,464
In contact with overhead bridges, etc....	2	18	35	407	37	425
Falling from or getting on cars or engs.	34	540	229	3,280	263	3,820
Other causes	18	563	475	4,219	493	4,782
Total (other than train accidents)..	54	1,121	902	13,453	956	14,574
Total all classes	234	3,669	1,196	15,845	1,430	19,514

The totals of collisions and derailments and of deaths and injuries caused by them continue very large. The general cause of the increase over former periods, so far as it is possible to speak definitely on the subject, has been repeatedly stated in these bulletins, and need not be given here. The specific causes of the more prominent accidents are given in connection with Table 2*a* as usual. The number of passengers killed in train accidents in this quarter, 180, is the largest on record except that for the quarter ending September 30, 1904 (Bulletin No. 13), when it was 228. Bulletin No. 10 contained the next highest record. The totals under this head, in this and the 12 bulletins last preceding, are as follows:

Passengers Killed in Train Accidents.

Bulletin No.	Quarter ending	Killed.	Bulletin No.	Quarter ending	Killed.
22.	December, 1906..	180	14.	December, 1904..	53
21.	September, 1906.	52	13.	September, 1904.	228
20.	June, 1906.	27	12.	June, 1904.	23
19.	March, 1906	62	11.	March, 1904	40
18.	December, 1905..	50	10.	December, 1903..	*a*147
17.	September, 1905.	43			
16.	June, 1905	41			
15.	March, 1905. ...	28			

a Three times the average of the nine preceding quarters.

The five principal accidents in Bulletin No. 13, with the number of persons killed in each, were: A bridge disaster in Colorado, 88; a butting collision in Tennessee, 63; a derailment at a misplaced switch in Illinois, 24; a collision in Illinois, 18, and a collision in New Jersey, 16.

Bulletin No. 10 includes a derailment in Pennsylvania, due to an accidental obstruction, 65 killed; a collision in Louisiana, 32; a collision in Michigan, 18, and one in Indiana, 16. Besides these disasters to passenger trains, there were in that quarter two collisions of work trains, killing 17 and 16 employees, respectively.

The other principal items in the present bulletin, compared with the last preceding quarter and with the quarter one year ago, appear as follows:

	Bulletins		
	No. 22.	No. 21.	No. 18.
1. Passengers killed in train accidents	180	52	50
2. Passengers killed, all causes	234	110	101
3. Employees killed in train accidents	294	215	320
4. Employees killed in coupling	84	81	85
5. Total passengers and employees killed, all causes	1,430	1,182	1,109

Of the 180 fatalities in this quarter, as shown above, 143 are attributable to three accidents—collisions No. 23 and No. 28 (Table 2*a* following) and derailment No. 10.

TABLE No. 2.—*Collisions and Derailments.*

	No.	Loss.	Persons Killed.	Persons Injured.
Collisions, rear	588	$627,125	113	907
" butting.	297	500,011	128	1,089
" trains separating	174	50,210	4	85
" miscellaneous.	1,167	539,533	63	879
Total collisions	2,226	$1,716,879	308	2,960
Derailments due to:				
Defects of roadway, etc	341	$250,231	8	648
Defects of equipment	771	569,550	20	167
Negligence of trainmen, signalmen, etc.	147	119,809	69	192
Unforeseen obstruction of track, etc...	68	72,626	13	66
Malicious obstruction of track, etc....	14	17,113	1	32
Miscellaneous causes	398	353,020	35	412
Total derailments	1,739	$1,382,349	146	1,517
Total collisions and derailments....	3,965	$3,099,228	454	4,477

*Six of the accidents in Table 2-A may be identified by reference to the *Railroad Gazette* accident reports for the months named:
Collision No. 22, December, Enderlin, N. D.
" " 23, December, Terra Cotta, D. C.
" " 25, October, Lansingburg, N. Y.
" " 28, November, Woodville, Ind.
" " 30, November, Lawyer, Va.
Derailment No. 10, October, Atlantic City, N. J.

Following is the usual list of Class A train accidents—all in which the damage is reported at $10,000 or over; notable cases in which passengers are killed, and those doing damage less than $10,000 and down to $2,000, wherever the circumstances or the cause may be of particular interest:

TABLE 2*a.*—*Causes of Forty Prominent Train Accidents (Class A).*

[NOTE.—R., stands for rear collision; B., butting collision; M., miscellaneous collisions; D., derailment; P., passenger train; F., freight and miscellaneous trains.]

No.	Class.	Kind of train.	Killed.	Injured.	Damage to engines, cars & roadway.	Reference to record.	Cause.
					Collisions.		
1	R.	P. & F.	1	10	$2,300	55	Freight train, stopped by automatic block signal, run into at rear by passenger train, which had overrun automatic disk block signal, the face of which was partly covered by snow. Engineman appears to have taken chances.
2	B.	F. & F.	1	5	2,560	85	Operator wrote "95" for "75" in telegraphic order.
3	R.	F. & F.	0	0	3,000	87	Block signalman B. authorized A to clear signal when block was occupied; engineman approached station in fog with speed not under proper control.
4	B.	F. & F.	0	0	3,192	10	Signalman gave false clear block signal to westbound train; operator failed to deliver order to eastbound train; one of these men in service 18 days, the other 8 months.
5	B.	F. & P.	1	11	4,000	45	Two empty engines, coupled together, encroached on time of regular passenger train; second engineman depended on the first; the first misread time by watch.
6	R.	F. & P.	2	26	4,475	79	Freight train approached station in fog with speed not under proper control.
7	B.	P. & F.	2	33	6,900	9	Operator omitted word "second" from order; operator in service 6 weeks.
8	R.	P. & F.	0	3	7,000	6	Signalman (1 a.m.) gave false clear block signal; flagman failed to go back, though instructed by locomotive whistle signal to do so. Signalman, 34 years of age, in service 8 days.
9	B.	F. & F.	5	1	7,600	19	Men in charge of eastbound train overlooked meeting point.
10	B.	P. & F.	3	24	8,500	13	Freight approached meeting place with speed not under proper control; conductor and engineman appear to have passed a switch without knowing it.
11	M.	P. & F.	2	24	9,056	82	Switch wrong; believed to have been maliciously misplaced.
12	B.	F. & F.	1	1	9,400	56	Operator omitted "2d No. 155" from order, though he repeated it to despatcher correctly; operator in service 39 days.
13	M.	F. & F.	0	0	10,300	72	Freight train without engine left standing on grade with no hand-brakes set; ran back down grade.
14	B.	F. & F.	4	3	10,998	16	Operator failed to deliver meeting order; operator decamped.
15	B.	P. & F.	3	7	12,330	14	Eastbound freight encroached on time of westbound passenger; engineman killed; conductor evidently reckless.
16	B.	P. & P.	1	49	12,500	1	Engineman's watch wrong; see note in text below.
17	R.	F. & F.	0	2	12,553	48	Failure to flag, and excessive speed.
18	B.	F. & F.	0	3	13,000	80	Operator fell asleep and failed to deliver meeting order; on duty 24 hours; his superior ignorant of this.
19	B.	F. & F.	4	3	13,200	76	Conductor and engineman of extra train made mistake of 1 hour in reading timetable. Engineman, 18 months in service, was killed; conductor 6 months in service.
20	B.	P. & F.	1	13	14,000	91	Despatcher sent order reading "No. 50." Order delivered read "No. 52." Impossible to decide whether error is chargeable to despatcher or to the receiving operator.
21	B.	F. & F.	3	3	14,543	17	Operator, holding three orders for train, delivered only two.
22	B.	P. & F.	9	66	15,000	74	Passenger train (1 a.m.) collided with switching freight train at entrance of yard. See note in text below.
23	R.	P. & F.	43	63	16,000	83	See note in text below.
24	B.	F. & F.	2	5	16,763	57	Northbound extra train overlooked order to clear track for southbound extra train; no explanation of forgetfulness.
25	R.	P. & P.	5	20	20,400	2	Extra passenger train ran into regular passenger train standing at station. See note in text below.
26	R.	P. & F.	1	9	21,900	73	Passenger train ran past automatic block signal and flagman; engineman killed. He made no effort to stop, and it is believed he had in some way been incapacitated before the collision.
27	B.	P. & F.	0	6	25,520	89	Misplaced switch at entrance of passing track. Wreck destroyed by fire, which appears to have started in a car of oil.
28	B.	P. & F.	43	155	37,000	40	See note in text below.
29	R.	F. & F.	0	11	38,000	114*a*	Rear collision of freights due to false clear block signal and nonobservance of yard speed limit. Passenger train on adjacent main track wrecked because not time to warn it. Wreck burned by fire from caboose stove.
30	B.	P. & F..	7	8	55,615	58	False clear block signal. See note in text below.
Total.....			144	564	$427,605		
					Derailments.		
1	D.	F.	0	0	$4,994	28	Careless running on descending grade; conductor and engineman on duty 23 hours.
2	D	P.	2	14	3,700	64	Angle-bar broken by shortening of rails

ment to conform to change of equipment. The above record for a single month is sustained by the records of longer periods.

Total repairs, as above, for standard engines of 1,600 class, from December, 1905, tol December, 1906, per mile	$0.025
Total repairs Neely equipment, December, 1906, to May, 1907, per mile	0.015

Sixty per cent. of all engine failures in this class in this heavy service are due to firebox and flue troubles. The greater mileage of the Neely-equipped engines is due to fewer failures in firebox and flues.

The Neely furnace, because of its more perfect combustion, is supposed to be more economical in oil. Owing to the extraordinary difficulty of securing reliable oil records over a long period of time, no attempt has yet been made to demonstrate this.

It appears that the great value of the Neely equipment lies in the fact that the firebox and flues stand up better, do not leak, therefore do not cause engine failures or require shop repairs and thus cause delays. As a consequence the same engines made about 20 per cent. more mileage a month when equipped with the Neely furnace. Engine 948 when running with standard equipment averaged 2,030 miles per month. Since equipped with the Neely furnace, although 14 months out of shop and ready for heavy repairs, it has averaged for five months 3,389 miles per month, or 67 per cent. more.

If the Neely furnace could be supplemented by a longer firebox, wider water spaces and shorter tubes, such a properly designed and operated oil-burning locomotive would undoubtedly prove far more economical to maintain and more convenient to operate than any coal burner.

Norfolk & Western Improvements.

BY GEORGE L. FOWLER.
Associate Editor of the *Railroad Gazette.*

IV.

YARD OPERATION.

It is on that division of the Norfolk & Western extending for the 105 miles between Bluefield and Williamson, as previously stated that about 62 per cent. of the traffic moving over the road originates. This division is known as the Pocahontas division and traverses the heart of the semi-bituminous coal region of West Virginia. It is here that the celebrated Pocahontas coal is mined, a coal that ranks with the best of the Welch for calorific values and steam producing qualities. To the west of the Pocahontas field lie the veins of the Thacker coal, a field ranking high as a steam maker, but containing a little more volatile matter than the Pocahontas and lying on a higher level geologically, so that the approach to anthracite is a little more remote, as the natural coking process has not been carried on for quite so long a time. With a location through these two fields, whose product ranks so high and is so favorably known the tonnage is naturally high. Consequently the coal and coke tonnage for the last fiscal year, ending June 30, 1906, was 13,474,246 tons, which includes 1,012,418 tons of coke and gas and steam coal from the Clinch Valley field which lies to the southwest of Bluefield on the Norton line. These figures are the result of the rapid growth of the output since the opening of the original mine at Pocahontas in 1883. In the first year after the opening of the mines there was but one operation with a total output of 80,633 gross tons. This has increased to the present proportions at the rate shown graphically on page 354 in the issue of March 15.

The cars in which this traffic is handled consist of hopper bottom, gondola, rack coke, box and stock cars. The hopper bottom cars are of widely varying capacities. These are 20, 25, 30, 40 and 50 tons. The cars of 20 and 25 tons capacity are being rapidly retired from service and when they are found to require more than $50 in repairs they are consigned to scrap. The 40 and 50-ton cars are used almost exclusively in the tidewater and eastern industrial trade, while the gondolas, that are of 30, 40 and 50 ton capacities are used mostly for the western trade where the receivers of coal and coke have been slow in acquiring unloading stations adapted to the economical use of the hopper bottom or self-clearing cars, such as are employed in the east with large savings in cost of handling materials. The rack coke cars have a carrying capacity far above that of their holding on account of the lightness of the material of the load. The rated capacities are 20 and 50 tons, but the actual load carried ranges from 20 to 30 tons. The company also have a number of large steel hopper rack cars (some of which have a wooden rack) with a side dump.

From the geological map of the territory served by the Norfolk & Western it will be seen that the Pocahontas field lies at the eastern extremity of the Pocahontas division, while the Thacker abuts against it and lies at the western end of the same. It is evident then that the Thacker coal, in order to reach the eastern markets, must pass through the Pocahontas territory, so that, as a matter of fact, the greater portion of it is mined for a western delivery, and again, while the larger percentage of the Pocahontas coal goes east, there is also a large tonnage shipped to the west.

With these facts in mind regarding the importance and value of the Pocahontas coal in the markets, especially on the coast, it is readily understandable why the Norfolk & Western was called upon to build a very large receiving and distributing yard at Bluefield.

There is almost no coal mined east of this point. The famous Pocahontas fault occurs a few miles west of Bluefield and this defines the limit of coal production as clearly as any artificial demarkation could do. The yard then, is outside the coal producing belt, and all freight of this character, originating on the line, comes into it from the same direction, namely, the west, passes through it and on out at the east.

During the last fiscal year, the tidewater shipments of coal and coke amounted to more than 3,450,000 tons, to which must be added about 5,000,000 tons more than went east, making the total coal and coke tonnage that passed through the Bluefield yard in the neighborhood of 9,000,000 tons.

It is, therefore, necessary to have ample facilities for the handling of this traffic, hence the Bluefield yard.

BLUEFIELD YARD.

In order to understand the method of handling the traffic a word must be said in regard to the system of selling and shipping Pocahontas coal. Of course, it is all carried in carload lots and the capacity of these cars ranges from 25 tons, in the case of the old cars that are now becoming obsolete, to the latest type of steel construction, which has a capacity of 50 tons. The coal is mined and placed upon the cars and shipped to Bluefield direct from the tipple of the operation producing it. As these tipples are located all along the line and its numerous branches to the number of 160 or more, it is, of course, impracticable to maintain an agent either for the producer or the railroad at each of them. The system is, therefore, so arranged that neither is necessary. The coal is sold through agents each of whom handle the output of several operations. A few years ago all of the coal of the Pocahontas field was sold by a single agency. The coal put in the cars at the tipple is, therefore, sent to its selling agent at Bluefield. No waybills are made out and no record kept, the car is simply loaded, a tag attached and sent away. This tag, which is reproduced, gives the operation at which the load originates, the initials and number of the car and the name of the shipping agent at Bluefield, to whom it is consigned. The cars are gathered from the operation sidings by shifting engines and crews. They also pick up, at the same time, all other cars that are empty or filled with general merchandise. These last cars are waybilled and consigned, in the regular way, from the station where an agent is maintained. For operations located on the main line, the cars are collected by the regular trains and are mixed in with box and other merchandise cars. A train may, therefore, come into the Bluefield yard with every car tagged to a shipping agent, or it may have one or more accompanied by waybills.

The conductor of these trains makes out a switch list on the form shown in which he lists only such cars as have waybills and regular consignments and ignores those loaded with coal. The result is that it frequently happens that not a single car is listed on the card handed in by the conductor, or at most one or two stray merchandise cars that happen to have been picked up. The consequence is that there are no records of the numbers, loads or destination of the coal cars when they reach Bluefield.

The train is run in on the eastbound receiving track and stopped just short of the scale house. The first move is to send a boy down the side of the train who collects all of the tags and marks on each one the tare weight of the car from which it is taken, keeping them in the order in which they are collected. He then takes them to the office of the weighmaster at the scale house. The data contained thereon is then transferred to a book. This comprises the name of the shipping agent, the initials and number of the car, its tare weight and the operation at which the load originated. These last are all recorded by number, one being given to each in the field. These numbers are printed in red on the face of the tag referred to above, so that a glance suffices to tell the source of the load.

As a general thing the agents are notified in advance from the operation as to the initials, number and capacity of each car that has been loaded and consigned to them during the day. With this information at hand, the agent is prepared to make up a shipping list, which is sent to the weighmaster, and from which the waybills for each car is made out. This information is usually sent in the form shown, before the train containing the cars reaches Bluefield.

This enables the weighmaster's clerk to fill in the destination and consignee of each car. Should this shipping list or order not have been received at the time of the arrival of the train, the agent is informed by telephone of the arrival of the cars and asked for the shipping directions, which are at once forthcoming. This makes it possible to complete the switch list card and hand it to the con-

ductor of the switching crew. This work is all done while the car inspectors are going over the train, which requires from 15 to 20 minutes.

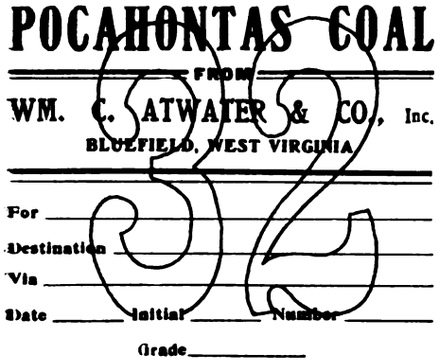
The yard is of the gravity type and the cars are let down over the scales which automatically registers the gross weights. The cars are then run into the proper tracks of the advance classification yard as detailed in the description of the Bluefield yard, in accordance with the information contained on the switch list. The gross weight having been obtained from the scales, the figures are read off in the order of the car locations in the train. This, of course, corresponds with that of the tags that have already been handed in and entered in the register book. These gross weights are accordingly entered in the same order from which the tare weights are subtracted, giving the net load. With this all the information is at hand for making out the waybills, which is accordingly done and a copy sent to the agents. This is the first and only information that the agent has of the weight of coal in the cars. The railroad company weighs the coal and gives the record to the shipping agent. In this way it has a check on the weights entered on the waybill, and the operator and agent is freed from the expense and trouble of weighing.

As soon as the cars have been dropped down upon the classification tracks they are made up into trains and pulled out. The time is usually too short to make up the individual waybills for each car, and the destination list only is, therefore, given to the conductor, and the waybills are forwarded by passenger train as soon as they can be made out. An exception to this is made in the case of cars destined for the Winston-Salem branch. There is a somewhat heavy business in southern shipments and the movement of solid trains is rapid. For these consignments a combined interline card and revenue waybill is made out. The original is written on thin, white paper and sent to the auditor, and a carbon copy made on a stiff card similar to that used on the switch list both in quality and size. This carbon copy is given to the conductor and serves as the revenue waybill.

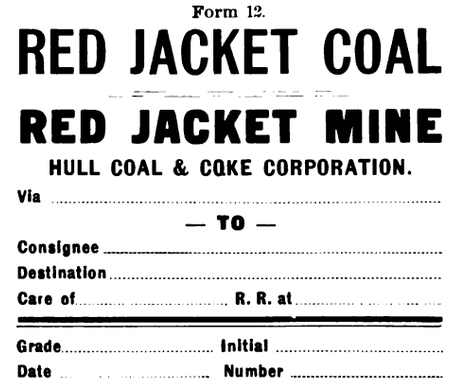
Owing to the fact that there are but few shippers in comparison with the number of cars forwarded, special waybills are printed so as to save time and writing on which the name of consignor and consignee, class of lading and destination are printed in, leaving nothing to be inserted by hand but the car number, date and weights, as shown by the accompanying reproduction of the blank. The other billing is done in accordance with the ordinary methods.

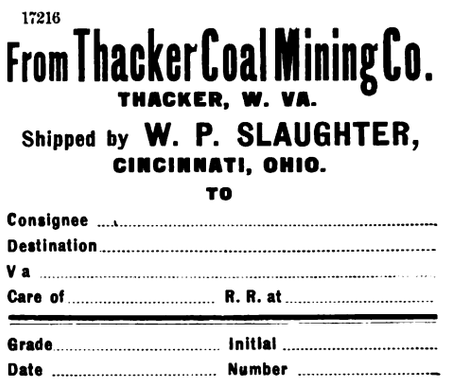
So much for the eastbound traffic. For the westbound work conditions are quite different. There are some loaded cars passing through the yard in the regular through western traffic, but the great bulk of the tonnage in this direction consists of empties; and, for this, special arrangements have to be made in order to meet the requirements of the several operations for cars. The loaded cars are sent through the yard in the regular way as specified in the description of the yard, and the records are kept in the same way as for the eastbound loads. The empties, however, have to be made up for distribution to the several operations in order to meet the requirements of this great originating traffic. There is a standing agreement between the several operators and the railroad company that the operations in the Pocahontas field shall be classified according to the number of coke ovens erected and the available car supply prorated on that basis. In the Thacker field to the west where the coal is not coked, cars are divided on the capacity basis. There are, too, a few operations in the Pocahontas field where there are no coke ovens, and these are rated in the distribution of cars similar to the mines in the Thacker field. The coke oven basis originated in the early days of the industry and has held until the present.

Under these methods the car distributor at Bluefield allots the number of cars that are available from day to day. Trains are made up and despatched as rapidly as the cars come in and are sent out for car distribution along the line. The consignment of the cars to the mines is made on the basis of car tonnage capacity. During the night trains are made up for despatching in the early hours of the morning for the supply of those operations located on spurs that leave the main line near Bluefield, such as those to Pocahontas or Bramwell and Goodwill. These are regularly assigned trains and the crew makes the round trip distributing the empties and collecting the loads that are then hauled into Bluefield

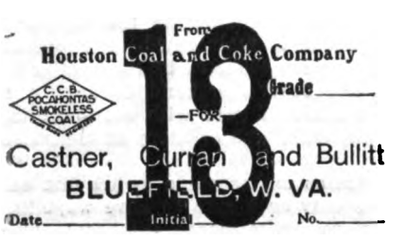


Mine Tag for Coal to Bluefield; Norfolk & Western.

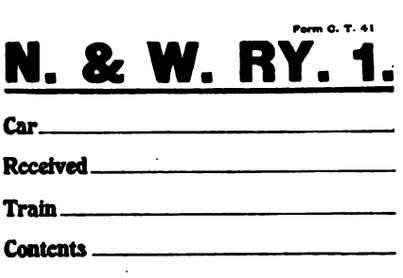




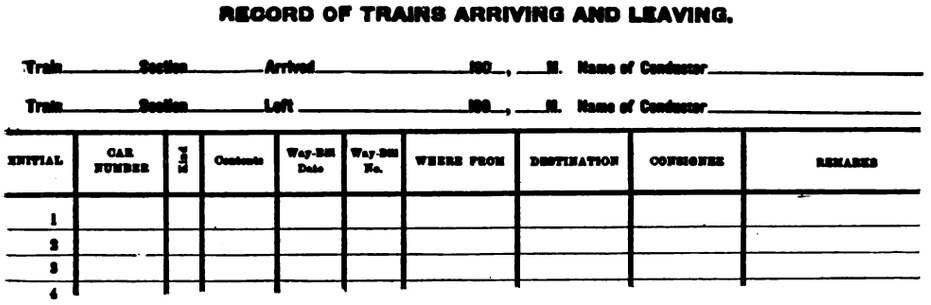
Mining Tags, Thacker Field; Norfolk & Western.



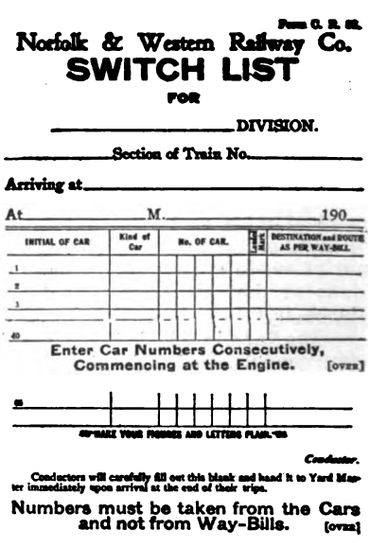
Mine Tag Card to Bluefield; N. & W. Ry.



Roanoke Switching Tag, N. & W. Ry.



Train Record Book (Old Form) Portsmouth Yard; Norfolk & Western.



Switch List Card; N. & W.

for billing and consignment. Bluefield is the regular classification and shipping yard for all eastbound traffic as is Williamson for the westbound.

The actual number of empties that will be available for daily distribution cannot be known in advance for any length of time, but reports are received at the office of the superintendent of transportation at Roanoke, who informs the distribution agent at Bluefield of the probable number of cars that will be available for each 24 hours, based upon the location of the cars and the ordinary handling of the traffic. This information includes, not only the approximate number of cars that will reach the district from the east, but also from Portsmouth and the west, together with detailed information as to the makeup of each train when it leaves Radford, 62 miles east, so that the switch list for the classification of the cars can be made up by the time the train reaches the yard. The cars may fall short or exceed these figures according as the traffic is expedited or delayed. This includes all of the cars to be distributed throughout the whole of the coal region, whether that distribution be made from Bluefield, Williamson or Portsmouth, so that the whole matter is in the hands of one man.

This car distributing agent also keeps a daily record of the number of empty cars delivered to and the number of loads taken away from each operation. In this way the condition of the sidings at those points can be ascertained at any time. With the variation in the number of cars available as compared with the probable number as reported from Roanoke, it also happens that the distribution cannot be made in strict accordance with the classification of the operations that has been alluded to. For this reason a daily statement of excess and shortage of the prorata delivery is kept so that the matter can be fairly adjusted from day to day in the distribution of the cars. The data thus collected and compiled serves as the basis for a daily report on the general situation that is made at 7 a. m. to the office of the superintendent of transportation at Roanoke. The physical operation of the yard has been handled in detail elsewhere.

WILLIAMSON YARD.

At Williamson, the next large yard west of Bluefield, the conditions are somewhat different, and there is of necessity a variation in the practice of keeping the car records. In the first place, the Williamson yard is made subordinate to that of Bluefield in the matter of eastbound shipments. All orders for car distribution are received from Bluefield and all eastbound loads, originating in the Williamson district, are sent to Bluefield under the operation tag for weighing and definite consignment. Williamson, too, is somewhat differently situated from Bluefield. The latter place is located to the eastward of the coal fields and there is almost no coal traffic originating to the eastward of it, while Williamson stands in the heart of the Thacker field, and must not only distribute cars in, but receives coal from both directions. Further than this, consignments of loaded cars pass through it, not only from the Thacker district, but also from the Tug river and Pocahontas districts that are located farther to the east.

Coal is also shipped under somewhat different conditions from the Thacker field than from the Pocahontas. Attention has been called to the fact that, in the Pocahontas field, the cars are loaded at the operations and tagged in a way that practically consigns

Form A. D. 58-B.

NORFOLK & WESTERN RAILWAY CO.

Interline Card and Revenue Way-Bill for Coal or Coke.

Car No. _____

Contents (Kind of Coal or Coke) _____

W. B. No. _____ Date _____

Billed from _____ Mine No. _____

Billed to _____

Via _____ R. R. to _____

" _____ " "

" _____ " "

" _____ " "

Consignor _____

Consignee _____

Final Destination _____

SCALE WEIGHT	RATE AND DIVISIONS
Gross	
Tare	
Net	
Minimum	

FREIGHT	ADVANCES	PREPAID	COLLECT	Prepaid Beyond

RECEIVING AGENT WILL NOTE THAT THIS IS THE ONLY WAY-BILL THAT WILL BE ISSUED FOR THIS CAR:

TRANSPORTATION INFORMATION.

Transferred to _____ Car No. _____

At _____ Date _____

Weight of Car and Contents _____ Net Tons

Marked Capacity of Car _____ Lbs.

Conductors moving this Car must fill in record of same below.

	CAR	Date 190	TIME
TRAIN No.	Left		M
	Ar'd at		M

Conductor.

If load is transferred, or car is left short of destination, or delayed, state reasons therefor under head of remarks.

REMARKS:

Interline Card and Revenue Way-bill (Bluefield); Norfolk & Western.

Car No. _____

To _____

Via _____

Contents _____

Norfolk & Western Railway Co.

CARD WAY-BILL.

FORM A. D. 58

W. B. No. _____ Date _____ 190__

From _____

Consignor _____

Consignee _____

Destination _____

Via _____

Prepaid, $	Collect, $
Estimated Weight	Actual Weight
	Gross
Where Weighed	Tare
190__	Net

Transferred to _____ Car No. _____

At _____ 190__

The regular Way-Bills for this Car have been forwarded by Passenger Train to Agent

At _____ Station

Conductors will fill out each space on back of this Card and the last one handling it at final destination will turn same over to Agent at that point for file.

Transportation Information.

Weight of Car and Contents { _____ Net Tons.

Conductors moving this Car must fill in record of same below.

	CAR	DATE 190	TIME
TRAIN NO	Left		M
	Ar'd at		M

Conductor.

TRAIN NO.	Left		M
	Ar'd at		M

Conductor.

If left short of destination, or delayed, state why.

Card Waybill Portsmouth Yard; Norfolk & Western.

Form A. D. 58-N.

Norfolk & Western Railroad Co.

Accounting Department.

LOCAL CARD WAY-BILL

FROM

BLUEFIELD

TO

Lambert Point

Way-Bill No.	Car Owner N. & W	Car Number
Lading COAL	Rate	Freight
Expenses	Prepaid	To Collect

Consignor, } Castner Curran & Bullitt.
Consignee, }

Way-Bill Weight	Scale Weight

190 _____ Agent.

Transportation Information.

Weight of Car and Contents } _____ Net Tons.

Special Card Waybill (Bluefield Yard); Norfolk & Western Ry.

C. R. 88.

Norfolk and Western Railway Company.

COAL FIELD, FREIGHT TRAIN CAR REPORT

_____ DIVISION. _____ WARD.

DATE _____ 190__

ENGINES	ENGINEERS	FROM	TO	ENGINEMEN

Tonnage Out of Initial Point _____ Tons.

Tonnage at End of Run _____ Tons.

_____ Conductor.

	EMPTIES	LOADS	STANDING	LOADS TO ROAD	MOVEMENT FROM	MOVEMENT TO	TIME TAKEN	TIME LOST
1								
2								
3								
54								
55								

Train Car Report (Williamson Yard), Norfolk & Western.

them to the representative shipping agents at Bluefield and these then give the shipping directions to the yard. In the Thacker district the same system is followed as far, as the making out of the waybills is concerned, but the coal is, for the most part, tagged for destination at the tipple and billed at Williamson, as very few of the operations maintain shipping agents at that place.

For this purpose a somewhat different form of car tag is used. It gives the consignee and destination, usually the routing, the grade of coal, date and car initial and number. Some call for the weights, but as this cannot be added at the tipple, and is not usually put on at the weigh office, it does not appear thereon. The tags also do not usually bear the operation number, though each one is numbered and is recorded as such in the weigh office. In fact, there is no uniformity in size, color or make-up of these tags, each one having evidently been designed by the user to meet his own peculiar ideas, the one requirement being that blank spaces shall be provided whereon to convey the information required in order to make an intelligent billing.

With this preliminary sketch of the conditions obtaining at Williamson we are now in a position to turn to the records and methods of handling the cars in detail.

The Williamson yard is provided with a hump, as stated in the description of the physical conditions, and the bulk of the loaded traffic passing through the yard is westbound; for, as previously stated, the greater portion of the traffic, both for the east and west originates between Bluefield and Williamson. In the classification of the westbound traffic trains are made up for Columbus, Valley Crossing, Portsmouth, which includes Cincinnati, and several connecting lines between Portsmouth and Valley Crossing. All of this is sent as local to Portsmouth, where the trains are broken up and reclassified. This refers solely to through traffic. Empty cars and cars for local delivery between Williamson and Portsmouth are made up in station order for such delivery in the usual manner.

For the eastbound work there are simply the local deliveries of loads and empties for the sparsely settled territory between Williamson and Bluefield and through freight which is sent unbroken to Bluefield to be classified there as already stated. In the case of the empties these are sent to mines east of Williamson for coal and coke loading. In the collection of the traffic an effort is made to avoid doubling back on the haulage as much as possible and, as westbound billing for loads originating west of Williamson is not done at this point, these cars are collected at Nolan, eight miles west and taken from there to Portsmouth with no other billing than the car tag attached at the mine. At the same time all the eastbound loads are hauled to Williamson, where they are simply sent on to Bluefield without either weighing or billing. In this way this yard is relieved of all weighing and billing of all loads originating to the west. Where cars come in from the east, as is the case at Bluefield, the destination orders are received from the home office of the operations, and this may be located at Columbus, Bluefield or Roanoke. On the other hand, all westbound traffic that originates to the east of Williamson is weighed and billed at that point as at Bluefield. And this is done very rapidly.

As for the records they are very simple, complete and clear. When a train arrives a messenger from the weighing office goes down the line and removes the tags from the cars, checking off the numbers, adding the tare weight and keeping them in order. In addition to these the conductor turns in a train car report made up on the blank 10½ or 10, which furnish the car record office all the information needed as to the movement of each car up to the time of its arrival at Williamson. Blank 10½ is used only in the coal fields. From this the car tags, the waybills, and the switch list, similar to that used at Bluefield, are made up, and this is done and ready for delivery to the yard conductor by the time the train has been inspected.

NORFOLK AND WESTERN RAILWAY COMPANY.

WEIGHMASTER'S RECORD OF COAL AND COKE WEIGHED AT _____ SCALES.

Day of Month		CAR Initial	CAR Number	Grade	From Mine No.	Series	Manifest No.	CONSIGNEE	DESTINATION	Route Via	Light Weight of Car	Gross Weight of Lading	NET WEIGHT	N & W Net Freight		REMARKS
	1														1	
	2														2	
	3														3	
	4														4	
	5														5	
	6														6	
															7	

Weighmaster's Record (Williamson and Bluefield); Norfolk & Western.

As the cars are dropped down over the scales the gross weight is taken and this, in connection with the tare that the messenger has noted on the tag, makes it possible to fill out the record book No. 153, which forms the basis from which the general movement is known. These are the only two permanent records that are kept aside from the tissue copies of the waybills. Of course, in the matter of the train records, they are made complete for both arriving and departing trains, and in order to facilitate a search when such action is needed. In the case of an arriving train those cars that pass through with it are written in with black ink, while those that are dropped are written in red. On the other hand, for departing trains those cars that passed through the yard with the train are written in in black and those that were picked up are added in red. These are usually cars of a given classification that operating conditions make desirable to forward together and which

Form A. D. 1M 8.

NORFOLK & WESTERN RAILWAY COMPANY. No. of Way-Bill _____

WAY-BILL FROM BLUEFIELD TO LAMBERT POINT. _____ 190__ No. of Car _____

CONSIGNOR	CONSIGNEE	DESCRIPTION OF LADING	BLUEFIELD SCALE WEIGHT	
			ACTUAL WEIGHT	
Castner, Curran & Bullitt,	Castner, Curran & Bullitt,	1 Car Run of Mine Coal.	Gross _____	Freight Charges Settled Through Auditor of Receipts' Office.
Mine No.			Light _____	
			Net _____	

This Way-Bill to be forwarded to Agent, Lambert Point, by first passenger train; and first impression copy to Auditor of Receipts' Office, Roanoke

Special Waybill, Bluefield Yard; Norfolk & Western.

It will be seen that in these two great yards of the Norfolk & Western coal traffic, the methods of handling the work are exceedingly simple and expeditious. This simplicity is, of course, possible because of the fact that between the two yards there are no complications of foreign connections to be considered, and everything in the way of a loaded car that comes into Bluefield from the east goes, with a few exceptions, through to Williamson, while those reaching Williamson from the west go on to Bluefield, the only exceptions being those intended for way delivery, which are handled by the local freight. Empty cars, on the other hand, on reaching either yard are ordered to some coal operation for loading.

Having now considered the methods employed at the two originating yards, we can turn to the large distributing yards at Portsmouth, Ohio and at Roanoke, Va.

PORTSMOUTH YARD.

Taking Portsmouth first; we have here an entirely different set of conditions from those existing in the two yards that have been

1	2	3	4	5	6	7	8	9	0
			N&W 84 DEC.13.06	B&M 29 DEC.13.06					
			30,684 98 - 11.06	30,965 B&O DEC.13.06					

Car Record Book, Portsmouth Yard; Norfolk & Western.

considered. At Bluefield and Williamson there is a large originating tonnage. At Portsmouth there is very little originating and even that has been filtered through the small collecting yards at Nolan and Naugatuck, where a primary billing has been done. The billing is put on a card waybill of the form shown and this card follows the car through to destination, the conductor filling out blanks on the back in wnich there are spaces for the recording of eight train movements, with the date and hour of departure and arrival of each train. These cards, with the regular waybills, form a complete set of waybills with all of the information as to car initial, number, loading and destination that is usually carried by such a document. Regular waybills are, however, made out from the cards, which cover only those cars that have been loaded with coal west of Williamson and are sent on to Portsmouth with the car tags in position. The tags are then removed at that place and were so hidden in it that it was difficult to trace one through the yard. Sometimes hours would be required to trace the movement of a single car, or to ascertain that it had ever reached Portsmouth. Accordingly, on January 1, a new book was opened in which the record of the car movement is reduced to the acme of simplicity. The ruling and the record is substantially as given in the accompanying illustration. This book is to be worked in sections of nine pages each. The page number represents the first figure of the car number, and the column number the last figure. In the sample we have page 3, so that all cars listed on that page would have 3 for the first figure, while the entry would be made in the column corresponding to the last figure. Suppose, then, a call were to be made for a Norfolk & Western car No. 35,624. Turning to page 3 and column 4, it would be seen that the car was received on train 84, Dec. 10, 1906, and despatched on train 92, Dec. 11. A call for Boston & Maine car, 30,265, shows it to have been received on train 29, Dec. 13, 1906, and delivered to the Baltimore & Ohio on the same date. As a further precaution a supplementary train list is made out on the switch list blank (C. R. 56). After a train has been made up, and before it leaves the yard a messenger goes down the side of it and enters the initial number and kind of car in the proper columns. On turning this list in to the office, the destinations are entered from the waybills. These cards are then filed away as a possible means of assistance in looking for a lost car, though they are rarely referred to.

FORM A. D. 134. SMALL.

NORFOLK AND WESTERN RAILWAY CO. Line Initial ..... Road Initial ..... Car No. ..... W. B. No. .....

INTER-LINE WAY-BILL FROM ..... TO ..... DATE ..... 190 ....

ROUTE VIA ..... Transferred Into { INITIAL ..... No. ..... At ..... 190 / INITIAL ..... No. ..... AT 190

THROUGH RATES

1	2	3	4	5	6	Special

Consignor	Consignee and Destination	Number and Description of Articles	Weight	Div'n's of Rates	Freight	Advances	Prepaid	Total	Proportion	Proportion	TOTAL To .....

Interline Waybill.

The Portsmouth yard forwards eastbound cars classified and shipped solid for Williamson, to which point the heavy class W locomotives are rated to haul 1,000 tons. As the line for the first part of the run to Kenova is straight and level the tonnage rating is 2,200 tons; from Kenova a helping engine is used.

For the westbound traffic the road has two branches, one to Columbus and the other to Cincinnati. For Columbus and the Hocking Valley connection the trains are classified and sent out solid, as are all other loads to Circleville, Chillicothe, Glen Jean and Bannon. The locals are, of course, made up in station order. Trains are also made up solid for Cincinnati.

Form A. D. 133—SMALL.

NORFOLK AND WESTERN RAILWAY CO.

ORIGINAL CAR.
Ini. .....
No. .....
POINT OF TRANSFER
.....

CAR { INITIAL ..... NUMBER ..... | WAY-BILL No. ..... DATE ..... 190 .....

WAY-BILL ..... to ..... for ..... via .....

CONSIGNOR	Consignee and Final Destination	Number and Description of Packages	Marks	Weight	Class	Rate	N. & W. Net Freight	Charges	N. & W. Prepaid	Total to Collect at	Proportions of Other Lines		Prepaid Beyond
	This Way-Bill to be used only for Freight destined for points beyond the line of the N. & W. Ry.												

Waybill; Norfolk & Western.

It will thus be seen that the work of the Portsmouth yard is exceedingly simple and the records and work of the yardmaster's office are reduced to a minimum, and yet they contain all of the information that is needed at a division terminal that is purely a receiving and despatching point, and where no account is taken of demurrage or car accounting. For this the single book suffices.

ROANOKE YARD.

At the Roanoke yard there is a somewhat greater complication than at either of the other points taken up owing to the fact that it is the junction point of four divisions. The main through

ample, in October last, 39,899 cars were passed through the yard, and of these 1,323 were weighed. In November 39,077 cars were handled, of which 1,477 were weighed. This gives an average of about 1,147 cars per day, of which about 46 were weighed. So that provision has to be made for handling less than 50 weigh cars a day.

As there are no connection for interchange at Portsmouth, with the exception of that with the Baltimore & Ohio, the records kept are of the simplest character.

Up to the first of January, 1907, two books contained all the records that were filed other than the tissue copies of the waybills that were issued. These were two books of form C. R. 9. One contained a train list of all arrivals regardless of direction and the other of all departures. It was made up from the conductors' switch lists and the waybills. It was complete, but individual cars

line from east to west there crosses the north and south road running from Hagerstown, Md., to Winston-Salem, N. C., so that there is a wider range of classification and more general breaking up of the trains than at any of the other yards. In the matter of records they are kept along practically the same lines as those used at Portsmouth previous to January 1. The traffic entering the yard differs from that of the other three points in that every car is properly billed at or near its starting point. Unlike the traffic originating in the Pocahontas and Thacker districts, that originating east of Bluefield is weighed and billed before reaching Roanoke, with the exception of an occasional stray car that may have been picked up between scale points. But these exceptions play no part of any importance in the general scheme of the yard operation. The permanent yard records are kept in books printed in the C. R. 9 form, and of these there are two for each division, one for arriving and the other for departing trains. That is to

Form A. D. 3½ F.

Norfolk and Western Railway Company.

No. of Way-Bill.....
No. of Car .....

COAL WAY-BILL from..... to 190

Consignor.	Consignee and Destination.	Description of Lading.	.....Scale Weight	Rate per Gross Ton.	N. & W. Net Freight		Charges.		Prepaid (N. & W. Proportion only.)		Total Freight and Charges.								Prepaid on Account of Other Lines.	
					Dlls.	Cts	Dlls.	Cts	Dlls.	Cts	Dlls.	Cts	Dlls.	Cts	Dlls.	Cts	Dlls.	Cts	Dlls.	Cts
		One Car COAL	ACTUAL WEIGHT. Gross..... Light..... Net.....																	
Mine No.																				

Coal Waybill; Norfolk & Western.

say, there are six in all, two for the line west, to Radford, Bristol and Bluefield, two to the lines east, to Norfolk, and two for the single division running through from Hagerstown to Winston-Salem. These records are compiled from the switch list, made out by the conductor, and the waybills.

In the matter of the handling of the cars for switching a novelty is used in the form of a Roanoke yard tag. The form of this tag is reproduced and on it is entered all of the information needed for the handling of the car through the yard. These tags are filled out by a messenger who does the work from the waybills as soon as they are handed in by the conductor, and then goes down the train fastening each one in place by tacks, so that by the time the train has been inspected on the receiving tracks the

Form A. D. 3¼ E.

Norfolk and Western Railway Company.

No. of Way-Bill.....
Car No. .....

COAL WAY-BILL from ..... to 190

CONSIGNOR	CONSIGNEE AND DESTINATION	DESCRIPTION OF LADING	WEIGHT as per SCALES	Rate per Gross Ton	N. & W. NET FREIGHT Doll.	Ct.	
			ACTUAL WEIGHT. Gross..... Light..... NET.....				
		1 Car Coal.					Freight Charges Settled Through Auditor of Receipts' Office.
Mine No.							

Coal Waybill; Norfolk & Western.

in station order to Lynchburg, Lynchburg and beyond, to Crewe, Crewe and beyond to Petersburg, and Lambert's Point. Going west cars are classified to Bluefield and Radford. In the locals no attempt is made at station order arrangement, the only thing being to keep the air cars in front. In fact, the classifications followed are merely those of junction points and local trains are obliged to do their own switching on the road.

It has been seen that in the classification at Bluefield, there is one for tidewater coal destined for Lambert's Point. These trains are sent through in block and are not switched on to the classification tracks at all. They are simply held in the receiving yard for inspection, where the bad-order cars are cut out and the train then sent down on to the forwarding track. The same method

switching for classification can be begun. The men work entirely by these tags and it is thus impossible for a car to be lost for, no matter where it may be in the yard, it bears its own destination and it is never necessary to ask any questions or search through a mass of waybills in order to determine the disposition of a car. This system is also especially valuable in the matter of bad order cars. Where these are set in on the repair tracks, the tag carries the lading mark, so that if it is perishable the repairmen go to work on it at once without further instructions. With the tags in position there is never any necessity for further references to the waybills until the car is in the train and ready to be pulled out, so that these can be kept and classified in pigeon holes just as the cars are upon the tracks. The tag has the further advantage over the usual method of chalking in that it cannot be washed out by rain and the labor involved in applying it is no more. Two messengers, one for day and the other for night service do all of the work, and this covers about 4,600 cars per day.

When a train has been made up, the conductor's car report is made out from the waybills and the list of cars in that train as brought in by a messenger. The bill is put on form C. R. 10 and is laid over the proper page of the outgoing book with a carbon sheet between so that the book contains an exact duplicate of the sheet given to the conductor and the time needed for a second copying is saved. The conductor makes the proper notations on the original as to where cars are dropped and turns the original in to the card record office.

There is, of course, a daily checking of the cars on the repair tracks for the information of the yardmaster, and a report of all movements is filed every morning at six o'clock.

The classifications, used for the Norfolk division, are for locals

is pursued for westbound strings of empties. In this way a train is sent on through without obstructing the yard at all and with little or no delay. Such trains are usually made ready for despatching within 45 minutes of the time of their arrival and the engine and crew for hauling them are ordered in advance. The time required for the classification of an ordinary train of 50 cars is about 45 minutes and trains can be inspected, put through the yard and made ready for despatching in about an hour and a half.

Trains entering the yard from the west are simply run in on the receiving tracks in the usual manner, but from the north, south and east they are held outside until ordered in. These three branches come together east of the passenger station, and back on the Y is a telephone station connecting with the interlocking signal tower. As soon as a train reaches this point the conductor tele-

phones the fact to the towerman, who, in turn, informs the assistant yardmaster at the east end of the yard. The latter is thus enabled to regulate the entrance of trains and admit the trains most desirable to handle at the time. If the trains were allowed entrance in the order of, and as rapidly as they arrive, it might happen that the yard could be congested with the number of trains of empties that had arrived in quick succession, while one loaded with perishable freight would be held back. It involves the possible holding of some of the crews for overtime, though this seldom occurs, but it does give the yardmaster a complete control of the situation.

C. R. 9, and the switching work is handled by means of the Roanoke switching tag C. T. 41. On the arrival of a train at the yard the conductor hands in at the yardmaster's office a switch list, C. R. 56, filled out with all of the information required. As this contains the car destination the switching tags are made out from it and a messenger puts the proper one on each car. This is done very promptly and the train is thus made ready for breaking up and sorting as soon as the switching crew is ready to take hold of it. The balance of the work consists merely in the yard movements that have already been described.

TRAIN CAR REPORT—SHOWING RECORD AND TONNAGE OF CARS AND THEIR SEAL RECORD.

Form C. R. 10.

Division ____ Freight (Class of Train), ____ ward. Date ____ 190__

Conductor A	Train No.	Where From	Schedule Leaving Time	Actual Leaving Time	Where To	Schedule Arriving Time	Actual Arriving Time	Engine Movements: Enginemen	Firemen	Eng. No.	From	To	Time Called to Report	Time Relieved	Hours and Mins. in Service: Hours	Mins.
A	B	C	D	F	G	H	J	K	KA	M	N	Q	R	S	U	V
													____ M.	____ M.		

Schedule Cost for Moving the Train

Actual Cost for Moving the Train

"F" Passenger, "E" Emigrant, "A" Baggage, "R" Postal, "X" Express, "R" Combination "I" Private, "M" M. of Way, "K" Cabin, "B" Box, "2 D" Single Deck Stock, "D D" Double Deck Stock, "Po" Poultry, "F" Flat, "G" Gondola, "H" Hopper, "U" Coke, "D" Coal Dump, "T" Tank, "D E" Dead Engine.

	Initial or Line of Car AB	Kind AC	Number of Loaded Car AD	Contents of Loaded or Number of Empt Car AF	Taken at Station Number AG	Left at Station Number AH	Check AI	Time Taken AJ	Time Left AK	Billed to Station Name or No. AM	Light Weight of Car AN	Weight of Contents of Car AR	Seal and Fastening Record: Seal "R" Door AV	Seal "L" Door AW	End Door "F" AX	End Door "B" AZ
1																
2																
3																
79																
80																
	Total,		____ Loads	____ Empty												

Certified Tonnage Out of Initial Point ____ 1000 Pounds ____ Agent or Yardmaster.

Certified Tonnage at End of Run ____ 1000 Pounds ____ Agent or Yardmaster.

Correct ____ Conductor.

Total Weight of Train ("A N and A R") ____ Tons "B B" Per Cent. of Total Capacity in Lading ____ Per Cent., "B C" Total Tons Hauled One Mile ____ Loaded ____ Empty.

WEATHER REPORT.

By Forwarding Agent or Yardmaster.

Temperature ____ Above ____ Below ____ Wind ____ Storm

Temperature ____ Above ____ Below ____ Wind ____ Storm

By Conductor. In Transit.

Temperature ____ Above ____ Below ____ Wind ____ Storm

Temperature ____ Above ____ Below ____ Wind ____ Storm

The Following Schedule of Tare Weight will be Used Where Cars Are Not Stenciled:

Box, 28 foot ..... 22,000 lbs.	Flat, 33 foot ..... 24,000 lbs.	Gondolas, Hopper Bottom, 26 ft. 21,000 lbs.	Empty Tank Cars ..... 28,000 lbs.
Box, 31 foot ..... 25,000 lbs.	Flat, 34 foot ..... 18,000 lbs.	Gondolas, Hopper, Bottom, 28 ft. 27,000 lbs.	Derrick Cars, complete .... 50,000 lbs.
Box, 34 foot ..... 25,000 lbs.	Flat, 34 foot 3¼ inch .... 21,000 lbs.	Gondolas, Hopper Bottom, 27 ft. 7¾ inch. ..... 29,000 lbs.	Postal Cards ..... 50,000 lbs.
Box, 36 foot ..... 29,000 lbs.	Flat, 34 foot 6 inch ..... 18,000 lbs.	Gondolas, Hopper Bottom, 35 ft. 21,000 lbs.	Officers' Cars, 1, 2, and 5 .. 86,000 lbs.
Stock, 34 foot ..... 22,000 lbs.	Flat, 36 foot ..... 28,000 lbs.	Refrigerator Cars. ..... 33,000 lbs.	Other Officers' Cars ..... 56,000 lbs.
Stock, 36 foot ..... 25,000 lbs.	Charcoal Cars. ..... 23,000 lbs.	Patent Stock Cars. ..... 26,000 lbs.	Coaches ..... 54,000 lbs.
Stock, 36 foot 2½ inch .... 28,000 lbs.	Gondolas, Drop End, 35 foot. 23,000 lbs.		Combined Cars ..... 46,000 lbs.
Poultry Car ..... 33,000 lbs.	Gondolas, Drop End, 36 foot. 26,000 lbs.		Baggage and Express Cars.. 50,000 lbs.
Flat, 31 foot ..... 18,000 lbs.	Coke Racks, 35 foot ..... 24,000 lbs.		Sleepers ..... 90,000 lbs.
	Side Dump Cars, 29 ft. 4 in. 23,000 lbs.		

INSTRUCTIONS TO AGENTS AND YARDMASTERS.

Agent or Yardmaster at initial point of train will make out and deliver this report to Conductor before departure of train, giving all information called for by headings "Date," "B" "C" "D" "A B" "A C" "A D" "A F" "A G" "A M" "A N" and "A R," also foot columns "A D" "A F" and "A R," placing totals at foot of column with lead pencil. If weight is not stenciled on car, use weight as per schedule above. In computing weights under column "A N" and "A R" be governed as follows: All pounds between 0 and 500 will be dropped, and between 500 and 1,000 pounds to be considered 1,000 pounds. In the case of cars used as way-cars in the train, an arbirarty weight of 5,000 pounds will be used. Agents or Yardmasters must certify to tonnage and seal record of train at time of leaving terminals. Agents, in making weather report, will give temperature, direction of wind, if light or strong, whether raining or snowing, cloudy or clear.

Agents or Yardmaster at end of train run will be handed this report by Conductor of train and must receipt for same in Conductor's train book, giving date and time received. After carefully comparing this report with the yard check of the train as to car numbers, seal record and with way-bills as to tonnage, agents will certify to tonnage in train when received, forwarding this report by first passenger train to Car Record Office, Roanoke, Va.

INSTRUCTIONS TO CONDUCTORS.

Conductors will complete this report as called for by headings "A" "K" "K A" "M" "F" "G" "H" "J" "N" "Q" "R" "S" "U" "V" "A J" "A H" "A K" "A V" "A W" "A X" and "A Z" adding to the report all cars picked up by his train after leaving initial point; giving all the information called for by all columns; also total footing of columns "A D" "A F" "A N" and "A R"; also certifying to correctness of tonnage in space provided above; report weather encountered on run in space provided, and hand this completed report to the Agent or Yardmaster at end of run and take receipt for same in train book. Under Seal and Fastening Record "R" will mean right door when going toward the engine. "L" left door. "F" front and door fastenings. "B" back and door fastenings.

Train Car Report (Williamson Yard); Norfolk & Western.

SOUTH NORFOLK YARD.

As will be inferred from the description of the South Norfolk yard the records at that point need be only of the simplest character. It is known that everything that comes into the yard is intended for a Norfolk delivery. It may be in the form of coal or coke for Lambert's Point or coal, coke or general merchandise for the city yards or a connecting line, but none of these deliveries are made at the yard itself. Hence the records need only show the arrival of a car and the date of its departure with its destination. For this purpose the record is kept in a book similar to form

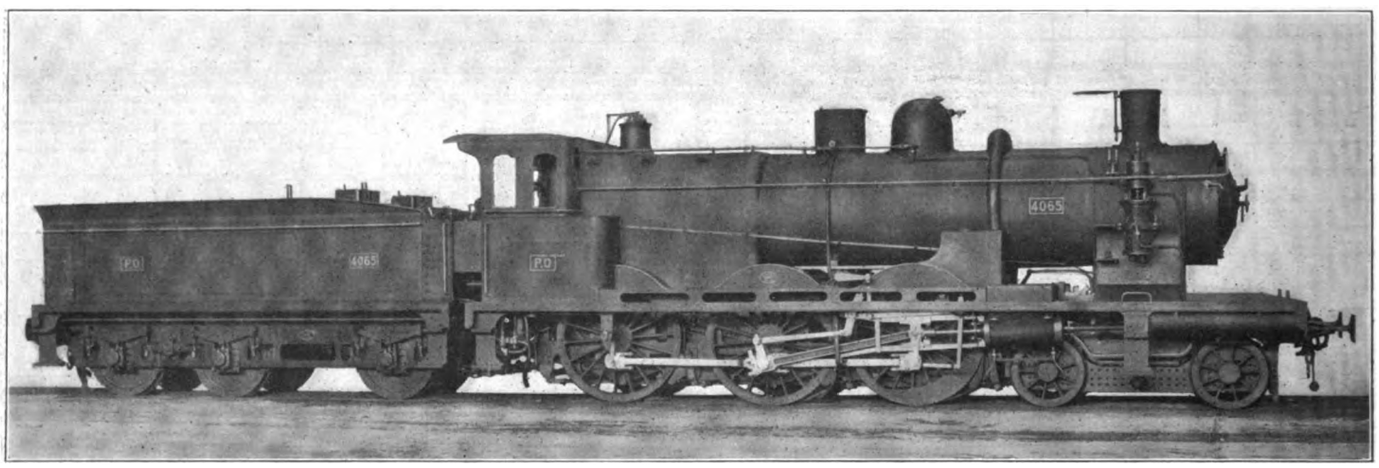
As in all large operations that are to be accomplished expeditiously the handling of cars through the yards and over the lines of a great railroad system must consist of simple movements that are not liable to delay or interruption. So in the case of the movement of coal and coke from the mines to the seaboard or the western markets, there is no doubling back on the route, but the traffic moves steadily forward from the tipple to the terminal with the minimum of clerical and switching attention. To pass the work in review the loaded cars are gathered and brought into the Bluefield yard, a miscellaneous assemblage of shipments from various mines and intended for destination lying at all points of the compass, but

mainly for the seaboard and the industrial plants in Virginia and the Carolinas. No sooner is such a train in the yard and before the car inspectors have finished their rounds, than the switch list is made out and order begins to come out of the confusion as the cars drop over the scales and in upon their proper tracks in the classification yard. Here the tidewater shipments are handled once for all and are sent forward with no breaking of bulk, with no delay for records or switching, and no need for a stop except for inspection at division points. They pass through and around the yards at Roanoke, Crewe and South Norfolk without interfering with or requiring switching and run direct to the terminal at Lambert's Point. Cars for other destinations are handled expeditiously and without back hauling, while the records of each yard are so kept that any and every car can be readily traced in its progress over the road. This means an economical handling and even this cost will probably be cut down when the yards are finished. At present the cost ranges at about 8½ cents at Portsmouth and 10 cents at Bluefield and Roanoke and this includes all of the expense of weighing and billing which does not usually fall to the share of the yard costs to the same extent that it does in this case where the volume of originating traffic is so large.

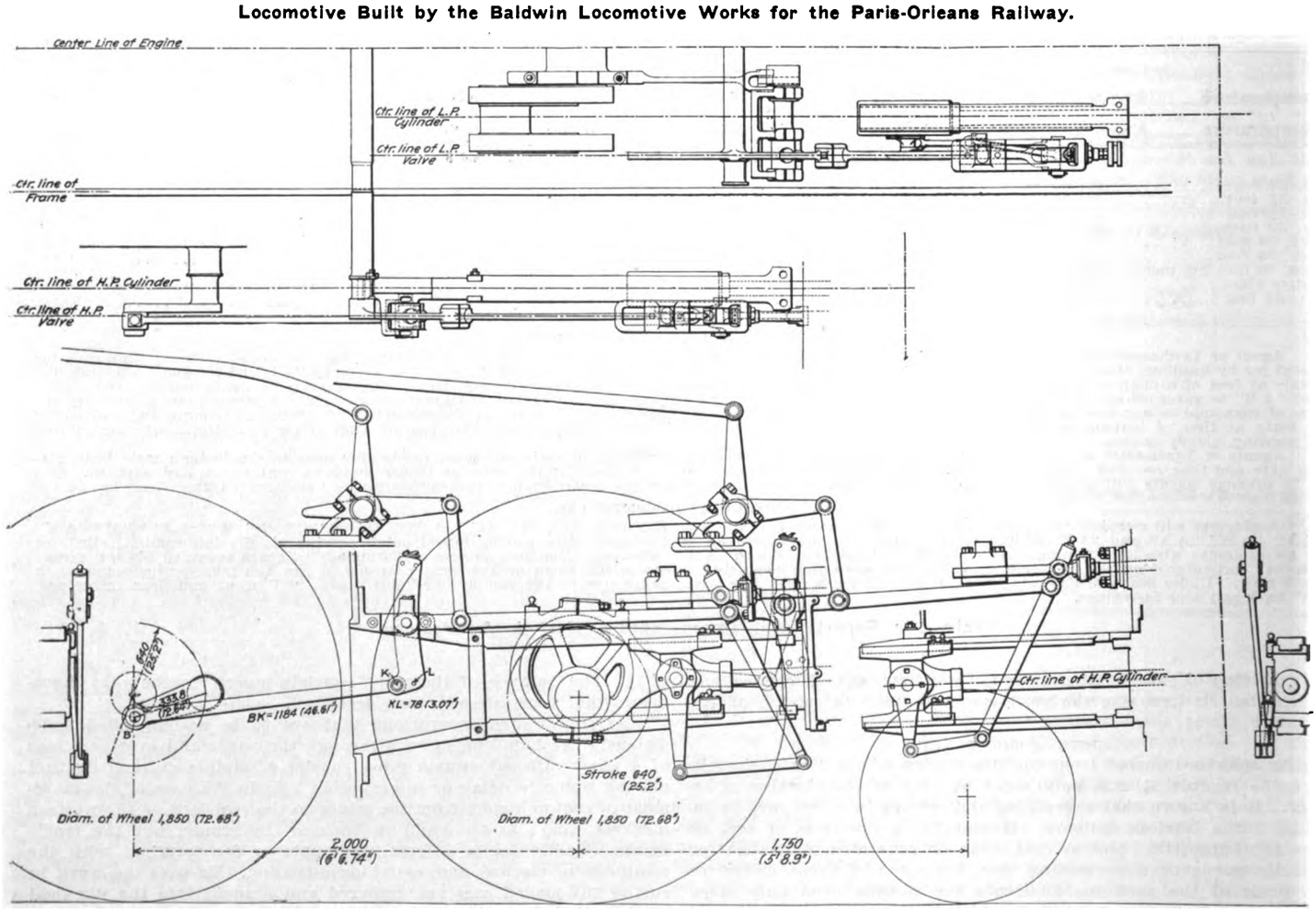
De Glehn Compound for the Paris-Orleans Railway.

The Baldwin Locomotive Works has recently built 20 ten-wheel locomotives for the Paris-Orleans Railway of France. These engines are compounded on the De Glehn system, and were built to drawings furnished by the railroad company. All measurements in their construction were made on the metric system, necessitating the introduction by the builders of many new standards and gages.

This statement is, in itself, full of significance, for one of the principal claims of the opponents to the introduction of the metric system in the United States has rested upon the assumption that its use would create endless confusion in shops where the whole organization and training of the men as well as all templates, drawings and tools are based upon the English system. Many engineers have in a small way had to do with the execution of work with the metric measurements, and have found no difficulty. But they were told that this was quite a different matter from the execution of large orders in regular manufacturing. Now an order for 20 locomotives while not large in view of present day practice, is by no means insignificant, and yet these engines were built from French drawings exclusively and entirely, and using the metric sys-



Locomotive Built by the Baldwin Locomotive Works for the Paris-Orleans Railway.



Valve Motion; De Glehn Compound Locomotive.