

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.
HISTORY OF THE LOCATION AND CONSTRUCTION OF THE LINES
WEST OF MOBRIDGE, SOUTH DAKOTA, BY VALUATION SECTIONS
AND SUBSIDIARY COMPANIES.

Compiled in 1915-1916
Revised in November 1925
Valuation Department
Chicago, Illinois.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY COMPANY
 Engineering Department Valuation Office
 Statement Showing Dates And Periods of
 Reconnaissance, Location, And Construction On Various Lines

LINE	Location by State	Mileage	Reconnaissance		Surveys		Date of Contract	Construction				Date of First Operating Time Card	Period		Time Elapsing Beginning to Compl.	REMARKS	
			Began	Finished	Began	Finished		Began Grading	Finished Laying	Finish First Ballasting	Original Program Completed (See Note a)		Of Recon.	Of Construction			
Cheyenne	Co. Dak.	106	3-1909	3-1909	3-1909	7-4-09	6-24-09	6-1909	1-10-11	Site Sur.	6-1912	12-29-10	4 Mo.	3 Yrs. 2M	3 Yrs. 5 Mo.	Benefitted from reconn. for main line	
Worren	"	62	3-1909	3-1909	3-1909	4-1909	6-25-09	5-1909	3-25-10	" "	4-1911	7-10-10	2 Mo.	1 " 11 "	2 Yrs. 1 "	Benefitted from reconn. for main line	
Cannon Falls	"	133	5-1909	5-1909	5-1909	5-1909	6-22-09	7-1909	11-11-10	" "	6-1912	12-29-10	7 Mo.	3 "	1 " 1 "		
Lewistown	Montana	137	3-1910	4-1910	3-1910	5-1912	6-1-12	6-1-12	1-1914	Sept. 1914	6-1910	1-1-14	2 Mo.	2 " 2 "	4 " 11 "		
Grass Ranch	"	36	12-1909	1-1910	1-1910	4-1910	6-19-10	5-15-10	8-14-13	* 5-13	6-1914	10-1-13	5 Mo.	4 " 3 "	4 " 9 "	No work Dec. 1910 to Aug. 1912	
Lewistown to Hoy	"	43	3-1910	6-1912	3-1910	9-1912	5-15-10	5-15-10	4-17-14	July 1914	10-1914	12-20-11	7 Mo.	4 " 5 "	4 " 5 "	Paids 10 Mt. 1910-6 Mt. 1911-5 Mt. 1912 balance 1913-14	
Key Jct. to Minifred	"	22	4-1912	4-1912	9-1912	10-1912	9-27-12	11-1912	11-18-13		8-1914	1-1-14	6 Mo.	1 " 11 "	2 " 4 "		
St. Varies Branch	Idaho	71	3-1907	11-1908	7-1907	4-1909	4-1-09	4-1909	6-1910	Oct. 1910	10-1911	7-10-10	11 Tr.	2 " 6 "	4 " 7 "	Benefitted from reconn. for main line	
Plover to Manito	Ida. & Wash.	20	11-1908	10-1911	12-1909	5-1912	6-21-12	6-14-12	6-1912	1913	1-1-14	9-28-13	2 Yrs.	1 " 6 "	5 " 2 "	Large scope of country covered reconn. and surveys.	
Coeur d'Alene	"	26	11-1908	10-1909	10-1909	12-1909	4-25-10	3-14-10	4-1910	4-1912	8-1912	9-28-13	4 Mo.	2 " 2 "	3 " 9 "		
Warden Branch	Washington	48	11-1908	1-1909	10-1909	1-1910	10-23-11	10-23-11	3-1910	11-18-10	Dec. 25-10	4-1911	12-4-10	8 Mo.	1 " 1 "	2 " 6 "	
Priest Rapids	"	45	10-1907	1-1909	12-1908	3-25-12	3-11-12	1-1909	4-3-13		3-1914	5-12-13	14 Mo.	2 " 3 "	6 " 6 "	Miles 17-19-25 graded 1 to 3 1909. Final began 3-1912.	
Evansville	"	99	3-1906	3-1909	4-1909	4-1910	3-25-10	4-1910	8-4-11	Oct. 1-11	6-1912	11-12-11	11 Tr.	2 " 2 "	6 " 4 "		
Emmons Branch	"	154	6-1907	7-1907	4-1908	12-1909	11-20-09	12-1909	11-12-10	* 22-10	6-1911	4-12-11	10 Mo.	1 " 5 "	5 "		
Missoua Gate	"	33	2-1908	5-1909	5-1909	6-1909	5-1-09	6-1909	6-15-10	Aug. 1-10	6-1911	8-14-10	4 Mo.	2 " 2 "	3 " 5 "		
New Wood River	Minnesota	17	5-1913	6-1913	6-11-13	8-11-13	10-14-13	10-1913	11-27-14	Nov. 1915	11-29-15	5-1916	3 Mo.	2 " 2 "	2 " 5 "		
Coyote Falls Iron River	Michigan	21	1900-08	4-1912	4-1907	4-25-12	5-1-12	8-10-12	5-1912	3-1914	12-1914	3-1-14	9 Mo.	2 " 7 "	14 "	Survey in Apr. 1907 partially covered adopted route. Final survey 1912.	
Madris Woodard Cutoff	Del. Fre. Iowa	51	1901	1912	1901-11	1904-12	3-1-12	5-25-12	5-27-12	6-1912	10-1913	Oct. 1913	10-1913	4 Mo.	1 " 5 "	12 "	Survey in 1904 covered adopted route. Final survey 1912.
Puget Sound Extension	To. Dak. So. Dak. Montana Idaho Wash.	1418	1900	1907	10-1905	3-1907	12-25-05	3-31-06	4-1906	3-1909	Nov. 1910	10-1911	4 Tr.	1 Mo.	3 " 10 "	12 "	Date of first through time card.

(1) Main Line
 (2) Paids according to Main Line Standards
 (3) Typical Branch Line- Open Country

(4) Typical Branch Line - Rough Plastered Country
 (5) Combination of (1) and (3)

(a) Date Construction fore because reduced to minimum. Ascertained from record of Construction Expenditures.

I N D E X

Valuation Section	From	To	Pages
South Dakota			
1, 1A, 1B, 1C	Mobridge	Haynes	1 - 6
" " 2	Moreau Jct.	Isabel	7 - 9
" " 3	Trail City	Faith	10 - 13
North Dakota			
1, 1A, 1B, 1C	Haynes	Montline	14 - 17
" " 2 and S.D.4	McLaughlin	New England	18 - 21
Montana 1	Montline	Harlowton	22 - 30
" 2	Harlowton	Lombard	31 - 34
" 3	Lombard	Butte	35 - 38
" 4	Butte	East Portal	39 - 53
" 5	Harlowton	Lewistown	54 - 56
" 6	Lewistown	Grass Range	57 - 59
" 7	Lewistown	Roy & Winifred	60 - 63
" 8	Lewistown	Great Falls	64 - 71
" 9	Great Falls	Agawam	72 - 73
" 10	Ringling	Dorsey	74 - 75
Idaho 1	East Portal	Washington- Idaho Line	76 - 87
" 2 & Wash. 2	Plummer Jct.	Manito	88 - 92
" 3 & 3A	St. Maries	Elk River	93 - 97
" 4 & Wash. 6	Dishman	Coeur d'Alene	98 - 100
" 5 & Wash.13	McGuires	Metaline Falls	101 - 103
Washington 1	Idaho-Washing- ton Line	Maple Valley	104 - 123
" 4, 5 & 5A	Maple Valley	Seattle & Tacoma	124 - 129
" 7	Warden	Marcellus	130 - 131
" 7A	Tiflis	Neppel	132 - 133
" 8	Beverly Jct.	Hanford	134 - 137

I N D E X

Valuation Section	From	To	Pages
Washington 9	Cedar Falls	Everett	138 - 142
" 10	Bagley Jot.	Enumolaw	143 - 145
" 11	McKenna	Helsing Jot.	146 - 149
Big Blackfoot Railway			150 - 153
Gallatin Valley	"		154 - 157
Tacoma Eastern Railroad			158 - 162
Puget Sound & Willapa Harbor Railway			163 - 167
Milwaukee Terminal Railway			168 - 170
Seattle, Port Angeles & Western Railway			171 - 172
Bellingham & Northern Railway			173 - 175

VALUATION SECTIONS SOUTH DAKOTA 1, 1A, 1B, 1C.

GENERAL LOCATION:

Valuation Section South Dakota No. 1 covers that part of the main line in South Dakota extending from the east abutment of the Missouri River bridge (about four miles west of Moberg) to the most westerly crossing of the state line between North and South Dakota, a distance of about 95 miles. From the river the line bears northwesterly across the Standing Rock Indian Reservation to near the North and South Dakota state line, which it follows in a general westerly direction and crosses six times previous to the final crossing east of Haynes, North Dakota. The sections intercepted by these crossings are called, for valuation purposes, Sections South Dakota 1A, 1B and 1C.

RECONNOISSANCE:

The first reconnoissance for what may be called the Northern or present route of the Puget Sound Extension was made in 1901-02. This examination began at Everts, South Dakota, and extended up the valley of the Moreau River to its head, thence descending into the Valley of the Missouri River near Camp Crook, thence northwesterly to Miles City, Mont., a distance of about 225 miles being covered. Another reconnoissance was made in January 1905 through practically the same territory except that the divide between the Moreau and Grand Rivers was followed. This route crossed the Little Missouri River about midway between the present crossing at Marmarth, North Dakota and Camp Crook, and proceeded thence westerly crossing Beaver Creek and Powder River to Tongue River, thence down Tongue River to Miles City.

During the Fall of 1905 and Spring of 1906 several exploration trips were made through territory lying to the north of that just described. One of these reconnoissances followed the Grand River from near the mouth of Oak Creek about 100 miles to Seim; another which was the most northerly extended along Oak Creek northwesterly to the divide between the Cannon Ball and Grand Rivers, thence westerly along the divide to the Little Missouri River near Marmarth, a distance of about 225 miles. Branching from this latter route at a point about 50 miles west of the Missouri River another route was reconnoitered to Seim, on the North Fork of Grand River.

From Seim this reconnaissance was continued in February 1906 northwesterly along the North Fork of Grand River, thence down Five Mile Creek to the Little Missouri River, thence west to Miles City, a distance of about 100 miles.

Altogether about 1000 miles of reconnaissance was made for the 200 miles of adopted and constructed line between Mobridge, South Dakota and Marmarth, North Dakota.

SURVEYS:

Previous to the building of the Pacific Coast Extension the terminus of the Chicago Milwaukee and St. Paul Railway at the Missouri River was in Everts, South Dakota, about 12 miles down river from Mobridge. In the Fall of 1905 the first survey for the extension started at a point between Glenham and Mobridge, crossing the Missouri River at Blue Blanket Island and reached the divide between the Moreau and Grand Rivers by development along the side hills. This line required heavy work. The distance was great and satisfactory foundations were not found for a crossing of the Missouri River. After a location had been made west along the divide between the Moreau and Grand Rivers for a distance of about 50 miles the parties working in Eastern Montana on this same route encountered difficulties which made it necessary to abandon the route entirely.

Investigations were made up the Grand River and also up Oak Creek, which empties into the Missouri River about a mile or so above the mouth of Grand River, with the result that a survey was made up Oak Creek to the divide between the Grand and Cannon Ball Rivers. This survey followed the state line closely from the site of the present town of McLaughlin, South Dakota, to the site of the present town of Haynes, thence swung northwesterly along Flat Creek crossing Buffalo Creek, and following Spring Creek to the Little Missouri River at Marmarth. Preliminary surveys were made from this line to the North Fork of Grand River but nothing satisfactory was obtained. The preliminary location surveys between the Missouri River and Montline were made in three sections by three parties, the first section being from the river to Tatanka, the second section from Tatanka to Reeder, and the third section from Reeder to Montline.

About 50 miles of location survey and many miles of preliminary line were discarded in favor of the adopted and constructed route between Mobridge and Montline.

CONSTRUCTION ORGANIZATION:

Construction was carried on under the supervision of a Construction Engineer with two Division Engineers in the field. The line was cut up into residencies averaging about 14 miles in length and construction proceeded simultaneously over the entire line. The office of the Engineer of Construction was in Minneapolis. The Division Engineers had offices at convenient points on their work.

CONSTRUCTED LINE:

The present constructed line crosses the Missouri River just below the mouth of Grand River on a single track three span steel truss bridge supported on high concrete piers faced with granite. Leaving the river on the west side the line follows the side hills for a short distance and then descends to Oak Creek Valley which it follows for about 20 miles. About eight miles west of Mahto the Oak Creek Valley develops into a sharp box canyon and about seven miles of very heavy work was necessary between Mahto and McLaughlin. The maximum gradient from the river to Mahto is $\frac{4}{10}$ of one percent. Near McLaughlin the line leaves Oak Creek Valley and follows the divide between the Grand and Cannon Ball Rivers to Watauga. Here it descends into Hay Creek Valley which it follows from Morristown to Thunder Hawk. From Thunder Hawk to Petrel no particular drainage is followed, the country being of an open and pot hole character.

CHARACTER OF COUNTRY:

The country in the Standing Rock Indian Reservation is used largely for grazing. Further west and along the North and South Dakota state line the land is used principally for dry farming and raising small grain. During construction the Reservation was inhabited only by a few Indians and Settlers living on small ranches along the creeks and waterways. In this region it was necessary to haul all supplies for surveys over trails or new roads.

CONTRACTS:

A general contract dated December 23rd, 1905 entered into with McIntosh Bros., General Contractors of Milwaukee, Wis., covered work from Everts, South Dakota in a general westerly direction to a point which was to be determined by the Chief Engineer of the Railway Company. The clearing, grubbing, grading, tunnel, bridge and culvert work, track laying, handling of stores and supplies for the Puget Sound Extension through South Dakota, North Dakota and to Butte, Mont., was done on the basis of cost plus a percentage, under this contract. McIntosh Bros. sublet the work between Mobridge and the North and South Dakota state line to six other contractors, who in turn relet portions of it to other firms.

No rail transportation was available and the location and construction of wagon roads by the contractor was necessary, involving a heavy preliminary expense. Practically all the contractors' outfits were ferried across the Missouri River at Pontis and hauled by team to the work. No supplies were obtainable locally.

The greater portion of the grading was done with grading machines, although wheel scrapers and fresnoes were used to a limited extent. Steam shovels were used on the heavy work in the Oak Creek Canyon between Mahto and McLaughlin. These shovels were brought to the work after the track was laid, being transported about three miles over land from the end of track to point of operations. A temporary line was built, leaving the main track at a point about two miles west of Mahto, bearing up Cottonwood Creek

and returning to the main line about one and one-quarter miles east of McLaughlin. The gradient up Cottonwood Creek was 2-8/10 percent. Coal and other supplies for the steam shovels was brought by rail to the junction about two miles west of Mahto and hauled from there by team.

Grading material in the Oak Creek Valley was principally shale and heavy gumbo and the heavy steam shovel work between Mahto and McLaughlin was largely loose and solid rock. Ledge rock was also found in many of the cuts.

During construction several earth slides occurred on this section, the more important ones being near Stratton and near Wakpala. At the latter place it was necessary to shift the location away from the side hill. Since original construction numerous slides have occurred, one of the most important ones being in 1910 at the west approach to the Missouri River bridge while the bridge was being filled.

Some important grading was also done to deflect the waters of the Missouri River under the main channel spans of the bridge.

As it was necessary to hurry the track laying work on this east end in order to move supplies to the operations further west, track was laid before some of the cuts were finished by the contractors and a large amount of work was done by Company forces after track laying in the way of completing the cuts and widening embankments.

Considerable incidental expense in connection with grading arose from numerous prairie fires in the Indian Reservation and the damage claims resulting therefrom and the reimbursement to contractors for delay while fighting the fire.

BRIDGES, TRESTLES AND CULVERTS:

The Missouri River bridge was constructed by Company Forces and involved the founding of the piers by the pneumatic caisson process at a depth of over 90 feet below mean low water. To facilitate the construction of the bridge and at the same time to forward material and supplies westward to the construction forces, a trestle was built on a comparatively low grade line extending across the river and over the flats of the Grand River. During the construction of the permanent bridge this temporary trestle was washed out entirely three times and at another time 34 bents were lost. Considerable other damage was experienced on the bridge construction resulting from these floods. The pile and framed bridges were built by the contractors in accordance with Chicago, Milwaukee and St. Paul standard plans.

The culverts on this section are of concrete or cast iron pipe. The cast iron pipe was shipped from Birmingham, Ala. and Addyston, Ohio. Material yards were located at Evarts, a point about three miles east of Evarts, a point about two miles east of Glenham, and, after the track was laid, at Cashmere, which was located at the summit of the 2-8/10 percent grade on the temporary line between Mahto and McLaughlin. Bridge and culvert material as a whole, however, was ferried across the river at Pontis and hauled by team to the points where needed.

TRACK LAYING AND BALLASTING:

Track reached the east bank of the Missouri River on September 22nd 1906, and reached the present station of Moreau Junction on the west bank on November 3rd of the same year. Track laying was continuous from that point until Cashmere on the temporary line was reached about January 1, 1907. Work was resumed west of the temporary line on July 11, 1907 and reached Haynes, North Dakota on October 9th of the same year. The track on the permanent line between Mahto and McLaughlin was laid in January and February 1908. The main line was laid with new 85 pound rail and sidings with lighter material, although many of the sidings were originally laid with the 85 pound rail on account of the shortage of other material. Ties were of treated white and red oak, pine, cedar and western fir. The oak ties were obtained at Kansas City and were used on heavy grades and sharp curves. The pine and cedar ties were from Wisconsin and Michigan.

Ballasting has been done at various times since 1907, material being taken from gravel pits located at Bowdle and Keldron, South Dakota, Rhame, North Dakota, and Paragon, Mont. The original ballasting followed track laying as fast as possible and as the track was laid from the east toward the west this made it necessary to take the material from the Bowdle pit, making a long average haul. Test pits for ballast were dug at a number of other places during construction.

SIGNS, FENCES AND CROSSINGS:

The entire line has been fenced, except through the important station grounds, with the standard four wire right of way fence. Portable snow fences were used during the early construction period but these have largely been replaced with standard permanent snow fences. Road crossings were graded during construction and have been planked and protected with signs, cattle guards or gates.

BUILDINGS:

Temporary buildings were erected during construction at Pontis, Cashmere, McIntosh, Keldron and Lemmon. Permanent depots and other engine terminal buildings were built at McIntosh in 1909, and a two stall engine house at McLaughlin in 1910. The round house at McIntosh was enlarged to 13 stalls, and a turn table constructed in 1912.

WATER SUPPLY:

Water in sufficient quantity and of good quality was difficult to obtain. Reservoirs were graded wherever there was any likelihood of impounding water and small water stations were established at every water-hole and used as long as the supply lasted. Altogether about twelve temporary water stations were installed on this section for use during track

laying and construction.

Of the permanent stations, the greatest difficulties were encountered at McIntosh and Lemmon. At Lemmon the railway company contributed a considerable portion of the expense on the construction of a reservoir, about four miles northwest of town which was expected to supply both the railway company and the town, but a satisfactory supply did not develop. A ten inch well was drilled 240 feet deep and a six inch well, 220 feet deep, both of which were failures. Another well was drilled 800 feet deep, in which water bearing strata was passed at a depth of about 200 feet, but this water was cased out as it was thought that a better supply would be obtained at a greater depth. When supply was not obtained at a depth of 800 feet the casing was blown open opposite the water bearing strata. This well furnishes the present supply.

At McIntosh five different water stations were installed. A reservoir was constructed west of town, which did not furnish sufficient supply. Two eight inch wells were drilled to a depth of about 200 feet in one location which were failures. Two other wells were drilled to a depth of about 170 feet, which were failures. A well was drilled about 200 feet deep near the round house, which was also a failure. The present supply is obtained from a reservoir east of town. In this reservoir a 24' x 70' deep well was dug which holds a supply for use during dry weather.

The reservoirs were usually constructed by the utilization of the railway embankment with an added amount of material; riprap being placed to protect against wave wash. The well drilling was usually done by contract, the Railway Company furnishing the material and transportation for men, material and equipment. Notwithstanding the various attempts to obtain water and the extraordinary expense connected with this work, it was necessary to haul water from the Missouri River for a large part of the construction work.

TELEGRAPH AND TELEPHONE:

The material for the telegraph line was distributed by work train and erected by the Railway Company Forces. Telegraph line averages about 35 poles per mile and carries eight wires. Train dispatching is done by telephone. Telephones have been installed in booths at "blind sidings" as well as in the depots.

OPERATION AND MANAGEMENT:

This section is operated as a part of the Trans-Missouri Division, the Division Office being in Mobridge, South Dakota. Heavy main line equipment is used.

THE MOREAU BRANCH
VALUATION SECTION SOUTH DAKOTA 2.

The Moreau Branch departs from the main line at Moreau Junction near the west end of the Missouri River Bridge and extends about 62 miles in a general south and westerly direction through Corson and Dewey Counties to Isabel. The line was constructed in 1909-10 to serve the lands being opened for homestead on the Standing Rock and Cheyenne Indian Reservations.

In 1906 an exploration followed by a location survey had been made in connection with the surveys for the main line of the Puget Sound Extension. This survey crossed the Missouri River at Blue Blanket Island and ascended to the Divide between the Moreau and Grand Rivers, with heavy development work. In the Spring of 1908 when it was decided to build a branch line in this vicinity a detailed exploration was made along the west bank of the Missouri River, particularly with the idea of obtaining a typical branch line connection between the constructed main line and the old survey along the Divide between the Moreau and the Grand Rivers. The information from this exploration indicated that the more advantageous route would be via Claymore Creek; consequently location parties were placed in the field to investigate the possibilities. These surveys developed the fact that the line along Claymore Creek would be very expensive, and their efforts were turned to surveys up Snake Creek. The location along the Divide in 1906 had been made for the main line, as previously indicated, and revisions were made to make it conform to branch line standards. A total of about 195 miles of preliminary and 87 miles of location survey was made to produce the 62 miles of line adopted and constructed.

The line as adopted and constructed leaves the main line at the west end of the Missouri River Bridge and follows up the Grand River Valley about two and one-half miles, then crosses the Valley and follows Snake Creek about 18 miles to the Divide near Trail City. Crossing of the Grand River is made between Moreau Junction and Snake Creek, and two other crossings were avoided by extensive channel changes. Numerous channel changes were also made along Snake Creek. From Trail City westwardly to the end of the line at Isabel the Divide between the Moreau and Grand Rivers is followed quite closely.

The construction was carried on under the supervision of a Division Engineer and Resident Engineers in the field. The Division Engineer reported to the Engineer of Construction at Miles City. The contract for the grading, bridge and culvert work, track laying, and the handling of stores and supplies was awarded

to McIntosh Bros., who sublet the entire line to H. A. Whittier of Billings, Montana. Outfits for the work were shipped from Billings via the Northern Pacific Railway to Miles City where they were transferred to the Chicago, Milwaukee & St. Paul Line and delivered to Wakpala. A temporary material yard was constructed at Wakpala and headquarters were established at this place for the Engineers and Contractors.

A few squaw men and Indians were living on small ranches along Snake Creek, but as a whole the country traversed was undeveloped at the time of construction, and no supplies could be obtained locally. As a consequence it was necessary for the contractors to build wagon roads and transport the supplies from Wakpala. This also necessitated the construction of a ferry over the Grand River. The smaller streams were forded and as they were subject to sudden flood considerable delay was experienced in the transporting of supplies. Part of the wagon road was through gumbo soil, which made it almost impassable in wet seasons.

Teams with grading machines, freenoes and wheel scrapers were used for the grading. The materials were variant. In the Grand River Valley, silt and heavy gumbo were encountered. In the Snake Creek Valley, silt, hardpan, gumbo soil, loose and solid rock and glacial drift were encountered. Between Trail City and Isabel the soil was lighter although hardpan and loose and solid rock were encountered in some of the deeper cuts.

A large slide occurred in Mile 7 which was removed with a steam shovel and the material used for bridge filling after the track was laid.

The material for the culverts on the first 23 miles of the line was hauled from Wakpala by team. On the last 40 miles the culvert openings were cribbed and the material delivered by train after the track was laid. Cast iron pipe was used largely for culverts although in some cases concrete and vitrified pipe was used.

The most important bridge on the line is the one used for the Grand River crossing which consists of a 140 foot steel through truss span on concrete piers. The false work for this bridge was built of sufficient strength to carry traffic and track laying was not held up during its construction. The pile bridges were built by the contractors in accordance with the Railway Company's standard plans. The piling is of western cedar and the guard rail, bracing, etc., of western fir. Material for the bridges on the first few miles was hauled by team from Wakpala, and for the remainder of the line it was delivered by work train at various points along the track as it progressed westward and taken to the points of erection by team, sufficient distance being maintained between the end of track and bridge sites to insure no delay to track laying. Bridge and culvert material was furnished by the Railway Company.

The track was laid with a Roberts Bros. machine, work being begun on April 2nd, 1910 and reached Isabel on May 25th. New 65 pound rail was used, with lighter material in a few of the side tracks.

Water supply was especially hard to obtain. Seven temporary plants were installed for supply during construction. Permanent stations are maintained at Landsau, where a reservoir has been graded, Trail City, and at Timber Lake. At Trail City permanent supply is secured from a reservoir about one and one-half miles from the town, necessitating a long pipe line. At Timber Lake a test well failed to yield supply and at present a 20 by 20 foot dug well is used. Several wells were drilled in the vicinity of Isabel but supply could not be found. Notwithstanding the rather unusual expense in connection with water supply for this line, water is often hauled by train from the Missouri River during dry seasons.

Material for the buildings was delivered by train after the track was laid. Depots were built at Moreau Junction, Trail City, Timber Lake and Isabel. The right of way has been fenced where conditions require it and the proper crossing facilities placed. As previously indicated, few crossings were required at the time of construction due to the undeveloped character of the country. A large number of the crossings now in use have been graded since track was laid, and fences built, necessitating changes in the original plan. Snow fence has been provided where protection is needed.

Material for the telephone and telegraph line was delivered by a work train. The line averages 35 poles per mile and carries two wires. Telephones are used for train dispatching purposes, being installed in booths at "blind sidings" and in the depots.

The line is operated as a part of the Trans Missouri Division, the usual branch line equipment being used.

THE CHEYENNE BRANCH
VALUATION SECTION SOUTH DAKOTA 3.

Valuation Section South Dakota Number Three covers the entire so-called Cheyenne Branch, extending from Trail City, on the Moreau line (Valuation Section South Dakota No. Two) through Dewey, Armstrong, Ziebach and Meade Counties to Faith, South Dakota, a distance of about one hundred and six miles. The line was constructed in 1909-10 by the C. M. & St. P. Ry. Co., to furnish transportation to the public land then being opened under Federal Homestead Laws, in the Cheyenne Indian Reservation, and to the other lands in the above named counties.

The first reconnaissance of this territory was made in November, 1902. This party left Everts, South Dakota, (about twelve miles down the river from Mobridge) crossed the river and made an examination up the Moreau River as far as Virgin Creek, thence following the creek south and southwesterly to the divide between the Moreau and Cheyenne Rivers, thence west along the divide to the west side of the Cheyenne Indian Reservation, a distance of about fifty miles, thence southwesterly to Belle Fourche, near the west line of the state, a further distance of about ninety miles.

In 1909 further examinations were made, one of which departed from the main line near the west end of the Missouri River bridge, and extended almost due south for about thirty-five miles, thence westerly through the center of the Cheyenne Indian Reservation. In the meantime a location survey had been made for the intermediate line known as the Moreau Branch, lying about half way between the route just previously described and the main line of the Pacific Coast extension. (See Historical Sketch of Valuation Section South Dakota No. Two).

Early in the spring of 1909 a location party was transferred from their work on the Moreau line to make preliminary surveys from the Moreau River up Virgin Creek, thence west along the divide between the Moreau and the Cheyenne Rivers, a distance of about one hundred and fourteen miles being covered.

A second party made the survey of various lines to find a feasible route from the head of Claymore and Snake Creeks to the mouth of Virgin Creek and the Moreau River. After making about fifty miles of preliminary, a location was made to Virgin Creek by the way of Du Charm Creek.

A third party made a location survey west from the head waters of Virgin Creek along the divide between the Moreau and Cheyenne Rivers to a point near Eagle Butte, between which points the

preliminary survey that had been previously made was closely followed. At Eagle Butte this survey diverged from the preliminary line on the divide and proceeded west along Elm Creek Valley as far as Arrow Head. From this point to Faith the located line again follows the original preliminary survey. The location surveys were completed to a point about fifteen miles west of Faith.

Approximately three hundred miles of surveys were made in determining the final location of the one hundred and six miles of constructed line.

From Trail City the line bears southeast down Du Charm Creek to the crossing of the Moreau River, a distance of about twelve miles, maximum gradient being two percent, and maximum curvature ten degrees. From the Moreau River crossing, the line follows Virgin Creek about eight miles, thence southwesterly about nineteen miles to the top of the divide near Ridgeview. On this twenty-seven miles the maximum gradient is one and five tenths percent, and curvature three degrees. Numerous crossings of Du Charm and Virgin Creek were necessary, and numerous channel changes were made to avoid other crossings. From Ridgeview west the line follows the divide between the Moreau and Cheyenne Rivers to near Lantry, a distance of about thirty-six miles with a maximum gradient of one and four tenths percent, and maximum curvature of five degrees. From this point Elm Creek Valley is followed to the present terminal at Faith, which is in the northeast corner of Meade County. The maximum gradient on this last thirty miles is one and twenty-five hundredths percent, and the maximum curvature five degrees.

At the time of construction this territory was used for cattle range with ranches many miles apart. In the Indian Reservations a few Squaw men and Indians lived on small ranches along Virgin and Elm Creek. The country being undeveloped, furnished no supplies and it was necessary to freight by wagon all sustenance and supplies used by the survey parties and later by the contractors.

Grading was done under a contract with McIntosh Bros. of Milwaukee who sublet the work to Shugart & Barnes Bros. of Iowa City. They in turn relet a large part of the work to smaller firms.

The construction was carried on under the direction of a Division Engineer, assisted by five Resident Engineers and parties. The Division Engineer reported to the Engineer of Construction, whose office was in Miles City, Montana.

The material yard was established at Wakpala, which was headquarters for the contractors and engineers. A wagon road was constructed across country from Wakpala for the transportation of supplies and material. This required the installation of a ferry for crossing Grand River, and a temporary wagon bridge over the Moreau River. The minor creeks were forded, and being subject to sudden floods often delayed the movement of supplies. The road was largely through gumbo soil, which made it practically impassable in the wet seasons.

The grading material encountered along the Du Charm Creek was the characteristic "Bad Lands" formation of hard clay shale, gumbo and cemented glacial drift, classified as loose and solid rock. Loose and solid rock was encountered in cuts along Virgin Creek Valley in sixty-six miles of open rolling prairie, between Ridgeview and Faith some gumbo and hard pan was found.

Teams with grading machines, fresnos, and wheeled scrapers were used for the grading. Powder was used to loosen the stratified rock, large boulders and glacial drift. The grading was pushed energetically in spite of the difficulty in obtaining supplies, repairs, etc., and was completed to Faith in November, 1909. Parts of the grade along the hill section were washed out during construction, which necessitated the extra expense of moving outfits back for small yardage jobs. Delays in securing town sites on the Indian Reservations necessitated the grading of a number of station sidings after the original construction had been completed.

The crossing of the Moreau River is effected on a one hundred twenty-six foot steel through truss span with a pile trestle approach. The other bridges on this line conform to the Railway Company's standard plans. Piling is Western cedar, the caps, guard rail, bracing, etc., of Western fir. The bridge iron was shipped from Milwaukee and Chicago.

Culverts were of cast iron pipe, purchased in the East and delivered to the Company lines in Chicago.

The Railway Company furnished all the bridge and culvert material, a material yard being established in Wakpala, and material for structures on the first few miles was hauled by team from the material yard. For the structures farther west the material was unloaded from the track as it was extended to the west and was hauled by team to the points of erection. In general this haul was about fifty miles as it was necessary to deliver material about this distance to insure no delay to track laying.

Track was laid with a Roberts Bros. machine and followed the grade completion as rapidly as possible. Work was begun in July, 1910, and reached Eagle Butte, mile sixty-five on September 20th, of the same year. It was then decided that it would be inadvisable to carry track laying beyond Eagle Butte that season. The South Dakota Railroad Commission took up the matter on the protest of the homesteaders and merchants west of Eagle Butte, and in November, 1910 formally ordered the remaining forty-two miles of track laid into Faith, regardless of the fact that the ground was frozen and the Railway Company was not prepared with the material. The roadbed between Eagle Butte and Faith was badly cut up due to its use as a wagon road for freighting supplies. The Railway Company paid contractors about \$10,000 in force account bills for redressing the roadbed and filling over culverts to permit track laying to Faith by January, 1911. It was also necessary to grade side tracks and engine terminals at Faith to permit the operation of the line. The main line was laid with new 85 pound steel, delivered to the Company lines at Chicago. Ties were of Western

fir and tamarac.

Parts of the first forty miles were ballasted with cinders from the Moberge engine terminal. The remainder of the line is surfaced with earth.

Temporary buildings were constructed at the material yard at Wakpala and at other points where required. Material for the permanent buildings was delivered by train after the track was laid. Standard combination freight and passenger depots were built at La Plant, Eagle Butte, Dupree, Arrow Head and Faith, with smaller stations at the less important places. A two stall engine house, coal, dock, etc., were built at Faith.

Provision of a suitable water supply was both difficult and expensive. During construction temporary water stations were installed in Miles Twelve, Eighteen, Sixty-four, Sixty-eight, and Seventy-five. These temporary plants usually consisted of a ten thousand gallon tank and a small steam or gasoline driven pump, and water was usually obtained from flowing streams or from temporary reservoirs made by placing an earth dam across a small water way. Test wells were drilled in Miles Forty-eight and One Hundred Six, the former being 500 feet deep. A well was dug in Mile Sixty-four, and two wells bored in Mile Eighty-four. Permanent stations are at Promise, La Plant, Eagle Butte, Lantry and Faith. Notwithstanding the unusual amount expended for a permanent supply, water is frequently hauled from the Missouri River by train.

Material for the telephone and telegraph line was distributed by work train. The pole line averages 35 poles per mile, and carries two No. 18 iron wires. Telephones are used for dispatching purposes, being installed in booths at "blind sidings" and in the depots.

The line is operated as a part of the Trans-Missouri Division, the usual branch line equipment being used.

VALUATION SECTIONS NORTH DAKOTA 1, 1A, 1B, 1C.

GENERAL LOCATION:

Valuation Section North Dakota No. 1 covers all of the main line of the Chicago, Milwaukee and St. Paul Railway Company's Puget Sound Extension in North Dakota. Beginning at the most easterly crossing of the North and South Dakota State Line near Thunder Hawk it follows the state line closely, crossing it six times between Thunder Hawk, South Dakota and Haynes, North Dakota, thence it extends in a general northwesterly direction to the crossing of the North Dakota-Montana State Line near Montline. The subsections intercepted by the frequent state line crossings are called, for valuation purposes, Sections North Dakota 1A, 1B, and 1C. The Line passes through Adams, Bowman and Slope Counties, and comprises about 103 miles of railroad.

RECONNOISSANCES AND SURVEYS:

The reconnoissances for this Section were naturally continuances of the routes examined in South Dakota, and are described in the Historical Sketch of Valuation Section South Dakota 1.

In May 1906 a preliminary line was surveyed and location made from a point near Petrel, North Dakota, southwesterly about 20 miles crossing Flat Creek Valley to a connection with a previous location survey that crossed the Little Missouri River in the extreme southwestern corner of the state of North Dakota, and extended on west to Miles City, Mont. A number of other explorations and preliminary surveys were made further to the south through Harding County, South Dakota. In July 1906 a line was located lying about three or four miles north of the present route between Rhame and Warmarth. About 50 miles of located line and many miles of preliminary survey were made in addition to those on the constructed route.

CONSTRUCTED LINE:

The line as constructed descends into Flat Creek Valley about four miles west of Petrel, North Dakota, and follows this valley to a point about midway between Bucyrus and Reeder, or to the divide between the Cannon Ball and Grand Rivers. From here it follows a branch of Buffalo Creek to Bowman where Spring Creek Valley is entered and is from there followed to Rhame. From Rhame the gradient is descending 5/10 percent westbound to Ives. Between Ives and the

Little Missouri River, Hay Creek Valley is followed through the "Bad Lands" and the gradient is one percent descending westbound. Leaving Marmarth at the Little Missouri River, Beaver and Corral Creeks are followed and the gradient is 5/10 percent ascending to the west.

CONSTRUCTION ORGANIZATION:

The construction organization consisted of an Engineer of Construction, a Division Engineer in the field, and the usual residency parties. The office of the Engineer of Construction was in Minneapolis. The Division Engineer maintained an office at a point convenient to his work. Residencies averaged about 16 miles in length and the construction proceeded over the entire line simultaneously.

The construction work was done under the general contract with McIntosh Bros., as described in the Historical Sketch of Valuation Section South Dakota I. McIntosh Bros. sublet the work to four other contractors, who in turn relet portions to smaller firms.

The material encountered in grading included common earth, hardpan, gumbo, loose and solid rock. The solid rock usually occurred in ledges between other classes of material, or in large boulders, making its removal expensive. The formation in the "Bad Lands" prohibited the use of grading machines and that sort of equipment and was generally handled with teams and scrapers, or in some cases by station men. The material was largely of a shaley nature and required considerable blasting.

The grading outfits were either ferried across the Missouri River at Pontis and hauled by team across country, or were unloaded from the Northern Pacific at Dickinson and hauled south to the point of operation. In either case the haul was long and road work was required for the transporting of the heavy loads. Pile bridges were built during construction, many of which have been replaced since with permanent structures. Bridge timber was hauled ahead of track laying and construction carried on to insure no delay to track work.

The culverts consisted largely of cast iron pipe which was hauled by team from stations on the Northern Pacific Railway.

A cloud-burst occurred in the vicinity of Marmarth in June 1907 causing the loss of two lives, many animals, a large amount of equipment, and considerable grading. The loss to the contractors was so great that liberal treatment was necessary to hold them on the work.

A few of the cuts were not finished before track reached them, in which case the work was completed after track laying, by the Railway Company Forces.

TRACK LAYING AND BALLASTING:

Track was laid on this section between October 9th and December 30th 1907. The work followed the finished grading as rapidly as possible, with an average progress of one and one-half miles per day. The main line was laid with new 85 pound steel delivered to the Company lines at Chicago. Ties were of treated oak, pine and cedar, the former being used on the heavy grades and sharp curves. The oak ties were obtained in Kansas City and the pine and cedar ties in Wisconsin and Michigan. Track was originally laid 18 ties per rail but the present standard is 20 ties per rail. Ballasting has been done at various times since 1907. The first lift was hauled from Bowdle pit and the majority of the gravel used since, from the pit at Rhame, which was opened in 1908, after the expenditure of a large sum of money in surveying, grading and constructing a spur track three miles long, and otherwise preparing for its operation. In 1909 more grading was done and tracks laid to increase the output of this pit.

WATER SUPPLY:

A suitable water supply has been difficult to obtain on this section and during construction was especially so. A number of temporary water stations were built for construction needs. Reservoirs were graded wherever there was a likelihood of impounding water. Wells were dug or driven and temporary stations established at every water hole and used as long as the supply lasted. Expensive wells were drilled at Hettinger, Marmarth, and on Mile 123. Wells were dug on Miles 103, 115, 140, 170, 191. Other wells were dug at Haynes, North Dakota and at Rhame, on the gravel pit spur. A filter galley 185 feet long was constructed in the Little Missouri River at Marmarth, and settling basins were installed at the Marmarth round house. An expensive reservoir and spillway was constructed in Mile 123, and the water in a farmer's reservoir near Flat Creek was purchased and piped 1800 feet to the right of way.

Permanent stations have been installed at Hettinger, Reeder, Bowman, Griffin, Rhame and Marmarth.

BUILDINGS:

Combination freight and passenger depots were built at Haynes, Hettinger, Bucyrus, Reeder, Gascoyne, Soranton, Buffalo Springs, Bowman, Griffin, Rhame and Marmarth. An engine terminal consisting of an 18 stall round house, with the other facilities, has been built at Marmarth. Buildings for section crews were constructed at places convenient to the work.

TELEGRAPH AND TELEPHONE:

The material for the telegraph and telephone lines was distributed by work train. The line averages about 35 poles per mile and carries eight wires. Telephones have been installed in booths at "blind sidings" and in the depots. Train dispatching is done by telephone.

FENCES, SIGNS AND CROSSINGS:

The entire line has been fenced except through the important station grounds, and necessary crossing facilities have been installed. Portable snow fences were used for temporary protection during construction. These have since been replaced by permanent standard fences.

OPERATION AND MANAGEMENT:

This Section east of Marmarth is operated as a part of the Trans-Missouri Division, the local offices being in Moberge, South Dakota. West of Marmarth is operated as part of the Musselshell Division with headquarters at Miles City. Heavy main line equipment is used.

THE NEW ENGLAND BRANCH

VALUATION SECTIONS NORTH DAKOTA 3 AND SOUTH DAKOTA 4.

The New England, or so called "Cannon Ball" branch extends from McLaughlin in the northern part of Corson County, South Dakota, about one hundred thirty-three miles in a general northwesterly direction through Morton and Hettinger Counties to New England. About nine miles of this line lies in the state of South Dakota, and is called Valuation Section South Dakota Four. The remainder is in North Dakota and is called Valuation Section North Dakota Two.

The line was constructed by the Chicago, Milwaukee & St. Paul Railway Company in 1910 to furnish transportation to the public land opened under Federal Homestead Laws in the Standing Rock Indian Reservation, and to other land in the region of the North Fork of the Cannon Ball River. The country was not developed to any extent at the time of construction.

Reconnaissance was made in May, 1909, when a party of engineers accompanied by officials of the Railway Company made an exploration trip and outlined the general route to be pursued in the surveys.

Four locating parties were placed in the field soon after the reconnaissance report was made. The parties were able to secure some supplies locally from ranchmen and homesteaders between Mott and New England, but for the line lying between McLaughlin and Mott supplies were hauled from towns on the main line. The location surveys were completed in September, 1909, and construction was undertaken at once, under the supervision of an Engineer of Construction with offices at Miles City, Montana, and a Division Engineer assisted by Resident Engineers and parties in the field.

As originally built this branch line left the main line at a point about one and four tenths miles west of McLaughlin. Later the track was laid from McLaughlin to the Junction and branch line trains are operated into McLaughlin over an independent track.

Leaving the main line about one and four tenths miles west of McLaughlin the line bears northerly across the Standing Rock Indian Reservation to Shields. At Shields the line begins diverging toward the west and from Leith bears almost due west to New England. The gradients between McLaughlin and Cannon Ball River crossing near Shields are rolling with a maximum of one and two tenths percent. From the Cannon Ball River the line ascends along Shields and Dog Tooth Creeks with easy gradients and good alignment to mile Fifty-one. At mile Fifty-one an ascent is commenced and from there continued on a one and one and a half percent gradient to mile Sixty, where the divide between

the North Fork of the Cannon Ball River and Flasher Creek is attained. This divide is followed to Mile Eighty-six and from Mile Eighty-six to New England the North Fork of the Cannon Ball River is followed very closely.

Between Miles One and Ten, three crossings of Oak Creek were necessary and several other crossings were avoided with channel changes. Numerous channel changes were also built along Dog Tooth Creek and important changes were made in the Cannon Ball River Channel, in Miles One Hundred Four and One Hundred Thirty-three.

The land in the Standing Rock Indian Reservation is used largely for grazing, and the land along the Cannon Ball River is used for grazing and dry farming. Some coal is mined in Mile One Hundred Twenty-six.

Contract for the grading, bridge and culvert work, and track laying was let to McIntosh Brothers of Milwaukee, who sublet the work to two other contractors. These sub-contractors in turn relet the work in short sections of from one to four miles. It was necessary for the contractors to construct wagon roads to transport their equipment, material and supplies to the work as very few highways were in existence in this locality at the time of construction. The Northern Pacific branch line had not yet been built into Mott, consequently supplies were hauled from points on the C.M. & St.P. Railway.

An extensive material yard was established at McLaughlin, for use during construction and the most of the supplies and material were hauled from there.

The grading was done with team outfits, grading machines, wheeled scrapers and fresnos being used. The cut quantities as a rule were less than embankment quantities and many cuts were therefore made sufficiently wide to permit the use of grading machines. Common earth, hard pan, loose and solid rock were encountered. Solid rock was generally of a floating nature. That is it did not occur in continuous bodies, but in the shape of large boulders or thin irregular ledges. Removal of this material therefore was difficult and expensive. The common earth was heavy and difficult to excavate. About nine miles east of Mott are a number of cuts through dry granular sand, which was very difficult to load and haul. A compromise classification was allowed for this material.

After the grading was finished in Mile One Hundred Four a washout occurred necessitating the replacement of a large amount of yardage.

Numerous prairie fires originating from construction camps were the cause of damage claims, and fire guards were plowed as a matter of protection.

Bridge and culvert material used between McIntosh and Mile post Fifty-five was hauled from the material yard at McLaughlin by team, and such material used between Mile Fifty-five and New England was hauled from Morristown, South Dakota. Culverts consisted largely of cast iron pipe, which was obtained in the East and delivered to the Company lines at Chicago. The pile bridges were built in accordance

with the standard plans of the Railway Company. Piles were of cedar, and caps, guard rail, and bracing were of Western fir. The bridge over the Cannon Ball River, near Shields, consisting of one fifty foot deck girder span and one one hundred thirty foot through steel truss supported on concrete piers with pile trestle approaches is the most important structure on the line. The concrete was placed, and the steel work erected by the Railway Company forces. The Railway Company furnished all bridge and culvert material.

McIntosh Brothers did the track laying, using a Roberts Bros. machine. Work was begun at the Junction May 27th, 1910, and followed the grading as fast as possible, reaching the Cannon Ball River crossing, Mile Thirty-four, on July 10th, where it was held up during the construction of the bridge. Work was resumed at this point on August 26th, and track reached New England on November 17th, 1910. New 65 pound steel rail was used for the main line and lighter material in the side tracks. Oak, cedar and fir ties were used, and tie plates were placed on the curves.

Some ballast was obtained by widening a gravel out in Mile Fifty-nine. This work was done in 1913, the material being loaded by hand. The gravel ballast for the first ten miles out of McLaughlin was hauled from Paragon, Montana, and was placed in 1911. The cinder ballast, some of which is placed yearly, is taken from the engine terminals at McLaughlin, McIntosh, Marmarth and Mobridge. A portion of the roadbed is ballasted with earth.

The right of way has been fenced where conditions require it, and the proper crossing facilities built. The portable snow fence was placed in 1911 and the permanent snow fence built in 1912.

As previously indicated the territory was sparsely settled at the time of construction, consequently a large number of the road crossings have been graded subsequent to the original construction.

Temporary water supply stations were installed at the Cannon Ball River and in Miles Fifty-five, Sixty-eight, Eighty-four, One Hundred Four, One Hundred Nineteen, and at New England. Permanent stations have been built at Tuttle, Shields, Raleigh, New Leipzig, Mott, New England, and Leith, and are in some cases equipped with windmills. The temporary stations were equipped with steam pumps and 10,000 gallon capacity tanks.

Temporary coaling stations for use during construction were installed at McLaughlin and New England and in Miles Fifty-one, One Hundred Four and One Hundred Thirty-four.

Standard combination freight and passenger depots were built at Shields, Brisbane, Leith, New Leipzig, Bentley, Mott, Regent, and New England, and smaller shelters at the less important stations. A two stall engine house has been built at New England. Material for the buildings was delivered by train and construction carried out by Company forces.

Material for the telephone and telegraph line was distributed by work train. The pole line averages 35 poles per mile, and carries two No. 18 wires. Telephones are used for dispatching purposes, being installed in booths at "blind sidings" and in the depots.

This branch is operated as a part of the Trans-Missouri Division, the usual branch line equipment being used.

VALUATION SECTION MONTANA 1

GENERAL LOCATION

Valuation Section Montana One covers the main line of the of the C.M. & St. P. Ry. Co's. Puget Sound Extension between the North Dakota-Montana state line and a point about three and three tenths miles west of Harlowton, Montana, and comprises about three hundred and thirty-seven miles of railroad.

RECONNOISSANCES

The explorations between the Missouri River and Miles City, Montana, made in 1901-02-05-06, are described in the Historical Sketch of Valuation Section South Dakota One. One hundred eighteen miles of main line in the state of Montana lies east of Miles City, consequently a considerable portion of this reconnoissance was in connection with Valuation Section Montana One. Another reconnoissance east of Miles City took place in March, 1908, starting at Terry, Montana; thence easterly up Fallon Creek; thence via Sandstone Creek up Carroll Creek; thence down Carroll Creek to the Little Missouri River at Marmarth.

A reconnoissance was started west from Miles City in September, 1904, a route being examined north of the Yellowstone to Alkali Creek, about forty miles west of Foreyth; thence up Alkali Creek over the divide between the Yellowstone and Musselshell Rivers and down to the present town of Musselshell; thence up the Musselshell River to Harlowton, which was situated on the Montana Railroad. This party continued explorations on west as will be described under other Valuation Sections.

A total of about one thousand and forty miles was covered in reconnoissance to obtain the three hundred thirty-seven miles of adopted and constructed line.

SURVEYS

Three survey parties were organized and equipped in Chicago, and sent to Miles City, Montana in January, 1906. The teams, wagons, etc., for the transportation of the parties were purchased in Miles City.

Two of these parties traveled over land to the head of Sheep and Ash Creeks at a point about ten miles southwest of Teedee, Montana, from which point they ran surveys east and west on the most

southerly route examined in reconnoissance. One party made a survey in a general southerly direction following drainage when practicable, crossing Fallon Creek and Little Beaver Creek to Box Elder Creek, which was followed to the Little Missouri River; thence down the Little Missouri to a crossing near the mouth of Hay Creek; thence up Hay Creek to the divide where connection was made with a survey from the east. This survey was made in March and April. During this time the other party ran a continuation of this line northwesterly from the point of origin near Teedee, down Sheep Creek to a crossing of the Powder River, near Mizpah; thence to the Tongue River, which was followed to Miles City. A secondary line was surveyed by one of these parties, starting at Marmarth and running westerly through Little Beaver and Lane Jones Creek Valleys to McKenzie's ranch about eight miles south of Teedee. In the meantime the reconnoissance from Terry to Marmarth had been completed and these parties were transferred to investigate the possibilities along the line. Their surveys developed the line as constructed.

The other party which was sent to Miles City, January, 1906, made preliminary and location surveys up the Yellowstone River past Forsyth; thence up Froze to Death Creek to a connection at a point about seven miles south of Thebes, Montana, with a line which had previously been surveyed from that point west to Summatra. A survey had also been made along the route adopted between Summatra and Melstone. Coincident with these surveys a survey was made up Big Porcupine Creek, from the Yellowstone Valley, which is west of Forsyth. This route was discarded and the party made the final survey along Big Porcupine and Horse Creeks.

Surveys west from Melstone along the Musselshell River were made by three parties in the early months of 1906. A large amount of preliminary survey work was necessary in the Musselshell Valley to avoid frequent crossings with the channel of the river and in this connection surveys and estimates for channel changes were made.

A summary of the surveys for this Valuation Section indicates that about twelve hundred seventy miles were covered to obtain the three hundred thirty-seven miles of adopted and constructed line or about three and three tenths miles covered in the surveys for one mile of constructed line. The surveys were made between January and May, 1906, and during the earlier months some extremely cold weather, and in many places deep snow, was encountered. The entire territory covered was sparsely settled and long hauls for supplies were necessary.

In addition to the locating parties, two engineers in charge of location were in the field to reconnoiter and direct the movements of the parties.

CONSTRUCTION ORGANIZATION

For purposes of construction this Valuation Section was divided into four divisions, each under the supervision of a Division Engineer and the required residency parties. The Division Engineers had offices at points convenient to the work and reported to Engineers of Construction. One of the Engineers of Construction had charge of

the line from Montline to the twelfth crossing of the Musselshell River, east of Melstone, and maintained offices in Miles City. The other Engineer of Construction had offices in Lombard and had charge of the line betterment work being done on the Montana Railroad, in addition to the construction work between Melstone and Harlowton.

The clearing, grubbing, grading, bridge and culvers work, track laying and handling of stores and supplies was done by McIntosh Bros. under the general contract dated December 23rd, 1905. McIntosh Bros. sublet the entire line and a large part of it was relet to small outfits and station men.

CHARACTER OF THE COUNTRY

The country between Marmarth and Terry was practically uninhabited in 1906, there being only one ranch house between Marmarth and Ismay and one cattle ranch between Ismay and Terry. At Ismay there was a ranch house and a small amount of land under irrigation. The bench lands on either side of Corral, Sandstone, and Fallon Creeks were unoccupied. The wide valley of the Yellowstone River between Bluff Port and Terry was devoted entirely to grazing but is now largely under cultivation. From the first crossing of the Yellowstone River, west of Terry, to Miles City, a lot of alfalfa was produced. Through the Fort Keogh Military Reservation, west of Miles City, the land was not under cultivation in 1906, but at the present time this is cultivated by dry farming methods. Leaving the west line of the Reservation, near Paragon, practically none of the wide valleys were under cultivation until Lock Bluffs was reached. The soil was largely gumbo but there is some good land next to the river which is being dry farmed at present. From Lock Bluffs to Foreyth the valley was under irrigation in 1906, and is now well occupied by farmers. Private irrigation systems were in existence in the valleys of the Yellowstone River and Big Porcupine Creek at the time of construction, being installed to facilitate the raising of hay for winter feed for the herds ranging over the territory lying to the north. Between Antwerp, in the Big Porcupine Creek Valley, and the first crossing of the Musselshell River, a distance of fifty miles, only one ranch was in existence in 1906. At the present time grain fields are scattered along the line between Vananda and Bascom and along the Musselshell River considerable irrigation farming is done.

CONSTRUCTED LINE

The line as constructed, leaving Montline follows Corral Creek through bad land formation on a maximum gradient of five tenths percent with light curvature to the divide between Corral and Sandstone Creeks at Kingmont; thence it descends along Sandstone Creek with a maximum gradient of four tenths percent and easy curvature for about thirty miles until Fallon Creek is reached near Ismay. From here Fallon Creek is followed for about thirty miles to Bluff Port; thence with side hill development the line descends into the Yellow Stone River Valley, near Terry, crossing the Northern Pacific main line between Bluff Port and Terry.

Several channel changes were made on Corral, Sandstone and Fallon Creeks to avoid bridge construction. Many of these were quite extensive. Large openings were required where crossings of these creeks were necessary, involving expensive bridge construction.

The south bank of the Yellowstone River is followed to a point about five miles west of Terry, where a crossing of the river is effected on a 1080 foot steel bridge. Thence the line remains on the north side for a distance of about twenty-four miles to another crossing of the river, from which point the Northern Pacific Railway is practically paralleled into Miles City. West from Miles City the line continues on the south side of the river for about five miles; thence crosses on another steel bridge and follows the north side to Mile Three Hundred Seventy-three, west of Forsyth, the maximum gradient along the Yellowstone River being five tenths percent.

West of Forsyth the line swings into Horse Creek Valley which it ascends on a maximum gradient of five tenths percent and with maximum curvature of two degrees. From a point east of Thebes to the summit west of Summatra a rough and rolling country is traversed. From this summit descent is made along Sunday Creek with comparatively light work and maximum gradient of five tenths percent to the first crossing of the Musselshell River about three miles east of Melstone. From Melstone west to Harlowton the line follows the valley of the Musselshell River, crossing the river eleven times on expensive steel bridges. Numerous channel changes were made to obviate other crossings, some of which were very expensive. The channel changes were necessarily well ripraped as was also the embankment adjacent to the river.

CONSTRUCTION

As previously stated under the paragraph "Construction Organization" the line was divided into four divisions for construction purposes.

First Division

The first division extended from Montline to the Northern Pacific Railway crossing, near Cato, a distance of about seventy-five miles. The contractor's outfits for this section were shipped via the Northern Pacific to Fallon near the west end of the section, from where they were hauled to the points of operation by team. Fallon was the point of distribution for the contractor's materials and supplies throughout the construction. The country traversed yielded no supplies of any sort, nor were there any wagon roads in existence. It was necessary, therefore, to construct and maintain wagon roads over this entire section. The numerous creek crossings on this road required a large amount of bridge construction.

The grading material encountered in the Corral and Sandstone Creek Valleys were had pan, loose and solid rock. The side borrow was usually gumbo or hard pan. In the Fallon Creek Valley the various materials occurred in the same cuts.

An important incident in the construction of this section occurred in June, 1907, when the water from a cloud burst at the head of Sandstone Creek swept down the valleys, carrying away equipment, live stock and supplies, and in many cases finished embankments. Two men lost their lives in this flood and many of the sub-contractors lost their entire outfits of construction equipment, supplies and stock. The washed out grading had not been accepted by the Railway Company. It was imperative, however, to hold the forces together and prosecute the work vigorously to prevent delay in the forward progress of track laying. The contractors were, therefore, given assistance in reorganizing their demoralized forces and accorded liberal treatment to enable and induce them to proceed with the work. A further result of this flood was a change in the alignment of about twelve miles of line, portions of which had been graded. This change materially increased the expense of construction.

Second Division

The second construction division westward extended from the Northern Pacific Railway crossing, near Cato, to the present town of Carterville, a distance of about seventy-five miles. Contractor's equipment, material and supplies were shipped over the Northern Pacific Railway to various points located along the line, as that Railway was in close proximity, although in the majority of cases it was on the opposite bank of the Yellowstone River. For the work on the twenty-five miles between the first crossing of the Yellowstone River west of Terry and the second crossing east of Tusler it was necessary to ferry all material, etc., across the river. Between Tusler and Forsyth the transportation was facilitated by the presence of highway bridges over the river, although it was necessary to ferry heavier equipment across the river as the bridges were not constructed of sufficient strength for such heavy loading.

The material encountered in the cuts was almost universally a mixture of loose rock, sand rock and solid rock. The borrowed material was ordinarily common earth, gravel and hard pan. Extremely heavy work was necessary along the bluffs on the north side of the Yellowstone River between Calypso and Kinsey. A steam shovel was taken across the river from the Northern Pacific track for this work. This was accomplished by dragging the shovel on the bed of the river through deep water by capstan and cable. One man lost his life during this operation. West of Bonfield Bluffs about two miles of the embankment was built in the swift current of the river. It was necessary to select large masses of rock for this fill and after the river froze over a special gang was maintained cutting the ice to allow the rock to reach the proper position at the toe of the slope. A second shovel was dragged across the river for the heavy work at Lock Bluffs.

Considerable riprap was placed for bank protection on the river side and numerous wing dams were constructed for the same purpose.

Third Division

The third division extended from the present town of Carterville to the first crossing of the Musselshell River about

three miles east of Melstone, a distance of about seventy-nine miles.

Contractor's headquarters were established at Forsyth. Supplies and equipment for the work between Carterville and Forsyth were unloaded at various points along the Northern Pacific Railway, and taken across the river to the points of use. For the territory between Forsyth and Melstone no wagon roads were in existence, consequently it was necessary to construct and maintain roads for transportation of supplies by team from Forsyth. The soil was largely gumbo, which made these roads practically impassable in the wet seasons. Water was hauled for this construction work from Froze to Death Butte Springs. East of Forsyth Bluffs, the material encountered was easily handled. At Forsyth Bluffs about a mile of heavy work was encountered through gravel, loose rock, sand rock and solid rock.

Steam shovels were used for this work which were knocked down, carried across the highway bridge at Forsyth and reassembled at the site of the work. Between a point about three miles east of Vananda and the head of Sunday Creek, near Summatra, the soil was all gumbo and was difficult to handle. The bottom layers of the deep cuts in this distance required blasting, and isolated boulders caused constantly recurring damage to grading machines.

The summit cut near Summatra involved the removal of some 200,000 cubic yards of material, and to enable track laying to proceed, a temporary line, on a one and five tenths percent gradient, was built lying to the south of the present operated line.

The grading material between Summatra and Melstone was largely gumbo. West of Forsyth in Big Porcupine Creek Valley numerous channel changes were made and irrigation complications were encountered which required expensive construction.

Fourth Division

The fourth construction division extended from the first crossing of the Musselshell River, near Melstone, to the junction with the Montana Railroad west of Harlowton, a distance of about one hundred eight miles. Grading outfits and supplies were hauled from Billings and Harlowton.

The principal features of the construction of this division were the numerous and extensive channel changes for the Musselshell River and the large amount of riprap required for bank protection. A large amount of the riprap material was hauled by wagon as suitable rock could not be obtained adjacent to the places where riprap was required. Wing dams were also constructed for protection.

General Notes

In general it can be said that more than the average amount of bridge work and bank protection was required on this section due to the fact that it lies almost entirely in the river valleys.

Disturbance to irrigation dams, intakes, etc. was a matter of large expense in the way of litigation, etc., and the expense of replacing and changing these systems was considerable.

High wages were paid for labor during construction on this Valuation Section due to the scarcity of men, climatic conditions and the large amount of other construction work in progress.

BRIDGES, TRESTLES & CULVERTS

The sub-structure and super-structure of all steel bridges on this section were constructed by the Railway Company forces. Timber bridges and the culverts were in general constructed by the contractors.

Pile bridges were built in accordance with the Railway Company's standard plans. Piles were of Western cedar and in a few cases of Eastern pine. The material for these structures was shipped via the Northern Pacific Railway to the points in closest proximity to the structures. The more important points of unloading were Forsyth, Rosebud, Hathaway, Miles City, Tusler, Shirley, Blatchford, Terry and Cato. Material was hauled from the points of unloading to the points of erection by team. The material for the structures between Terry and Tusler was rafted across the river. For the territory between Forsyth and Melstone the material was hauled from Forsyth, with the exception that a small part of it was hauled from end of track as it progressed eastward from Harlowton. Delays in the delivery of material due to the difficulty and the distance of team haul made it necessary to temporarily crib or fill many openings to permit a proper disposition of grading material.

TRACK LAYING AND BALLASTING

McIntosh Bros. did the track laying using a Roberts Bros. machine on about three hundred miles of the work. Track laying proceeded from three different points determined from the availability of transportation of material. Thus track was laid west from Montline, material being delivered over the track already laid through South and North Dakota; from Cato east and west with material delivered over the Northern Pacific Railway to Cato; from Harlowton east material being delivered on the Northern Pacific Railway at Lombard; thence hauled to Harlowton by the Montana Railroad.

A material yard was established in Mile TwoHundred Seventy-one, near Cato, and a connection with the Northern Pacific Railway graded and track laid. At this yard material for about forty miles of track was received and stored. Work began from this yard on May 27th, 1907, using a machine and proceeded east reaching Mile Two Hundred Fifty-three on August 25th. A delay of about a month was experienced due to the flood in Fallon Creek. The track laying machine was then shipped to Harlowton. Track laying continued easterly by hand, reaching Mile Two Hundred Forty-one October 16th. Track reached Montline from the east on December 30th, 1907, and proceeded west without interruption to a connection in Mile Two Hundred Forty-one with the track laid east from Cato.

Track was laid west from Cato to the Yellowstone crossing by hand between August 19th and November 11th, 1907. Bridge material was delivered over this track from the Northern Pacific connection at Cato, thus expediting its erection. When track from the east was connected with the track from the west in Mile Two Hundred Forty-one, the machine was forwarded to the bridge and track laying continued westward with very little interruption. Track with this machine reached Mile Three Hundred Ten on February 19th, 1908, where connection was made with the track laid from Harlowton.

Track laying eastward from Harlowton was all done with the machine shipped from Cato, with the exception of about five miles west and two miles east of Miles City, which was laid by hand. Track reached Melstone December 30th, 1907, and the Yellowstone bridge, west of Miles City, Mile Three Hundred Ten, February 16th, 1908.

A material yard was constructed about two and a half miles west of Roundup, in which about two miles of temporary track was laid.

Ballasting on this section was begun in 1908, using material hauled from gravel pits at Thame, Kinsey, Paragon, Melstone and Harlowton. Since 1910 some gravel for ballast has been taken from a pit near Two Dot. Development of these pits and construction of tracks to them involved considerable expense. The pit at Thame is five miles from the main line. That at Kinsey is one mile from the main line and that at Paragon three and a half miles from the main line.

WATER STATIONS

Between Montline and Ismay the running water in Sandstone Creek is insufficient, therefore a reservoir was constructed at Baker. The dam required about 40,000 cubic yards of material and an area of about 150 acres was flooded. For construction purposes a temporary water station was installed in Mile Two Hundred Eighteen and water taken from Sandstone Creek.

It was necessary to dig wells in the creek bed at Ismay and Mildred as Fallon Creek becomes dry during the summer months. A dam was constructed at Ismay with the intention of impounding the water in Fallon Creek, but on account of the unsuitable nature of the banks, it could not be maintained. Originally the supply of water was obtained at Terry from a spring some distance north of the track. At present a well is used. Between Terry and Forsyth water is obtained from the Yellowstone River, stations being maintained at Terry, Bonfield, Miles City, Paragon, Thurlo and Forsyth. From Forsyth west the situation was difficult. No permanent running streams existed between Forsyth and the Musselshell River. A reservoir impounding the water in Horse Creek was built at Vananda. About 68 acres were flooded at this place. Reservoirs were also constructed in Miles Three Hundred Ninety-two, Three Hundred Ninety-four, Three Hundred Ninety-six and Four Hundred.

The railroad embankments with an additional amount of material and riprap for wave wash protection were utilized as dams. These reservoirs collected a fair amount of water and were especially useful during track laying, saving long hauls on tank cars. Permanent stations are now maintained at Vananda, Thebes, Ingomar, Summatra, Melstone, Delphia, Roundup, Waldheim, Burgoyne, Shawmut and Harlowton.

SIGNS, FENCES AND CROSSINGS

The right of way has been fenced and the proper crossing facilities provided, except in inaccessible and isolated places, and through the important terminals and station grounds. The material was delivered by train. Snow fence is provided where protection is required.

BUILDINGS

Many temporary buildings were built and used during construction for supply and store houses, camps, etc.

The material for the permanent buildings was delivered by work train after the track was laid. Standard combination freight and passenger depots were installed at the important stations and smaller depots for the accommodation of operators, etc., at the less important sidings. Engine terminals were built at Miles City, Melstone and Harlowton and quite extensive shops at the former place.

TELEGRAPH AND TELEPHONE

Telegraph and telephone material was distributed by work train. The pole line averages about 35 poles per mile, and carries an average of 8 wires. Telephones have been installed in the depots and in booths at "blind sidings", and are used for train dispatching purposes.

OPERATION AND MANAGEMENT

This Valuation Section is all on the Musselshell Division. The local offices are in Miles City. Heavy main line equipment is used. The Manual Block system of operation is used over this entire Division.

VALUATION SECTION MONTANA 2.

GENERAL LOCATION:

Valuation Section Montana 2 covers about 91 miles of the Chicago Milwaukee and St. Paul Railway Company's Puget Sound Extension in Montana, lying between a point about 3-3/10 miles west of Harlowton, Montana and Lombard. The line follows the Musselshell River to its headwaters, crosses the Little Belt Mountain Divide and descends to the Missouri River at Lombard, passing through Meagher, Gallatin and Broadwater Counties.

The original line was constructed by the Montana Railroad Company in two sections; that from the point near Harlowton to Summit being built in 1900 and the part between Summit and Lombard in the years 1894-95-96-97. The Montana Railroad Company entered into an agreement and lease with the Chicago Milwaukee and Puget Sound Railway Company on December 11th, 1907, in which the former Company agreed to improve the line between Harlowton and Lombard and granted trackage rights to the latter Company for a period of 99 years. On January 15th, 1910 the Montana Railroad Company deeded its entire road and property lying between Lewis-town and Lombard, Montana to the Chicago Milwaukee and Puget Sound Railway Company.

SURVEYS:

The reconnoissance in September 1904 beginning at Miles City and extending west along Yellowstone and Musselshell Rivers to Harlowton, as described under Valuation Section Montana No. 1, was continued on west to Lombard along the Montana Railroad and from this report it was decided to use the Montana Railroad for train operation on this Section.

There were a number of surveys made for the revision and betterment of the Montana Railroad previous to the adoption of the line as reconstructed. The topography of the country is such that it was necessary to contour practically the whole valley from Summit west to Lombard to obtain a satisfactory location.

CHARACTER OF COUNTRY:

The Valley of the Musselshell River was fairly well developed at the time of reconstruction, and is now well settled by ranchers, and numerous irrigation ditches exist. Some grazing is done on the higher lands. After crossing the Divide near Summit

the line passes through the open country at the head of the Smith River Valley and enters the Valley of Sixteen Mile Creek near Ringling. This Valley soon narrows into a deep winding box canyon known as Sixteen Mile Canyon. The topography here presents an exceedingly rough and mountainous appearance.

CONSTRUCTED LINE:

The line as revised ascends from Harlowton with a maximum gradient of one percent to Groveland station. Here the gradient increases to two percent to attain the Divide at Summit. From the Divide the line ascends across drainage with a maximum gradient of one percent to Ringling. From Ringling the line lies in the Sixteen Mile Canyon until the Missouri River crossing is reached at Lombard. For this portion the maximum gradient is one percent and a large amount of sharp curvature is used.

CONSTRUCTION ORGANIZATION:

The revision and betterment work of the Montana Railroad was carried on under the supervision of the Chief Engineer of that line with the necessary Assistants and under the general direction of the Chicago, Milwaukee and Puget Sound Railway Company. McIntosh Bros. did the work under a general contract which covered clearing, grubbing, grading, culvert, bridge and tunnel construction, track laying and the handling of supplies and stores. The work was sublet to the Firm of Dittmar, Breadbury & Weitbrech, who in turn relet part of the work to other contractors.

CONSTRUCTION:

During the period between 1906 and 1910 practically the entire road belonging to the Montana Railroad Company between Harlowton and Lombard was rebuilt to conform to the Chicago, Milwaukee and St. Paul standard of construction. This work was done in two sections, that between Harlowton and Moyne in 1909-10 and between Moyne and Lombard in 1906-07-08.

The grading on the revised line between Harlowton and Martinedale was light but some heavy work occurred between Martinedale and Lennep. From Summit to Ringling heavy work was encountered and from Ringling to Lombard the construction work was very heavy and often difficult to execute. Numerous crossings with Sixteen Mile Creek occur and several channel changes were made to avoid others. Eight tunnels varying in length from 160 to 380 feet occur between Fanalulu and Lombard, a distance of 30 miles. During this construction trains were operated on the old line of the Montana Railroad and where the old line and revised line had the same alignment or interfered, a temporary track was constructed for the operation of trains. In many cases this required the construction of temporary bridges. The canyon is very narrow and the material encountered was largely solid rock, which necessitated extra forces to protect and maintain the line under operation.

BRIDGES, TRESTLES AND CULVERTS:

The original bridges and culverts on the Montana Railroad were of light construction and these structures were all rebuilt to conform to the Chicago Milwaukee and St. Paul Railway Company's design. The culverts are principally of cast iron pipe. A number of steel bridges with masonry structures and a few concrete arch culverts were built, work being done by the Railway Company forces.

TRACK LAYING AND BALLASTING:

In connection with the reconstruction of the line, new 85 pound rail was laid in the main track and lighter material in the sidings. This work was done in 1907-08-09. 90 pound rail has since been laid in the mountainous district on the sharp curves. Fir ties from the West were used. Ballast was obtained from pits located at Two Dot, Groveland, Minden and in Mile 164. About 70,000 cubic yards of material was moved in stripping the pit near Two Dot in addition to a large amount of force account which was done in connection with this work. Ballast has been placed at various times between 1908 and 1914.

FENCES AND SNOW PROTECTION:

Right of way fences with the necessary crossing facilities have been built except at inaccessible and isolated places. All cuts into which the snow drifts badly are protected with either portable or permanent snow fences.

WATER SUPPLY:

The Montana Railroad maintained water supply stations at Two Dot, Groveland, Freeman, Summit, Spur 47, New Dorsey, Deer Park and Lombard, which have since been removed or replaced with standard structures. Permanent water stations are now maintained at Two Dot, Groveland, Bruno, Sixteen, Nathan, Cardinal, and a temporary station at Two Dot Pit.

BUILDINGS:

In connection with the revision of the Montana Railroad old depots were removed or torn down at Martinsdale, Lennep and Dorsey. Section dwellings were removed at Dorsey and old Fanalulu. At Summit and Lombard engine houses, coal derricks, etc. have been torn down. Combination freight and passenger depots are now maintained at Two Dot, Martinsdale, Lennep, Bruno, Ringling, Maudlow and Lombard. Smaller depots for train operators are maintained at the less important places, and buildings for section crews at places convenient to the work.

TELEPHONE AND TELEGRAPH:

Material for the telephone and telegraph line was distributed by work train. The line averages 35 poles per mile and carries an average of eight wires. Telephones are used for train dispatching, being installed in booths at "blind sidings" and in the depots.

ELECTRIFICATION:

This entire Section has been equipped for operation by electricity. Substations were built at Two Dot, Summit and Josephine. Power is obtained from the Montana Power Company's Plant at Great Falls, being transmitted to the substations at 100,000 volts alternating current. It is transformed and re-generated to 3,000 volts direct current for train operation.

OPERATION AND MANAGEMENT:

This Section is operated as a part of the Rocky Mountain Division, the local offices being in Three Forks, Montana. Automatic block signals are in use over the entire section.

VALUATION SECTION MONTANA 3.

GENERAL LOCATION:

Valuation Section Montana 3 covers about 92 miles of the main line of the Chicago, Milwaukee & St. Paul Railway Company's Puget Sound Extension extending from Lombard, Montana in a general westerly direction through Broadwater and Gallatin Counties to Sappington, thence in a westerly and northwesterly direction through Jefferson, Madison and Silver Bow Counties to Colorado Junction, a point about one and one-half miles west of Butte, where a junction is made with the Butte Anaconda & Pacific Railway.

RECONNOISSANCE AND SURVEYS:

The reconnoissances in the Fall of 1904, as previously described in Valuation Sections Montana Nos. 1 and 2, continued on west from Lombard along the Missouri and Jefferson Rivers thence across the Continental Divide in the Rocky Mountains to Butte, Montana. It was from this report that information was obtained for the instrumental surveys.

Three survey parties were placed in the field in January 1906 to make preliminary and location surveys between Three Forks and Butte. These parties worked until August 1906. During the Winter of 1907-08 another party made surveys from the vicinity of Three Forks east to Lombard. Numerous preliminary lines were surveyed over this Section and the nature of the country required extensive contour and line projection work. Many of the projected lines were established on the ground and discarded before the route as adopted and constructed was decided upon.

CHARACTER OF COUNTRY:

Between Lombard and Piedmont the line as constructed is in close proximity to the Northern Pacific Railway Company's main line, although the Missouri and Jefferson Rivers lie between the two railroads a large portion of the distance. Between Piedmont and Butte the line diverges from the Northern Pacific Railway and crosses the Continental Divide several miles south of that line. Territory between Piedmont and Butte is all of a rough mountainous character.

CONSTRUCTED LINE:

At Lombard the line crosses the Missouri River near the mouth of Sixteen Mile Creek thence in a general southwesterly direction follows the Missouri River Valley to the mouth of the Jefferson, Madison and Gallatin Rivers, which unite and form the Missouri River a short distance east of Three Forks. From this point the Jefferson River Valley is followed to Piedmont thence up the east slope of the Rocky Mountains across the Divide and down the west slope, with heavy development work, to Butte. Between Lombard and Piedmont the gradients are light and maximum curvature is 8 degrees. The ascent on the east side of the mountains is made on a two percent gradient and 1-66/100 percent gradient is used on the west slope. Numerous sharp curves are used in the mountain district.

CONSTRUCTION ORGANIZATION:

The construction organization consisted of an Engineer of Construction who had general charge of the work, assisted by one Division Engineer and eight Resident Engineers and parties. The residency lengths varied from 9 to 16 miles. The Engineer of Construction maintained offices in Butte.

McIntosh Bros. did the work under their general contract covering the clearing, grubbing, grading, bridge and culvert work, track laying, etc. The work was sublet to various other firms who in some cases relet parts of their work to other contractors.

CONSTRUCTION:

Between Lombard and Piedmont contractors' equipment, material and supplies were unloaded at various points along the Northern Pacific Railway and taken to the points of use by team. Piedmont was the point of delivery for the work on the east slope of the mountains and Butte for the work on the west slope. Wagon roads were constructed by the contractors for handling the supplies and equipment.

The cuts between Lombard and Piedmont were largely made through loose and solid rock. Two important channel changes were made in the Jefferson River between Willow Creek and Alcazar. These channel changes were both made with team outfits. A large amount of embankment was washed out along the Jefferson and Madison Rivers during June 1908, and was rebuilt with teams and later widened with train hauled material. This same flood washed out portions of the Jefferson River bridges near Three Forks and occasioned considerable riprapping by Company Force and work train service. West from Piedmont the cuts were composed of disintegrated granite and solid rock. This disintegrated granite was extremely hard to handle and a large amount of powder was required on this Section.

To facilitate the delivery of the material for the high steel bridges and tunnel work in the mountains, grading east from Butte and the construction of temporary timber trestles was pushed with great vigor.

A temporary line was graded and used for train operation over Pipestone Pass pending completion of a tunnel. Nineteen long and high timber trestles were built between Colorado Junction and Cedric which have since been filled by contract and Company Forces.

BRIDGES, TRESTLES AND CULVERTS:

The pile and frame trestles were built in accordance with the standard drawings of the Railway Company. The original long trestle over Silver Bow Creek east of Colorado Junction was constructed by contract as were also the timber bridges between Lombard and Piedmont.

Those between Butte and Piedmont were erected by the Railway Company Forces. The steel viaducts and concrete culverts were built by Railway Company Forces. Timber culverts were placed by contract.

TUNNELS:

Four tunnels numbered 10, 11, 12 and 13 occur on this Section. These were drilled under contract in 1907-08 and the concrete lining has been placed since by Company Forces. Tunnel No. 10 caved in during construction and caused a large additional expense for retrimbering and bracing. The work on Pipestone Pass tunnel, or No. 11, was done by McIntosh Bros.

Material yards for bridge and tunnel material were located at Newcomb, Piedmont, Willow Creek, Sappington, Jefferson Island and Three Forks. All material was furnished by the Railway Company and delivered to these yards. The material used by the contractors was hauled by team to the structure sites.

TRACK LAYING AND BALLASTING:

In June 1907 a consolidation locomotive was sent to Butte for track laying and general use. This locomotive was in service constantly for a period of about one year before the track from the east was connected up. McIntosh Bros. did the track laying, using a Roberts Bros. machine over the entire distance with the exception of about four miles at the Continental Divide. The work was in progress at different places and at different times during 1907-08, being started from Butte early in 1907 and in the Fall of the same year track was started west from Piedmont. Track was laid over the Divide during the Summer of 1908 and between Lombard and Piedmont between January and July of that year. Material yards were at the places previously mentioned under the paragraph on tunnels. The main line was laid with 85 and 90 pound steel.

The original ballasting was done in 1908 and some ballast has been placed yearly since that time. Ballast was composed of gravel, lime rock and disintegrated granite, taken from pits located at Barron, Lime Spur, Vendome and Janney.

WATER SUPPLY:

Permanent water supply stations were installed at Three Forks, Alcazar, Piedmont, Grace, Donald and Butte Yard. Temporary stations were installed at various places during construction, water being taken from the natural resources.

BUILDINGS:

Combination freight and passenger depots were built at Three Forks and Piedmont. A large freight house was built in Butte and the Butte, Anaconda and Pacific passenger depot was used jointly at that point. Smaller depots for the accommodation of operators were built at the less important places. Engine terminal facilities consisting of a 15 stall round house, turn table, clinker pit, etc. were built at Three Forks. A two-stall engine house was built at Piedmont and four-stall engine house with other facilities at Butte Yards to care for the helper engines used on the mountain grades. An imposing brick passenger depot with an entire new layout of tracks was later constructed at Butte.

FENCE AND SNOW PROTECTION:

Right of way fence has been placed where conditions required it, and the necessary crossing facilities installed. Material was delivered by work train after the track was laid.

TELEGRAPH AND TELEPHONE:

Material for the telegraph and telephone line was distributed by work train. The line averages 35 poles per mile and carries an average of eight wires. Telephones are used for train dispatching, being installed in booths at "blind sidings" and in the depots.

ELECTRIFICATION:

This entire Section has been equipped for operation by electricity. Substations were built at Eustis, Piedmont and Janney. Power is obtained from the Montana Power Company's plant at Great Falls, being transmitted to the substations at 100,000 volts alternating current. It is transformed and regenerated to 3,000 volts direct current for train operation.

OPERATION AND MANAGEMENT:

This Section is operated as a part of the Rocky Mountain Division, the local offices being in Three Forks, Montana. Automatic block signals are used throughout.

VALUATION SECTION MONTANA 4

GENERAL LOCATION

Valuation Section Montana 4 covers about 230 miles of main line in Montana between Colorado Junction, near Butte, and the Montana-Idaho State Line, near the east portal of the St. Paul Pass Tunnel.

EXPLORATIONS

The first reconnaissance west of Butte started November 1st, 1904, when a route was examined from Butte to Anaconda, thence up Warm Springs Creek to Flint Lake, about forty miles. This trip was made by team as good roads existed up to Flint Lake. Operations ceased at this point about November 15th, on account of winter weather, no preparations having been made for carrying on Mountain work during that season.

In May, 1905, the exploration of this route was continued west from Flint Lake; crossing the head waters of Rock Creek and over a spur of the Rocky Mountains, bounding Bitter Root Valley on the east; thence down Ross Fork of the Bitter Root River into Bitter Root Valley; thence up Nez Perces Fork of said river to Nez Perces Pass. An alternate route west from Flint Lake was examined via Skalkaho Pass and Creek of same name to Grants Dale in the Bitter Root Mountains.

These routes were examined carefully and barometric readings taken frequently - an engineer, with an assistant and two men with pack horses and cooking outfit composed the party.

The next important exploration was of Lolo Pass, on which a party started in October, 1905, at Missoula, following up the Bitter Root River to Lolo Creek; thence up this Creek to Lolo Pass; thence north along the divide to the head of the South Fork of Fish Creek; thence down Fish Creek to Rivulet. The lateness of the season and the deep snow, covering all horse feed on the mountains, forced this party back.

In January, 1906, a party composed of an engineer with 3 men made a thorough exploration of the Bitter Root Divide and all important streams flowing easterly to the Bitter Root and Missoula Rivers. The exploration work covered the divide from Lolo Pass on the south to the head of Cedar Creek on the north, an approximate distance, measured along the State boundary line,

of from sixty to sixty-five miles. In connection with this work, notes were taken to locate all streams, side trips made down same, and elevations taken at frequent intervals to determine possible gradients. This work was carried on in 15 to 30 feet of snow.

The examination of the aforementioned routes consumed about 15 months' time between November, 1904, and February, 1906.

The next exploration for a pass through the Bitter Roots was made up the St. Regis River in the summer of 1906, starting near Saltese and following a fork or feeder of said river. Every available prospect was carefully examined in this territory, consuming about three months' time on the part of the engineer and crew, though without the hardships connected with winter work.

In addition to the mountain exploration work previously described, an exploration was made from Butte west in the summer of 1906 along the Deer Lodge, Hellgate, Missoula and St. Regis Rivers to Saltese. This involved no particular difficulties as good roads existed along the entire route and the proximity of the Northern Pacific Railway aided in the work. This exploration was completed in one month.

The country traversed in the Bitter Root Mountains was practically void of trails, and where any existed they had been neglected so that wind falls made travel a slow and tedious process. Pack horses carrying provisions for three to four weeks' supply were used when possible. In the winter months toboggan sleds and men packers were used to convey supplies.

Also about 150 miles of close reconnoissance was made while instrumental surveys were in progress. Following is a statement showing approximate mileage covered in reconnoissance.

South of Nez Perces Pass

Butte - Anaconda - Flint Lake - Nez Perces Pass	150	Miles
Flint Lake, Skalkaho Pass - Grantsdale	85	"
Skalkaho Pass - Willow Creek - Grantsdale	25	"
	<u>260</u>	"

Lolo Pass

Missoula - Lolo Creek to Lolo Pass	50	"
Lolo Pass via South Fork - Fish Creek to Rivulet	25	"
	<u>75</u>	"

Fish Lake Pass Route

Rivulet, Fish Creek - Fish Lake Pass	75	"
Trout Creek - Lost Pass	25	"
	<u>100</u>	"

Superior Cedar Creek Routes

Superior - Cedar Creek - Oregon Gulch	100	"
Divide from Lolo Pass to head of Oregon Gulch	75	"
	<u>175</u>	"

Butte to Saltese; River Valleys	230 Miles
Saltese to St. Paul Pass - Mountains	50 "
Close reconnaissance during instrumental Surveys	150 "
	<hr/>
	430 "
Total	1040 Miles

This 1040 miles covered in reconnaissance as compared with the 230 miles of adopted line indicates that the territory was quite thoroughly investigated, about $4\frac{1}{2}$ miles being covered in reconnaissance for each mile of adopted line.

SURVEYS

Taking up the preliminary surveys in consecutive order, two parties were outfitted at Missoula, Montana, about December 15, 1905. One had instructions to go to Lolo Pass and make a traverse of the summit of the Bitter Root Mountains from Lolo Pass north-westerly for the purposes of obtaining all information possible as to the existence of any and all passes that might be available for a crossing of the Bitter Root Mountains. This survey was to be made with transit, stadia rod and barometer. Provisions for the party were assembled at Missoula, hauled by team to Lolo Hot Springs and thence to the divide, by man power on sleds, as the depth of snow prevented the use of pack horses, except for the first few trips. A large amount of provisions were hauled to a cache at the summit and drawn upon as required. Trails were cut from Lolo Hot Springs to the cache and kept open by frequent trips. About 20 men were constantly employed with this party. Actual work on the traverse commenced December 25th, 1905, and was finished March 4th, 1906. During that time 40 miles of traverse lines were run and platted. This work included running outside lines and platting positions of possible tunnel sites and approaches. Continuous snow storms on the high elevations of the Bitter Root Divide made this work slow, dangerous and tedious, as well as costly.

The other party was also sent to the Lolo Pass with orders to run a preliminary line down Lolo Creek. Work was commenced by this party December 25th, 1905, at Lolo Pass and ended at Hot Springs, February 1st, 1906; 15 miles of preliminary line with full contours being run and projection made.

In July, 1906, another party took up this survey at Lolo Hot Springs, and ran down Lolo Creek to Missoula and at the same time made additional surveys at Lolo Pass. This party ran 31 miles of preliminary, 3.5 miles of location and 42 miles of close reconnaissance covering 7 weeks' time.

Above covers all the work done on the Lolo Pass Route in Montana.

Working Northerly from Lolo Pass the next survey was made in May, 1906, from Rivulet, up Fish Creek, a distance of 15 miles consuming 3 weeks' time.

The next survey consisted of a traverse of the Bitter Root divide from the head waters of Cedar Creek, which discharges into the Missoula River, near Iron Mountain, Montana. The party, for this work, moved from the Lolo Pass Traverse, down Fish Creek to Rivulet, thence to Iron Mountain, thence to the divide at the head waters of Cedar Creek. Work on this traverse was commenced March 14th, 1906, and completed August 1st, 1906. Lines were run Southeasterly along the divide, with many side trips locating tunnel sites, etc. 60 Miles of preliminary, with 100 miles of close reconnaissance work, required 6½ months with a large crew averaging 19 men. All provisions for this crew were hauled by pack trains from Iron Mountain. A second party worked on this traverse from August 1, to August 25th, 1906, running 13 miles of traverse with contours and 2 miles of location. Total territory covered was 72 miles of preliminary, 100 miles of close reconnaissance and 2 miles of location, requiring 7 months.

The next preliminary surveys were made up Cedar Creek, beginning at Iron Mountain, crossing the divide, between the head waters of aforementioned Creek, and the St. Joe River. Three separate parties worked on this Creek on the East or Montana Slope of the Bitter Roots. Total time consumed for all parties was 5 months, seventy-eight miles of preliminary line were surveyed in this time with an average of 16 men in each party.

The parties next took up the preliminary on the adopted, or St. Paul Pass Route, beginning in August, 1906, and completing in November of the same year. The total time for all parties was 5½ months, during which time 66 miles of preliminary lines with contours were run and projected locations made.

Work was started on surveys between Ross, 10 miles west of Butte, and Saltsee, in August, 1906, nine parties being placed in the field almost simultaneously. These parties carried on the preliminary and location survey work for about 211 miles of adopted line. The territory east of St. Regis was fairly well settled with wagon roads available in most places, and operated railroads were in close proximity. Here the work lay entirely in the valleys of the Deer Lodge, Hellgate, Missoula and St. Regis Rivers, which required a large amount of topographical survey and projection work to obtain a suitable location. West from St. Regis mountain conditions as to surveying prevail, with a medium heavy growth of timber.

The location work was carried on in conjunction with the preliminary survey work and will be considered in the same summary.

Following is a statement showing the mileage, etc., of survey work.

Number of crews in field -----	10
Time on the work--Months--All Parties --	49
Average number men in each party-----	20
Miles of preliminary Survey-----	994
Miles of location Survey-----	423

Miles of line as adopted ----- 220
 Ratio, mileage of Preliminary Surveys, to mileage adopted line 4.5
 to 1
 Ratio mileage of location Surveys to mileage adopted line----- 1.9
 to 1

The progress was variant, about 12½ miles of preliminary per month being the average in the mountains as compared with the average progress of 27 miles per month in the valleys.

In the mountains every prospect was investigated, while in the river valleys the work was confined to the betterment of the one possible route.

Between Butte and Ross an independent line was located by the G. M. & St. P. Company in 1910, covering about 14 miles of line. A large amount of topography was taken on this stretch and the valley thoroughly contoured before the line was finally located.

ENGINEERING ORGANIZATION

The construction engineering organization consisted of a Division Engineer, in charge of the entire section, who reported to the Chief Engineer in Seattle, two assistant Division Engineers, five District Engineers, and twenty-seven Resident Engineers with the usual assistants and crews. The plans and bills of material for the temporary bridges, etc., were worked up in the Division Engineer's office. The usual inspectors, etc., were also employed.

CONTRACTS

This section was built under two separate contracts at different periods. The work from Cliff Junction (now Finlen) west to the state line being done on the original construction program, 1906 to 1909, and the work between Colorado Junction and Finlen in 1912 and 1913. The tracks of the Butte Anaconda and Pacific Railway were used for the operation of the G. M. & St. P. trains between the last named places until October, 1913.

The work from Cliff Junction to the State Line was let, under competitive bids from a large number of well known contracting firms, to the Winston Brothers Co. of Minneapolis on February 19th, 1907. The principal sub-contractors were W. B. Cronk, A.D. McDougal & Co., Stewart & Welch and Streeter & Lusk. Besides the above there were a large number of firms handling shorter portions of the work and many station men. The first grading work was started near Missoula in July, 1906, but as a whole, grading operations were commenced in April and May 1907, and completed in December, 1908, though portions of the line east of Missoula were not finished until June, 1909.

The work from Colorado Junction to Cliff Junction (now Finlen) was done partly by contract and partly by the Railway

Company's forces. The principal contractors were Guthrie McDougal & Co. The work done by the Railway Company's forces consisted of train hauling material on the B. A. & P. Ry. Co. tracks to construct embankments where adjacent borrow could not be obtained. This work was started in September, 1912, and completed in October, 1913.

CONSTRUCTED LINE

Construction on the main line between Colorado Junction, and Finlen was commenced in September, 1912. Starting at Colorado Junction the line descends Silver Bow Creek parallel to the B. A. & P. Ry. and the Northern Pacific Railway with light work for six or seven miles. The line then enters Silver Bow Canyon where the construction involved many difficult features due to the proximity of the two existing tracks and Silver Bow Creek. The sides of the canyon are high perpendicular cliffs with the creek occupying a considerable portion of the narrow valley. The heavy rock work covers about six miles, terminating near Finlen. West of Finlen construction was started in May, 1907. Here the line swings sharply to the north and enters the wide valley of Deer Lodge Creek, which it follows with side hill development work involving heavy cuts and fills, for about fourteen miles, or to the first crossing of Deer Lodge Creek. From this point to four miles west of Kohrs the work is light, and after crossing the Northern Pacific at Sinclair, the line is parallel and about one hundred feet distant from the Northern Pacific line. From four miles west of Kohrs to Garrison work is quite heavy, deep cuts and high fills being dominate features.

The above described section of line, from Finlen to Garrison lies in a wide flat valley, partly under cultivation by irrigation methods. Alignment is good - maximum curvature 3 degrees and gradient $\frac{4}{10}$ of one per cent.

Near Garrison, the Deer Lodge and Blacktail Rivers unite to form the Hellgate River. The valley of this river is followed to Bonner. The general characteristics of this river are embodied tersely in its name. In June floods it carries a large amount of water, the drainage area from adjoining mountains being extensive. Generally speaking, the valley is narrow, widening out occasionally which places are usually under cultivation. As a measure of safety, the grade line here is high, and where channel changes were made, a large cross-section area was provided. The construction of two lines of railway, together with the space occupied by the channel of the river consumed the entire width of the valley in many places. To maintain a maximum of 3 degree curvature many deep cuts and four tunnels through projecting rock points were necessary, between Garrison and Missoula, and many channel changes were made to save frequent crossings.

At Bonner the Big Blackfoot River joins the Hellgate and forms the Missoula River, which is followed to St. Regis.

For the first 20 miles west from Missoula the roadbed lies in a wide highly cultivated and irrigated valley, fairly smooth, making light work as a rule. However, there is some extremely heavy work between 6 and 9 miles west of Missoula.

Just west of Huson the valley converges with high bluffs on either side. Between here and St. Regis benches are occupied at considerable elevation above the river, which is crossed three times on expensive steel structures. Considerable cross drainage is encountered also, causing other expensive waterway openings.

At St. Regis the ascent of the east slope of the Bitter Roots is commenced along the St. Regis River with moderately heavy work and some sharp curvature to Haugan. Here the mountain grade and corresponding heavy mountain work commences and continues to the east portal of the St. Paul Pass Tunnel. This is typical mountain work, characterized by deep cuts, tunnels, and high embankments. Numerous high timber bridges were built during original construction, which were filled later. Here the maximum gradient is 1.70 percent with maximum curvature of 10 degrees. Grade compensation is made for curvature.

In general this 230 miles of railway lies entirely, with the exception of the distance from Haugan to the state line, along streams of varying size, which caused more than the average amount of bridging and bank protection work. The existence of one or more railways in the same valley also added complications to the construction although it relieved the transportation problem.

CLEARING AND GRUBBING:

There was very little clearing necessary between Butte and Garrison as most of the land crossed by the right of way was previously under cultivation, with the exception of the portion in the Silver Bow Canyon which was rocky and devoid of vegetation. Between Garrison and Missoula medium heavy clearing was encountered. Practically no clearing was done between Missoula and Huson. From Huson west to St. Regis some medium heavy clearing was necessary.

West from St. Regis heavy clearing was encountered. The right of way was cleared for full width, except through the forest reserve, where extra widths were required by the government. Strict rules were enforced as to burning brush and skidding and decking logs by the government inspectors. Permits were required for burning and all precautions possible were taken against forest fires. These items all added to the expense of the work.

The grubbing varied about as the clearing and was paid for as per specifications.

GRADING:

The outfits and supplies for the construction work on this section were shipped in over foreign lines to the nearest point and hauled to the work in the best way possible. Between Butte and Haugan the close proximity of other railroads was a great help, but often the work of moving from the point of unloading to the work was arduous owing to the fact that in most

cases the foreign line was on the opposite bank of the river and very few wagon crossings existed. In some places temporary bridges or ferriss were built. These were expensive, however, on account of the swift water and steep rocky banks.

For the work east of Bonner the Chief points of purchase for contractor's supplies were Butte and Deer Lodge. The main commissary was established at Deer Lodge. Missoula was the point of purchase for supplies in that vicinity and west. Important commissaries were established at Bonner, Huson, and Taft. Supplies were distributed to the various camps from these points, sometimes by rail to the nearest point of delivery and from there by wagon. At Bonner a boat was used to ferry the supplies across the river from the Northern Pacific station. This was expensive and a good many supplies were lost here on account of the swift current.

Material handled by the contractors in this section was variant in the different valleys traversed. In the Deer Lodge River Valley common excavation predominates with a small portion of classified material. In the deep cuts along the Hellgate River, a large amount of solid rock and other classified material was encountered. Conditions as to material in the Missoula River Valley are practically the same as in the Hellgate Valley up to Missoula. West from there for twenty-two miles the material handled was largely common. From the twenty-two mile point west to the commencement of the mountain work at Mile 98, the excavation developed more or less solid rock.

From the foot of the 1.7 percent grade to East Portal, solid rock is the predominating classification of the excavation.

From the point where the line leaves the St. Regis River Valley to the St. Paul Pass Tunnel, the country was virgin forest with no trails, therefore it was necessary to build roads at a heavy expense.

On the lowlands, where common material predominated, the grading work was largely done with teams. Most of the rock work was done by station men, using trap tunnels wherever possible, and rock cars and track to carry the material to the fills. Steam shovels were used on the heavy work done jointly with the Northern Pacific in the Hellgate Canyon, and at a few other points, but as a rule the transportation problem eliminated this class of equipment.

In closing the subject of grading, contracts, etc. it might be mentioned that after Winston Brothers had finished the contract work, Railway Company forces were used to a large extent in filling temporary bridges, raising and widening banks and daylighting cuts.

A large part of the later bridge filling in the Bitter Root Mountains was sluiced in place.

Some of the structures were filled with material from daylighted and widened cuts.

The work between Colorado Junction and Finlen was done to a great extent under adverse conditions. A large amount of blasting was a necessary part of the construction. Care was used in blasting so that traffic on the parallel railroads would not be interfered with or trains endangered by flying rock. Train haul work done by use of the B. A. & P. Ry. Co's tracks was necessarily interfered with by the passage of that Company's trains. All of above tended to increase cost of this section.

BRIDGES, TRESTLES & CULVERTS:

All bridges except steel structures were built by contract in accordance with the standard plans of the C. M. & P. S. Ry. Co. under the direction of Winston Brothers Co. as per contract. Stringers were of Douglas fir and piles of cedar. The former were purchased and shipped from the Pacific coast to stations on the Northern Pacific Railway, where they were unloaded and hauled by team to the various points of erection.

Stringers used on the high bridges in the Bitter Root District were shipped to DeSwet on the N. P. Ry. then hauled west again on the Coeur d'Alene branch of that railway to Haugan, Saltese and Taft, from which points they were hauled by team over the newly constructed roads and trails to points of erection.

Trestle timber other than stringers, such as posts, sills braces and caps were also purchased at Coast points, except a small portion which was obtained from local saw mills.

Idaho cedar piles were used, originating on west slope of the Bitter Roots loaded at stations on the N. P. Ry., thence shipped to points of erection.

Culverts between Colorado Junction and Finlen are constructed of timber, cast iron pipe and concrete. Haul on cast iron pipe was from Chicago and vicinity on C. M. & St. P. Railway, concrete arches were built by Railway Company's forces. Concrete pipe was built at Tomah, Wisconsin and hauled to Butte on C. M. & St. P. rails. Timber culverts were built by the Railway Company with material furnished from stock.

Between Finlen and Cyr all culverts were built of sawed timber, which originated at Bonner and was hauled on the N. P. Ry. to stations on that railway nearest to points of erection, thence by team.

Iron for culverts was shipped from Chicago and other Eastern points, freight being paid on foreign roads from Minneapolis.

Between Cyr and Superior many log culverts were built from local timber.

From Superior to Saltese both sawed and hewn timber obtained locally was used in culvert construction.

On the Bitter Root slope there were many long culverts under high fills. Timber used in these was sawed and hewn and a large amount of log cribbing was constructed. Most of this timber was hauled by team to sites.

PERMANENT BRIDGES:

The permanent foundations for the steel bridges in the Missoula and Hellgate River Valleys were built by Contractors and the steel was erected by Company's forces. Floods caused considerable damage to all of this work which was under construction in the summer of 1908. This delay caused the foundation work to be done during the following winter which added to the expense.

The cement for these foundations was shipped from the east to the nearest point on a foreign railway and transferred from there to the point of construction by teams.

The concrete aggregates were obtained at the nearest local point possible.

The steel work was fabricated in the east and shipped via C. M. & St. P. Ry. to Butte, from there by foreign lines to the nearest material yard, from where it was taken by work train to the point of erection.

SPECIAL FEATURES:

Between Finlen and Huson irrigation ditches were encountered which required in many cases special construction.

A grade revision has been made near Sinclair reducing the original 1 per cent gradient to a 4/10 of one per cent.

Many large channel changes were made in the Hellgate River Valley. These were extra large on account of the extreme flood periods of this river.

An unusual flood occurred in the Hellgate and Missoula River Valleys during the summer of 1908, which seriously damaged the C. M. & St. P. work under construction and the Northern Pacific operated line, as well as flooding cultivated fields and carrying away construction material and equipment. After the flood several grade and line revisions were made. Some of which were done jointly with the Northern Pacific.

An expensive wagon road was built in the Bitter Root Mountains for construction purposes, part of which is chargeable to this valuation section. This is more fully described in the Historical Sketch Valuation Section Idaho 1.

Many slides occurred on this section during construction and early operation, which added to the construction expense.

Large areas of land were purchased and damaged timber paid for in connection with the bridge fill sluicing in the Bitter Roots.

A 5 ton cable tramway was built between the east portal of St. Paul Pass Tunnel and the summit, for handling bridge timber, for structures on the west slope. This was about 5000 feet long and was built of native hewn timber.

During the years of 1907-08-09 when the railway company had a large construction force working in this district, they were able to keep down the forest fires originating from the burning of clearing, camps and other customary causes, by the use of fire patrols, which were maintained at all times during the dry season. In cases where the fire patrols were not able to cope with the fires, there were always large construction forces close at hand, which could be called upon for assistance at any time, and there was no hesitancy in calling on construction forces when there was danger of a fire getting beyond control. During the summer of 1910, at a time when the entire country was dry, and the railway company forces were materially reduced in this district, there were several small fires at various points. During the early summer as such fires occurred, they were handled by the National and State forest forces, assisted by the Railway Company forces, and in a general way, the fire situation was considered as being under good control until August 20th, when there occurred an unexpected change of weather, resulting in high winds which reached tornado velocity. The occasional smoldering fires at various points, with the entire country very dry, were soon increased to such an extent that the entire district from Avery to Saltese was largely a mass of fire. The strong winds transferred burning embers and sheets of flame from point to point, so that practically nothing escaped. All living creatures perished with the exception of those that managed to get into the tunnels. The Forestry Department buried the bodies of 25 fire fighters in the vicinity of Avery on August 24th. Between 75 and 100 fire fighters are supposed to have lost their lives in this territory between August 21st and 25th, 1910.

In addition to the loss of life above mentioned, loss of property was enormous and consisted of standing timber over the whole burned area, owned by Government and private parties. Railway Company property consisting of construction camps, supplies, equipment, construction material on hand, cars, turn tables, station buildings, track, etc.

The reconstruction of, approximately, the 40 miles of railway damaged by this fire cost the Railway Company about \$300,000.

The old construction wagon road, which had not been used since the line was opened for traffic, was cleared and repaired for handling the supplies and material. Employees and material from all divisions were rushed to the scene as fast as possible. The gathering together of material and equipment was exceedingly hard as all the mills in the vicinity had been burned and those farther away had closed down and prepared to fight the fire. The country was

scoured for teams to haul material. The timber bridges were in most cases totally destroyed, and steel bridges were warped and weakened. The rails were bent and broken from the intense heat and the track was covered with fallen timber.

The line was out of commission for 16 days so the loss in suspension of traffic was also great.

About twenty miles of timber flumes being used in the bridge fill sluicing were burned, and it was necessary to reconstruct them before the work could be completed.

TUNNELS:

Between Garrison and St. Paul Pass, there are six tunnels, the first one being numbered 14 and located near Garrison. This tunnel is 1975 feet in length with the usual standard section. An unusual amount of over break occurred here caused by striking an extensive pocket of disintegrated rock. There was also a large amount of force account work done here due to the unusual conditions.

No unusual conditions occurred at tunnels number 15 and 16.

No tunnel was contemplated, on the original line, at the present location of tunnel 16½. The flood of 1910 undermined the river banks and roadbed, which had been constructed at this point, causing a change of alignment, throwing the center line farther into the bluff and making the construction of this tunnel necessary.

This change came so late in the construction program, however, that it was impossible to complete the tunnel in time for track laying and a temporary run around was constructed.

Ordinary conditions existed at tunnels number 17 and 18. At tunnel number 19 a serious slide occurred soon after track was laid, making it necessary to line it with concrete at once.

The work on the aforementioned tunnels was all done by hand, the top heading method being used. Cars and track with horses carried the material to the fills and waste banks. The timber lining was largely coast fir shipped to the nearest point on foreign railway lines and from there hauled by team.

The work on the St. Paul Pass Tunnel was done by Winston Brothers Company. The top heading was driven first after which the lower portion was drilled and broken up. Model 20 Marion shovels operated by air worked in from each end, loading the material on 1½ yard cars, which were handled by electric motors.

To furnish the electricity a power house was built at Taft, and a transmission line from there to the east portal of the tunnel, where a substation was installed. A transmission line was also built over a summit to serve the west end.

The tunnel was lighted by electricity and trolley wires were strung for the motors. The power plant at Taft was operated by steam. Three 8 hour shifts were maintained entirely through the construction as the work was rushed all possible to avoid delay to track laying and the consequent opening of the line.

Men were hard to keep as the work was disagreeable and hard. Several large veins of water were encountered and at times the working conditions were almost unbearable. The deep snow in the winter also retarded the work and made the men dissatisfied. To overcome the shortage of men a bonus system of payment was established.

The timber lining at the east end was foreign lumber shipped to Taft and hauled from there by team. Lining in the west end was largely native timber from the Clear Creek Saw Mill.

The tunnels on this section, have been lined, where necessary, with concrete, since the line was opened for traffic, with the usual high car outfit.

TRACK LAYING:

For track laying purposes, material yards for storing track material of all kinds were established at Morel and Huson. Track laying operations covered ten months as a whole - actual work of laying covered about 160 days, making an average of 1.4 miles per day. Commencing at Cliff Junction August 8, 1908 track was laid in several sections at different times reaching Missoula March 29, 1909. Rails, fastenings and other track material were shipped from the East over foreign lines - ties from Western points on foreign lines. Main line steel was new 85 pound, sidings and yards were laid with second hand - 75, 60 and 56 pound material. Work was all done with a Roberts Brothers Machine. Track laying began at Huson September 7, 1908 and continued west to Cyr ending there September twenty ninth. The same crew began again at Huson October 2, 1908 and laid track east to Missoula, ending October twenty-first. From Cyr west track laying began December 1908 and ended at St. Regis January 6, 1909. From Haugan track was laid east to St. Regis between October fourth and December 5, 1908 and from Haugan, west to the State line between October fifth and November 5, 1908. Continuous track laying was impossible on account of delay due to construction of the larger steel structures.

BALLAST:

For ballasting operations on the part of this section from Cliff Junction to East Portal, gravel pits were developed, at Sinclair, Haskell, Thelma, Frenchtown, Superior and Haugan.

The line from Colorado Junction to Cliff Junction was ballasted in 1913 from the gravel pit at Deer Lodge.

WATER SUPPLY:

For track laying operations numerous temporary water stations were installed. Owing to the fact that the line follows

waterways along the entire distance as far as Saltese, there were no unusual difficulties experienced in obtaining an adequate supply of good water. Temporary tanks were later replaced with permanent standard structures.

FENCES AND SNOW PROTECTION:

Soon after track was laid fence material was distributed by work train and the construction was started. The right of way was fenced on both sides except in inaccessible and isolated places. Cattle guards and wing fences were built at important road crossings and gates were installed at farm crossings.

Snow sheds were built at points where developments indicated they were required. The daylighting and widening of cuts in the mountains was also in line with protection from snow.

BUILDINGS:

As rapidly as material could be assembled, after track was laid, the necessary buildings for operation were constructed. Engine terminals were built at Deer Lodge and Alberton with quite extensive shops at the former place. Permanent frame depots have been built at the important stations, and neat parks are maintained. At Missoula a commodious brick depot, with second story for Division Offices, was built and artistic parking and well arranged driveways add to its appearance. A brick freight depot with extensive track layout was built here also. Buildings for section facilities were built where needed.

TELEGRAPH:

Material for telegraph lines was distributed by work train. This work was finished as soon as possible as it was the most important feature for safety in train operation. In addition to the telegraph instruments, dispatchers' telephones were installed in the depots, and in booths at blind sidings.

SIGNALS:

Automatic block signals are used throughout.

EQUIPMENT:

Rotary snow plows are operated over the line west of St. Regis during the winter season. East of St. Regis flangers are used to keep the track clear of the comparatively light snow fall.

ELECTRIFICATION:

This entire section is electrically operated. Substations have been built at Morel, Gold Creek Ravenna, Primrose,

Tarkio, Drexel and East Portal. Power for the Morel station is obtained from the Montana Power Company's Plant at Great Falls, and for the others from the plant at Thompson Falls. The power is received at the substations at 100,000 volts, alternating current, where it is transformed and regenerated to 3000 volts direct current, for train operation.

OPERATION AND MANAGEMENT:

The east end of this section between Colorado Junction and Deer Lodge is a part of the Rocky Mountain operating division and is handled by the Superintendent and his Assistants at Three Forks, Montana.

The part between Deer Lodge and the state line is the major portion of the Missoula operating division with Superintendents' headquarters at Deer Lodge.

VALUATION SECTION MONTANA 5.

Valuation Section Montana 5 covers the line extending from Harlowton in a general northerly direction through Meagher and Fergus Counties to the junction of the Great Falls and Hilger Lines west of Lewistown and comprises about 64 miles of railroad.

The line between Harlowton and Lewistown was built by the Montana Railroad Company in 1903 and when purchased by the Chicago, Milwaukee & Puget Sound Railway Company formed a part of the former Company's main line between Lombard and Lewistown.

The original surveys took place in August and September, 1902 under Mr. T. A. Clark, and the final survey was made in the Spring of 1903. Three separate preliminary surveys were made before the final adopted location was obtained.

In general, the line as constructed follows open creek valleys with a rolling gradient of one percent although a one and five-tenths percent gradient is used to attain a summit near Oka station.

The territory between Harlowton and Lewistown was unsettled at the time of construction of this line. All supplies, contractors' equipment, bridge and culvert material, etc., were shipped to Harlowton, from there they were hauled by teams to the points of use. No supplies were available locally.

A contract was awarded to the Utah Construction Company for the grading, bridge and culvert work, who in turn sublet the entire line to J. R. McShane & Company of Omaha, Neb. Construction was started in the Spring of 1903 and completed in October of the same year. The country being unsettled very few laborers could be obtained locally and it was necessary to import them via the Northern Pacific Railway to Lombard, thence via the Montana Railroad to Harlowton. Due to the bad water, camping conditions were adverse and it was necessary in many cases to haul water for long distances.

A large amount of cemented gravel was encountered in the grading, which required blasting. Some shale and solid rock was also encountered. After the completion of the grading in 1903 the contractors brought suit for additional compensation on account of the necessity of blasting the cemented gravel, and after several years of litigation received \$70,000.00 in settlement of their claim.

The Chicago Milwaukee & Puget Sound Railway and the Chicago, Milwaukee & St. Paul Railway have done a large amount of improvement work since their acquisition of the line in 1910. The entire line has been relaid with heavier rail, and cuts and embankments widened, culverts replaced, pile bridges strengthened and reconstructed, right of way fenced, and fire guards plowed. When the line was extended to Great Falls and other branch lines built out of Lewistown, extensive changes were made at that point.

The Montana Railroad depot at Lewistown was situated at the southerly end of First Avenue and the line originally terminated at the end of track about 900 feet north from the depot. When the Hilger Line was built it was connected with the end of track at this point. In the new layout two main tracks were graded, leaving the old line east of Spring Creek and extending through town about 200 or 300 feet to the east of the old main line and the Hilger Line, and crossed Main Street at approximately the same place. This involved the moving of the old engine terminal facilities, building new bridges across Spring Creek, grading new spurs to the various industries, and the construction of three channel changes in the Flour Mill Power Canal. The excavation was exceedingly wet due to the seepage from the Power Canal, and a long retaining wall was constructed as a matter of safety just east of the present depot. The site of the present passenger and freight depots was a waste of low ground that was flooded with water in wet seasons and a large amount of Force Account was paid in connection with the filling due to the special conditions.

Extensive freight yards were built in the outskirts of town along Spring Creek Valley. These necessitated three important channel changes at Spring Creek. The banks of the new channels are well protected with hand placed riprap and three dams were constructed to retard the flow of water. Part of the grading in these channel changes and yards was done by teams and grading machines, and part with train hauled material. Considerable hand work was required in the channel changes due to the soft wet material.

The engine terminal buildings are located at the extreme east end of the freight yards, and a large amount of grading was required as the channel of the creek originally lay where these buildings now stand.

During the construction work in Lewistown it was necessary to maintain tracks for the operation of the Grass Range, Hilger and Harlowton Lines, which often required the construction of temporary tracks and added materially to the cost of the work. The old Grass Range Line ran through the site of the present round house, and the old Hilger Line ran through the present location of the passenger station.

At Harlowton in 1907 a new connection with the main line was built which was about 6400 feet long, and is now the west leg of the wye. After this was built about 4000 feet of old track was taken up.

About 124 miles of six furrow fire guards have been plowed.

56 pound steel was laid in 1903. This was replaced with new 65 pound and 75 pound steel in 1912. The ties in the old road-bed were largely of hewed pine. Renewals have been made with western fir sawed ties. Tie plates have been placed on all new ties. Gravel ballast placed on the line since 1910 was hauled from gravel pits located at Two Dot, fourteen miles west of Harlowton on the main line, from pits in Miles 19 and 49, and the Brooks pit eleven miles north of Lewistown on the Hilger Line.

Temporary water stations were at Judith Gap, Straw and Moore, and three temporary stations were used at Lewistown. Permanent stations are maintained at Oka, Straw, Moore and Lewistown.

Many of the original culverts have been replaced since 1910 with corrugated iron, cast iron and concrete pipes. The pile trestles were rebuilt in 1911 to conform to the Chicago, Milwaukee & St. Paul standard design.

Right of way fence with the proper crossing facilities has been provided except through the important station grounds. Portable snow fence is used where protection is required.

Combination freight and passenger depots were built at Oka, Judith Gap, Garnell, Straw and Moore. In 1913-14 a two story brick passenger station with rooms for the Superintendent's offices, and a one story freight house, were built at Lewistown. These buildings are surrounded with artistic parking and well arranged driveways. Engine terminals and shops were also built at this point in 1913-14 including a 12 stall round house, machine and blacksmith shop, power house, general store house, etc. The buildings are all of modern superstructure on concrete foundation.

Telephones for train dispatching purposes have been installed in booths at blind sidings as well as in the depots.

The line is operated as a part of the Northern Montana Division, with local offices in Lewistown. Standard main line equipment is used, and the traffic is fairly heavy.

VALUATION SECTION MONTANA 6.

Valuation Section Montana 6 covers the branch line, extending about 36 miles in a general easterly direction from Lewistown to Grass Range, Montana. This branch is situated entirely in Fergus County, and is usually known as the Grass Range Line.

During the Fall of 1909 and the Winter of 1909-10 reconnoissance, preliminary and location surveys were made for a branch line from Lewistown to Weede on the Musselshell River. Two survey parties were on this work, one between Lewistown and Grass Range, and the other between Grass Range and Weede. An attempt was made to attain the divide near Heath on a 1 percent gradient, but the work was found too heavy, so the line was located on a 2 percent gradient as it now is. A total of about 88 miles of location survey was required to produce the 36 miles of adopted and constructed line.

The line as adopted and constructed follows the east fork of Big Spring Creek from Lewistown to Heath with varying gradients, the maximum being .97 percent. From Heath an ascent is made on a 2 percent gradient to a divide at Orange in Mile Twelve. This divide is a low gap between the Big Snowy Mountains lying on the south, and the Judith Mountains on the north. Leaving the divide a descent is made on a 2 percent gradient along the South fork of McDonald Creek to Norton. From Norton to Grass Range, McDonald Creek Valley is followed on varying gradients, the maximum being 1 percent. At the time of construction McDonald and Big Spring Creek Valleys were under cultivation, and wagon roads were in existence. Water was plentiful and of good quality. All equipment was transported by team from Lewistown. A small amount of horse feed was obtained locally, but for the most part all supplies were hauled from Lewistown. Labor was scarce and men were shipped in from various points.

This line was constructed at two different periods under separate contracts. A contract was entered into with McIntosh Brothers in 1910 for the construction on the basis of

cost plus a percentage. Under this contract the work was sublet to three other firms. The grading was begun in May, 1910, and was practically completed on the first 24 miles east from Lewistown by December, when the work was ordered discontinued and forces were disbanded. Likewise between Mile Twenty-four and Grass Range considerable grading had been done, but no bridge or culvert work. A second contract was entered into with D. J. Burke on August 29th, 1912 for the completion of the first 24 miles on a force account basis with fixed rates of pay for teams and other equipment and the construction of the last 12 miles to Grass Range, on a unit price basis.

The grading was variant, some miles running as low as 5000 cubic yards, and some 50,000, the average being about 22,000 cubic yards per mile. Common material predominated, being about 65% of the total. The work was largely done with the use of teams and grading machines or scrapers as the case required. The rock work on Miles Eight to Fifteen inclusive was done by station men with the use of cars and track to carry the material to the fills. Numerous channel changes were made along the creek valleys to avoid crossings, and several irrigation complications required expensive work. In McDonald Creek Valley the line encroached upon and interfered with the public highway in many places, necessitating the purchase of right of way and the reconstruction of the highway on a new location by the Railway Company.

In the interim between the cessation of work in 1910 and the resumption in 1912, two bad slides occurred in Mile Ten, which were removed by force account, but continued to give trouble after the track was laid, necessitating a shoe fly for train operation. The Moran slide at Station 140-150, Mile Ten was the most serious. A steam shovel was installed in this cut and the material removed was hauled to the Lewistown yards.

The bridge and culvert work was done by D. J. Burke under his contract. The bridges were pile trestles built in accordance with the C. M. & St. P. standard plans. The culverts were of corrugated iron pipe and timber. All material was furnished by the Railway Company and delivered to the material yard at Lewistown; from there it was hauled to the points of erection by team with a haul limit of 14 miles. From Norton east the material was hauled from end of track as the track laying progressed. In some cases the track arrived at the bridge sites before the structure was completed and it was necessary to put them temporarily in shape in order not to delay the progress of the track. These bridges were completed later and the contractor was reimbursed for his extra expense.

Track laying was done by Company forces with a Roberts Brothers machine, and followed the finished grade as rapidly as possible. The main line was laid with new 75# steel and

the sidings with lighter material. The ties were of Western fir. Ballast was placed in 1913, being hauled from Wachusett Pit, located on the Lewistown-Great Falls Line about 8 miles west of Lewistown.

Right of way fence with the necessary crossing facilities was provided except through the important station grounds. Standard combination freight and passenger depots were built at Forest Grove and Grass Range, and smaller depots at Heath, Norton and Becket. Water stations were installed at Norton and Grass Range, and section crew facilities at points convenient to the work.

The line is operated as a part of the Northern Montana Division with headquarters at Lewistown. The usual branch line equipment is used as the traffic is fairly light.

VALUATION SECTION MONTANA 7.

Valuation Section Montana 7 covers the lines known as the Roy and Winifred Branches, both lying wholly in Fergus County, Montana. The Roy Branch extends in a general north-easterly direction from Lewistown to Roy, and comprises about 43 miles of railroad. The Winifred Branch leaves the Roy Branch at Roy Junction and extends about 24 miles in a general north-westerly direction to its terminus at Winifred. This latter line follows the Dog Creek Valley and is sometimes designated as the Dog Creek Line. The former line is usually known as the Roy Line.

The first surveys for these lines were made in 1910 when a preliminary and location survey was made to Roy. As will be shown later a short section of the line was immediately constructed following these surveys, and about a six mile section in 1911. In 1912 the final construction was commenced, just previous to which a location was made revising the previous survey to a considerable extent. This work was done in September, 1912.

On September 15th, 1912, surveys were started toward Winifred from Roy Junction. The controlling feature on this survey was the crossing over the divide between Deer and Dog Creeks. Two complete surveys were made at this place, one for a one percent and one for a one and one-half percent gradient. Surveys were completed into Winifred on October 27th, 1912.

Summarizing the surveys for the two lines we find that 90 miles of preliminary and 68 miles of location survey was made for the 43 miles of adopted and constructed line to Roy, and 40 miles of preliminary and 24 miles of location survey made for the Winifred Branch.

The Lewistown-Roy Line follows natural drainage over almost the entire distance. Between Lewistown and Baxter, Burnett Creek is followed. One mile north of Baxter a divide is attained by the use of a maximum one percent gradient. From there the line descends on a one percent gradient to Warm Spring Creek, near Brooks. Leaving Brooks the gradients on the first 4 miles are rolling, thence an ascent along Bull Creek on a maximum 1-2/10 percent gradient is made to Hilger. From Hilger a descent is made along Gumbo and Deer Creeks on a 1-2/10 percent gradient to Armelle Creek. Armelle's Creek

is ascended on a 1-5/10 percent gradient to the divide on Mile Thirty-four. From Mile Thirty-four a continuous descent is made to the terminus at Roy, the maximum gradient being 1-5/10 percent. The curvature is mediumly sharp, 8 degrees being the maximum.

On the Winifred Line a 1-5/10 percent gradient is used to attain and descend the divide between Dog Creek and Deer Creek. Heavy side hill development work is used over the divide, thence the line follows the Dog Creek Valley on a maximum gradient of one percent to Winifred.

The first 12 miles from Lewistown was built in 1910-11 and was known as the Kendal Extension, as the Kendal Mines were located about 18 miles north of Lewistown on the east slope of the North Moccasin Mountains. In 1911 the line was extended 5 miles farther to Hilger and in 1912-13 it was extended to Roy, and the Winifred Branch built.

McIntosh Brothers were the general contractors for the 12 miles built in 1910. They sublet the work to Brown, O'Neil & Leahy. The five mile extension to Hilger in 1911, was let to D. J. Burke. In May, 1912, D. J. Burke was awarded the contract covering the construction of a six mile extension north from Hilger. After forces were organized and the work under way, the length of this extension was reduced to 4 miles and an indemnity was paid to the contractor for his additional expense in moving his equipment away from the work without being able to complete it. In September, 1912, D. J. Burke was awarded the contract for completing the line to Roy, also for the grading on the Winifred Branch. The grading into Winifred was completed in October, 1913, and to Roy in December of that same year.

Between Lewistown and Hilger the grading was done with grading machines, dump wagons, and scrapers. Material encountered was usually earth, with the exception that hard pan, shale, loose and solid rock occurred in the deeper cuts. From Hilger north to Armells Creek, on the Roy Line, the material was largely gumbo and was not easy to handle. In the heavier cuts, and especially in the Summit Cut in Mile Thirty-four, gravel intermingled with hard pan, loose and solid rock was encountered. Along Box Elder Creek the material was comparatively easy to handle, hard pan being encountered only occasionally. The work between Hilger and Roy was done with fresno scrapers, grading machines and wagons. At the Summit Cut caterpillar engines were used for hauling the grading machines. A steam shovel was also transported over land to this cut as a matter of precaution, it appearing that the material was not going to be handled satisfactorily by the grading machine. The steam shovel was only used for a short time as the grading machines did better work than was expected. Teams with scrapers and grading machines were used on the Winifred Line with the exception that a steam shovel was used in the heavy cut near Roy Junction. This shovel was brought to the work after the track had been laid north from Hilger.

The bridge and culvert work on the first 12 miles from

Lewistown was done under contract with McIntosh Brothers. From Hilger to Roy, and from Roy Junction to Winifred such structures were built by D. J. Burke under contract. Bridges were all built in accordance with the Railway Company's standard plans. Bridge timber was of Western fir and the piles of cedar.

The culverts were of timber, corrugated iron and cast iron pipe.

All bridge and culvert material was furnished by the Railway Company. The material was hauled by team from Lewistown until the line was completed to Hilger. The material for the Roy Line north of Hilger and for the Winifred Branch was hauled by team from Hilger, where a material yard was established. The construction work on the Lewistown-Great Falls and Lewistown-Grass Range Lines was in progress at this time, and Lewistown was used as a point of supply for all of this construction. Consequently, the material was unloaded at Lewistown, reloaded and shipped to Hilger, where it was unloaded and hauled to the points of use.

Track was laid by hand between Lewistown and Hilger in November, 1911. The track between Hilger and Roy Junction was laid by hand during July, 1913, by Contractor, D. J. Burke. A machine was used between Roy Junction and Armelle, which place was reached December 9th, 1913. Work was delayed here until March 21st, when work was resumed, and track laying was completed into Roy on April 17th, 1914. The work from Armelle to Roy was done by hand. Track laying on the Winifred Line was done with a machine. Work was commenced on October 10th, 1913, and completed on November 18th.

Second-hand 56 and 60 pound rail was used with fir ties. The track was side surfaced during the summer of 1914, and some ballast has been placed since that time.

Right of way fence with the proper crossing facilities was built where required. A large part of the fence is a combination woven and barbed wire, used on account of the line passing through a sheep country. Portable snow fences are maintained where protection is needed.

Good water in sufficient quantity was obtained from running streams on the Roy Line. Permanent water stations were established at Roy Junction, Armelle and Roy. On the Winifred Line water supply is not good and was hard to obtain. For construction purposes a dam was built across Dog Creek at Christina, but this water was not of good quality for locomotive purposes. Wells were drilled at Winifred, but the water also proved to be of poor quality.

Combination freight and passenger depots were built at Hilger, Roy and Winifred, and smaller structures at the less important places.

Telegraph and Telephone material was distributed by work train. Telephones are used for dispatching purposes, being installed in the depots and in booths at blind sidings.

These lines are operated as part of the Northern Montana Division, the Division Offices being in Lewistown. The ordinary branch line equipment is used as the traffic is comparatively light.

VALUATION SECTION, MONTANA 8.

GENERAL LOCATION

Valuation Section Mont. 8 covers the Lewistown Great Falls Line, which extends in a general northwesterly direction from Lewistown through Fergus, Choteau and Cascade Counties to Great Falls, a distance of about 137 miles. The section actually terminates in West Great Falls about one and one-half miles west of the passenger depot.

SURVEYS

An exploration of this territory was made early in 1910, and immediately following four location parties were placed in the field to make more detailed surveys of the routes examined. The first party worked from Glengarry on the Harlowton & Lewistown Line in a northwesterly direction to Arrow Creek. The second party made surveys in the Big Sag Country, the third in the Belt Creek District and the fourth between Belt Creek and Great Falls.

Leaving Glengarry this survey extended almost due west for three miles, thence northwesterly to the Judith River, thence along the Judith River about fourteen miles to Sage Creek. In the Sage Creek Valley a loop line was surveyed to reach the divide between that creek and Running Wolf Creek. Leaving the summit the line ran north and west to Coffee Creek, which was followed to near its junction with Arrow Creek. Arrow Creek was followed in a southwesterly direction for about ten miles, thence the line swung northwesterly past Square Butte and reached the high bench at Waltham, thence southwesterly and westerly across Belt Creek to Falls Yard. The total length of this line was 166 miles. The surveys were completed in the Fall of 1910.

In October, 1911, further surveys were undertaken with a view of shortening the original line of 166 miles to about 135 miles. Three parties covered the territory quite thoroughly, making about 114 miles of discarded survey before finding the adopted line.

Partial records indicate that about 417 miles of location survey was made to produce the 137 miles of adopted and constructed line exclusive of the many miles of preliminary.

CONSTRUCTED LINE

The line as constructed follows Big Spring Creek on a descending gradient for the first nine miles out of Lewistown. In Mile Nine Big Spring Creek forms a junction with Cottonwood Creek and the line crosses these creeks on a high timber trestle. This trestle is used and was built jointly by the C.M. & St. P. Ry. and the Great Northern Co. From this

point the line strikes across heavy drainage toward Arrow Creek, and as a consequence the gradients are rolling and the work is very heavy. It might be interesting to know that the line from Lewistown to Arrow Creek does not vary from a straight line more than four miles at any point.

From Arrow Creek Station the line descends with a 1.5 percent gradient and with sharp curvature along Surprise Creek to Pownal. This territory is Bad Land formation and heavy cuts and fills are used for the side hill development. This gradient between Arrow Creek and Pownal is the heaviest on the line, and as will be shown later quite complete facilities are provided for helper engines between the stations.

From Pownal the line descends along Arrow Creek to Ira Junction with the so-called Big Sag, thence follows the Big Sag through valley formation, but with rolling gradients to Highwood, a distance of about fifty miles.

Leaving Highwood a descent is made along Highwood Creek for about four miles, thence an ascent with side hill development to the bench at Waltham, thence a descent with extremely heavy work to Belt Creek, thence an ascent to the bench near Salem, which bench is followed to the Falls Yard, which is in the outskirts of Great Falls.

Through Great Falls two lines were constructed, one to the freight house and team tracks and one to the passenger station. These lines diverge near Black Eagle Park. The line to the passenger station bears almost due west from Black Eagle Park to an undercrossing with the Great Northern Havre Line, thence swings southwesterly along the Missouri River to the passenger station on First Avenue, thence crosses the Missouri River, and extends in a northwesterly direction to the end of the Valeria Section. The freight line is commonly called the Valeria Way Line. From the junction at Black Eagle Park this line extends in a southeasterly direction along the so-called Valeria Way to Eighth Street, thence west to Third Street, thence north to the freight house and team tracks at Second Avenue. In accordance with the franchise this line is operated by electric engines.

NATURE OF THE COUNTRY

Between Lewistown and Arrow Creek the country was fairly well settled and some highways were in existence at the time of construction. Since construction many new settlers have arrived and a large amount of additional land has been put under cultivation.

Between Arrow Creek and Highwood the valley was occupied largely by stock ranches. In this section a considerable amount of alfalfa and hay was produced by irrigation methods. The adjoining bench lands were uncultivated. Between Highwood Station and Great Falls the country is quite rough and is partly

of Bad Land formation.

As would be indicated by the description very little provender could be obtained locally at the time of construction, and, as a consequence, most of it was shipped in over the Great Northern Railway, thence hauled by teams to the points of use.

CONSTRUCTION ORGANIZATION

Construction was carried on under the overhead supervision of a division engineer, three district engineers and eleven resident engineers. The division engineer maintained offices in Lewistown. There was also an assistant engineer of bridges and buildings with offices in Lewistown, who cared for the construction of permanent bridge work and culverts. A Master Carpenter's Office was maintained to attend to the construction of the water stations, depots, etc. When track laying began the office of Superintendent of Construction was opened in Lewistown to care for the track laying, ballasting and other miscellaneous items of construction.

CONTRACTS

Twohy Bros. Company of Portland, Oregon were given the contract for the construction of the first sixty-three miles of line out of Lewistown and for the work within the city limits of Great Falls. The contract for the construction of the seventy miles between the sixty-third mile point and Great Falls was awarded to Winston Bros. Company of Minneapolis, Minn. These contractors did a part of the work with their own forces, but a large part of it was sub-let to other contractors.

Labor was scarce during the entire period of this construction and thousands of men were shipped from both the East and the West. During the Fall months when harvest was in progress, it was especially hard to get men, and those that were on the work left for the harvest field. This labor difficulty entered largely into the cost of the line.

As previously indicated in the description of the country there were a few wagon roads in existence, but it was necessary in many cases for the contractors to construct roads to facilitate their operations. The more important road work was done near Arrow Creek where a road was constructed down to the valley of Surprise Creek and in the vicinity of Belt Creek and Red Coulee. In connection with the work in Belt Creek a timber bridge was built across the Creek at what was known as the Peck and Lacy Crossing. Road work was paid for by the Railway Company. The bridge was later sold to the county for about one-half its original cost.

CONSTRUCTION

To facilitate a description of the construction, the work will be divided into sections according to the contract.

Section No. 1. Lewistown to Mile Sixty-three.

Twohy Bros. established their headquarters and store houses at Stanford on The Great Northern Railway and transported supplies, material and equipment by team from there. The equipment, etc. used in the vicinity of Lewistown was transported from that point. Shipments to Stanford were usually routed via the Chicago, Milwaukee and St. Paul Ry. to Judith Gap where they were transferred to the Great Northern.

The grading on this section was variant, but generally quite heavy. Between Miles 0 and forty-five, the average was 41,000 cubic yards, Miles forty-five to fifty-one, 103,000 cubic yards, and Miles fifty-one to sixty-three, 28,000 cubic yards. Practically 100 percent of the material was classified. The grading was largely done by teams with the use of grading machines or scrapers as the occasion required. Steam shovels were used in the approaches to the Sage Creek Tunnel and on the heavy work in Miles twelve and thirteen. These shovels were brought overland from Stanford to the point of use, a distance in each case of about twenty-one miles. Coal and explosives were hauled from Stanford. At the Sage Creek Tunnel Approach Cuts bad water occasioned frequent delays while boilers were being cleaned and flues renewed. As a last resort a two and one-half inch pipe line was laid from the East Approach to Judith River.

Taken as a whole the grading on the first sixty-three miles was extremely difficult and was very deceiving to the contractors. What appeared on the surface as common earth changed to shale, loose and solid rock when the cuts were opened. In the Arrow Creek Valley where the material was apparently silt, it was found too hard to plow. Grading machines operated with sixteen and twenty horses were unable to perform efficient work. Cemented gravel developed in many of the cuts which required blasting. Along Big Spring Creek a considerable amount of wet excavation was encountered which was classified as loose rock. The work on Mile Nine where the Great Northern and the C. M. & St. P. lines are in close proximity was all done by the Great Northern, the C. M. & St. P. Co. standing their share of the expense. The fill at Station 620 on Mile Twelve was placed during the Winter Season, and in the Spring the settlement was so great that about 15,000 additional cubic yards were placed. After the line had been in operation a short time a slide occurred under the foundation of the east abutment of Judith River viaduct, which caused a break in the concrete work. About 9,000 cubic yards of approach embankment were removed and a pile trestle driven to relieve the pressure.

Several slides occurred on the Surprise Creek Hill between Miles Forty-five and Forty-eight after Twohy Bros. had completed their work. The contracts for removing these slides were

let to D. J. Burke. In many cases it was impossible to obtain measurements from cross sections, consequently he was paid on car measurement.

Section No. 2. Mile Sixty-three to Falls Yard.

Winston Bros. established headquarters and store house at Fort Benton on the Great Northern Railway. Outfits and supplies were shipped to Fort Benton and transferred to the work by teams.

The grading on this section was also quite variant. Between Miles Sixty-three and 105 the average was about 25,000 cubic yards per mile. From 105 to 155, about 55,000, 115 to 119 about 145,000 and 119 to 135, 45,000. Grading machines and scrapers with teams were used wherever possible. The rock work was done by hand.

In Mile eighty-two, the line as located when the contracts were let, skirted the north shore of Big Crane Lake, but later, to shorten the distance and save curvature, it was decided to cross a portion of the lake. A temporary pile trestle was constructed for the use of the contractor at the Railway Company's expense and fill material placed therefrom. The lake bed was soft, causing excessive subsidence and the wave wash flattened the bank out. A large amount of rip rap was placed as a protection against the wave wash.

A very serious slide known as the Amphitheater Slide occurred on Mile 117 on this section between Tunnels Three and Four. This slide first appeared to be a subsidence as the embankment settled from six to eight feet over night. It has been estimated that the vertical drop aggregated over 100 feet. An attempt was made to raise the fill with borrowed material, but while the work was in progress cracks developed in the surface of the ground above the slide. A steam shovel was installed on the upper side of the fill to remove the sliding material and place it on the slopes down to Belt Creek to retard the movement, if possible. This steam shovel was twice buried and uncovered by hand shoveling. A part of the bore of Tunnel No. Four was included in this slide.

Section No. 3. Within the Great Falls City Limits.

The grading on the line to the passenger station was quite heavy averaging 58,000 cubic yards per mile, largely of solid rock. The work was all performed with steam shovels and standard gauge equipment. A large amount of this material was placed between the main line and the Missouri River bridge which required switching on switch backs.

The grading on the so-called Valeria Way Line averaged about 18,000 cubic yards. All of this work, done in Great Falls, was necessarily under the restriction of city ordinances and many precautions were taken to protect passers-by, etc. This extra work was paid for on a force account basis and added a considerable

amount to the cost.

TUNNELS

There are six tunnels on this section. They were driven and lined with timber by contract. The concrete lining was placed by the Railway Company forces.

Tunnel No. 1 or Sage Creek Tunnel is 2014 feet long. Blue shale, hardpan, loose and solid rock were encountered in the drive, and the east half was quite wet. During the construction of this tunnel a cloud burst occurred which obliterated the surface ditches over the west portal, and as the gradient is adverse, partially filled the tunnel with water. The water was pumped out at a considerable expense and caused about ten day's delay. This tunnel was lined through-out with concrete soon after the track reached it.

In Surprise Creek Tunnel, or Tunnel No. 2, blue shale material was encountered. This tunnel was not lined with concrete.

The four Belt Creek tunnels were through materials of hard blue shale, loose and solid rock. The hardest material was encountered in Tunnel No. 5. The timber lining for these tunnels was hauled from Windham on the Great Northern.

The Amphitheater Slide necessitated the re-timbering of about 200 feet of Tunnel No. 4, and the widening of the bore by eighteen inches. Concrete materials and outfit were hurried to this tunnel immediately after the slide and it was lined with concrete as a protection against further distortion. The lining in the east end was re-enforced with concrete buttresses to insure greater stiffness.

BRIDGES AND CULVERTS

The pile and timber bridges were constructed in accordance with the C. M. & St. P. Co's. standard plans by the contractor's forces. All the material was furnished by the Railway Company, delivered on cars to the point nearest the work and thence hauled by team. The piles were of cedar and the timber of western fir.

For Section No. 1, the material was delivered at a spur known as the Twohy Bros'. spur, about twelve miles south of Lewis-town on the Harlowton Line, at Brooke on the Hilger Line and at Stanford and Dover on the Great Northern. For Section No. 2, Winston Bros. work, material was delivered at Windham, Great Falls and Fort Benton, all on the Great Northern Railway.

The permanent bridges and the concrete culverts were constructed by the Railway Company's forces under the direction of the Assistant Engineer of Bridges and Buildings. The important permanent bridges were the Judith River Viaduct, Indian Creek Viaduct, Sage Creek Viaduct, Belt Creek Viaduct, Red Coulee Viaduct and the Missouri River Crossing in Great Falls. These

bridges all consisted of steel super-structures on concrete foundations. There were also several other concrete viaducts and large concrete arch-culverts.

Concrete aggregates were obtained as near the construction sites as possible, but in many cases this was very difficult, and they were hauled for long distances. Cement, lumber, reinforcement, equipment, camp supplies, etc. were all hauled from the nearest point on the Great Northern or C. M. & St. P. Lines. The steel work was erected after the track reached the bridge site.

The culverts on this line were of various types. Corrugated iron pipe was used in fills between three and twelve feet in height. For other places cast iron pipe, cast concrete pipe or timber boxes were used with the exception of the places where the concrete arches were built at important water ways. The cast concrete pipe was made by Railway Company forces in Great Falls. The culverts with the exception of the concrete arches were all installed by the contractor's forces.

TRACK LAYING AND BALLASTING

Track laying was begun on Dec. 23rd, 1912 and was completed in January 1914. The work followed the completion of grading as rapidly as possible, but was held up at the various permanent bridges during the erection of the steel. New seventy-five pound rails were used with western fir ties. The work was practically all done with a Roberts Brothers' machine.

Ballasting was begun on May 6th, 1913 and the first lift completed in September, 1914. Material was taken from pits located at Wauchusett, Amherst, Ware and Arrow Creek.

FENCES, BUILDINGS, WATER SUPPLIES, ETC.

The entire right of way was fenced and the necessary crossing facilities provided. The work was done by contract and the material furnished by the Railway Company. Snow fences were provided where protection was required.

Temporary water tanks were erected at Wauchusett, Amherst, Sage Creek, Mile Fifty, Mile Sixty-two, Geraldine and Shonkin and near the east city limits of Great Falls. Two temporary tanks were also constructed on Highwood Creek west of Highwood Station.

Permanent water stations were installed at Ware, Denton, Pownal, Square Butte, Geraldine, Montague, Highwood, Salem and Great Falls.

The development of water supplies for this line was very expensive. Deep wells were drilled at Arrow Creek and Pownal, which did not develop a satisfactory supply. At Ware and Square Butte springs were developed, and at Great Falls the intake is in the Missouri River.

Standard freight and passenger depots were built at Danvers,

Denton, Coffee Creek, Arrow Creek, Pownal, Square Butte, Geraldine, Montague, Shonkin, Highwood and Waltham, and smaller depots or shelters at the less important places. At Great Falls a large two story brick passenger depot, surrounded by a well laid out park, was built, and at the freight terminal, a brick freight house with a two story office portion. An engine terminal consisting of an eight stall roundhouse, turn table, power house, sub-station and other facilities were built at Falls Yard. The buildings are modern construction with concrete foundations and brick super-structures. Two stall engine houses, clinker pits and wyes were installed at Arrow Creek and Pownal to care for the helper engines.

The Valeria Way and the yards at Falls Yards were equipped for electrical operation. Electric locomotives operated with 1500 volts, direct current, are used.

OPERATION AND MANAGEMENT

This line is operated as a part of the Northern Montana Division with offices in Lewistown. Standard equipment is used.

VALUATION SECTION MONTANA 9

Valuation Section Montana 9 extends from a connection with the Lewistown-Great Falls Line in West Great Falls to a terminus at Agawam, a distance of 65 miles.

The surveys were begun about August 1st, 1912, under the supervision of E. O. Reeder, Assistant Chief Engineer, and under the general direction of A. G. Baker, Division Engineer, with Charles F. Healey as Locating Engineer. The route was along the north side of the Sun River Valley for a distance of about 20 miles out of Great Falls; it then ascended to the higher bench, or prairie, on which it was located, to the crossing of the Teton River; thence crossing the Teton River and along the easterly or northerly side of the valley thru the town of Choteau; thence along the higher bench or prairie to the terminus at Agawam.

Other than in the vicinity of Priest Lake, south of Choteau, the preliminary surveys practically coincide with the final location. Near Priest Lake several lines were surveyed over a distance of from five to ten miles. The located and constructed line provided for ruling grades of 1.2% north bound and 1.0% south bound and maximum curvature of 6 degrees.

The line was constructed along the general route as above described. Construction work in the Sun River Valley was generally of ordinary character of work in flat bottom lands, except that a landslide near Manchester threw the location into heavier work than would have been otherwise necessary and the necessity of an overhead crossing of the Great Northern at Vaughn involved some heavy grading and a long high trestle bridge in that vicinity. The bench land traversed was, and is, under the Sun River Irrigation Project, which involved more expensive construction than would have otherwise been required, involving the construction of a number of culverts, syphons and bridges for irrigation ditches and canals.

Gravelly and hard pan material was encountered in grading on the bench land, but no extraordinary difficult conditions were encountered except in the vicinity of Priest Lake, in the Teton River Valley near Choteau, and on the bench in the vicinity of Farmington.

At Priest Lake the embankment was on wet partially submerged land and after the roadbed had been completed a flood which caused a rise in the level of the lake made it necessary to reconstruct the roadbed on a higher grade line.

In the Teton Valley and in the vicinity of Choteau, floods--after the roadbed had been completed--caused extensive washouts and expensive work in restoring and repairing the embankments and bridges and culverts. This flood occurred during an interval while the work was temporarily suspended and some construction material which had been delivered and left at sites of proposed structures was carried away, involving considerable expense in recovering such of it as was not lost.

On the Farmington Bench and near Agawam some difficulties were encountered due to the nature of the ground which contained many boulders and because of seepage from irrigation ditches which added to the difficulties and cost of work. Sliding gravel on the slope below an irrigation ditch a few miles north of Choteau made some revision of line and reconstruction of roadbed necessary.

The contract for clearing, grading, and the erection of bridges and culverts necessary for the construction of the line was made with Twohy Brothers Company, dated November 1, 1912. The greater part of the grading and culvert work, and a part of the bridging was done under this contract, but about December 1, 1913, construction work was suspended and Twohy Brothers Company released from further work and a final estimate of the work done by them was made. Suspension of the work and delay in completing this line was due to the delay in the development of the country, caused by the non-completion of the Sun River Irrigation Project. Subsequently when construction work was resumed in April 1915, contracts for the completion of bridges, and for completing grading, repairing roadbed at washouts, and for raising the grade at Priest Lake, was made with D. J. Burke. Some of the bridge work was done directly by Railway Company forces, this including the trusses at the Great Northern Crossing at Vaughn and the bridge over the Teton River.

Track laying was completed to the terminus at Agawam in December 1916, 85# relay rail was used for approximately the first 20 miles out of Great Falls and the remainder being 65# rail.

This now is operated as part of the Northern Montana Division with headquarters at Lewistown.

VALUATION SECTION MONTANA 10.

Valuation Section Montana 10 covers the branch line of the Chicago, Milwaukee & St. Paul Railway extending from Ringling, Montana, in a general northerly direction to Dorsey, a distance of about 5-2/10 miles. This branch lies wholly in Meagher County.

This line was built in 1895-96 as a portion of the main line of the Montana Railroad. As described in the Historical Sketch on Valuation Section Montana 2, the Montana Railroad Company entered into an agreement and lease with the Chicago, Milwaukee & Puget Sound Railway Company on December 11th, 1907, in which the former Company agreed to improve the line between Harlowton and Lombard, and granted trackage rights to the latter Company for a period of 99 years. The Montana Railroad deeded their entire property to the Chicago, Milwaukee & Puget Sound Company in 1910. In revising and improving the line between Ringling and Summit a more advantageous route was found lying a considerable distance south of Dorsey, and in 1912 the rail between Dorsey and Summit was taken up. A town named New Dorsey is now situated on the main line and the old town is called Old Dorsey. In 1910 the White Sulphur Springs and Yellowstone Park Railway Company constructed a line from White Sulphur Springs to a connection with the old Montana Railroad, near Old Dorsey, and leased the line between Dorsey and Ringling for a period of 25 years.

The surveys for this line were made in connection with those for the Montana Railroad and very little information in regard to them is available. The same is true with respect to original construction.

Prior to the lease with the White Sulphur Springs and Yellowstone Park Railway, the line was materially improved by doing some grading and general track work, and by the substitution of better and heavier rail and new ties. New 85 pound rail was laid. This work was done by the Railway Company forces.

The old Montana Railroad bridges were of light construction. Consequently the four pile bridges on this line have been renewed to conform with modern construction. One masonry, one timber and two vitrified pipe culverts comprise the culvert work on this line. These were put in by Company forces at the time the road was repaired.

The right of way is fenced from a point about a mile north

of Ringling to the connection with the White Sulphur Springs and Yellowstone Park Railway near Old Dorsey. Portable snow fence is provided where protection is required. The proper road crossing facilities have been provided. The fencing was done by Railway Company forces.

The Montana Railroad Company had a warehouse 30 by 150 feet, two shearing sheds 40 by 105 feet and 50 by 82 feet, respectively, and a few other minor structures at Dorsey, which are still maintained by the Chicago, Milwaukee & St. Paul Railway Company.

The line is operated by the White Sulphur Springs and Yellowstone Park Railway Company, whose headquarters are at White Sulphur Springs. The ordinary branch line equipment is used.

VALUATION SECTION IDAHO 1

GENERAL DESCRIPTION:

Valuation Section Idaho 1 covers all of the main line of the C. M. & St. P. Ry., in the State of Idaho, comprising about 98 miles.

RECONNOISSANCE:

As a natural consequence all explorations in Idaho were continuous of those described in the Historical Sketch of Valuation Section Montana 4 and must therefore be continued in the same order of description.

Starting with the most southerly route that was considered practicable, namely; the Nez Perces Pass Route, the explorations were continued south from Rose Fork down McGruder Creek to the Selway Fork of the Clearwater River, in May, 1905. No trails existed along the last named river and progress with a train of pack horses was slow and tedious and not without danger due to the necessity of fording streams at high water stage. This party consisted of an Engineer and two men with pack horses and provisions for four weeks. They followed Selway Fork to the junction of Moose Creek, thence up Moose Creek easterly to its head at Lost Horse Pass, thence back to Grantsdale in Montana. They were in the field four weeks and covered about 100 miles. Another Engineer started in May, 1905, at Lewistown, Idaho and examined this route easterly up the Clearwater River to Selway Fork, thence up Selway to Nez Perces Pass. Between Lewistown and Kooskia examination was made from trains on the Northern Pacific Ry. East from there pack trains and saddle horses were used. About 75 miles of this exploration was covered by train and about 100 miles on horse back which required about a month of time.

Next in sequence is the Lolo Pass Route. No exploration was made from Lolo Pass west in 1905, but an instrumental survey was started in February, 1906, which will be described later under the head of "Preliminary Survey".

The next exploration covered a proposed route from Fish Lake Pass in the Bitter Roots down the North Fork of the Clearwater River to Ashsanka over an approximate distance of 125 miles. Many side trips were made in connection with this exploration and elevations were taken on bench and uplands along the north side of the riv

This closed explorations covering a line from the Bitter Roots with Lewiston, Idaho, as the western objective point.

The route explored next in sequence departed from the last named about 60 miles west of the Bitter Root Divide and extended west on a high bench terminating at Garfield, Wash., near the state line, a distance of about 75 miles, with a shorter exploration of 50 miles lying to the south.

Another exploration was made from Collins, Idaho, northerly to St. Maries covering about 45 miles. This trip had in view a connection with the present constructed line from the Fish Creek Pass Garfield Route, and the information obtained was used later in connection with the St. Maries Branch.

In May, 1906, an exploration was made east from Avery, or what was then known as North Fork, up the St. Joe River to the head waters and connected with the Cedar Creek explorations on the south slope of the Bitter Roots. This trip covered about 60 miles and required about a month's time. The country was wild and rugged and pack horses were used for transportation.

Lastly we take up the exploration of the present or adopted line from St. Paul Pass via the St. Joe River through Watts Summit in the Coeur d'Alene Mountains to the state line near Tekoa, Washington. Very extensive explorations were made along this route, about 300 miles being covered.

Following is a summary of reconnoissance work in Idaho:

Nez Perces Pass, Selway Fork and Moose Lake -	100	Miles
Nez Perces Pass to Lewistown - - - - -	175	"
Fish Lake Pass and North Fork of Clearwater River - - - - -	125	"
Garfield Route - - - - -	125	"
Collins to St. Maries - - - - -	45	"
Main St. Joe River, Avery to Fish Lake - - -	60	"
The adopted route - - - - -	300	"
Total	930	"

Practically all of these explorations were made in a wild uninhabited country. Pack horses, men packers, and boats were used for transportation. It was necessary to carry provisions for each trip as no stores existed in the country between the Bitter Root Mountains and the end of the railway at Kooskia. Lack of trails made it necessary for each party to hew its own way through the thick timber and brush, making progress slow. The greater portion of the territory had not been mapped, which added greatly to the difficulties of the work.

SURVEYS:

Preliminary surveys followed the reconnoissance reports, the following described routes being selected:

No.1-Lolo Pass westward down the Looksha, or Middle Fork

of the Clearwater River to the main river, thence down the main river to Lewistown, Idaho.

No. 2-From Fish Lake Pass on the Bitter Root Divide down a branch of the North Fork of the Clearwater River to the main North Fork, thence westerly through the Palouse River county to Garfield.

No. 3-From Superior westward via Cedar Creek, Wisdom Gulch and the St. Joe River to Avery.

No. 4-The adopted route from St. Paul Pass down the North Fork of the St. Joe River to the main river, thence west along the river to Benwah Lake, thence through Watts Summit to Tekoa.

Alternate routes were also surveyed in connection with the above four main courses, the principal one being from St. Maries to Tekoa via the St. Maries River and Hangman Creek.

Taking up these routes in order, work on No.1 was first begun in December, 1905. A party under an Engineer named Hays, started east from Kooskia with instructions to make a survey up the main Clearwater River and the Looksha, or Middle Fork until another party was met working toward them. Due to the uncertainty of supply transportation during the Winter a substantial depot was established up river as far as possible, to be drawn upon as the work progressed to the east. The establishment of this base of supplies cost \$1400.00. Mr. Hays had a larger crew than the ordinary location party as he took boatmen, trail makers and extra axe men, and the cost of this survey was exceedingly expensive. About 50 miles of the country surveyed laid in the so-called Black Canyon and work was difficult and hazardous. In April while moving provisions up river by boat a boatman was drowned. Otherwise no serious accidents occurred on Hays party.

On March 2nd, 1906, Engineer Talcott and crew, who had just completed the preliminary survey between Lolo Pass and Lolo Hot Springs, as described on Valuation Section Montana 4, started a preliminary survey line west toward Hays party. Sufficient provisions for two or three months' work had previously been hauled by team, pack trains and sleds from Missoula and stored on the Divide. Talcott took all of these supplies with him as it was impossible to keep the trail open behind. The country was wild and rugged and survey work consisted of side hill development until the river elevation was reached, thence the line followed the river valley, which was a deep box canyon. Sleds were used for transporting camp and provisions as long as the snow lasted, after which rafts were built to convey them down the river. By May 18th, 1906, this party had surveyed about 45 miles with contours for a projected location. On this date while moving camp on a raft it was capsized and all the outfit hopelessly lost. Talcott and his crew then worked their way down the river about 20 miles to Hays Camp where they obtained sufficient supplies to last them until they walked into Greer, Idaho, a distance of about 50 miles. Here they obtained funds and went to Spokane and were disbanded. Talcott's party averaged about one-half a mile per day in spite of all the adverse conditions. Hays party continued on up the river and connected with Talcott's survey in June. He ran 94 miles of preliminary for 68 miles of projected location. When this work was completed Hays party returned to Kooskia and commenced a survey down the river to the west, covering

about 25 miles of line between June 25th and July 20th.

This completed all the preliminary work on the Lolo Pass-Lewistown Route. The work covered practically eleven months' time of two parties, and 151 miles of preliminary survey was made, with an average of 23 men in each party. 130 miles of projected location was obtained from these surveys.

No extensive instrumental surveys were made on Route No. 2 in the Bitter Foot Mountains except on the Divide to determine a tunnel location. An important survey was made from Garfield east via Jamestown and up the Palouse River to the Divide. Two parties worked on this survey a total of six months, covering 103 miles of line, or an average of .55 miles per day. Most of this work was through rough timber country.

In connection with work on Route No. 3 a party started in April, 1906, westward from Wisdom Gulch down the head waters of the St. Joe River. Provisions were brought from Iron Mountain by pack trains and stored for further use. This was a wild rugged territory of steep mountain slopes and thick timber. The party, averaging 20 men, ran 54 miles of preliminary for 34 miles of projected location, and were in the field four months. Another party started working eastward from the Fork of the river at Avery in June, 1906, to meet the party just previously mentioned. Provisions were packed from St. Joe, Idaho over newly made trails. This party averaged 20 men, ran 21 miles of preliminary survey, and were in the field two months. As a whole the work on this route was hard, dangerous and expensive. High water and ice jams impeded the work as frequent crossings were necessary.

In taking up the work on Route No. 4 the nature of the territory is such that it might be well to make a division in the general description at Avery, the foot of the mountain grade. Between July, 1906, and March, 1907, twelve separate location parties were in the field, covering the territory between St. Paul Pass and Avery very thoroughly. The length of adopted line is 25 miles, so it can be seen that every prospect was investigated and careful surveys made, to obtain the present supported 1.7% gradient. Base of supplies for these parties was Saltese and pack trains were used for transportation.

A party started in January, 1906, working east from Saltese to St. Maries via Hangman Creek and the St. Maries River. Work on this route ceased after the party had been in the field four months and had surveyed 80 miles of preliminary and 20 miles of located line.

Several parties in the meantime had been put to work along the finally adopted route, as it had been decided as the most advantageous. The work over this entire course was slow. The territory was wild, rugged and mountainous. Many difficulties were encountered in the line of high water, ice jams and in making trails causing much lost time on the survey work. However, the work from Avery to Benwah Lake was confined to the banks of the St. Joe River and the problem to be solved was the adoption of one side or the other. Between Benwah Lake and the state line, the difficulty was

finding the best route through the Coeur d'Alene Mountains. Watta Summit with the half mile tunnel was the best that could be found.

Following is a summary of the survey work for all routes:

Average number of men in party	19
Total number of parties	20
" time - months	76
" miles of preliminary surveyed	790
" " " projected location	164
" " " located line	199
" " " adopted line	98
Ratio preliminary to adopted	8 to 1
" location " "	2 to 1

ENGINEERING ORGANIZATION:

This Valuation Section was built under two construction divisions. The East end between St. Paul Pass and Avery was under the jurisdiction of the Division Engineer in charge of Valuation Section Montana 4, this portion being under the direct supervision of a District Engineer with four Resident Engineers and parties. There was also a Tunnel Engineer with a force of assistants at St. Paul Pass tunnel, who reported direct to the Chief Engineer at Seattle.

The portion between Avery and the Idaho-Washington State Line was the major part of the Idaho Division and was under the supervision of a Division Engineer, three District Engineers and eleven Resident Engineers with parties.

The Division Engineers had their offices at convenient points in their territory and reported to the Chief Engineer in Seattle.

CONTRACTS:

The clearing, grading, bridge and culvert work, between St. Paul Pass and Avery was let by contract to Winston Bros. Company, who sublet the work to six other contractors. The territory between Avery and Idaho State Line was included in H. C. Henry's contract. He sublet to two other contractors. The first sub-contractors in turn sublet the work to nearly 100 different parties.

In considering the work under contract and the prices paid, the inaccessibility of the territory covered by the heavy mountain work along the west slope of the Bitter Root Mountains was a serious matter. While it is a fact that the contractors had the use of a wagon road that was constructed by the Railway Company it should be borne in mind that this road was necessarily of a rough nature with steep grades and might be called a slow freight road. As a rule it was located a considerable distance above or below the road bed, and equipment, tools, explosives, etc., were taken from the road to the work by men. These conditions existed along the entire line from St. Paul Pass to St. Joe. From St. Joe to Pedee Viaduct the line is quite favorably located for delivery of supplies, etc. by water. Between Pedee and the State Line the conditions as to accessibility were again difficult and expensive.

In addition to the difficulties of transportation the matter of obtaining men for the work was serious. A large amount of other construction work was in progress throughout the country and the men were very independent and high wages prevailed. In many cases men were shipped in over foreign lines of railroad or by boat or in any possible manner, at the expense of the employers.

CONSTRUCTED LINE

Leaving the west portal of the St. Paul Pass Tunnel the line descends on a 1.7% maximum gradient with development along the steep mountain slopes. The direction is generally east to the North Fork of the St. Joe River, thence with a sharp loop it runs west down the North Fork to Avery, which is the foot of the mountain grade. The general characteristics of this 21 miles are a sharp curvature maximum 10 degree, high trestles crossing side drainage, deep cuts, high embankments, and numerous tunnels. A large share of the excavated material was solid rock.

West from Avery the north side of the St. Joe River is followed on a .4% gradient for about 31 miles to a crossing of that river. This crossing is made on two steel truss spans. From here the south bank of the river is followed to Ramsdell. At St. Maries the St. Maries River is crossed on steel spans. Between St. Joe and Ramsdell the gradient is level. The grading work on this last 52 miles is extremely heavy for a valley line, solid rock being the predominating feature of the classification. Leaving Ramsdell a short tunnel is used to pierce a projecting rock point and a crossing of Benwah Lake is made on a long pile trestle. Here the ascent of the Coeur d'Alene Mountains is commenced and continues for about 16 miles on a 1% gradient to the tunnel at Watts summit. After passing through the tunnel a .4% gradient is used to gradually descend the west slope. The grading work in this last section is steep side hill development with largely solid rock classification and many deep ravines are encountered, requiring expensive bridges.

CLEARING AND GRADING:

Grading operations on this section commenced May 1st, 1907, and were completed July 15th, 1909. Clearing and grubbing on this section was a heavy item, timber being encountered over the entire distance. Part of the work was in the Government Forest Reserve, where the usual extra precautions were enforced in regard to burning brush, and skidding logs. The solid rock work was all done by station men using trap tunnels wherever possible, and cars and horses to carry the material to the fills.

It was the policy of the Railway Company to hurry the grading all possible while work was being done under contract, and consequently many large temporary trestles were built which were filled either by the Railway Company forces or contract outfits after the track was laid. Many of the bridges in the Bitter Roots were filled with material obtained in daylighting and widening cuts for snow protection, and others were filled by the sluicing method. In connection with the latter, large areas of land were purchased from the Government and many miles of flumes were built to divert the mountain streams to the places where water was needed.

BRIDGES, TRESTLES AND CULVERTS:

As previously stated under grading, numerous temporary trestles were built on this section in order to prepare the line for track laying as soon as possible. 21 were built on the west slope of the Bitter Root Mountains and their total length was about 9800' with an average height of about 110', the maximum being 150' and the minimum 52'. These structures required the use of approximately 8,000,000 F.B.M. of timber and about 80 tons of iron. The timber, with the exception of the small dimension material such as bracing, guard rail and ties, was shipped from Coast points via foreign railroads to Taft, Montana, then conveyed by teams to East Portal, thence to the summit by the electric tramway, thence distributed by wagon road to the points closest to the sites. From the wagon road they were taken to the bridge erection with traveling blocks operated on ropes supported by the standing timber, or fastened to the rock cliffs. The small dimension lumber was cut in a portable saw mill which had been established in the Clear Creek Valley by the Railway Company. The iron for these bridges was shipped from the East.

The concrete foundations for the Kelly and Clear Creek viaducts were built during the early construction period, the equipment, cement, etc., being brought in by team from Taft, Montana. The steel work was fabricated in the East and shipped on foreign lines to Plummer, Idaho, from where it was taken to the bridge sites by work train. Clear Creek bridge is 165' high and Kelly Creek 205' high, and the steel erection was done during the winter of 1908, so the difficulties in the deep snow are obvious.

Along the St. Joe River, Avery to Ramsdell, there are several small Pile bridges. The important structures are the steel spans used in crossing Slate Creek, the St. Joe River and the St. Maries River. The concrete foundation for the St. Joe River crossing was placed during early construction, material being hauled from Ferrel, Idaho, by wagon. Ferrel is situated at the head of navigation on the St. Joe River. Material was delivered to that point by boat. The other steel spans were placed on timber foundation. False work for the St. Joe River crossing was built to carry traffic and track laying was not delayed for its construction. The other steel bridges required no false work, girders being erected when the track reached them.

The bridge at Ramsdell over Benwah Lake was about 2800' long and has seven piles per bent. Piles are 100' long, some of them being two 50' sticks spliced. Timber for this bridge was brought in by raft on the lake.

Between Ramsdell and the Watts summit several large temporary trestles were built, timber and piles being hauled by team to the sites.

The permanent structures at Chatolet and Pedee Creeks were built during construction. Foundation material was delivered by boat. The super-structure was fabricated in the East and shipped to Plummer over foreign rails from where it was taken by work train to the points of erection.

Few piles were used on the Bitter Root structures, while

those along the St. Joe River were practically all pile bridges.

The culverts on this section were largely built of hewn logs obtained along the right of way, although a small amount of squared timber was used where desirable logs could not be found. Preparation of foundation for the culverts under the high embankments was a matter of care and expense.

TUNNELS:

On the Bitter Root slope west from Roland there are sixteen tunnels varying in length from 183' to 1516'. The total length is 8464'. Some of these required timber lining, a few being through self-sustaining solid rock. Timber used in lining was approximately 2,000,000 F.B.M., with about 1800 cords of lagging.

A small part of the lining timber was obtained locally from the Clear Creek mill, but most of it was shipped in from other points. Between Avery and the state line on the west there are 3 tunnels varying in length from 341 feet to 2550 feet, the last being Watts Tunnel near Sorrento. All of these tunnels were timber lined, involving the use of about 2,000,000 F.B.M. of timber.

Tunnel #37, near Herrick, caved in at the portals soon after track was laid and it was necessary to construct a run around track for the operation of trains while the tunnel was made safe by placing a concrete lining.

Concrete lining has been placed in the other tunnels that require it since the line was opened for traffic.

SPECIAL FEATURES:

Special features pertaining to construction on this Valuation Section can be enumerated briefly as follows:

An electric power plant was built at Taft, Mont., with transmission line to the St. Paul Pass Tunnel. This is more fully described in the history of Valuation Section Montana 4.

A portable saw mill was set up and operated at the expense of the Railway Company in the Bitter Root Mountains for cutting small dimension lumber for bridges, tunnel lining, and culverts. This mill was located about a quarter of a mile from the line up Clear Creek valley. The machinery was hauled from Taft, Montana, where it had been shipped by rail.

As previously indicated by the description of the reconnaissance, the territory in the Bitter Root Mountains was unsurveyed and no roads or trails were in existence, consequently it was necessary to construct a main wagon road between Taft, Mont., and St. Joe, Idaho before construction could be undertaken. The part between St. Joe and Avery was built by H. C. Henry, and the part between Avery and Taft, by Winston Brothers. All the work was done on a force account basis, and cost the Railway Company about

\$335,000.00. The major portion of this road lies in the state of Idaho and is therefore chargeable to this Valuation Section.

An electrically operated five ton cable tramway was built from the east portal of the St. Paul Pass Tunnel to the summit of the Bitter Roots for handling bridge timber, rail, etc. for the west slope. This was about 5000' long and was built of native hewn timber.

The forest fire of 1910 which burned up cars, construction material, camps, equipment, buildings, bridges, etc., between Avery and Saltese and so damaged the line that operation was suspended for sixteen days, represents a large item of construction cost. The bridge filling by sluicing was in progress at the time of the fire and many miles of timber flumes were burned, which were reconstructed to complete the work. This is more fully described in the Historical Sketch on Valuation Section, Montana 4.

Serious slides have occurred practically over the entire length of this section. Some were taken out by the contractors' forces during early construction, and some by the Railway Company's forces after track was laid. Some of the more important will be mentioned as follows:

A slide occurred at a point about one and one-half miles west of Calder which suspended traffic and necessitated a run around track. The alignment was afterward changed at this point to alleviate future trouble.

A sand cut about two miles east of St. Joe has given trouble ever since traffic was started. Steam shovels have been installed four or five times and thousands of yards of material excavated, and the alignment has been changed several times. Trouble is still experienced here, however, and it is necessary to clean the ditches several times a year with a ditching machine.

A Shoo Fly was built through the St. Joe station grounds pending the completion of the big cut just east of the depot. This cut is very wet in the west end and has given considerable trouble. A large amount of material has been excavated with a steam shovel here and the material used for widening and raising embankments between St. Joe and Ramsdell.

At a point one-half mile east of Omega a slide occurred of approximately 26,000 cubic yards, which necessitated the use of a Shoo Fly. A steam shovel was used in clearing this slide and a permanent change of alignment made.

Continuous slides before track laying at the so-called Little Plummer Cut about one and one-half miles east of Karnac necessitated the construction of a temporary line on 14 degree curves. In 1910 a contract was let for filling the bridge over Little Plummer Creek, the material to be taken from this cut. The cut filled up almost faster than it could be excavated and the embankment spread out and settled taking the bridge with it and seriously damaging the concrete culvert. An entire new bridge was

built and work was temporarily suspended. In 1911-12 a Railway Company steam shovel was operated in this cut and the material hauled for bridge filling. From this work it developed that it would be impossible to obtain a safe line through the cut and a permanent line change was made using 11 degree curves. The bridge has been a continual source of trouble and has just recently been replaced by a substantial fill.

These few cases only mention the more serious troubles due to these causes. During the years of 1910-11-12 several extra gangs were employed on this section removing dangerous rock, widening and daylighting cuts, revising the alignment and clearing slides. Their work was in connection with construction of the line.

Embankment subsidence along the St. Joe River is an item of importance, especially between St. Joe and Ramsdell.

An unusual amount of shrinkage occurred on the fill between Sorrento and the state line, necessitating train hauling a large amount of material to keep the track in condition for operation.

TRACK LAYING AND BALLASTING:

The track material on this section with the exception of that on a few miles in the Bitter Root Mountains was all stored in a material yard at Plummer, Idaho, where a connection with the O.W.R. & N. Railway was made and several storage tracks laid to facilitate operations.

Beginning on April 24th, 1908, track was laid east from Plummer reaching Pedee viaduct on June 6th. The erection of the steel on Pedee and Chatcolet viaduct delayed work until July 10th, when work was resumed and continued east reaching Clear Creek viaduct, Mile 118, on September 30th. Track was laid from Plummer west to the state line in November.

Track between St. Paul Pass Tunnel and Clear Creek Viaduct was laid by hand in the fall of 1908. The ties had been made locally and previously distributed by team along the road bed. The rail and fastenings were shipped to Taft, Montana, thence hauled by team to East Portal where they were transferred to the tramway and taken to the summit. At the summit they were transferred to wagons for distribution along the line. The difficulty and expense of these operations are obvious, but it was imperative that this track be laid as the snow season was coming and it was needed for the erection of Kelly and Clear Creek viaducts. A delay in the erection of these bridges meant a subsequent delay in the opening of the line for traffic.

New 85 pound 33 foot rail was used with native ties. The original ballasting was done in 1908-09 when about a four inch lift was made, gravel being taken from four pits. That part of the line between St. Paul Pass and Avery was ballasted with material taken from gravel pit at Haugan, Montana. That part between Avery and Ramsdell was ballasted from the Pyle gravel pit located between Calder and Herrick. That part between Ramsdell and the state line was ballasted with material from the pit at Malden, Washington.

Stripping was required at the Pyle gravel pit. The track between Avery and the state line on the west was given a final dressing with gravel from the pit at Kenova, Washington. A second lift has been placed over the entire line, some work being done yearly.

WATER SUPPLY:

Water supply during construction was obtained from various natural resources along the line which have in many cases been further developed and established as permanent stations. A deep well was drilled at Sorrento for a permanent supply.

FENCES AND SNOW PROTECTION:

Right of way fence with the necessary crossing facilities was built after track was laid, the material being distributed by work train.

The daylighting and widening of cuts were done in many cases for snow protection. Snow sheds were built at the tunnel portals in the Bitter Root Mountains.

BUILDINGS:

An engine terminal consisting of a twelve stall round house, fuel oil storage, turn table, sand storage, clinker pit, coal storage, ice house, etc., were built at Avery. The topographic features here required a large amount of expensive filling in the river valley for the construction of these buildings. The locality is not a desirable one and it was necessary to construct apartment houses and a hotel for the convenience of the employees in order to keep efficient help at this point.

Combination passenger and freight depots were built at Avery, St. Joe, St. Maries and Sorrento. A small depot was built at Herrick. At Plummer Junction a very artistic bungalow depot was built with extensive platforms. A freight house is maintained at Plummer. Engine terminals for the branch line trains are maintained at St. Maries and buildings for Division Offices were built there.

Buildings for section facilities were built at places convenient to the work.

TELEGRAPH:

The telegraph material was distributed by work train. Telephones were installed in booths at blind sidings and in the depots.

SIGNALS:

Automatic signals were installed as soon as practicable after the line was in operation.

ELECTRIFICATION:

The east end of this section from Montana State Line to Avery is electrically operated. A substation has been built at Avery. Power is obtained from the Montana Power Company's plant at Thompson Falls, being transmitted to the substation at 100,000 volts alternating current, where it is transformed and regenerated to 3000 volts direct current for train operation.

OPERATION AND MANAGEMENT:

The part of this Valuation Section between St. Paul Pass and Avery is included in the Missoula Operating Division, the offices being in Missoula. The remainder, or the part between Avery and the state line on the west, is a part of the Idaho Division, with offices in Spokane.

VALUATION SECTIONS IDAHO 2 & WASHINGTON 2.

The Plummer Junction to Manito Line usually known as the Spokane Line was built in 1913, to gain entrance to Spokane. About 15 miles of this line lies in the State of Idaho and for Valuation purposes is called Valuation Section Idaho 2. The other portion or about 5 miles, is in the State of Washington, and is called Valuation Section Washington 2. At Manito a connection is made with the O. W. R. & N. Ry., whose track is used by the C. M. & St. P. Co., between that point and Spokane.

When the Puget Sound extension was first contemplated it was intended that the line pass through Spokane and records show that in May 1906 a report was made on available places for the location of freight and passenger facilities in that city.

In the fall of 1906 a very complete reconnaissance was made covering several main line routes through Spokane and an alternate main line with a branch line to Spokane. From this report it was decided to route the main line as it was built and build the Spokane connection later. This report covered about 750 miles of line.

In the fall of 1908 the surveys for the branch line were undertaken. An exhaustive reconnaissance was made of all the territory lying south of Spokane and north of the main line between Malden, Washington and Ramsdell, Idaho. It seemed at this time that the most advantageous line would be one through Coeur d' Alene. Consequently very thorough investigations were made with that in view. Report was made covering the route leaving the main line at Ramsdell; thence following the St. Joe River and the Coeur d' Alene Lake Banks to Coeur d' Alene. The gradients on this route were excellent, but the expensive bridge work prohibited its construction.

A route leaving the main line at Plummer and passing through Coeur d' Alene was then investigated very thoroughly. Profiles obtained with barometric readings indicated that there was a wide choice of gradients.

Following this last reconnaissance a location party was placed in the field to obtain further information. This party worked from December, 1908, until March, 1909. The information obtained from this survey indicated that the route through Coeur d' Alene would be very expensive and consequently a route leaving the main line at Malden was investigated. Parties were in the field during the summer of 1909, investigating a line from Malden to Spokane, via Plaza and Hangman Creek, or an alternate main line connection between Rosalia and Plaza. These surveys did not develop a desirable location so the parties were transferred to Plummer to further investigate that route. They worked all fall and through the winter until late in March, 1910, and their surveys clearly indicated that nothing desirable could be found passing through Coeur d' Alene.

During the summer of 1910 reconnaissance was made investigating the possibilities of a line connecting with the O. W. R. & N. near Mica and in the following winter two location parties were put in the field with the result that two surveys were made, one connecting with the O. W. R. & N. at Mica and one at Dishman, the latter with the idea of obtaining a better grade between Mica and Dishman than the present operated O. W. R. & N. The gradients on these surveys were not satisfactory so the project was temporarily abandoned.

In the fall of 1911 another reconnaissance was made which out-lined the final route and during the winter of 1911-12 the final location survey was made.

Records show that between 1908 and 1911, 300 miles of reconnaissance, 650 miles of preliminary and 59 miles of location survey were made to produce the 20 miles of adopted and constructed line, or 33 miles of preliminary and 3 miles of location for each mile of adopted survey. Much of the work was done in winter weather when considerable snow was encountered. The territory on Plummer and Spokane route was largely covered with timber, but was settled to some extent and teams were used for transportation.

The construction was carried on under the supervision of an Assistant Engineer with three residency parties. The Assistant Engineer reported to the Division Engineer then in charge of the construction of the Spokane terminals, who in turn reported to the Assistant Chief Engineer in Seattle.

This branch leaves the main freight line at Plummer Junction, Idaho, and travels in a general northwesterly direction to its destination. At Plummer Junction it crosses over the Wallace Branch of the O. W. R. & N. Co., and the waters of Plummer Creek on one structure. From here it climbs for about two miles on a 1 percent gradient to a summit, then descends on a .75 percent gradient for six miles, then rises again at the same rate over a short summit and descends to Merritt, thence rises at the same rate to Saxby.

From Saxby the gradient is generally descending, .75 percent maximum until the Anwaco Branch of the O. W. R. & N. near Bell is crossed, from which place an ascent is made on a 7/10 percent gradient to Manito. Maximum curvature is 3 degrees except at Plummer where three 10 degree curves occur, and Manito where a 6 degree curve is used in making connection with the O. W. R. & N.

The grading, clearing, bridge and culvert work was done under contract by H. C. Henry, who sublet to three other firms, namely: Otto Hanson, Carlson & Chindahl, and Henry & McFee. The two former did all their own work but Henry & McFee relet a portion to smaller contractors. Outfits for the construction on the north end were delivered on the O. W. R. & N. at Lockwood, a point about a mile north of Manito Junction. From there they were moved over the county roads to the places of operation. Outfits for the central portion were delivered on the O. W. R. & N. at Ford, Idaho and delivered from there. For the South end Plummer was the Point of delivery by rail, from which place they were taken to the work over the county roads. The county roads on the northern end of the line were in fair condition and very little work was required, but for the central and southern portions considerable work was required for transporting the heavy outfits.

In general: the portion of the line in Idaho required clearing - some quite heavy. The portion in Washington is largely through land that had been previously under cultivation but some clearing was required where unimproved land was encountered. The grubbing varied in proportion to the clearing.

The grading was fairly heavy, averaging about 46,000 cubic yards per mile, largely of classified material.

A steam shovel was used in the two rock cuts on the work at Plummer Junction. The rock in these cuts was blue basalt, and was extremely hard. Steam drills were used and an extraordinary amount of explosive; notwithstanding which considerable of the rock required a second breaking up before the shovel could handle it. Part of the material from these cuts was hauled across the then operated main line to make the fills on the wye tracks and the wagon road to Plummer. This necessitated flagmen each way from the crossing and delayed the work to some extent. Special precautions were also observed in regard to blasting on account of the close proximity of the two operated lines of railroad, namely: C. M. & St. P. and O. W. R. & N. The two cuts across the draw from Plummer Junction on the loop curve were taken out by station men. The rock here was unusually hard. Most of this material was hauled across the bridge over Plummer Creek and the O. W. R. & N. and used in the station ground filling. A steam shovel was moved over the county road from Plummer Junction to the first summit cut and did all the work up to Mile Sixteen. Some of the material on Miles Seventeen and Eighteen was wasted above grade on account of the difficulty of maintaining track and hauling in the deep snow, and

a desire to push the work. A second steam shovel that was moved over county roads from Plummer did all the work on Miles Fourteen, Fifteen and Sixteen. On Miles One to Thirteen inclusive, two steam shovels were used in the heaviest cuts, one being moved overland from Ford and the other from Lockwood. Some of the lighter grading on these miles was done with teams. Bridges were built as per C. M. & St. P. standard plans. Material for the bridges at the northend was delivered by the O. W. R. & N. at Bell and for the south end at Plummer. Part of the material for the central portion was delivered at Ford. Teams were used to transport material from the points of delivery by rail to the scene of erection. Cedar piling was used, procured at St. Maries, or in the vicinity.

Several overhead wagon bridges for both public and private roads were built on this line.

Part of the culverts in Idaho were built of hewn timber obtained on the right of way. Suitable timber was not always found at culvert sites and some of this material was hauled for considerable distance. The other timber culverts were built of sawed timber hauled with teams from the closest point of delivery by rail. Some of the culverts under light fills were constructed of corrugated iron pipe.

The track was laid by hand in June, 1913, using Plummer as the material base. New 90# 33' rails were laid for the main line with lighter second hand material in sidings. A large portion of the ties were purchased elsewhere along the C. M. & St. P. line. A few were obtained on the right of way.

Ballast for the south end was brought via the main line from the Kenova Gravel Pit. The most of the ballast, however, came from the Spokane Bridge Pit about 12 miles east of Dishman on the Coeur d' Alene line. An extraordinary amount of ballast was used on account of the recently constructed fills settling abnormally under the weight of traffic.

A temporary water tank was installed at Camas Creek about four miles north of Plummer Junction for use during track laying and ballasting. Permanent water stations with drilled wells were installed at Plummer Junction and Manito.

Soon after track was laid material for right of way fence was distributed and fences built in accordance with the State specifications, and with cattle guards or gates at the road crossings, as needed.

The buildings were constructed by Company forces after track was laid. Depots were built at Plummer Junction, Worley, and Manito, and shelters at the less important sidings. Buildings for section facilities were built at places convenient to the work.

Telegraph material was distributed by work train and wire strung as soon as possible after track was laid. Dispatcher's telephones were installed in booths at blind sidings in addition to the regular instruments in the depots.

Automatic signals have just recently been installed.

This line is operated as a part of the Idaho Division.

SPECIAL FEATURES OF CONSTRUCTION:

An especially expensive feature of the construction occurred at Plummer Junction where it was necessary to change the main line of the C. M. & St. P., the Wallace Branch of the O. W. R. & N., and build a new channel for Plummer Creek. Originally the main line of the C. M. & St. P. passed through Plummer Junction on a tangent lying north of the present depot location. To obtain sufficient room to make the loop and obtain a proper overhead clearance over the O. W. R. & N. the main line was changed, leaving the tangent east of the depot on a 10 degree curve, thence swinging back on another 10 degree curve which curve continued forms the loop for the Spokane line. The main freight line connects with the old tangent west of the depot. A comparatively level grade was desired through the station grounds where the passenger trains would make the station stop, which necessitated changing the O. W. R. & N. Wallace Branch to maintain proper clearance. A new roadbed was built for the O. W. R. & N. on the North side of the Creek channel and a new channel made for the creek. This gave the advantage of crossing both the railroad and the creek on one bridge.

The winter of 1912-13 was exceedingly severe in the vicinity of Plummer. About five feet of snow remained on the ground for a long period of time. The weather was exceedingly cold. The contractors had not expected such weather and were not prepared to combat it. Their water supplies for steam purposes were frozen and deep snow was a great impediment. Men would not work in the severe weather so considerable loss was experienced by all. The contractors cleared the snow for the fills under construction, but, unfortunately, the ground had frozen previously and when the spring thaw came these fills settled and spread in such a manner that many of them were almost entirely rebuilt. When the track was laid they again gave way and were raised with train hauled material. Wing ties were placed on all the big fills while ballast was being hauled to guard against the track tipping and overturning rolling stock. Damage was also done to bridge ends by this settlement.

VALUATION SECTIONS IDAHO 3 AND 3A

The St. Maries Branch leaves the main line at St. Maries and extends in a general southerly direction about 72 miles to Elk River, Idaho. The portion between St. Maries and Purdue, or about 50 miles, is designated as Valuation Section Idaho 3, and that between Bovill and Elk River, Valuation Section Idaho 3A. Between Purdue and Bovill the tracks of the W. I. & M. Ry. Co. are used, this portion being designated as Valuation Section 3B.

Some reconnaissance work, along the route adopted for construction, was done in connection with the main line, Valuation Section Idaho 1, in 1905-06. Early in 1907 another reconnaissance trip was made in search for a branch line as now built, and in July, three location parties were placed in the field to develop the possibilities. One party started at St. Maries and worked up the St. Maries River to Santa. The second party started at Santa and worked up the river to the summit between the St. Maries River and the east fork of Potlatch Creek. The third party worked down the last named creek to a connection with the W. I. & M. Ry. at Bovill.

The St. Maries River lies in a narrow tortuous valley, at many places narrowing to a box canyon with abrupt rock cliffs. The river bottom is covered with a thick growth of brush and the river is subject to quick rises, often rising during a summer rain so that fording is impossible. Wagon roads were in existence for about 40 miles south of St. Maries and teams were used for hauling supplies to the parties in this district. South of here pack trains handled the camps and supplies.

These parties finished a consecutive preliminary survey with information for a projected location between St. Maries and Bovill, and were called in in December.

Another party was sent out in February, 1908, to stake and revise the projected location. They finished their work in June. Work then temporarily ceased along this route as it had been decided to investigate a possible route between Plummer and Potlatch.

In November, 1908, two engineers made a trip investigating the possibilities along the last named route. They made a report covering either the departure from the main line at Plummer or Sorrento, and on various alternative features covering summits, gradients, etc., and also investigated the traffic possibilities to a considerable extent. Their trip covered about 50 miles and was very thorough.

In December of the same year a party, averaging 18 men, started a preliminary survey south from Sorrento along the route outlined in reconnaissance, with Potlatch as the objective point. They ran a consecutive preliminary between these two points, were in the field eleven weeks, and made 88 miles of survey covering all the important points very thoroughly. The territory traversed was covered with a medium heavy growth of timber, and deep snow was encountered during the entire period of the work. Considerable time was lost due to inclement weather.

A comparison between the projected location along this last mentioned route and the information at hand on the St. Maries to Bovill route indicated the latter as the more desirable, consequently that survey was retraced and construction started between St. Maries and Bovill in April, 1909.

In the meantime surveys had been made between Bovill and Elk River, and in July, 1909, two parties retraced this survey and made revisions at the Ruby and Elk Creek summits. Construction was begun between Bovill and Elk River in July.

Summarizing the survey work, 270 miles of reconnaissance, 266 miles of preliminary and 224 miles of location survey, were made to produce the 71.7 miles of adopted and constructed line, or 3.7 miles of preliminary and 3.1 miles of location survey to one mile of adopted line. Parties were in the field for a period of 23 months.

The line as constructed follows the St. Maries River quite closely for about 40 miles, in which distance four crossings of the river are made on timber Howe truss spans of various lengths. There is necessarily a large amount of sharp curvature used in following the meanderings of the river. The gradient is practically level until mile 10 is reached where an ascent is commenced on a maximum 2% gradient to Rover in mile 14. Just north of Rover the river makes an abrupt turn and a tunnel was necessary to pass through the high rock cliff. From here to mile 42 the gradients are light and generally rising. Between miles 42 and 49 the line passes over the summit between the St. Maries River and Potlatch Creek with heavy side hill development work and a maximum of 2½ percent gradients on the north slope and 2 percent on the south slope. Between mile 49 and Purdue the gradients are light. Between Bovill and Elk River a succession of rolling gradients occur, as the line passes over three summits with a maximum of 2½ percent gradients. At Neva a tunnel is used to pass from the Ruby Creek to the Shattuck Creek drainage.

Contract for the clearing, grading, bridge and culvert work was let to H. C. Henry, who in turn sublet it to several other contractors. The existing county road was used for the transportation of equipment and supplies on the first 42 miles south of St. Maries, a commissary being established at St. Maries. Between the 42 mile point and Elk River suitable wagon roads were not available, consequently it was necessary to construct a main road for the entire distance, with branches to the various camps. This was done at a heavy expense. A commissary was established at Bovill for this portion.

Clearing and grubbing were required over practically the entire line. All merchantable timber was skidded in such manner

that it could be readily loaded by work train and disposed of later.

The big fills on the St. Maries wye were made with material obtained from the big cut in the St. Maries yards. A steam shovel with dinky trains was used for this work. The grading between St. Maries and Sherwin was largely done by station men, although teams with wheeled scrapers were used on some of the work between Santa and Clarkia.

A steam shovel outfit was used for the heavy work on miles 48 and 49. This shovel was shipped to Purdue on the W. I. & M. Ry. and brought from there over the newly constructed grade to the point of operation. A steam shovel was also used on the heavy work just south of Bovill. The remainder of the grading to Elk River was done by station men. Taken as a whole the grading on the entire line was mediumly heavy, averaging about 27,000 cubic yards per mile between St. Maries and Bovill and about 34,000 between Bovill and Elk River. Classified material predominates.

The tunnels at Rover and Neva are both standard solid rock sections lined with timber. Overbreak occurred in both. The lining in the tunnel at Rover was hauled from St. Maries, a special branch from the main road and a temporary bridge over the river being required for delivering to the tunnel site. The lining in the Neva tunnel is partially hewn timber, which was obtained close by. The sawed timber was hauled from Bovill.

The bridges on the first 40 miles are principally pile trestles with the exception of the timber Howe truss spans at the river crossings. For the southern portion the more important bridges are frame structures on mud block and pile foundations.

The timber for this work on the first 40 miles was hauled from St. Maries by team, with the exception of the piling, which was obtained from the closest possible standing timber. The Howe truss spans were erected by the Railway Company's forces. The other work was done by contract. The timber for the bridges on the south end was hauled from Bovill.

The culverts are principally built of hewn logs obtained on the right of way.

Track laying commenced at St. Maries in October, 1909, and was extended to the first St. Maries River crossing in mile 9 that month. It was held up here during the construction of the bridge. The falsework for the other river crossings was built strong enough to sustain traffic, and track reached the fourth crossings in mile 34 in February, 1910. The falsework here had been taken out by the high water, consequently work was held up until May when the falsework was replaced and track laying continued to the connection with the W. I. & M. Ry., at Purdue. The work between St. Maries and Purdue was done with a track laying machine but under adverse weather conditions, as the snowfall was heavy and continuous. The difficulties of keeping a newly laid track clear of snow are obvious. Track was laid between Bovill and Elk River in June, 1910.

Seventy-five pound relay and sixty-five pound new rail was used. The former on the first 39 miles south from St. Maries

the latter from the 39 mile point to Elk River.

Ballast for the line north of Purdue was obtained from Sherwin pit. Stripping at this pit was done by force account before track was laid.

Ballast for the line south of Bovill was purchased from the W. I. & M. Ry. f.o.b., cars at Bovill. Ballasting was done in 1910.

Water supply for track laying was taken from the various streams along the line. Permanent tanks have since been established where needed.

Right of way fence with necessary crossing facilities has been built where needed since the track was laid. Material for the buildings was delivered by train and construction carried on by the Company forces. One story frame depots with agent's living rooms were built at Fernwood and Elk River. At Bovill the W. I. & M. depot is used. A fuel oil supply station was built at Bovill.

Shelter sheds were placed at the less important side tracks and section crew facilities built at places convenient for the work. A small engine terminal, consisting of a 5 stall roundhouse, sand house, fuel oil supply and storage, etc., was built at St. Maries to care for the branch line engines.

Telegraph material was distributed by work train soon after track laying was finished and was erected by the Railway Company forces. Telephones were installed in booths at blind sidings as well as in the depots.

The branch is operated as a part of the Idaho Division. Standard equipment is used, the traffic being heavy. Flangers and snow plows are used to keep the track clear during the winter season.

SPECIAL FEATURES

Serious slides have occurred in many places some of which were removed by the contractor's forces during the construction but many by the Railway Company forces after the track was laid.

Subsidence has been excessive on embankments in the river valleys.

Small forest fires occurred during the construction, originating from camps and other customary causes, for which the Railway Company paid damages to the timber owners. Damages were also paid for timber destroyed by blasting.

The material in the vicinity of Sherwin is disintegrated granite which at the time of the excavation was solid rock, but through the action of the elements it now has the appearance of sand. This material was taken out on a one to one slope on account of this disintegration.

Permanent road changes were necessary in many places on

account of the conflict with railway grading. These changes were at the expense of the Railway Company.

VALUATION SECTIONS IDAHO 4 AND WASHINGTON 6.

The Coeur d'Alene Branch leaves the O. W. R. & N. at Dishman, Washington and extends in a general easterly direction to Coeur d'Alene, Idaho, a distance of about 25½ miles, about 12 miles of which lies in the State of Washington and for valuation purposes is called Valuation Section Washington 6. The other portion is in Idaho and is called Valuation Section Idaho 4. The O. W. R. & N. tracks are used between Dishman and Spokane under agreement with that Company.

The exploration and survey work for this Branch was made in connection with the work on the proposed Plummer to Spokane Line via Coeur d'Alene, an independent branch from Spokane to Coeur d'Alene being decided upon when it was found that an economical main line connection to Spokane through Coeur d'Alene could not be obtained. About 102 miles of reconnaissance, 123 miles of preliminary survey and 41 miles of location survey were made to produce the line as constructed, or about five miles of preliminary and 1.6 miles of location for each m¹ of adopted survey.

The line as constructed leaves Dishman on light gradients and curvature over a slightly rolling country to the Washington-Idaho state line. Just east of the state line a crossing of the Spokane River is effected on a high steel bridge. From here it follows the Spokane River on an undulating grade line one percent maximum and with 4 degree curvature. Just west of Coeur d'Alene crossings are made over the Spokane & Inland Empire Railway, Spokane & International Railway, and under the Northern Pacific. The terminus at Coeur d'Alene is on a dock at the lake front.

The Construction Engineering Organization consisted of one District and three Resident Engineers with parties. The District Engineer reported to the Division Engineer in Spokane who had charge of several pieces of construction work in the vicinity. He in turn reported to the Assistant Chief Engineer in Seattle.

The line was constructed under the name of The Idaho and Western Railway. Contract for the clearing, grubbing, grading, bridge and culvert work was let to H. C. Henry, who sublet the entire line. Construction was

begun in April 1910 and track laying completed in April 1912.

Practically no clearing was encountered between Dishman and Spokane River. East of the Spokane River and occasional piece of unimproved land and a few orchards were encountered that necessitated clearing. Grubbing was paid for as per specifications.

The grading on the first ten miles east from Dishman was light. Very little roadbed excavation occurs, the embankments being built from side borrow. This work was done with teams. In the vicinity of Spokane River some heavy cuts and fills were encountered, which were taken out with steam shovels. Between here and a point seven miles west of Coeur d'Alene the grading was fairly light, although in Miles 10 and 11 some heavy cuts were taken out. This work was done by teams with wheeled scrapers and frescoes. The last seven miles entering Coeur d'Alene are fairly heavy with considerable classified material. Steam shovels were used on this work.

Pile trestles were used for necessary openings with the exception of the Spokane River crossing. The material was partly native and partly coast timber delivered over the existing lines of railroad to the closest station and taken to the point of erection by teams.

A temporary frame bridge on piles was built across the Spokane River to avoid delay to track laying before the permanent work was commenced, although track was not laid until the permanent work was well under way. Consequently the material for the substructure was all shipped in on foreign rails. The permanent bridge consists of four 50 foot deck plate girder spans with concrete trestle approaches. Work was begun in August 1910 and finished in February 1911, the substructure being built by contract and the superstructure by Company forces. Through a special arrangement with the Spokane & Inland Empire Railway, the foundation piles were unloaded from the car on their main line, opposite the bridge, and dragged from there to the work. Tools, cement, reinforcing steel, lumber and supplies were shipped to the Spokane Bridge station on the Spokane & Inland Empire Railway from where they were hauled by teams. Much of the excavation was difficult on account of water and large boulders.

At Coeur d'Alene the line passes under Garden Avenue in a 272 foot tunnel. Here a through cut was taken out and backfilled after the concrete arch was built.

Extensive docks were built on the lake front in Coeur d'Alene for transferring from the lake craft to cars, and vice versa.

Track laying began in November 1910 at Dishman and was extended to Spokane Bridge in December of that year. Work was resumed in February 1911 when six miles were laid. In September track was laid to within three miles of Coeur d'Alene and finished into Coeur d'Alene early in 1912. New 65 pound Bessemer Steel was used with native ties.

Ballasting was done in 1913 from the Spokane River pit. The quality of the gravel was good and no stripping was required. Water tanks were erected at Dishman and Spokane River Bridge during construction. At Dishman the supply is obtained from the City mains - at Spokane Bridge from the river.

Standard right of way fence with cattle guards and crossing gates was built soon after track laying. The material was distributed by work train.

The buildings were erected by Company forces as soon as material could be delivered on Chicago, Milwaukee & St. Paul rails. A frame freight depot 32 by 120 feet was built at Coeur d'Alene, and buildings for section facilities at Dishman, Spokane Bridge and Gibbs.

Telegraph material was distributed by work train and erected by Company forces.

The Idaho Division officials attend to the local operation of the line under the overhead supervision of the General Offices in Seattle. Standard branch line equipment is used.

SPECIAL FEATURES DURING CONSTRUCTION:

Many complications arose during construction due to the interference with existing irrigation systems, and much expense was incurred in special construction to care for the individual cases.

A large expense was incurred at the under crossing of Northern Pacific Railway near Coeur d'Alene in keeping their line open for traffic while excavating beneath them.

Right of way complications in Coeur d'Alene materially delayed and interfered with the construction work and were a matter of large expense.

VALUATION SECTIONS IDAHO 5 AND 5A, AND WASHINGTON 13.

The Pend 'Oreille Branch of the Chicago, Milwaukee and St. Paul Railway was built under the name of the Idaho and Washington Northern Railway, and was acquired by the Chicago, Milwaukee and St. Paul Company after the line was in operation.

This line leaves the Coeur d'Alene Line, Valuation Section Idaho 4, at McGuires, Idaho, and extends, about 105 miles, in a general northwesterly direction to Metaline Falls, Wash. The part between McGuires and Tweedie, a distance of about 34 miles, lies in the state of Idaho, and for Valuation purposes is designated as Valuation Section Idaho 5. That part between Tweedie and Metaline Falls is in the state of Washington and is designated as Valuation Section Washington 13. The branch from Coleman to Clagstone Junction is all in Idaho and is known as Valuation Section Idaho 5A

The line connects with the Spokane International Railway at Clagstone Junction and at Grand Junction. Prior to the acquisition by the Chicago, Milwaukee and St. Paul Company, Idaho and Washington Northern trains were operated into Spokane over the Spokane International tracks and through shipments were routed via that line.

Construction was under the direct supervision of F. A. Blackwell, General Manager and Promoter, and a Chief Engineer with the necessary assistants.

The line as constructed traverses an open rolling country with light gradients and curvature from McGuires to Rathdrum. At Rathdrum the timber country is entered and heavier grading work is encountered. From here the gradients are generally rising with a maximum of one and five-tenths percent and medium curvature to a summit at Jenida. From Jenida there is a continuous descent on a one percent gradient with a large amount of curvature for six miles to Coleman. From Coleman to four miles north of Tweedie, gradients, curvature and work are all light, and from here into Newport a descent is made on a seven-tenths percent gradient with some sharp curvature. As would be indicated from the description, the construction work on this portion is variant, being light between McGuires and Rathdrum, and between Coleman and Tweedie, and fairly heavy between Rathdrum and Coleman, and Tweedie and Newport. The average per mile was about 14,000 cubic yards, a part of which was of classified material.

North from Newport the gradient is gradually descending for four miles, thence practically level to Jared, thence a gradual rise is made to Metaline Falls with the exception of a short piece of temporary line built on three percent gradients in Mile 100. Between Newport and Metaline Falls the Pend 'Oreille River is followed quite closely and crossed once on an expensive bridge. This region is of a mountainous character and the work is correspondingly heavy and difficult, averaging about 30,000 cubic yards to the mile, largely solid rock. Three tunnels were required; one near Blueslide which is 1094 feet long, one in Mile 100 which is 666 feet long, and one in Mile 102 which is 92 feet long. Between Ione and Metaline Falls there are slides that are continually moving and require constant work to keep the line in safe condition for traffic.

The Clagstone Branch was built on light gradients and easy curvature, the work being medium with an average of about 14,000 cubic yards per mile.

Construction was carried on in three units and at different times; the Clagstone Branch and the work between Grand Junction and Newport being started in April 1907. The work between Newport and Cement was commenced in January 1909, and between Cement and Metaline Falls in May 1910.

The connection with the Chicago, Milwaukee and St. Paul Coeur d'Alene Line at McGuires was graded in 1910.

A large amount of construction work was in progress during the year of 1907 and it was impossible to find a competent contracting firm who would undertake the construction of this line. Its construction was imperative, however, as industries were being developed which required an outlet by rail. Therefore the grading between Grand Junction and Newport was done by the Railway Company forces under the direct supervision of the Chief Engineer. Sufficient grading was done by hand to permit rough track laying and the work was completed with steam shovels and train hauled material.

After the line was in operation into Newport it was decided to extend it to Cement in order to obtain the traffic that had previously been carried down the Pend 'Oreille River by boat. The contract for the construction of a roadbed ready for track laying was let to Grant Smith & Company. During the progress of the work it was decided to extend the line to Metaline Falls and the same firm was awarded the contract to complete the work to that point.

It was the policy of the Railway Company to have the Contracting Company prepare a Shoo Fly around the important cuts and hurry the lighter work in order that track could be laid and the material from the large cuts distributed by train.

Heavy clearing and grubbing was required over the entire line between Rathdrum and Metaline Falls.

The bridge work is not extensive but a few important structures were built. In Mile 41 a 60 foot Howe truss span with pile trestle approaches is used to cross over the Great Northern Railway. A pile and framed trestle about 80 feet in height and 1500 feet in length is used to cross Ashenfelter Bay about a mile north of Newport.

The Penn Oreille River crossing in Mile 98 is the most important bridge on the line. This consists of one 145 foot deck Pratt truss span, one 380 foot deck Pratt truss span, and one 80 foot deck girder span, resting on concrete foundations. The distance from base of rail on this bridge to low water elevation is 135 feet and the bed of the river is 70 feet below low water. The bridge was erected without false work, the spans being made cantilever by loading the land end with sufficient weight to counterbalance the weight of the steel as it extended over the canyon. Four months' time was required to erect and rivet the steel, which was fabricated in the East.

A 71 bent trestle about 90 feet in height is used to cross Vail Gulch in Mile 99.

The other bridge work was of the usual pile or framed trestle construction. Material was obtained at the local mills.

Corrugated iron pipe was used almost entirely for culvert openings. A very few vitrified pipe and small timber box culverts are found.

Track was laid between Grand Junction and Newport and on the Clagstone Branch in 1907, between Newport and Cement in 1909, and between Cement and Metaline Falls in 1910. The connection with the Chicago, Milwaukee and St. Paul Coeur d'Alene Branch at McGuire's was laid in 1910. New 75 pound 33 foot rail was used for the main track and lighter material for the siding. Ties were of native fir.

Right of way fence, telegraph lines and buildings were constructed by the Railway Company forces after track was laid. Medium sized frame depots were built at Newport, Dalkena and Ione, and smaller buildings at the less important points. A brick depot 36 feet by 100 feet, and freight house 30 feet by 120 feet, were built at Spirit Lake. Neat parks and platforms are maintained at the depot sites, which give the buildings a nice appearance.

Extensive engine terminals and shops were built at Spirit Lake, the buildings being constructed of concrete, brick and steel.

Permanent water supply stations were installed at Rathdrum, Spirit Lake, Coleman, Dalkena and Ione.

The line is operated as a part of the Idaho Division, standard main line equipment being used. Traffic is mediumly heavy.

VALUATION SECTION WASHINGTON 1.

GENERAL LOCATION

Valuation Section Washington 1 covers 304 miles of the main line of the C. M. & St. P. in Washington, extending from the Idaho-Washington state line on the east, to the junction with the Columbia and Puget Sound Ry. (Now Pacific Coast Ry.) at Maple Valley, Washington, on the west.

RECONNOISSANCE

Reconnaissance or exploration work on this section covered various routes embracing an area having an approximate width of 70 miles north and south, and 300 miles in length east and west.

Commencing with a most southerly route and working north to the adopted location, the first line examined was a continuation of that ending at Lewiston, Idaho, as described in Valuation Section Idaho No. 1. From Lewiston, Idaho, the proposed line was examined, following the Snake and Columbia Rivers to Portland and was made before the construction of the North Bank Route of the Spokane, Portland & Seattle Railway. This was a general examination made on railroad trains, steamboats, horse back and on foot, and covered the south bank of the Snake River from Lewiston to Riparia and the north bank of the Columbia River to Vancouver; thence to Portland over a distance of about 300 miles.

The route next in order, working to the north, covers part of the foregoing route but was examined at a different time and is described as follows:

Commencing at Lewiston, Idaho, thence west along the south side of Snake River to Riparia; thence crossing same and along the north side to Page; thence via Glade, nearly due west to a crossing of the Columbia River; thence up Cold Creek to North Yakima; thence up Naches River to the Naches Pass at summit of the Cascades; thence down Green and White Rivers to Buckley, making a total distance of about 260 miles. This examination was made in 1905 by several different engineers working on east and west portions of the route. That portion lying east of North Yakima was over open country and rapid progress was made. West from North Yakima through the Cascade Mountains, work of exploration was quite difficult and slow. Trains of pack horses with provisions were necessary as no

settlements existed. Parties worked from North Yakima west to the divide and from Buckley east to the same point.

In addition to above, alternate routes over the Cascade Mountains were investigated. Trips were made from the Naches River up Bumping River to Carlton Pass from the east, and from Morton via the Cowlitz River to the same pass on the west, about 75 miles - mostly heavy mountain work on the west slopes. An examination was also made from North Yakima, up Atanum Creek to Cispus Pass on the divide of the Cascades; then down the Cispus River to its junction with the Cowlitz River, a total of about 100 miles.

Returning to the country east of North Yakima; alternate routes were examined from the Columbia River northwesterly up the North Fork of Cold Creek, down Selah Creek to North Yakima, about 40 miles with various shorter trips along the Columbia River, aggregating about 135 miles.

A consecutive reconnaissance practically along the adopted route was also made with several side trips. About 705 miles in all was covered along this line on exploration work. The territory east of the mountains was comparatively open and teams were used. Several Engineers were on this reconnaissance and it covered a considerable period of time.

Summarizing all the various explorations made for final or adopted line we have the following:

Lewiston-Portland Route	350 Miles
Lewiston-North Yakima-Naches Pass Route	260 "
Miscellaneous routes connected with above	165 "
Carlton Pass Route	75 "
Cispus Pass Route	100 "
Adopted or Snoqualmie Pass Route	300 "
Miscellaneous routes connected with above	405 "
Total miles explored	1655 "

From the above we have a ratio of 5.5 miles of exploration to each mile of adopted and constructed line.

SURVEYS

Preliminary and location surveys along the routes examined in reconnaissance were started in October, 1905, the first party being sent to Buckley, Washington. As fast as parties could be organized, they were assembled in Seattle and sent to the most advantageous place to start their work, until about 20 parties were in the field. The final location surveys were finished in March, 1907, although the work cannot be considered final, when the location proper was finished, as revisions and changes were made during the construction period whenever a betterment was found possible; sometimes even at the expense of the purchase of additional right of way and the loss of grading done on the first line.

The extreme eastern part of the state is covered with the foot-hills of the Coeur d'Alene Mountains and although most of the

timber was cleared and cultivation had started, much difficulty was encountered in getting the cheapest practical line. These hills are rambling with general drainage to the west.

At Hangman Creek preliminary surveys were made for miles north and south in an attempt to get around the high ranges of hills to the west. An attempt was made, after crossing the Creek to follow it to the Northwest and cross the Palouse branch of the Northern Pacific near Spangle; thence almost due west, through the headwaters of the Rock Lake drainage, to the south bank of Lake Coville; thence in a southwesterly direction to the present line location at Hillcrest. Several attempts were also made to avoid this work by a southern route, the two most important of which can be described as follows:

Crossing the state line near Jamestown, Idaho, the first line ran almost due west through Garfield, Washington, to Vulcan; thence northwest to St. John; thence almost due west to the present line at Revere.

The other important southern preliminary line crossed the state line near Palouse City, from thence northwest to Elberton; from there followed the Palouse River, with several crossings, west to the O. W. R. & N. Winona branch, which it crossed about 4 miles north of Winona; thence west to the present line at Marengo.

These lines were found impracticable and it was finally decided to build a temporary line between Tekoa and Seabury with one percent gradients, so located that a 4/10% line could be built later without interfering with traffic.

The line down Pine Creek presented difficulties on account of the rambling nature of the Creek and the deep canyons leading into it, from the sides. The country was open and cultivated, however, and fair progress could be made. The work along Rock Lake was extremely hard owing to the abrupt rock cliffs, much of the work being done with the aid of ropes. At the south end of Rock Lake this line crosses Rock Creek and follows its valley west to Revere which is the end of the west bound 4/10% descending grade. From here the gradient is generally rising, although undulating until Hillcrest is reached. Between Revere and Paxton the work was side hill and the difficulty laid in fitting the grade line. At Paxton a crossing of Dragoon Draw called for several preliminary surveys, and just west of Paxton the crossing under the S. P. & S. Ry., caused some search for a suitable location. Between Paxton and Marengo the country is rolling with the drainage to the west.

A network of lines were surveyed in an attempt to eliminate the heavy work at the entrance to Cow Creek and the expensive crossing at that Canyon. An attempt was made to go north and cross near Cow Lake, but that was found too indirect, so a temporary location one 1% grade and 7 degree curve was made, at the entrance to Cow Creek Canyon and it was proposed to gradually work the line back into the hill, using the material for raising the sags, thereby eliminating the 7 degree curve, and finally cut the gradient to 4/10%.

Soon after crossing Cow Creek Canyon the survey work was confined to Lind Coulee, (the head of the Crab Creek Drainage) which is wide and presents a rolling appearance. Several preliminary lines were surveyed in an attempt to stay on the north side of the Coulee, but it was found impracticable.

A prospective line was surveyed, north of Lind, beginning near Ritzville, bearing west down the third Coulee, on the north side of Deadman's Lake, to Hutchinson's Ranch, about 14 miles due west of Othello. The survey was stopped here and the party turned back.

A little west of Lind we reach Crab Creek Valley proper. The survey work was confined here to this valley, and with the exception of the preliminary survey just described on the north side, the work consisted of finding the best location on the south slopes. In the vicinity of Othello several location surveys were made in an attempt to reduce the work just west of there. Two lines were surveyed about a mile west of the present line and several in close proximity, the objective point being the elimination of the horseshoe curve. Nothing practicable was found so the line was built as it now is, on a temporary gradient.

Between Othello and the Columbia River the work consisted of side hill development along the Saddle Mountains.

The river crossing presented many difficulties. Preliminary surveys were made on both sides of the river for miles, including topography and soundings. Current speeds were also investigated. A preliminary survey down the west bank of the river was made to Timmerman's Ferry, across the river there and up the east bank for 10 miles. From Timmerman's Ferry two preliminary lines were surveyed south through Pasco, to Ainsworth, across the Snake River at Ainsworth and south to Wallula Junction. Also, from Timmerman's Ferry two lines were surveyed to the northwest along the Yakima River to Home Rapids and over the divide into the Cold Creek Drainage.

The west shore of the Columbia is flat for about half a mile; then abrupt cliffs rise to a great height. Here two important surveys were made, with many side lines; one line ran southwest along the cliffs for about 8 miles; then swung northwest and joined the present line near Johnson Creek summit. The other went almost due north for 5 miles and then swung to the northwest, following Johnson Creek to the divide. A line practically along the last named was adopted. Finding the best practicable supported grade line on both sides of Johnson Creek summit called for a large amount of survey work. On the west slope four preliminary lines were surveyed, all lying north of the present line and all joined the present line in the Yakima Valley near Thorp.

As regards survey work the territory between Paxton and Kittitas can be classed under one head. It was sparsely settled and covered with sage brush and greasewood, infested with rattlesnakes and coyotes, and famous only for its high winds, and blinding dust storms. Water was hard to get, sometimes hauled for twenty miles. On the whole this work was unpleasant and hard.

From Ellensburg west the work was confined to obtaining the best possible route up the Yakima Valley. Here the Northern Pacific occupied the choicest location and it remained for the C. M. & St. P. Engineers to find a practicable line. This caused many surveys to be made, especially in connection with the river crossings and the tunnels. Near Easton, a location could not be obtained without interfering with the Northern Pacific line, so revision surveys for that railroad were made.

At Easton the work of finding a location over the Cascades presented itself. Exhaustive surveys were made, every prospect being traced out in an attempt to reduce gradient, curvature, and shorten the summit tunnel. The mountains were densely wooded and in the winter the heavy snowfall was a great impediment. Supplies were handled on pack trains. It was finally decided to postpone the construction of the tunnel, so the line through the Snoqualmie Pass was surveyed. Coming down the west slope the work consisted of finding the best possible supported grade line. In a densely wooded section such as this, with deep canyons coming into the main valley, this was no small task. The rock cliffs on this slope were very steep, often necessitating the use of ropes. In other places the slopes were covered with rock debris which would slide at the least provocation, making the work exceedingly dangerous.

West from the foot of the mountains at Cedar Falls, the Cedar River Valley was surveyed. Here, in addition to the physical difficulties of a line down this valley, was encountered the problem of obtaining a location suitable to the City of Seattle, who owned the territory contiguous to Cedar River between Cedar Falls and Landsburg, the intake for the city water supply being in the Cedar River at Landsburg. All territory, tributary to this river up stream, from Landsburg was carefully watched and guarded against water pollution.

As soon as the Railway Company's Engineers entered this so-called Sanitary District, the Seattle newspapers became apprised of the fact and gave the project a great deal of unfavorable publicity, claiming that the construction and operation of a Railroad through this watershed would pollute the city water and thereby menace the health of the community.

The City appointed a committee of doctors to examine the proposed location and make report. Their report was unfavorable and a serious opposition to the Railway developed. It was generally advocated that they seek a location elsewhere. This was in the summer of 1906. Another desirable route could not be found, and construction plans had advanced by this time to such an extent that a change of this nature would be very disastrous. A new location was made, however moving the line farther from the river. The roadbed standards were also widened to take care of the drainage. After this location a party of experts examined and approved it, from a sanitary point of view, but the public refused to be satisfied, so another revision was made, removing the line still farther from the river and adding materially to the construction cost. This was completed in November, 1906.

On completion of this survey the maps and profiles were made and filed with the City, accompanying a request for right of way.

In examining the survey, the City Engineer's Office applied the standard of measurements that govern City work, and refused to accept the surveying done by the Railway Company's Engineers on the grounds that it was not accurate.

The City was then asked to select a man, competent to make this survey, according to their standards, which they did; their party starting on this work in February, 1907. Winter weather and the rough nature of the country made this survey, according to City Standards, slow and tedious. This party finished the work to the satisfaction of the City Engineers, on May 21st, 1907.

Following is a final summary of the miles of location and preliminary surveys, the mountain work being shown separately.

Total miles of preliminary east of Cascades	1,000
Total miles of location east of Cascades	460
Total miles of preliminary-Mountain work	300
Total miles of location-Mountain work	70
Total miles of projected line	300

This would indicate that 4 miles of preliminary and $1\frac{1}{2}$ miles of location survey, were made for each mile of adopted line.

ENGINEERING ORGANIZATION

For construction purposes Valuation Section, Washington Number one was divided into the following divisions:

The Idaho-Washington State Line to Rosalia; Part of the Idaho Division.
 Rosalia to Beverly; Eastern Washington Division.
 Beverly to Rockdale; Yakima Division.
 Rockdale to Maple Valley; Part of Coast Division.

The portion of the Idaho Division was handled by the Division Engineer, one District Engineer and three Resident Engineers with their crews.

The eastern Washington Division, covering 155 miles, was handled by a Division Engineer, four District Engineers, and Nineteen Resident Engineers, having residencies of variable length.

The Yakima Division, covering 97 miles, was handled by a Division Engineer, three District Engineers, and Thirteen Resident Engineers with their usual crew.

The part of the Coast Division on this Valuation Section was handled by one Division Engineer, Two District Engineers and Seven Resident Engineers, this being a heavy mountain section of line.

The Division Engineers had their offices at the most convenient place, in their territory, and reported direct to the Chief Engineer in Seattle.

CONSTRUCTED LINE

In general this portion of the constructed line can be

covered by the following governing features; Between the east state line and the Columbia River the ruling gradient is 4 tenths of one percent with the exception of the temporary grades as stated under the topic "Surveys". Four degree curves are the maximum for this portion. From the Columbia River to Kittitas; mountain grades prevail; 3.2 percent on the east slope and 1.5 percent on the west, with maximum curvature of 6 degrees. Between Kittitas and Easton the ruling gradient is 4 tenths of one percent, maximum curvature is 6 degrees; although one unavoidable 8 degree curve is in this section. Up the east slope of the Cascades to Keechelus the maximum gradient is 8 tenths of one percent, curvature 4 degrees maximum. Keechelus to Rockdale, over the high line through Laconia; mountain grades again prevail; east slope 3.2 percent, west slope 2.75 percent. Here 10 degree curves are the maximum. Between Rockdale and Cedar Falls a 1.74 percent supported grade is used with 10 degree curvature. From Cedar Falls to Maple Valley 4 tenths of one percent is the ruling gradient with 4 degree curvature maximum. Compensation for curvature is made in all grades.

CONTRACTS

Contract was made on May 31st, 1906, with H. C. Henry covering the clearing, grading and bridging for the entire line, with the exception of the terminal work in the Cities of Seattle and Tacoma and the substructure of the Columbia River Bridge. The terms of this contract were, in brief, that H. C. Henry was to sublet the work, at the cheapest possible price, subject to the approval of the Chief Engineer. Work that could not be let at a satisfactory price he was to do with his own forces. Payment was made on a basis of actual cost plus a percentage. The principal sub-contractors were Grant Smith & Company, Otto Hansen, E. K. Taylor, McArthur and Mangan, Joseph Allen, Jacobson & Lindstrom, Lorrimer & Gallagher, and C. J. Johnson. There were a number of others who had a small section on first sub-contract. The principal sub-contractors did some of their work with their own equipment, and sublet some of it to smaller contractors and station men.

During the period of this construction a large amount of other work was in force and wages were high. Common laborers were paid as high as \$3.00 per day, and other wages were as proportionately high. The panic of 1907 cut the labor wages for a short time but not to any great extent. Construction was going on over the entire line at the same time. High wages and scarcity of men made those that could be had, very independent, as they knew that they could quit at any time, and walk a few miles to another camp, where work was awaiting them. Considerable difficulty was experienced in keeping crews full on this account, and men were shipped from all over the country to this work, in many cases at the expense of their employers.

CLEARING AND GRUBBING

Part of the first 3 miles at the east end of this section was covered with a scattering growth of yellow and scrub pine. Here the right of way was cleared for the full width and grubbing paid where required as per specifications.

From Tekoa to Rock Lake very little clearing was required, although usually at the Pine Creek crossings a little clearing was necessary. A few orchards were cut into by the right of way, and clearing was necessary at these points. Generally this work was insignificant and was done on force account basis. Along Rock Lake there was a growth of small scrub pine and fir. Clearing was done almost the entire length of the line, along the lake, for the width of the right of way. This work was extra hard owing to the sharp abrupt cliffs and inaccessibility of some of the timber. Between Rock Lake and Cow Creek no clearing was required.

At the entrance to Cow Creek the line entered the sage brush country and from here to Kittitas the heavy growth of sagebrush and greasewood required clearing before grading commenced.

Up the Yakima Valley medium heavy clearing was required.

Between Easton & Maple Valley the clearing is a large item. The timber was heavy and contained a dense growth of underbrush. Extra precautions were necessary to guard against forest fires. Along Lake Keechelus and through the forest reserve extra clearing was required by the government. (As a rule a strip 300 feet wide was cleared through the reserve, but at the bridge sites wider sections were required). Government inspectors were on hand all the time. Permits were required to burn the brush and strict rules were enforced in regard to skidding and decking the logs.

Between Cedar Falls and Maple Valley the work was delayed through the controversy with the City of Seattle so that the clearing and burning was done during the summer of 1907, which necessitated additional fire precautions. The work was done by force account for this reason.

The item of grubbing was large on this mountain district, as would be indicated from the foregoing regarding the clearing and density of the timber.

GRADING

At the east end of this section the construction forces had the advantage of proximity of railroad facilities for shipping in outfits, etc.

The grading work east of Tekoa was done with teams and wheelers. This class of material could have been handled better by means of trap tunnels but the cuts were not deep enough to permit this kind of work. With teams the material was too hard to plow in dry weather, and in wet weather no work could be done. Work was suspended during the wet weather in the fall, winter and spring of 1907 and 1908.

A steam shovel with dinky locomotives and dump cars was installed in the deep cut at Tekoa, which outfit worked through the winter. The material did not handle well with a steam shovel and a large amount of blasting was required. The shovel was moved across Hangman Creek, on completion of this cut, where it took out the big cuts and made the borrow for the big fills just west of Tekoa.

The grading from here west to Seabury is about the same kind of work, and was done with teams. From Seabury down Pine Creek Valley the work was heavy with a predominance of solid rock. The deeper rock cuts were taken out by the trap tunnel method and the more shallow by working into the face. Horses were used to handle the rock cars, all of the drilling and handling of the rock was done by hand. The transportation problem between Tekoa and Rosalia was not a very serious proposition as the country was well settled and fair roads were in existence. Some improvement, to prepare them for the heavy loads was required and considerable maintenance was necessary to keep them in shape. Branch roads from the main highways to the camps and line were built where necessary.

Near Malden the material changes to a coarse gravel formation with a few scattering boulders. This grading was done with teams. The Malden yards were widened to their present size with a steam shovel, after track was laid, the material being used for ballast.

Along Rock Lake the solid rock work was done by hand. In the deep through cuts trap tunnels were used. Considerable of the material, from the daylight cuts, along the lake was wasted by side casting, much of which rolled into the lake and is not now in evidence. Almost all the material excavated in tunnel number 14 and its approaches was wasted in the lake.

West from Rock Lake to Paxton the work was all hand and team work.

The problem of transportation here was more serious. Supplies were hauled from Rosalia as far as Rock Lake. For the work along the lake, and as far west as Revere, the base of supplies was St. John, on the O.W.R. & N. The shortest haul from St. John was eight miles and it ran up to about twenty-five or thirty. The roads west of Rosalia were not good, grades were steep and a great deal of work was done on them to put them in shape for the heavy hauling.

From Revere west to Cow Creek, Sprague, on the Northern Pacific, was used as a base for supplies. The steam shovel outfit, used in the cuts just west of Paxton, was hauled across country from Sprague. This was a 60-ton Bucyrus shovel, with outfit of dinky locomotives, cars and track. The distance was eighteen miles over worse than ordinary country roads. Work was done over the entire road for the transportation of this outfit.

On the big gravel out at the entrance to Cow Creek Valley a Thew swing steam shovel was used with dinky engines, etc. This outfit was hauled 15 miles from the Northern Pacific at Ritzville and paralleled the haul on the shovel just previously mentioned for expense. The other work in this district was hand and team work. Teams with wheelers and fresnoes were used whenever possible, but the rock cuts were all done by hand using rock cars to carry the material to the fills. Between Ralston and Lind the base of supplies was Lind. This country was settled to some extent and roads were in existence. Very little work had previously been done on them, however, and the nature of the soil is such that it cuts up badly and deep ruts were easily formed during the heavy hauling. This light soil which turns

to powder under the wheels rises in dense clouds around the teams. The high winds pick this material up easily, often turning daylight into darkness. The teamsters put bells on their horses to protect against collision in this kind of weather. Water was scarce here and was in many cases hauled for miles.

From Lind west to Taunton the greater share of the grading was done with teams, using slip scrapers, wheelers and frescoes. The deep cuts along the saddle mountains were taken out by station men using trap tunnels where possible. A Thew swing steam shovel with dinky locomotives, cars and track was used in the big cut at Beverly. The shovel was knocked down and brought from Vulcan by boat. Transportation on this 72 miles was a serious problem. For the east end Lind was the base. Some of the outfits and supplies on the west end came via the River from Vulcan. Some were hauled across country from Ellensburg and North Yakima, ferried across the river and hauled to the work. The roads that were in existence were little more than trails through the sage brush and sand, and for a good share of the distance roads were built and maintained by the contractors. The country was barren and horse feed was hauled in from the nearest base. The transportation problem through here added materially to the price paid and the ultimate cost of the construction. The same description as given to the roads east of Lind regarding dust holds true here also.

The heavy rock work, with the exception of approaches to tunnel #45, on the Johnson Creek slopes just west of Columbia River was done by station men, trap tunnels being used where possible. Cars with horses were used to carry the material to the fills. A good many temporary bridges were built in this section which have since been filled.

The approaches at tunnel #45 were taken out with steam shovel outfits, a 65 ton Bucyrus shovel being used in the west end, and a Model 30 St. Paul Derrick Co. shovel on the east end. The 65 ton shovel was hauled over wagon roads from Ellensburg. The Model 30 was brought from Ellensburg to the west end of the tunnel after the track was laid. From there it was hauled over the top of the tunnel and installed in the east approach. Teams with wheelers and slip scrapers, were used on the light work between Kittitas and Murdock.

The Craig's hill cut at Ellensburg was taken out with a steam shovel. Standard gauge air dump cars were used for hauling this material. Ellensburg was used as a base of supplies for most of this work. A few camps near the river took advantage of the river boat service, but this was expensive also. Water was scarce between the river and Kittitas and long hauls were necessary.

From Ellensburg, west to Upham the transportation problem was comparatively simple. The Northern Pacific was close and the haul from unloading points was not long, although in some cases considerable road work was necessary. A steam shovel was used in the cut about three miles west of Ellensburg, taking out the cut and making the Olson Ditch change. This shovel was moved west, on completion of this cut, and took out the big cut at Thorp and the one just west of there. The moving of the shovel was expensive on account of bridging the river several times. For the lighter work in this vicinity teams were used, and in the rock cuts, station men worked with trap tunnel

or any feasible scheme. A steam shovel was used in the big cut near the Northern Pacific Nelson's Spur about five miles west of Cle Elum. Between Nelson's Spur and Easton the most of the work was done with teams.

The heavy rock work over the Cascades was done by station men. A steam shovel was installed in the big cut at Whittier. This outfit was brought via the Northern Pacific to Upham and hauled from there to the cut.

Near Ragnar the material changes to gravel. Here two of the big fills, commonly called Topographer's Gulch and Pearson's Gulch were partially sluiced in place, an adequate water supply being obtained close by.

Many of the rock fills on the west side of the mountains occur on steep side hills, in which cases, it was necessary to either dig ditches or place rock dry walls to retain the toes of the slopes.

Through the mountains the transportation problem was indeed serious. This territory was a wilderness of virgin forest. Before camps could be built a wagon road was necessary. The construction and maintenance of this road cost the Railway Company about \$30,000. The topography was rough, clearing heavy, and the road crossed the North Fork of the Snoqualmie in many places. Most of the road was covered with puncheon. The main commissary was established at Sallal at the end of the Northern Pacific branch line. Material and supplies were distributed over this road from that point. The deep snow also was a great impediment to the work here. Contractors were paid extra for handling the snow in order to keep the work moving. In some cases camps were opened during the winter and it was necessary to shovel snow and do clearing before the camp could be built. Every incentive had to be made to keep the men working during the winter season.

Down the Cedar River Valley the light work was done with teams. Close proximity of the Northern Pacific in this section relieved the transportation problem and steam shovels were used to a great extent on the heavy work.

Through the Seattle City watershed the work was carried on under the rigid inspection of a sanitary engineer, who had 3 assistants. These men were all paid by the Railroad Company and the sanitary engineer was furnished with a horse.

The presence of these inspectors and the arbitrary disposal of material kept the small outfits out, consequently all of this work was done by the head contractor. He built four camps in this territory. The buildings were especially constructed with shingle roofs and special plans were carried out regarding the disposal of sewage, etc., at each camp. Labor was scarce during the period of this work and the men disliked the strict surveillance imposed by the sanitary inspectors. These items all tended to increase the cost of the work.

The drainage over this entire district was especially taken care of by the sanitary engineer.

BRIDGES, TRESTLES AND CULVERTS.

In general the timber bridges and culverts were built

during the time the grading was in progress. The material for these structures was shipped to the nearest point on an existing railroad and hauled from there to the sites either by team or in some cases with traction engines. Material was delivered to railroad stations and distributed about as follows:

<u>Limits of Territory</u>	<u>R.R. Station Delivery</u>
State line to Tekoa	Lowell O.W.R. & N.
Tekoa to 4 miles west	Tekoa O.W.R. & N.
4 miles west Tekoa to Pandora	Seabury Spokane & Inland
Pandora to Head of Rock Lake	Rosalia-N.P. & " " "
Head of Rock Lake to Castleton	St. John O.W.R. & N.
Castleton to Marengo	Sprague Nor. Pacific
Marengo to Ralston	Ritzville " "
Ralston to Corfu	Lind " "
Corfu to 5 mile W. of Columbia River	Vulcan Great Northern
5 miles west of Columbia River to Ellensburg	Ellensburg Nor. Pacific
Ellensburg to Horlick	Murdock " "
Horlick 3 miles W. of Cle Elum	Cle Elum " "
3 miles W. Cle Elum to 3 miles E. Easton	Nelson's Spur " "
Vicinity of Easton	Easton " "

Material for these structures in the Cascade Mountain district was cut as close to the site as possible. For the large frame bridges on the west slope a small portable saw mill was established at the main structures, and the logs cut there. For the less important structures material was hauled from the saw mill locations. The material below the cap, in many of the small structures, was round timber. The culverts were built of flatted logs.

The material delivered by the Great Northern, at Vulcan, was rafted down the river to Beverly and wagon hauled from there. Through the irrigated district from Renslow to Horlick vitrified pipe, and in a few cases wood stave pipe of the proper size was used to take care of the irrigation ditches. This material was shipped to Ellensburg and delivered from there by wagon.

At Ellensburg the Northern Pacific laid a temporary spur leading from their track, around Craig's Hill, to the C. M. & St. P. right of way, where the material was unloaded. This spur was taken up as soon as the Murdock material yard was ready for use. In general the timber used was coast fir, the piles used on the east end came from the vicinity of Potlatch, Idaho. Between the Columbia River and Easton the piling was obtained from a point about ten miles north of the Murdock material yard from where it was hauled to Murdock by means of a traction engine and a train of wagons. A pile camp was also established about three miles south of the present line near the Northern Pacific Station at Upham. Piles for bridges in that vicinity were supplied from there. Bridges and culverts were built according to C. M. & St. P. standard plans.

PERMANENT STRUCTURES

Permanent bridges were built at the following locations during the original construction period.

Bridge EE 62 at Tekoa, Washington. The material for the substructure was obtained as follows: Cement from the east, sand from Freeman sand pit about twenty-five miles north on the O. W. R. & N. Crushed stone from a local rock crusher. Form lumber from Spokane. Tools were transferred here from the Cow Creek Viaduct. The superstructure was erected by Company forces before track laying commenced. Steel was shipped to Tekoa and delivered by the O. W. R. & N. Ry. on a special spur, directly under the present bridge. An inclined track was built up the slope at the west end of the bridge and steel work hauled up on small cars with hoisting engines. The traveler was framed and erected at the west end of the bridge.

The construction of bridges EE-128 and 130 along Rock Lake was unusually hard owing to the severe topography at these locations. Concrete aggregates were obtained locally with the shortest possible haul. Cement was shipped from the East and hauled by wagon from St. John. The superstructure was fabricated in the East, shipped to Lind by train, brought to the bridge sites after track was laid, and erected by Company crews.

For bridge EE-164 over Cow Creek, sand and gravel were obtained from a pit on private property about $1\frac{1}{2}$ miles from the bridge, cement was shipped from the East to Ritzville and hauled from there by wagon. Piling, form lumber and tools were shipped to Ritzville and wagon hauled from there. Considerable plant was required on foundation work here on account of water. Steel was shipped to Lind and stored in the material yard, reloaded and hauled to the bridge after track was laid. Erection was made with two derrick cars, and the aid of a traveler, with two booms, operated on a track laid in the bottom of the draw.

Bridge EE-266 (See Special Report on this bridge)

For Bridge EE-386B- FF2 - FF4 - FF10 - FF16B - FF18 - crossings of Yakima River, crib piers filled with rock were built during construction for temporary foundations. Pile falsework was driven during construction, steel was shipped to Murdock Material Yard for EE-386 B - FF2 - FF4 - FF 10 - and hauled to the bridge after track was laid. The falsework for these bridges was built strong enough to carry trains, so track laying would not be delayed. Steel for FF 16B and FF-18 was shipped to Easton on the Northern Pacific and taken to bridge sites after track was laid. The erection was all accomplished by means of derrick cars.

Culverts FF-257 and 255 were built of concrete during construction. Concrete aggregates were obtained at the culvert sites, but form lumber, cement and the brick for the invert was hauled by team at a large expense.

TUNNELS

Working westward from the east end of this section the first tunnel work encountered during construction was tunnel number 42. It was built with standard rock section, lined throughout with timber, not removable. The timber was hauled by wagon from Rosalia. As will be shown later, this tunnel caved, in 1911, and was converted into an open cut.

Tunnel Number 43, near Palisade, was a solid rock tunnel, no lining.

Tunnel numbered 44, also near Palisade, was a solid rock tunnel partially lined. The timber was hauled from St. John. These tunnels were taken out by driving the top heading first. Work was all hand work and done by station men. Concrete portals have been put up on tunnels 43 and 44 since operation started. This work was done with the ordinary standard gauge high car.

Tunnel numbered 45, near Boyleston, is a solid rock tunnel partially lined with timber, not removable. The lining was coast fir timber shipped to Ellensburg, and teamed to the tunnel.

Tunnels numbered 46 and 47, between Thorp and Horlick, were lined throughout with timber not removable. Lining timber was coast fir shipped to Thorp and teamed from there.

Tunnels numbered 48, near Easton, 49, near Whittier, 51, near Landsburg, and 52, near Noble, were lined with timber, not removable. The timber for tunnel 48 was shipped to Easton and hauled to the tunnel site. Lining of the other three was hewn timber procured as near the site as possible. Tunnel numbered 52 has since been converted into an open cut.

The enlargement and lagging in these tunnels is an item not to be overlooked. The work was all hand work let to station men. All these tunnels have since been lined with concrete.

Tunnel numbered 50, the Snoqualmie Tunnel, has been built since operation started. This tunnel was concrete lined throughout at the time of construction. Work was done by the Company forces. The west end was taken out by the European or bottom heading method, and the east end by top center heading method.

TRACK LAYING

Track laying on Valuation Section Washington #1, was carried on at separate periods and operations started at convenient points where material could be delivered, over connecting and existing lines of railroad. Rails were shipped from Chicago and vicinity over foreign lines. The first operation connected with this work was the establishment of the material yards for assembling rails, fastenings, ties, etc. The points selected for this purpose were Lind at the crossing of the Northern Pacific Ry., and Murdock where another crossing of the same railroad was made. The last mentioned being 5 miles west of Ellensburg. At Lind an extensive layout of tracks was necessary to take care of track material as well as timber and piles for bridge work. Some of these tracks have since been taken up. At Murdock, conditions were similar except that a large amount of trestle was constructed to make the connection with the Northern Pacific as the grades are separate. Extra land for this was leased at considerable expense. The trestle bridge and all tracks are now removed and the land restored to its original condition in accordance with the terms of the lease.

In considering the cost of establishing the yard, the expense of removing same is an item to be considered, as a part of the cost of track laying operations. Work on both these material yards was started in May, 1908.

The first regular track laying operations, with a Roberts Bros. machine, commenced at Lind on March 19th, 1908. Track was laid west continuously for 38 days, until Taunton was reached, a distance of 43 miles, or 1.15 miles per day. On May 6th track laying started at Lind and continued east, ending on May 20th at Cow Creek Viaduct pending completion of said viaduct. This twenty miles was laid in thirteen days or about 1.6 miles per day. Track was detained at Cow Creek until August 15th, 1908, when it was resumed and laid continuously to the Idaho-Washington line reaching there November 2nd, 1908, covering about eighty miles in about seventy days or 1.1 miles per day. Track laying operations were resumed at Taunton June 3rd, 1908, and continued west, as fast as the grade was prepared for it, until the east bank of the Columbia River was reached on July 31st. Track laying did not commence again at the Columbia River until February 18th, 1909, when it was laid west up to the Johnson Creek Tunnel March 11th, 1909.

Operations from Murdock were as follows: Began February 8th, 1908, laying east as fast as grade was ready to Renslow, arriving there on July 23rd, 1908. Then began again at Murdock July 28th, 1908, and laid west until October 28th, 1908, reaching Topographer's Gulch, near Ragnar on that date. This covered 70 miles in seventy days.

Track between Ragnar and Maple Valley was laid in short stretches at different times between December, 1907, and January 21st, 1909.

Relative to track laying operations in the Cascade Mountain district, it might be mentioned that following the completion of the track to Topographer's Gulch, near Ragnar in November, the line west of Easton was abandoned and permitted to snow up and remain in that condition until March, 1909, when a complete rotary snow plow outfit was organized and proceeded to clear the track. This required nine days. The snow encountered had settled to the depth of about 8 feet and in places had filled with ice which came from snow water seeping into the cuts and freezing during the winter months.

The main line was laid with new 85# 33' rails, the passing and side tracks with 65# and 60# second hand rails. Ties for the territory between the state line and Easton were sawed ties obtained from Coeur d'Alene, Idaho and shipped to Lind. Ties over the mountains were obtained from the right of way.

TEMPORARY SPURS

A large number of temporary spur tracks were laid for construction purposes and later taken up.

Following are some that can be noted:

Temporary spur at west end of Cow Creek Viaduct for the bridge crew. About 800' long.

Camp Spur 2500' long, 5 miles west of Ralston taken up.

At Beverly the main track was laid off true center temporarily and afterwards taken up.

Safety switch and 800 feet of track west of Columbia

River Bridge - Afterwards used by contractors on Priest Rapids Line.

Spur track just west of Rye, for water cars, for gravity system to present tank, also several temporary tracks for contractors filling bridges.

Spur track built down to water level East of Tunnel #46 to remove rock blasted into river.

Spur laid on present site of Squaw Canyon siding and afterwards taken up.

Wye track laid at Warden and taken up.

At Tekoa, a temporary track on the O. W. R. & N. was laid for the unloading of structural steel for the Latah Creek Viaduct.

Besides the above the regular passing and industry tracks were laid as fast as the points were reached, also camp outfit spurs where necessary.

BALLAST

For ballasting several gravel pits were opened up, involving the purchase of right of way, stripping over lying material and laying a system of tracks for taking out material.

These gravel pits were located as follows: Malden, Kenova, Paxton, Marengo, Lind, Servia, Othello, Beverly, Cohasset, Ole Elum, and Ragnar.

Ballasting operations followed track laying as closely as weather and other conditions permitted.

As a rule, ballast to a depth of four inches was used on the first lift.

WATER SUPPLY

Temporary water supply stations for engines, during track laying, ballasting, and early operation, were installed at Tekoa, Pandora, Malden, Lavista, Revere, Cow Creek, Lind, Roxboro, Othello, Beverly, Rye, Kittitas, Horlick, Ole Elum, Upham, Roaring Creek, Rockdale, Garcia, Bandera, Ragnar, Cedar Falls and Maple Valley. Many of these have been replaced by permanent stations.

SPECIAL FEATURES

Following is a list and brief description of a few of the special construction features on this section.

The fills in the vicinity of Tekoa settled and spread out during wet weather causing considerable trouble. To alleviate this they were cross ditched, open tile drains laid, and ditches back-filled with cinders.

The line changes west of Tekoa have been made since operation started, using steam shovels and standard gauge equipment. Material was used for filling temporary bridges.

Tunnel Number 42 east of Rosalia caved in, while concrete lining crew were putting in the footings. An expensive shoo fly was built around the tunnel for operation of trains, while the tunnel was being converted into an open cut. All trains were diverted via foreign lines during the construction of the shoo fly.

Near Paxton a temporary line was graded, as it was thought the main line grading would delay track laying. The main line was completed, however, so the temporary grade was not used.

Some important channel changes were made for Pine Creek between Pandora and Rock Lake.

The line revision at the entrance to Cow Creek Valley, mentioned under Surveys, has been made, but not as originally planned. A through cut was taken out on a 3 degree line. The material being used for constructing a new grade west of the cut and raising out the sag at the east end. The approaches to Cow Creek Viaduct were also filled with this material.

At the west end of Cow Creek Viaduct a line change was made to better the bridge location, after considerable grading had been done

Owing to the lightness of the material in the fills between Lind and Warden it was necessary to blanket them with gravel for protection against the high wind. This was done by Company forces and work trains.

At Othello some grading on a line was done before revision. This is in evidence just west of the station on the north side of the track.

A serious slide which stopped traffic for several days occurred near Corfu. This was a dry slide and it was estimated that a million cubic yards was included in the movement. Steam shovels were hurried to this location and a permanent change of line made, disturbing as little of the siding material as possible. A temporary shoo fly was built for operation of trains during the period of construction of the permanent changes.

The temporary bridges on the Johnson Creek hill were filled from borrow pits located along the hill, steam shovels and standard gauge equipment being used. In connection with this two serious train wrecks occurred, which enter into the expense.

Through the irrigated district from Renslow to Horlick considerable expense was incurred in changing small ditches and maintaining waterflow during construction. The yardage involved was small but the expense was not so insignificant.

Numerous expensive slides occurred both during construction and early operation, in the vicinity of Horlick and west from there for 5 miles. A sluicing outfit was installed, using the Yakima River water pumped to the proper pressure, and the hillsides were washed

into the river, sufficient material being removed to insure a safe slope.

Damages were paid to the N. P. for current changes in the Yakima River where blasting lodged large quantities of material in the river, causing erosion to the Northern Pacific embankment. Special precautions were observed in regard to blasting, where the Northern Pacific line was close. Watchmen were maintained along their track to protect trains and telegraph wires.

The Northern Pacific line was changed at the expense of the C. M. & St. P., near Easton, to permit the construction of the latter.

The State of Washington had previously made surveys for a state road along the south bank of Lake Keechelus, where the C. M. & St. P. line was built. The Railway Company paid for a revision survey, changing the location of the proposed road to the other side of the lake and paid the State the estimated increased cost of the road on the new location.

Through the forest reserve damages were paid the government for the timber destroyed by blasting. Also extra bills were paid for cutting dangerous trees that were outside the regular clearing.

A snow slide at Bridge FF-84, (Humpback Creek) took out almost the entire bridge. The bridge has since been filled and a snow shed built for protection against further trouble in this vicinity.

A few small forest fires occurred during construction through the Cascades.

The temporary bridges on the Cascades were filled by train haul from steam shovels widening and daylighting cuts, along the line. The permanent culverts were built by Company forces.

Considerable added expense was incurred in maintaining traffic, when permanent steel superstructures were placed.

In connection with the construction through the Sanitary District, sanitary experts were brought from the East by the Railway Company to investigate and report on the alleged water pollution, and also to make suggestions as to the design, etc., of the ditches and filters.

Some important channel changes were made for the Cedar River between Cedar Falls and Maple Valley.

In November, 1911, an unprecedented flood occurred in the Cedar River Valley, which did serious damage to the permanent bridges in addition to washing out a large amount of roadbed. Restoration of the damaged embankments and repair of the bridges cost the Railway Company approximately \$175,000.

FENCES AND SNOW PROTECTION

Soon after track was laid, work trains distributed fence material. The right of way was fenced on both sides,

except in isolated places, with standard barbed and woven wire fence. Cedar fence posts were used. Patent wire gates of the sizes agreed upon in the right of way contract were installed. At highways and important road crossings C. M. & St. P. standard cattle guards were placed with the necessary wing fences.

Some snow fences were built through the central part of the state.

Through the Cascades cuts were daylighted or benched for snow protection and snow sheds were built.

BUILDINGS

The construction of station and terminal buildings was started as soon as practicable after the track was laid and prosecuted diligently until finished. Division terminals were established at Malden, Othello and Cle Elum, and roundhouses, turntables, coal bunkers, etc., built to care for the engines. Facilities were also provided at Laconia, Rockdale and Cedar Falls to care for the helper engines. The coaling stations have been since replaced with fuel oil storage and service tanks. Combination freight and passenger depots were built at the important stations and smaller depots at some of the less important places.

TELEGRAPH

Telegraph material was distributed by work trains. In addition to the telegraph instruments installed in the stations, are telephones used for dispatching trains. Telephones were also installed in telephone booths at blind sidings.

SIGNALS

As soon as practicable automatic signals were installed through the mountains on this section.

ELECTRIFICATION

From Othello west this section has been equipped and is operated by electricity. Substations were built at Taunton, Doris, Kittitas, Cle Elum, Hyak and Cedar Falls. Power is obtained from the Washington Power Company's plants at Long Lake, Little Falls, and Snoqualmie Falls and transmitted to the substations at 100,000 volts alternating current. This is transformed and regenerated to 3,000 volts direct current for train operation.

EQUIPMENT

Standard main line equipment is used between the state line and Othello.

Rotary snow plows are used to keep the line open in the Cascades during the winter. East of the Cascades, flangers are usually used to clear the comparatively light snow fall, although in the winter of 1914, it was necessary to use rotary snow plows on the Johnson Creek Hill.

OPERATION AND MANAGEMENT

The eastern portion of this section, between the state line and Othello, is operated by the Idaho Division Officials, with offices at Spokane.

The territory between Othello and Maple Valley is a part of the Coast Division with headquarters for all officials in Tacoma.

Roadmaster's offices are maintained at Malden, Ellensburg, and Cedar Falls. Section crews are located at the necessary points along the line. Watchmen are maintained through the Cascades.

VALUATION SECTIONS WASHINGTON 4, 5, and 5a.

GENERAL LOCATION:

Valuation Section Washington No. 4 covers all property in the City of Seattle jointly or individually owned or used by the Chicago, Milwaukee and St. Paul Railway Company, and also covers this Company's right to use, under a lease, the tracks of the Columbia and Puget Sound Railway (now Pacific Coast Railroad) extending from the end of Valuation Section Washington No. 1 at Maple Valley to Seattle. This comprises about eleven miles of single main track and twelve miles of double main track owned by the Pacific Coast Railroad, and used under lease by the Chicago Milwaukee and St. Paul, several miles of yard tracks in Seattle individually owned by the Chicago Milwaukee and St. Paul, and several miles of industrial tracks in Seattle jointly owned or used.

Valuation Section Washington No. 5 covers the main line between Black River Junction and Tacoma Junction, comprising about 28 miles of single main track. This section was built by the Chicago Milwaukee & Puget Sound Railway Company for the Chicago Milwaukee and St. Paul Railway Company but is at present jointly owned by the Chicago Milwaukee and St. Paul Company and the O. W. R. & N. Company.

Valuation Section Washington No. 5a covers all property either jointly or individually owned or used by the Chicago Milwaukee and St. Paul Railway Company in the City of Tacoma, including the lines known as the Tacoma Local Terminals and the Tacoma Sound Terminals.

RECONNOISSANCE AND SURVEYS:

A reconnoissance was made in July and August 1904 between Maple Valley, Seattle and Tacoma. This report recommended the so-called "Cedar River Line" between Maple Valley and Seattle, and the so-called "Bluffs Line" between Seattle and Tacoma. This seemed a very feasible location and was strongly advocated by the Chief Engineer, who was afraid of the flood conditions in the various streams if a lower line was adopted. This line can be briefly described as hugging the north side of the Cedar River Valley very closely between Maple Valley and Black River Junction, crossing over the Columbia and Puget Sound Railway, the Northern

Pacific Railway, the Puget Sound Electric Railway, and the Duwamish River on a high crossing near our present Black River Junction, and entering Seattle from the south and west. It was planned that the line to Tacoma would leave this line on the west side of the Duwamish River just west of our present Black River Junction and follow the west side of the Duwamish, White, Stuck and Puyallup River valleys to Tacoma. The line to Tacoma was to hug closely the bluffs, crossing the line at its Bluffs station, revising that line to take it over the Chicago Milwaukee and St. Paul tracks. Surveys were started on this route but after a more careful examination of the country had been made the Chief Engineer reluctantly abandoned this so-called Bluff Line and a direct line through the valley between the Northern Pacific Railway and Puget Sound Electric Railway was decided upon.

Strong objections were raised to a route confined between these two Railways, and examinations and surveys were made for a line crossing the Electric Road at what was then called Stuck Station, about two miles south of Auburn and paralleling the Electric Line on the west to a connection with the main line west of Black River Junction. A new survey was made between the point of connection near Black River Junction and Seattle, paralleling the Electric Road to a point south of Riverton, thence swinging to the west, passing back of the Riverton stone quarry, crossing the Duwamish River west of Georgetown, and following Colorado Street to the terminal property in Seattle.

Lines were also surveyed crossing the Northern Pacific Road near Auburn and following the east side of the White River Valley to a connection with the Cedar River Line near Renton. Lines were also investigated through the range of hills lying between the White River Valley and Puget Sound with the thought of shortening the distance between Seattle and Tacoma, but owing to the height of the hills and the short drainages encountered, this project was early abandoned. This range of hills terminates at Sumner in a bluff about 500 feet high, which point became the controlling feature in the location of the line.

Early in April 1906, the arrangement was made with the Columbia & Puget Sound Railway for the use of their tracks between Maple Valley and Seattle and the survey for the present line between Seattle and Tacoma was then completed. This line crosses the Northern Pacific near Black River Junction, and under the Renton Branch of the Puget Sound Electric near Renton Junction. Between Renton Junction and Auburn it lies between and practically parallel to the Northern Pacific and the Puget Sound Electric Railways, crossing the White River between Kent and Thomas. Near Auburn the Puget Sound Electric diverges to the west and the Chicago Milwaukee and St. Paul continues on south, encircling the bluff at Sumner, thence in a general northwesterly direction down the Puyallup River Valley to Tacoma. In making the surveys great care was taken to ascertain high water information and the grade line was laid accordingly.

It was originally planned to go through the Sumner Bluff in a tunnel about 1000 feet long, but when it developed that a large amount of material would be required to construct the fills in the valley where, owing to swampy conditions, side borrow was not obtainable, it was decided to make a mammoth borrow pit of this point, and a 4 degree, 30 minute curve line was located and a temporary 7 degree, 30 minute line was built. The line is being gradually thrown back to its proper location.

SUMMARIZING:

The surveys on the Tacoma Line were started about November 15th, 1905, with two locating parties, and were completed in May, 1906. Approximately 150 miles of preliminary survey was made to produce the 28-3/10 miles of adopted and constructed line.

CONSTRUCTION ORGANIZATION:

Three Resident Engineers were placed on the Tacoma Line in May 1906 to take charge of the construction. These Engineers reported direct to the Division Engineer in Seattle.

When the so-called Bluffs Line was decided upon in 1905 it was thought work could be commenced at once, and a small outfit of teams was sent to this work from the East by McIntosh Bros., who at that time contemplated handling the construction of the entire Puget Sound Extension. This outfit arrived about November 25th, 1905, but in the meantime the so-called Bluffs Line had been abandoned and the direct line across the valley decided upon. Surveys were in progress but the work had not advanced to such an extent that construction could be started; consequently this team outfit was delayed until December 20th, when they went to work between Auburn and Sumner. This outfit worked until June 1906, at which time a settlement was made and they were moved to the eastern part of the state. In the meantime, the contract with H. C. Henry for the construction of the line west of Butte had been made, and in May 1906 he sublet the work between Seattle and Tacoma to Cross and Sanders, who did most of the grading work themselves. The bridge work was let by H. C. Henry to W. J. Cross.

CONSTRUCTION:

In general, this line between Black River Junction and Tacoma traverses a valley which is to a certain extent boggy and soft. Good side borrow in sufficient amount to finish the embankments could not be obtained in many cases. Consequently the embankments were made low and narrow and were completed with train hauled material from the Sumner pit after the track was laid.

Notwithstanding the fact that considerable attention was paid the matter of high water in laying the grade line, an unprecedented flood occurred in November 1906 and considerable damage was done to the new embankments then under construction. This flood, and the continued wet weather during the winter of 1906-07 seriously delayed the construction work and added to the expense. Numerous standard pile trestles were built in places where side borrow could not be obtained and where high water

conditions were uncertain, many of which trestles have since been filled with material from the Sumner pit.

Some clearing and grubbing were necessary as the land was not entirely under cultivation at the time of construction.

In connection with placing culverts it was necessary to haul in material and to construct a more solid foundation as the culverts necessarily occurred in soft ground. The bridges were built in accordance with the standard plans of the Railway Company.

A large amount of riprap was placed. The greater part of this material was obtained from the Bell-Scott Company, who had quarries at Wilkeson on the Northern Pacific. The cars were received over the transfer track with the Northern Pacific at Tacoma, and hauled to the point of unloading by work train.

TACOMA LOCAL TERMINALS:

All of the grading on the Tacoma Local Terminals for that part of the line between Tacoma Junction and A Street was done by the Railway Company Forces. The material was largely hardpan although some solid rock was encountered. The land between K and G Streets was very swampy and considerable settlement and subsidence has occurred on the fill at this place. The property was largely covered with buildings at the time of purchase, which were moved or razed at considerable expense. It was necessary to regrade the road and street crossings and rebuild sidewalks, where they were encountered. The street in front of the freight house and team tracks was regraded to accommodate those facilities.

TACOMA SOUND TERMINALS:

The fills for the yards at the Tacoma Sound Terminals were largely made from material obtained in dredging the waterways to the docks and wharves. Substantial bulk heads with riprap and brush were placed to prevent washouts during the filling. Entrance to these terminals was originally obtained on a long pile trestle which has since been filled and the line double tracked.

Many of the industrial spurs to the mills, etc. in these terminals were built across land that had been previously filled with slabs and sawdust, making the construction of the trestles unusually expensive.

SEATTLE TERMINALS:

About the same conditions held true in the Seattle terminals as in the Tacoma Sound Terminals, although with the exception that a large amount of the property in the Seattle Terminals lies close to the city water front while that in Tacoma is in a more outlying district. It was necessary to dredge and place a large amount of material in the Seattle Terminals as much of the adjacent property which is now improved was not improved at the time of construction.

Numerous complications in the way of street, water and railway crossings occurred in these terminals, which added materially to the delay and expense of the work. A large amount of paving and planking for roadways and crossings was required at the freight house and various team tracks. An extensive trackage layout was constructed near Georgetown at the Van Asselt yards for storage purposes and for the separation and classification of the Tacoma and Seattle freight.

MAIN LINE MAPLE VALLEY TO SEATTLE:

In accordance with the terms of the lease with the Columbia and Puget Sound Railway a large amount of improvement work was done by that Company to bring their railroad up to the standard of the Chicago, Milwaukee and St. Paul Company. In addition to the work done by the Columbia and Puget Sound Company the Chicago, Milwaukee and St. Paul Company built a passing track for their individual use adjacent to the track of the Columbia and Puget Sound at Maple Valley; and at Black River Junction the Chicago, Milwaukee and St. Paul together with the O. W. R. & N. Company did considerable work in changing the line of the Columbia and Puget Sound to permit a revision of the connections at this point.

BUILDINGS:

The station buildings belonging to the Columbia and Puget Sound Railway are used in common with that Company on the line between Maple Valley and Seattle. Between Black River Junction and Tacoma, combination freight and passenger depots were built at Kent, Auburn, Sumner and North Puyallup, and section facilities at places convenient to the work.

At the Tacoma Local Terminals a large freight house, capable of handling the business, with rooms for the Agent's offices, was built. A two story frame passenger station which was purchased from the Tacoma Eastern Railroad is used temporarily. In the Tacoma Sound Terminals complete and extensive engine and terminals shops, car construction and repair shops, etc. were built, together with large docks, wharves, warehouses and grain elevators for the transfer of shipments from cars to ocean going vessels, and vice versa.

At Seattle a large freight house and several large storage warehouses were built in addition to the docks, wharves and warehouses, on the water front. The O. & W. passenger station in Seattle is used jointly with that Company. A small engine terminal is maintained to care for the yard engines and the comparatively few road engines that tie up at this point.

It is not within the limits of this article to go into any detail in regard to the extensive building construction and the difficulties encountered in obtaining satisfactory foundations, etc. in Seattle and Tacoma.

MISCELLANEOUS:

Track laying was started at Black River Junction on August 6th, 1908. New 85 pound rail and native fir ties were used. The right of way has been fenced and the proper crossing facilities provided where the conditions require it. Material was distributed by work train and construction carried out by the Railway Company Forces. Telephones are used for train dispatching purposes, being placed in the depots and in booths at blind sidings. Automatic block signals are used over the entire section.

ELECTRIFICATION:

From Maple Valley to Tacoma the line has been equipped and is operated by electricity. This is a continuation of the electrification described in Section Washington 1 with substations at Renton and Tacoma.

OPERATION AND MANAGEMENT:

The line used under the trackage right lease with the Columbia and Puget Sound Railway Company's is operated under the supervision of that Company's officials. Operation on the remainder of these sections is supervised by the Coast Division officials, with offices in Tacoma.

The O.W.R. & N. trains are operated between Black River Junction and Tacoma Junction under the supervision of the Chicago, Milwaukee and St. Paul Railway Company officials.

VALUATION SECTION WASHINGTON 7.

Valuation Section Washington 7 covers the branch line of the C. M. & St. P. Ry., extending from the main line station Warden, in a general northeasterly direction to Marcellus, a distance of about 48 miles.

During the winter of 1908-09 an engineer made a general exploration covering an area about 40 miles wide and 60 miles in length, lying between the Great Northern and the C. M. & St. P. Railways, bounded by Cow Creek on the east and Moses Lake on the west. This work was done on horse back and required about three months' time. He made a very complete report as to the traffic possibilities of the territory, in addition to outlining a possible branch line. A location party was sent to Warden in October, 1909 to develop the possibilities of the route outlined in the reconnaissance report. This party was in the field four months, running 93 miles of preliminary and 200 miles of location survey for the final 47 miles adopted, or two miles of preliminary and four miles of location for each mile of adopted line. Construction commenced in March, 1910. Track was laid in December of the same year.

For construction purposes a District Engineer's office was established in Warden, under the direct supervision of the Chief Engineer in Seattle. The line was divided into four residencies of various lengths.

Leaving Warden this branch runs northeasterly for about 25 miles, thence nearly due east to the terminus. The gradients are undulating with a maximum of 2%. The alignment is good, consisting of long tangents intercepted by east curvature.

H. C. Henry was awarded the contract for the clearing, grading, bridge and culvert work, which he sublet to seven other contractors. This work was largely done by teams with wheeled scrapers and fresnos. Outfits were delivered by rail to points on the C. M. & St. P., Northern Pacific and Great Northern Railways, depending on the distance to the places of operation.

Most of the territory traversed was covered with sage brush and greasewood, which required clearing for light grading.

In general, the grading was light. Much of it was side borrow work. Some classified material was encountered. The worst difficulty to overcome was the wind, which blows almost

incessantly in this vicinity, and made the work very disagreeable and expensive as in many cases newly graded embankments were blown away. Water was scarce and of poor quality and was usually hauled for long distances. Men were hard to hold under such conditions.

No unusual bridge work was required. Those that were built were standard pile trestles. The material was delivered at Warden by rail from where it was hauled by team to the points of erection.

Culverts were built of vitrified pipe, hauled by team from Warden.

The drainage requirements as anticipated during construction were very deceiving. This territory is subject to spasmodic heavy rainfall and cloud-bursts, which require unusual drainage facilities. As a consequence many of the culverts installed during original construction have been washed out and replaced by pile bridges.

Warden was the point of supply for track laying. A Roberts Bros. machine was used and new 65 pound rail was laid. Track laying began July 7th, 1910 and was completed on November 16th of the same year. No work was done, however, between July 27th and September 18th. The track was side surfaced immediately after it was laid.

A temporary water tank was erected about 19 miles north of Warden for track laying purposes. Permanent tanks with drilled wells have since been installed at Ruff and Marcellus.

Standard right of way fences have been built with the necessary crossing facilities.

The buildings were constructed by Company forces soon after the line was opened for traffic, the usual section facilities being built at Tiflis, Ruff and Marcellus, and depots at the two last named places.

Telegraph material was distributed by work train and erected by Company forces. Telephones were installed in booths at Blind sidings, as well as in the depots.

The branch is operated as a part of the Idaho Division, the usual branch line equipment being used. Traffic is not very heavy except in the wheat hauling season.

VALUATION SECTION WASHINGTON 7A

Valuation Section Washington 7-A covers what is known as the Moses Lake Line which leaves the Warden-Marcellus branch, Valuation Section Washington 7 at Tiflis and extends in a general northwesterly direction about 16 miles to Neppel on the eastern shore of Moses Lake. The general exploration work for this branch was done in conjunction with that work on the Warden-Marcellus Line, although a close reconnaissance outlining the adopted route was made just previous to the instrumental survey.

On June 25, 1911 a locating party started west from Tiflis and completed their work on July 31st, during which time they ran 42 miles of preliminary and 40 miles of location survey to obtain the 15 $\frac{1}{2}$ miles of adopted line, or about 2- $\frac{2}{3}$ miles each of preliminary and location for one mile of adopted survey.

Just previous to construction, which took place in 1912 the line was resurveyed and some revisions made.

Construction was carried on, under the supervision of an Assistant Engineer, who reported to the Assistant Chief Engineer in Seattle.

The Line as constructed leaves Tiflis on a slight descending gradient for about a mile thence climbs to a summit in mile 4 on a varying gradient with a maximum of 1.5% thence descends to Sieler on a maximum gradient of .9%. From Sieler the gradients are generally descending with a maximum of 1.5% to mile 15, thence level to Neppel.

In Mile 3 the line passes under the Connell Branch of the Northern Pacific Railway.

The clearing, grubbing, grading and culvert work was let by contract to H. C. Henry, who sublet to three other contractors. Equipment and supplies were unloaded at Tiflis and hauled from there by team to points of use.

A moderately heavy growth of sage brush and grease wood covered the uncultivated land which required clearing.

Grading was started in May 1912 and completed in December of the same year. The work was largely done with teams and was light, averaging about 12,000 cubic yards per mile. A small percentage of classified material was encountered.

The most difficult feature of the grading was the work in connection with the crossing under the Northern Pacific in mile 3 where it was necessary to maintain traffic while the material was being removed from under their track.

Considerable grading has been done since the original work was finished in widening and removing the tops of cuts to improve the view at road crossings as required by the Public Service Commission.

All the bridge work occurs in the first three miles west of Tiflis and was built by Railway Company forces.

Corrugated iron pipe for the culverts was shipped by rail to Tiflis, from where it was hauled to the sites by team.

Track was laid by hand, 60# relay steel being used. Ballast was obtained from Neppel pit.

The material for right of way fence, telegraph lines, station buildings, etc., was delivered by rail after track laying had been completed and construction work was carried out by the Railway Company forces. A 24 ft. by 88 ft. standard framed depot was built at Neppel. Telephones were installed in booths at blind sidings in addition to those in the depot.

The line is operated as a part of the Idaho Division, the usual branch line equipment being used.

VALUATION SECTION WASHINGTON 8.

Valuation Section Washington 8 covers the branch line which leaves the main line at the west end of the Columbia River Bridge near Beverly and extends in a general southeasterly direction to Hanford, a distance of about 45 miles.

The first reconnaissance work for this branch was done in connection with the main line. (See Historical Sketch on Valuation Section Washington 1) when lines were surveyed down the river, along the west bank to Timmerman's Ferry while searching for a suitable river crossing. These lines did not pass through Hanford but followed the river closely for about 35 miles and developed the fact that a railroad was possible should business develop to warrant its construction.

Early in 1907, two parties made preliminary surveys for a line leaving the main line near the Columbia River crossing and extending south along the west bank of the river. These surveys indicated that the construction of such a line would be expensive and accordingly in fall of that year a close reconnaissance was made of that territory. This reconnaissance report covered both an expensive line built on supported gradients and a cheaper typical branch line.

In December 1908 a party was placed in the field to investigate some difficult location along the river, between fifteen and twenty miles south of the main line. This survey developed the fact that the economical construction of only one railroad was possible in this vicinity. Consequently the construction of miles 17, 19 and 20 was undertaken immediately and was practically completed by March 1909 when work temporarily ceased.

Another party was placed in the field in January 1909 to revise and relocate the line bringing it through White Bluffs, which up to this time had been ignored. Their survey was completed in June of that year. In the Spring of 1910 further surveys were made retracing the previous survey in places and revising in others.

Records show that about 175 miles of reconnoissance, 200 miles of preliminary and 95 miles of location survey were made to produce 45 miles of adopted and constructed line or about $4\frac{3}{10}$ miles of preliminary and 2 miles of location for each mile of adopted survey. This represents only the work done between 1907 and 1912, and does not include the many miles of reconnoissance and preliminary made in this vicinity in connection with the main line surveys.

The engineering work during construction was handled by two District Engineers with five Resident Engineers and parties. The District Engineers reported to the Assistant Chief Engineer in Seattle.

Starting south from Beverly Junction a 1.7% gradient is used to make a descent of about 50' to the first bench above the river. From here the gradients are rolling and work is light for about five miles. Between miles 5 and 16 higher ground is occupied to prevent damage from a proposed dam at Priest Rapids. This added to the construction cost, the work being heavier and a larger percentage of classified material encountered. Heavy work continues through mile 20. Between mile 21 and Hanford the grading is comparatively light. Some cross drainage is encountered, along the first 20 miles, requiring bridges for waterway openings.

The contract for the clearing, grading, bridge and culvert work was let to H. C. Henry, who sublet the entire line to other contractors. The main commissary was established at Beverly Junction, where spur tracks were laid for unloading equipment and supplies. Material was taken by wagon from here over the entire distance.

A medium heavy growth of sage brush and greasewood covered the uncultivated land, which required clearing. South of Priest Rapids a part of the land was irrigated and under cultivation.

The light grading was done with teams and scrapers. Two steam shovels were used, one in the heavy cuts near Priest Rapids, and another in the heavy work in mile 20.

The former shovel was rented from a local concern, but the latter was brought in over the country roads with considerable difficulty.

The rock work between mile 5 and Priest Rapids was done by station men, using small cars and horses to carry the material to the fills.

The light grading work between Mile 20 and Hanford was extremely difficult as the soil is a light clay, and gravel intermingled with boulders varying in size from Nigger Heads to six or eight cubic feet in volume. These were dug out by hand and removed on a stone boat.

The grading of the first five miles was hurried so track could be laid as soon as possible, and a yard was established in Mile Five for bridge and culvert material. From here it was taken to the points of erection by team.

Bridges were built by the contractor's forces with the exception of Bridge numbered EE-1042 near Allard Pumping Station. This bridge, which consists of a deck plate girder span on concrete abutments, was built by the Railway Company forces. The concrete work was done before track laying, the aggregate being obtained locally and the cement hauled in by teams. The girders were erected when the track reached that point. The culverts were erected by the contractor's forces, timber openings being used under the heavy fills, and corrugated iron pipe under the lighter ones.

The track on the first five miles was laid by hand early in the construction period. Track laying was completed with a machine in 1913. New 65 pound, 33 foot rail was used for the main track and lighter second hand steel for the sidings.

The track on the first eight miles was ballasted with material from Cohasset pit, located about three miles west of Beverly Junction on the main line. Broken stone, taken from a slide in mile twenty, was used between miles eight and twenty. Ballast material for the tracks between mile twenty and Hanford was taken from small pits located along the track, the more important ones being in miles 25, 26, 39 and 42.

Permanent water supply stations have been installed at Priest Rapids and Hanford. At Priest Rapids the water is pumped from the river through a long pipe line. At Hanford the supply is taken from the city water mains.

Standard right of way fence with necessary crossing facilities has been built where required.

The buildings were constructed by the Railway Company forces after track was laid. Standard 24' x 86' one-story frame depots were built at Hanford and White Bluffs, and smaller depots at Priest Rapids and Levering. Section facilities have been built at places convenient to the work.

Telegraph construction material was distributed by work trains and erected by the Railway Company forces. Telephones were installed in booths at blind sidings as well as in the depots.

This branch is operated as a part of the Coast Division, the usual branch line equipment being used. Traffic is light except during the fruit season.

SPECIAL FEATURES:

The irrigation ditch crossings, in many cases, required expensive special construction. At Bridge EE 1042 the newly constructed ditch was lined with concrete.

The territory was sparsely settled and subject to high winds, blinding dust storms and occasional cloud bursts, which all tended to add to the difficulty of construction.

A cloud burst occurred in 1913 which washed out four bridges on miles 7 and 8, and stopped traffic for several days.

Numerous changes were made in existing wagon roads during construction and considerable work was done by the contractor's forces to keep them in shape for the heavy hauling. In connection with this, temporary wagon bridges were necessary across the irrigation ditches.

VALUATION SECTION WASHINGTON 9.

GENERAL LOCATION:

Valuation Section Washington 9 covers what is commonly known as the Everett Branch, which leaves the main line at Cedar Falls and extends in a general northerly direction about 55 miles to Everett, Washington.

RECONNOISSANCE AND SURVEYS:

Three engineers made separate reconnoissance trips for this line, all covering approximately the same route. The first trip was made in 1906 on horseback, and required only a few days as the engineer was in the field in connection with the main line surveys, which were then under way, and no special preparations were required. He outlined a railroad to be built on main line standards, and the construction would have been expensive. The two later examinations took place just previous to the location surveys and were very thorough, as search was being made for a typical branch line. All together 200 miles of line was covered in the reconnoissance and complete reports made in regard to gradients, curvature and future traffic.

Location parties were placed in the field in April, 1909, and kept at work almost continuously until construction started in April, 1910. Every prospect was thoroughly investigated. The first 20 miles north from Cedar Falls were covered with heavy timber, which retarded the progress of the parties. The steep slopes in Tokul Creek district offered many difficulties, and required several preliminary lines with extensive topographical surveys. North from Tolt the land traversed was swampy and subject to floods, and the river crossings required careful study and close examination of the features along the banks. The transportation of supplies and camp was not difficult, however, as the Northern Pacific and the Great Northern branch lines were in operation and fair wagon roads were in existence.

Summarizing the surveys, we find that 100 miles of preliminary and 125 miles of location survey were made for about 55 miles of adopted line. Parties averaging about eighteen men each, were in the field nineteen months.

ENGINEERING ORGANIZATION:

The construction engineering organization consisted of one Division Engineer, with offices at Everett, assisted by one District Engineer and seven Resident Engineers. The Division Engineer reported to the Assistant Chief Engineer in Seattle.

CONSTRUCTED LINE:

The line as constructed leaves Cedar Falls on a slight descending gradient for a couple of miles. Thence descends rapidly on a 2.2 percent gradient, with sharp curvature to Tanners, where the valley of the South Fork of the Snoqualmie River is reached. The line descends this river valley with comparatively light gradients and curvature to mile Eleven, where the crossing of the main Snoqualmie River is made on a 200 foot steel truss. Here the grade line reverses and ascent is made on a maximum of one percent to a summit between the South Fork and Tokul Creek in mile Thirteen. From here to mile Twenty-one a steady descent is made on a one percent gradient, first up Tokul Creek for a couple of miles then looping across the Creek to the north bank and down to the Tolt River Valley. In miles Twenty-two and Twenty-three a rise in the grade line is made to obtain the required clearance at Tolt River crossing. From mile Twenty-three to Everett the gradient is practically level with the exception of the rise through Monroe, and Snohomish and for the river crossings. The gradient entering Everett is one percent ascending.

CONTRACTS:

Contract for the clearing, grubbing, grading, bridge and culvert work was let to H. C. Henry, who sublet it to numerous other firms.

Transportation facilities are fairly favorable over the entire line. The C. M. & St. P. Railway served the work close to Cedar Falls. The territory between Tanners City and Tolt was served by the Northern Pacific branch line and between Tolt and Everett by the Great Northern Railway. Wagon roads were built from the Railway stations to the work where necessary, some of which required considerable work. Between Tolt and Everett it was necessary to corduroy the existing wagon roads in many places to prepare them for the heavy loads.

This work was done at the Railway Company's expense.

CLEARING, GRUBBING AND GRADING:

The general characteristics are widely different on the two ends of the line, and for description it might be well to make a dividing point at mile Twenty-five. The work south of or between that point and Cedar Falls was the ordinary cut and fill grading, with some side borrow, and was done with teams or by station men. Clearing was required on this part, some quite heavy, with a corresponding amount of grubbing.

North from Mile twenty-five, or between that point and Everett most of the land traversed was swampy, and subject to frequent floods, necessitating an extraordinary high grade line. Adjacent borrow for the extensive fills could not be obtained, consequently temporary standard trestles were built and the embankments made with train hauled material. About 388,000 lineal feet of piling, 20,000,000 F.B.M. of timber and 75 tons of iron were used in the construction of these temporary trestles. Over a million cubic yards of material was train hauled to fill these trestles, from steam shovel borrow pits located at high spots along the line, or in some cases, quite a distance from the right of way, necessitating considerable construction work to obtain access to them.

Some clearing was required on the north end of the line, although not in such large quantity as on the south half. Grubbing was required in many cases for the pile driving as land was sometimes encountered that had been previously cleared but not stumped.

A spur track about a mile and a quarter long was built along the south bank of Ebey Slough to serve a saw mill and several other proposed industries. Track was laid and ballasted in 1911, but business did not develop as anticipated and the track has been taken up until such time as business will warrant its maintenance.

In Everett a branch line about 4 miles long, called the Riverside Line, was built up the Snohomish River. The storage and switching yards, as well as numerous industrial spurs, are located along this line. Only one cut occurs on the Riverside Line, and the major part of the embankment was made with train hauled material.

BRIDGES, TRESTLES AND CULVERTS:

In general it can be said that an unusual amount of standard bridge construction was required in addition to the temporary trestles for filling purposes. Truss spans were required for the frequent stream crossings, and several high and long trestles were built where cross drainage was encountered, on the south half of the line. Short pile bridges of 3 or 4 spans were built frequently through the swampy land to act as equalizer water ways during flood seasons. Near Everett the crossings of the Ebey Slough and Snohomish River required draw bridges as these are navigable streams.

Pile and frame trestle work was done by contract as also was the falsework for the truss spans. Truss spans were framed and erected by the Company forces.

The material used in the structures erected by contract was furnished by the contractor, a flat price being paid covering the material, its delivery, and erection.

Hewn logs were used for culvert construction where it was possible to obtain them. The sawed culvert timber was furnished and placed by the contractor in the same manner as the bridge material. A small amount of vitrified culvert pipe was used, which was purchased at Renton, Wash., and shipped in by rail.

TRACK LAYING AND BALLASTING:

Track was laid with a Roberts Bros. machine, new 65 pound rail being used. Track laying commenced on January 29th, 1911, and was completed August 4th, of the same year. The material yard for track laying was in Cedar Falls.

The ballast for the first few miles north of Cedar Falls was obtained from Ragnar Pit on the main line, Valuation Section Washington 1. The remainder of the ballast was obtained from pits located along the line. Ballasting was commenced on March 5th, 1911, and finished October 22nd, of the same year.

WATER SUPPLY

Temporary water tanks were erected at North Bend and Tolt for construction purposes. These have since been replaced by permanent structures. At North Bend water is obtained from the city mains, and at Tolt a long pipe line was laid to develop a gravity system. Permanent tanks are also located at Monroe and Everett. In both places the supply is obtained from the city mains.

SPECIAL FEATURES:

Serious subsidence has taken place on the embankments through the swampy region north of mile 25. In some cases this amounts to two or three hundred percent of the original fill quantities.

Erosion from high water and excessive floods has been an item of considerable expense, especially on miles 44 to 46, and 50 to 52.

Riprap for bank and bridges protection was put in, in large quantities, soon after track was laid. The material was obtained from widened cuts and on the main line, Valuation Section Washington 1. Sheer walls and in some cases mattresses have been used for protection at the river crossings.

Frequent highway changes and overhead bridges were necessary and added materially to the construction cost.

Frequent grade crossings with existing lines of railroad required joint survey work and special frogs.

Right of way through the towns of Duval, Snohomish, Monroe and Everett was expensive and required special construction and special methods for carrying on the work.

Serious slides have occurred in Tokul Creek Loop, mile 14, which have necessitated several line changes. A large amount of material has been excavated in caring for these slides.

A line change was also made at Rutherford Springs in mile 18 after an attempt had been made to fill the bridge crossing the draw at that place. It was impossible to hold the fill in place with the material at hand so the alignment was moved into the hill at a heavy expense.

BUILDINGS, TELEGRAPH AND FENCE:

Material for right of way fence, telegraph lines and buildings was delivered by train after the track was laid. Fence with the necessary crossing facilities was built except in inaccessible places.

The buildings were constructed by the Railway Company forces, standard one story frame combination freight and passenger depots being built at North Bend, Tolt, Duval, and Monroe. A large frame freight depot with temporary passenger facilities was built at Everett. Shelters have been built at less important sidings. An oil supply plant, turntable, etc., was built at Everett and some facilities installed at Cedar Falls to care for the branch line engines. Telephones were installed in booths at blind sidings in addition to those in the depots.

OPERATION AND MANAGEMENT:

The Everett Branch is operated as a part of the Coast Division, standard equipment being used as a traffic is quite heavy.

VALUATION SECTION WASHINGTON 10.

During the summer of 1907 three reconnaissance trips were made in connection with the proposed surveys for this branch. They all had Enumclaw as the objective point, the difficulty being in finding a suitable connection with the main line. One route was investigated west from Enumclaw along White River to Auburn; one north through Franklin to connect with the main line in the Cedar River Valley; and one east along Boise Creek.

Instrumental surveys were begun in April, 1908, and continued through July, in which time seventy-one miles of preliminary and two miles of location survey were made. Work then temporarily ceased until April, 1909, when it was resumed and continued until July 4th, in which time eighteen miles of preliminary line and fifteen miles of location were surveyed.

A resurvey was made in December, 1909, just previous to construction and several revisions made.

Summarizing the survey work; a total of eighty-nine miles of preliminary and thirty-one miles of located line were covered or a ratio of six and one half miles of the former and two and three tenths miles of the latter to one mile of adopted line.

The line as constructed leaves the main line at Bagley Junction, a point about four miles west of Cedar Falls, and extends in a general southerly direction to Enumclaw. About two miles of the White River Lumber Company's track is used jointly with that Company, between the Wye at Enumclaw Junction and the headblock of the C. M. & St. P. depot and yard tracks at Enumclaw. According to the contract this track is maintained solely at the expense of the C. M. & St. P. Company.

That part of the line between Bagley Junction and Selleck, a distance of about two miles, was constructed by the Seattle & South-eastern Ry. and was purchased by this Company. This line was of medium construction work on approximately a 2.65% gradient and maximum curvature of twelve degrees. From Selleck the gradient is descending on a maximum of one percent to the crossing of Green River in mile five, thence the gradient is rolling with a maximum of 1.4 percent to the crossing of the Buckley Branch of the Northern Pacific in mile seven, thence descending with a maximum of 1.2 percent to Veazie Creek, in mile eleven, thence ascending with a maximum of 1.7 percent

to Enumclaw Junction. A large amount of curvature, some quite sharp, is used in following the contours of the mountains. Between Kangley and Green River the main line of the Northern Pacific is followed quite closely.

The construction was carried on under the supervision of a District Engineer who reported to the Division Engineer in Seattle. The contract for clearing, grading, bridge and culvert work was let to H. C. Henry who in turn sublet to other contractors.

Clearing and grubbing were necessary over the entire line as it passes through heavily timbered region.

The grading was mediumly heavy, averaging about 24,000 cubic yards per mile, of which a large portion was classified material.

Contractor's supplies and equipment were shipped over the existing lines of railway to the point nearest the work and taken from there by teams. Some wagon road work was necessary for the transportation.

Three important bridges were built, one over Green River and the main line of the Northern Pacific Ry., in mile seven, one over the Buckley Branch of the Northern Pacific at Bayne, one in the Enumclaw Yards where a log flume belonging to the White River Lumber Company was crossed. A large part of the latter bridge has since been filled with train hauled material. The crossing of Green River required a 125 foot Deck Howe Truss, which was built by the Railway Company forces. The other bridge work consisted of pile and frame trestles which were built by the contractor's forces. Material was purchased from local mills.

The culverts were largely built of hewn timber obtained on the right of way, although some vitrified pipe was used which was purchased at Renton, Washington, and shipped in by rail.

Track laying was commenced on October 6th, 1910, and completed on November 18th of the same year. Ballasting was done during the same period, with material from the Enumclaw gravel pit.

Right of way fence with the necessary crossing facilities has been built except in inaccessible and isolated places.

The buildings were constructed by the Railway Company forces after the track was laid, and the material was delivered by rail. A 24' x 98' one story frame depot was built at Enumclaw. Section facilities were built at Enumclaw Junction and Bayne. Passenger shelters were placed at the less important sidings.

Telegraph material was distributed by work train and erected by the Railway Company forces. Telephones were installed in the depots and in booths at blind sidings.

Permanent water supply stations have been installed at

Selleck and Enumclaw. At Selleck the supply is obtained by gravity from a local stream and at Enumclaw from the city mains.

The Enumclaw Branch is operated as a part of the Coast Division, the usual branch line equipment being used.

VALUATION SECTION WASHINGTON 11

The McKenna Gate Line is a branch of the C.M. & St. P. Ry., which extends about 34 miles, in a general westerly direction, from a connection with the Tacoma Eastern R. R. at McKenna, to a connection with the C. M. & St. P. and O. W. R. & N. Companies joint line to Grays Harbor, at Helsing Junction. The line is used, in conjunction with the T. E. R. R. on the east and the jointly owned line on the west, to operate trains between Tacoma and Hoquiam, which is situated on Grays Harbor.

In addition to the main line track on this Valuation Section, several short and three important industrial spurs were built. The three important spurs are the Johnson Creek Spur, which is about three and one-half miles long and leaves the main line in Mile Eight; the Gregory Mill Spur, which is about five miles long and leaves the main line at Gregory in Mile Fifteen, and the Bordeaux Spur, which is about one and one-half miles long and leaves the main line at Mumby. These spurs are all included in the Valuation Section Washington 11.

Surveys for this line were made between May 1908 and May 1909. About 124 miles of preliminary and 65 miles of location survey were made to produce the 34 miles of adopted and constructed line, or $3\frac{7}{10}$ miles of preliminary and $1\frac{9}{10}$ miles of location for each mile of adopted survey.

The construction engineering organization consisted of one District Engineer and six Resident Engineers with the usual parties. The District Engineer reported direct to the Chief Engineer in Seattle.

Contract for the clearing, grading, grubbing, bridge and culvert work was let to H. C. Henry, who sublet it to three other contractors. The proximity of the existing lines of railway aided the contractors in bringing their equipment to the work, although considerable road work was done between the points of unloading and the points of operation.

Leaving McKenna gradients are light and rolling, but generally rising to a summit in Mile Eight, at which point a descent is begun on a maximum $\frac{5}{10}$ percent gradient to the

Des Chutes River crossing in Mile Fifteen, from there they are slightly rolling, but generally descending with a maximum of $4/10$ percent to the connection at Helsing Junction, the base of rail at the connection, being about 150 feet lower, than at Des Chutes River crossing. Near Maytown in Mile Twenty-two the Beaver Creek and Black River drainage is reached and followed to Mile Twenty-nine.

Clearing on the first twenty miles from McKenna was medium and consisted of second growth fir with heavy underbrush. From Mile Twenty to Twenty-eight heavy timber was encountered. The merchantable timber was saved, some being cut into piles, telephone poles, ties and fence posts, and some being skidded for future loading by work train. Clearing on the last five miles was light.

Grading was commenced in June, 1909 and completed in March, 1910. The work is variant, some miles being quite heavy and other quite light, averaging about 16,000 cubic yards per mile, a large part of which is classified material. The heaviest work occurred in Mile Eight, where about 75,000 cubic yards were moved, and a steam shovel was used. The other work was done with teams and scrapers with the exception of the solid rock excavation, which was done by station men. Quite a large amount of the work was done by force account, due to special conditions, such as wet material and loss of the original roadbed by floods, etc. These conditions were more pronounced in Miles Twenty-one to Twenty-eight inclusive.

The Johnson Creek Spur was built in 1910, and was constructed with steep gradients maximum $2-2/10$ percent, but easy curvature. The grading averaged about 2600 cubic yards per mile.

The Gregory Spur was built in 1911 and was constructed on rolling gradients with a maximum of 2 percent and some sharp curvature. The grading averaged about 8,000 cubic yards per mile, about 30 percent of which was classified.

The Bordeaux Spur was built in 1911 and involved the moving of about 47,000 cubic yards. The gradients are steep, about 2,000 feet of 4 percent gradient being used, maximum curvature 10 degrees. This spur crosses under the Northern Pacific Grays Harbor branch, requiring the construction of the overhead bridge, and the consequent difficulty of maintaining traffic on another track while excavating beneath it.

The important bridges are the Nisqually River crossing

in Mile one where two 125 foot deck, timber Howe truss spans were used with long pile trestle approaches; the Northern Pacific crossing in Mile Eight, where a steel girder span is used with pile trestle approaches; the Des Chutes River crossing in Mile Fifteen, consisting of a steel girder span and pile trestle approaches; the Mud Lake bridge in Mile Eighteen, and the Chehalis River crossing in Mile Thirty-four, which consists of two 125 foot through timber Howe truss spans on crib piers with long pile trestle approaches. The other bridge work consists of ordinary pile trestles built in accordance with C. M. & St. P. standard plans. Timber and piles were obtained locally.

Culverts were principally built of hewn logs obtained on the right of way, although some squared timber was used where desirable logs could not be obtained.

Three crossings of the Northern Pacific Railway Company tracks occur on this line, one in Mile Eight, where the C. M. & St. P. track is carried over the Tenino Line of the N. P.; one in Mile Eighteen, where the Northern Pacific double track Point Defiance Line is carried over the C. M. & St. P. and one in the Rochester Station grounds, at grade with the Gate to Centralia Branch of the Northern Pacific.

Track laying began on November 24th, 1909 and was completed on June 15th, 1910. 75# relay and 65# new steel was used. The material yard was established at McKenna. Ballasting was done between April and August, 1910, the material being taken from the pit at Rainier.

Material for the buildings was delivered by train after the track was laid and construction was carried out by the Railway Company's forces. Depots were built at Rainier, Maytown and Rochester, the one at the last named point being used jointly with the Northern Pacific. A permanent water station was built at Offutt, supply being obtained in Offutt Lake and pumped through a long pipe line. Section facilities were built at places convenient to the work. Telegraph material was distributed by a work train and erected by the Railway Company forces, telephones being installed in booths at blind sidings in addition to those in the depots. Right of way fence with the necessary crossing facilities was built except in isolated places.

The line is operated as a part of the Coast Division, standard main line equipment being used.

SPECIAL FEATURES

The falsework at the Nisqually River crossing in Mile One, and the Chehalis River crossing in Mile Thirty-four was

taken out by the high water and was replaced by force account. Protection from log jams was also a matter of large expense at these bridges.

Wagon road changes, especially in Miles Twenty-one, Twenty-four, Twenty-seven, Twenty-eight and Twenty-nine, were expensive. Work was largely done by force account.

A great many of the culverts were washed out during construction, and were replaced by force account.

BIG BLACKFOOT RAILWAY
VALUATION SECTION MONTANA 1.

Valuation Section Montana 1 of the Big Blackfoot Railway covered the line owned by that Company, extending in a general easterly direction through Missoula and Powell Counties from a connection with the C. M. & St. P. Railway Company's Spur at Bonner, Montana to Browns Lake, comprising about 60 miles of line.

Grading was completed and track laid to a connection with the Anaconda Copper Mining Company's Logging Spur in Mile Eleven in 1909-10-11. The grading on the remainder was under way in 1910 when work was discontinued, and it has not as yet been completed.

In September, 1907, a reconnaissance was made beginning at Bonner, Montana, and extending in a general northeasterly direction along the Big Blackfoot and Clear Water Rivers. A second reconnaissance of this same territory was made in March, 1909. This last reconnaissance was followed by instrumental surveys. The surveys at this time did not terminate at Browns Lake, but extended on north along the Clear Water River. Construction was begun on the first 11 miles in December, 1909. The surveys had been made rather hurriedly due to the fact that other railroads had parties in the field at the same time, and when construction was undertaken, numerous revisions were made. In June, 1910, instructions were issued to extend the line east to a terminus at Browns Lake and surveys were made accordingly.

The line as located and adopted crosses the Big Blackfoot River soon after leaving the connection with the C. M. & St. P. Spur at Bonner, and follows the north bank of the river in a general easterly direction to its junction with the Clear Water River; thence follows the Clear Water River almost due north for about 4 miles to a crossing of the river in Mile Thirty-three; thence swings east to Ovando, touching the north bank of the Big Blackfoot River about 4 miles east of the Clear Water crossing. From Ovando the line swings south of east to the terminus at Browns Lake.

A spur about a mile long leaves the main line at Blackfoot Junction and crosses the river to a connection with the A. C. M. Company's logging road.

The first 19 miles of the line lies along the Big Blackfoot River Canyon and the curvature is quite sharp, although the gradients are light, the maximum being .5 percent. From Mile Nineteen to the Clear Water crossing the line lies in what is locally known as Nine Mile Prairie, and the gradients and curvature are moderate. East of the Clear Water crossing the line traverses a rather rough, mountainous territory.

The C. M. & St. P. Spur was built in the Fall of 1909, just prior to the beginning of construction on the Big Blackfoot Railway. A connection was made between this spur and the Northern Pacific Bonner Mill track, which tracks are used jointly by the two companies.

As previously indicated construction was authorized in December, 1909, for about 11 miles of line, extending from the C. M. & St. P. Spur at Bonner, to a connection with A. C. M. logging road near Blackfoot Junction. An office was established in Bonner for the Assistant Engineer in charge of the work, who reported directly to Mr. J. R. Tools, President of the Company. The Assistant Engineer had the usual office force and one Resident Engineer and party. Contract for the grading and culvert work was let to Clifton, Applegate & Company. Contract for the timber trestle work was let to O. E. Peppard of Missoula.

When it was decided to extend the line on to Browns Lake in June, 1910, Clifton, Applegate and Company were awarded the contract, who in turn sublet the work above Mile Eleven to the White Construction Company.

Good wagon roads were in existence from Bonner to the connection with the logging road, but about 2 miles of road were opened up above that point, the principal expense of which was the construction of three temporary wagon bridges across the river. The bridges were built with stringers of trees cut from near by timber on rock filled crib piers, and the floors were of poles. A bridge was also built across the river on Mile Two near Station 103. This bridge was of the same construction, with the exception that the floor was of plank, which were afterwards used for sway bracing on the railway bridges.

The grading on the first 11 miles was moderately heavy, varying from 15 to 50 thousand cubic yards per mile, the average being about 33,000. Classified material predominated, being about 90 percent of the total. The grading was largely done by station men with the usual outfit of cars and track. Clifton, Applegate & Company used a model 40 Marion Shovel with $1\frac{1}{2}$ yard cars in the heavy cut at Bonner and several cuts on Miles Five and Six, and on Mile Nine.

In moving the steam shovel from the cut at Bonner to the work on Mile Five, it was found necessary to dismantle it and reassemble it at its new location. For the other moves the shovel was not dismantled.

In November, 1910, orders were issued to discontinue all work, and the Engineering forces were laid off by the middle of December. In July, 1911, orders were issued to complete the work to the connection with the logging road, and this work was finished in October, 1911. When the work was closed down in November, 1910, the grading was pretty well completed on the first 9 miles. When work was resumed, it was necessary to complete the grading on Miles Ten and Eleven, and the spur at Blackfoot Junction. A steam shovel was used to take out the cuts between Stations 720 and 763, and the cut at Station 750 was taken out by the trap tunnel method.

As previously indicated the pile trestle work was done by contract. The piles were cut from the closest timber. The other material, with the exception of the stringers, was sawed in the mill at Bonner and hauled by team to the points of use. The stringers were of coast fir, shipped by rail to Bonner, thence hauled by team.

The piers for the Big Blackfoot River crossing on Mile One were built by Bates & Rogers Construction Company, and the steel work erected by the C. M. & St. P. Bridge and Building Department. The foundations at this bridge were unusually expensive as the bed of the river was covered with sunken logs, which interfered with the driving of the cofferdams. This trouble was finally overcome by cleaning up the river bottom with an orange peel dredge. The falsework here was knocked out twice by log jams. The Big Blackfoot crossing on the spur connection with A. C. M. logging road, Mile Eleven, was built by Dibble & Kelly of Spokane, the material being furnished and delivered on the ground by the Railway Company.

The line of the Railway encroached upon and interfered with the old highway, necessitating several expensive changes.

The first change began about 200 feet to the left of Station 170 on Mile Three, crossed the Blackfoot River, and continued up the south side of the river to a point opposite Station 288 in Mile Six, where it again crossed to the north side of the river, and to the north side of the track. From this point the new road was graded on the Railway Company's right of way to about Station 495, where it crossed to the south side of the track and connected with the original highway. The right of way for the new highway was paid for entirely by the Railway Company. This change also necessitated two wagon bridges across the Blackfoot River, the cost of which was borne by the Railway Company and Missoula County on a 50 percent basis. It was necessary to construct temporary bridges over the river to care

for the traffic until such time as the permanent bridges could be completed. These bridges were of log stringers and crib piers with plank floors, the plank being used later for flooring the permanent bridges. The expense of constructing the temporary bridges was borne by the Railway Company. Other changes secondary in importance were made on Miles Six and Seven, on Mile Nine, Mile Ten, and Mile Eleven.

The track material was unloaded in the material yard at Bonner. The ties for the first 3 miles were cut in the mill at Bonner and distributed during track laying. The ties for the balance of the line were delivered on the right of way from the adjoining timber. Track was laid by hand. The passing track at Bonner and about a mile and a half of main line had been laid in 1910, when work was discontinued. Track laying was completed in the Fall of 1911. The Contractor's steam shovel was cut into a gravel bank on Mile One, and enough ballast distributed and put under the track to give it a good running surface.

The C. M. & St. P. Railway Company operated this line acting as Agent for the Big Blackfoot Company until December 31, 1916. On that date the line was purchased by the C. M. & St. P. Ry. Company, and it is now operated as a part of the Missoula Division.

GALLATIN VALLEY RAILWAY

VALUATION SECTIONS MONTANA 1, 2 AND 3.

The Gallatin Valley Railway, a subsidiary line of the C. M. & St. P. Railway Company, extends in a general southerly direction about 27 miles to Bozeman Hot Springs; thence about 11 miles easterly to Bozeman; thence about 25 miles almost due north to Menard. The terminus at this latter point is about 17 miles east and 6 miles north of the point of beginning at Three Forks. Two branch lines leave the main line, one about 5 miles long from Belgrade Junction to Belgrade, a station on the main line of the Northern Pacific, and one extending south from Bozeman Hot Springs to Salesville, a distance of about 15 miles. For Valuation purposes this Railway is divided into three sections. Valuation Section #1 includes the main line between Three Forks and Bozeman Hot Springs, and the branch line to Belgrade, a total of 32.4 main track mileage. Valuation Section #2 includes the main line from Bozeman Hot Springs to Bozeman, the branch line from Bozeman Hot Springs to Salesville, and the street car lines in Bozeman, a total of 16.2 main track mileage, and 2.6 miles of street car track. Valuation Section #3 includes the main line from Bozeman to Menard, a total distance of about 25 miles.

The line lies wholly in Gallatin County, Montana, and traverses a very rich agricultural district, a large part of the land being irrigated. The valley lands produce timothy, alfalfa, and small grains. The bench lands which are dry farmed produce wheat. The country is well settled and served by good highways. Plenty of sustenance was obtained for the live stock while the lines were under construction.

An Electric line between Bozeman and Salesville through Bozeman Hot Springs, together with the street car line in Bozeman, was operated by the Gallatin Valley Electric Company prior to September 8th, 1910, on which date the corporate name was changed to the Gallatin Valley Railway Company. The Chicago, Milwaukee & Puget Sound Company acquired the capital stock of the Gallatin Valley Railway Company in 1911, and transferred this stock, along with their other holdings on September 24th, 1912, to the C. M. & St. P. Railway Company. The line from Three Forks to a connection with the Electric line at Bozeman Hot Springs, was built by the Chicago, Milwaukee & Puget Sound Railway Company in 1910, the Belgrade branch in 1911, and the line from Bozeman to Menard in 1912.

The main line between Three Forks and Bozeman Hot

Springs crosses the Madison River near Three Forks and follows the Gallatin River and its West Fork quite closely, crossing the West Fork once near Bozeman Hot Springs. Considerable cross drainage is encountered on this part of the line, requiring bridges for openings. The branch line from Bozeman Hot Springs to Salesville continues on south along the West Fork of the Gallatin River. One crossing of the West Fork of the Gallatin River is made on the Belgrade branch.

Between Bozeman Hot Springs and Bozeman the line crosses drainage, but the grading is fairly light.

The line between Bozeman and Menard follows the valley of the East Fork of the Gallatin River to Hillisdale, and in a rough way parallels the line between Three Forks and Bozeman Hot Springs, lying about 10 miles east therefrom. Numerous irrigation ditches were encountered and numerous channel changes were made for small creeks to avoid expensive bridges.

The gradients on each of these lines are irregular and rolling, the maximum being 1.3 percent, which occurs on the Menard line. The construction is typical of branch lines, and some sharp curvature is used.

The usual preliminary and location surveys were made. Those for the line between Bozeman and Salesville by Westinghouse Church Kerr & Company under contract with the Gallatin Valley Electric Railway Company. These contractors also did some preliminary survey work between Bozeman Hot Springs and Three Forks. The surveys for lines built by the Chicago, Milwaukee & Puget Sound Railway were made by that Railway Company's Engineers.

Contract for the grading on the line from Three Forks to Bozeman, the Belgrade branch, and the line from Bozeman to Menard, was let to the Callahan Construction Company, who sublet a considerable portion of the work. In general the grading was light, the heaviest work being between Logan and the Madison River crossing, near Three Forks, on Valuation Section Montana #1, and on the first two miles out of Bozeman, on Valuation Section Montana #3. This latter work was done with a steam shovel and dinky train outfit.

The Electric line from Bozeman to Salesville through Bozeman Hot Springs was constructed in 1909. The contractors, Westinghouse Church Kerr & Company, furnished all material and did all the construction work, including grading, track laying, rail bonding, erection of depots, sub-stations, pole lines, trolley, and the installation of electrical apparatus. This work included about two miles of construction in the streets of Bozeman, involving paving.

The street car lines in Bozeman were originally constructed in 1892 with 36 pound rail and 6 inch by 6 inch ties. In 1912 these lines were reconstructed and 65 pound rail laid. Considerable paving was done in Bozeman in 1912-13 and 14.

The grading material encountered was usually common earth and gravel, although some loose and solid rock was encountered in the deeper cuts and considerable hard pan on the Menard line. Some clearing and grubbing was required on each section. The grading was largely done with teams.

During the construction of the Belgrade branch about 2 miles of road bed was washed out by floods. This bank has been washed out twice since, in 1913 and 1914.

Six important bridges are used as follows: One 156 foot timber Howe truss span with pile trestle approaches over the Madison River, near Three Forks. One 68 foot timber Howe truss span with pile trestle approaches over the Northern Pacific Railway Company's track, near Logan. One 70 foot steel girder span with pile trestle approaches over the West Gallatin River on the Belgrade branch. One 156 foot timber Howe truss span with pile trestle approaches over the West Gallatin River, near Greenwood station. One 70 foot steel girder span with pile approaches over the Northern Pacific track, and one 40 foot steel girder span with pile trestle approaches over the East Gallatin River, both near Bozeman on the Menard branch.

The pile bridges built by the C. M. & St. P. Railway Company conform to their standard design. Those on the Electric line between Bozeman and Salesville were originally of a light type of construction and have in many cases been rebuilt to conform with the standard design.

The culverts are of timber and corrugated iron pipe.

Three material yards were used during construction. One was located at Three Forks, one at Belgrade, and one at Bozeman. Material for the culverts and bridges was hauled from the nearest yard to the structure site.

Right of way fence with the necessary crossing facilities has been built where required.

The track, on the lines built by the C. M. & St. P. Company, was laid by the Railway Company forces, following up the completion of the grading as fast as possible. The work was done partly by hand and partly with a machine rigged up especially for this job. The ties are of Western fir. 60 and 65 pound rail was used. The track has been side surfaced.

Temporary water stations were located at Camp Creek and at Bush. Permanent stations are maintained at Camp Creek, Bozeman Hot Springs, Bozeman and Menard.

Combination freight and passenger depots have been built at Manhattan, Camp Creek, Bozeman Hot Springs and Salesville, smaller depots at Spring Hill and Menard and passenger shelters at the less important sidings. At Bozeman a concrete freight house

40 x 60 feet, and a brick passenger depot 26 x 96 feet has been built. An engine house, car barns, sub-station, etc. were also built at Bozeman. Telephones are used for train dispatching, being installed in the depots and in booths at blind sidings.

Light steam engines are used and electric cars are operated between Bozeman and Salesville. Street car service is maintained in Bozeman.

Until December 31st, 1918, the Gallatin Valley Railway was operated as a separate organization with the C.M. & St.P. Ry. Co. owning all of the outstanding stock. On that date the railway property and franchises of the Gallatin Valley Co. were conveyed to the Chicago, Milwaukee & St. Paul Co. and it is now operated as a part of the Rocky Mountain Division.

TACOMA EASTERN RAILROAD
VALUATION SECTIONS WASHINGTON 1 to 1e INCLUSIVE.

The main line of the Tacoma Eastern Railroad extends about 68 miles in a general southerly direction from Tacoma to Morton, Wash., and with its several branches serves the rich timber and mining territory in the vicinity of Mount Rainier. The main line, for Valuation purposes, is called Valuation Section Washington 1, and the branches Valuation Sections 1a, 1b, 1c, 1d, and 1e, respectively.

The two important branches are Valuation Sections 1a and 1d. The former is the line about 16-6/10 miles in length between Salsich Junction and McKenna, and the latter is the branch between Park Junction and Ashford, a distance of about six miles, and forms an entrance by rail to Ranier National Park. The other branches, 1b, 1c, and 1e are spur tracks two or three miles in length leaving the main line at Tanwax Junction, Kapowsin and East Creek Junction, respectively, and were built to serve logging and mining industries.

The North Coast Timber Company owned a large amount of valuable timbered land in the vicinity of and south of Tacoma, and in about 1885 or 1890 they built a logging road south from Tacoma to transport this timber to market. Logging operations were carried on vigorously, and as fast as the land was cleared of timber the railroad was extended farther, reaching the present station of Eatonville in July, 1903. Previous to this time the business of the line had consisted of the transportation of logs for the North Coast Timber Company. Other companies had in the meantime established mills and camps in the vicinity of the line, and a common carrier business was now undertaken.

The line was extended to Ashford in July, 1904 and regular passenger trains, carrying mail and express, were put in service to care for the tourist travel to Mount Rainier and the transportation of men to and from the logging camps. Some wagon road development was done and a comfortable hotel built in Ranier National Park by the Railway Company to promote travel thereto. The hotel was later disposed of and is now operated by private parties.

The line was extended south from Park Junction reaching the terminus at Glenavon in July, 1907. In the summer of 1907 the McKenna Branch was decided upon and construction was started immediately, track reaching McKenna in March, 1908.

The grading work for the Tacoma Eastern Company was done under the supervision of an Engineering Department, and exploration trips were made in advance of the line, more especially, however, to investigate the traffic possibilities in the way of timber than

line betterment. The territory traversed was rugged and undeveloped and the grading work was, as a rule, done by hand. The line was built primarily as a logging road, and, consequently, steep gradients and a large amount of sharp curvature was used. Numerous spurs were built from the main line to facilitate the logging operations. The more important ones, as previously described, have been left on the ground and are in use at present.

The Chicago Milwaukee and St. Paul Company acquired a controlling interest in the line in 1908, and soon after, it was decided to extend the line on south to Morton. Surveys developed the fact that it would be more advantageous to depart from the old line, toward Morton, at Cowlitz Junction, a point about three and one-half miles north of Glenavon. The track between this point and Glenavon has since been taken up with the exception of about 900 feet of track, which is maintained for set out purposes.

Prior to the transfer of ownership, the records, maps and profiles were all destroyed by fire. Consequently an entire resurvey was made in 1910.

The extension from Cowlitz Junction to Morton was surveyed and built under the supervision of the Chicago Milwaukee and St. Paul Chief Engineer's office in Seattle, one Resident Engineer having charge of the field work during construction.

Starting south from Tacoma an ascent is made on a three percent gradient for about three miles to a table land approximately 400 feet above sea level; thence south over this plateau with rolling gradients and light work for eight and one-half miles, when another ascending three percent gradient is used to attain a plateau near Salsich Junction. The grading on this section is mediumly heavy.

South from Salsich Junction to Harding, Mile 15, the gradients and work are light. Between Harding and Thrift an ascent of over 200 feet is made in two miles. A short distance south of Thrift the gradient becomes descending and continues until Lake Kapowsin is reached in Mile 24. Grading work to this point is generally light with an occasional heavy cut or fill.

Leaving Kapowsin station the west bank of the lake is followed with medium grading for about two miles to Lakehead, where the Ohop Valley is entered, and from there followed with gradual descending gradients and light construction work to Mile 29, where an ascent is commenced on steep gradients and with heavy construction work, and continues to Mile 32, a rise of about 250 feet being made in three miles. Through Miles 32, 33 and 34 the gradients are rolling and light, the grading is medium heavy, and two important bridges are used to cross Lynch Creek and the Mashell River. In Mile 34 an ascent is begun and from there continued on varying gradients to LaGrande station in Mile 37, where the Canyon of the Nisqually River is reached. The river bank is followed on rolling gradients and medium heavy work to Mile 41 where the headworks for the Tacoma Light & Power Plant is reached. Here Alder Creek empties into the Nisqually and the Railroad turns into Alder Creek Canyon which it follows with steep ascending gradients to a summit in Mile 43. Leaving the summit descent on steep gradients is made to Mile 46, thence an ascent on about a one percent gradient through Elbe to the Nisqually River crossing in Mile 50.

From Mile 50 Mineral Creek and Round Top Creek are followed on rolling and occasional steep gradients to a divide in Mile 58 where the Tilton River drainage is reached. From here the gradient is descending to Morton with a maximum of 2-3/10 percent. The line extends about three miles south from Morton on rolling gradients generally ascending.

As would be indicated from the description, the line lies entirely in a rugged mountainous region and a large amount of sharp curvature was necessarily used.

Clearing and grubbing were required over the entire line, some quite heavy. The grading was variant, some miles running as heavy as 35,000 cubic yards and some very light, the average being about 17,000, of which a large percentage was classified material. As previously stated, the construction was largely done by hand due to the inaccessibility of the country traversed. Since the line has been under the control of the Chicago, Milwaukee and St. Paul Railway a large amount of construction work has been done in the way of betterments, line changes, reducing curvature and gradients, bridge filling, etc.

The line from Salsich Junction to McKenna, Valuation Section Washington 1a, passes partly through timbered and partly through cultivated land. The gradients are rolling with three sharp ascents westbound although the general tendency is descending to the west as the terminus is about 80 feet lower in elevation than the point of beginning. The roadbed construction was light, averaging about 9,000 cubic yards per mile, a large part of which was classified.

The line from Park Junction to Ashford, Valuation Section Washington 1d, was built on steep gradients, a rise of about 440 feet being made in the 6-6/10 miles. The construction work was light, averaging about 3,000 cubic yards per mile.

A rather complicated situation arose in Tacoma where the connection with the Chicago, Milwaukee and St. Paul Railway Company's track was made, necessitating several long pile trestles and changes to the existing city street bridges crossing the canyon.

After leaving Tacoma the bridge work on the first 30 miles is light, only one short pile bridge being used until Lynch Creek crossing in Mile 32 is reached where a 68 foot timber deck Howe truss is used with a high timber trestle approach. In Mile 34 a 66 foot timber deck Howe truss with pile trestle approach is used to cross Mashell River. Bridges of some considerable size are more frequent from Mile 34 to Mile 46 through the Nisqually River and Alder Creek Canyons.

In Mile 51 a crossing of the Nisqually River requires a 120 foot through timber Howe truss with a long pile trestle approach. From Mile 51 to Morton several pile bridges occur, a few of which are more than the average in size; especially between Cowlitz Junction and Morton.

The bridge timber was obtained from local mills and the piling from adjacent standing timber.

Culverts were built of hewn logs obtained on the right of way.

Track laying followed grading closely, being extended as fast as possible. Starting from Tacoma, Kirby was reached in December 1901, Holz in April 1902, Eatonville in July 1903, Elbe in July 1904, Park Junction in October 1904, Mineral in December 1905, Watkins in March 1906, Glenavon in February 1908, Morton in September 1910. The branch from Park Junction to Ashford was laid in December 1904, from Salsich Junction to McKenna in April 1908, and the line from East Creek Junction to Ladd in May 1906. The original track was laid with 60 pound new steel, of which about fifteen miles of the material came from the Krupp Works, Germany, being shipped to Tacoma by boat. The remainder was Illinois Steel Company's stock shipped by rail from the East. The light rail has been replaced with 75 pound and 85 pound material between Tacoma and Salsich Junction, and in Miles 34 to 44. Ties were of native fir.

The line was ballasted from pits located along the line, soon after track was laid, the more important pits being in Miles 2, 13, 22, 31, 54 and 62. The McKenna Branch was ballasted from a pit at Salsich Junction.

Right of way fence with the necessary crossing facilities has been built where required.

Two-story frame 24 by 52 foot combination freight and passenger depots were built at Morton, Watkins, Mineral, Elbe, Alder and Eatonville. A depot 24 by 76 feet with living rooms upstairs was built at Kapowsin, and a 24 by 60 foot depot at Bismarck. Smaller depots were built at Park Junction and Salsich Junction. Engine terminals consisting of a five stall round house, a machine shop, paint shop, coal storage, etc. were built at Bismarck, and section facilities at places convenient to the work.

A 24 by 54 foot one-story frame depot was built at McKenna, Valuation Section Washington 1a. A 24 by 52 foot two-story frame depot was built at Ashford, Valuation Section Washington 1d.

Permanent water stations were established on the main line at Salsich Junction, Kapowsin, Eatonville, Williamson, Elbe, Mineral and at 19-Mile Creek, about ten miles south of Mineral. Fuel oil supply stations are being built at Kapowsin and Mineral.

Telephones were installed in booths at blind sidings and in the depots.

Standard main line equipment is used as the traffic is quite heavy.

Until December 31st, 1918, the Tacoma Eastern Railroad was operated as a separate organization with the C. M. & St. P. Ry. Co. owning all of the outstanding stock. On that date the railway, property and franchises of the Tacoma Eastern Railroad Co. were conveyed to the Chicago, Milwaukee & St. Paul Co. and it is now operated as a part of the Coast Division.

PUGET SOUND & WILLAPA HARBOR RAILWAY

VALUATION SECTION WASHINGTON 1.

The Puget Sound and Willapa Harbor Railway extends about 66 miles in a general westerly direction from a connection with the C. M. & St. P. Railway Company's Grays Harbor line at Maytown, Washington, to Raymond, Washington, which is situated on the tide flats along the Willapa River. The line passes through the important towns of Centralia and Chehalis and serves the rich timber country along the Chehalis and Willapa Rivers.

Records show that a large amount of reconnoissance and survey work was required to produce the line as adopted and constructed. An attempt was made to connect with the C. M. & St. P. Ry. at Helsing Junction, but this line did not develop favorably when surveyed. Seven distinct reconnoissance surveys were made, the first in September 1910, and the last in June 1913, a total of 161 miles being covered. About 120 miles of preliminary survey and 100 miles of location survey were made or about two miles of preliminary, and one and one-half miles of location for each mile of adopted line. The preliminary and location surveys were made between March and August 1913.

Construction prior to track laying was carried on under the supervision of a Chief Engineer with eight Resident Engineers and Parties. After track laying the engineering force was materially reduced, but considerable construction was carried on in the way of widening cuts and embankments, building depots, telephone lines, fence, etc. Construction was begun in August, 1913, and completed for track laying in July, 1915.

Contracts for clearing, grubbing, grading, bridge and culvert work were let to three contractors; Guthrie McDougall & Company having the work on Miles One to Forty-two inclusive, and Miles Sixty-five and Sixty-six; Hans Pederson, Miles Forty-three to Fifty-four inclusive, and the Willapa Construction Company, Miles Fifty-three to Sixty-four inclusive.

The line swings south from Maytown and following no particular drainage travels almost due south over the slightly rolling country on light gradients and easy curvature to Chehalis. Here it swings to the west and the Chehalis River Valley is entered and is from here followed with frequent crossings of tributary streams to Doty, in Mile Thirty-seven. The gradients and curvature for this portion are light, maximum curvature being 6 degrees and gradient 9/10 of 1 per cent. The Elk Creek Valley is entered at Doty and from there followed with frequent side drainage and main stream crossings to a point $1\frac{1}{2}$ miles west of Bedford, where the line swings into the Beaver Creek drainage, which is followed to Sudbury, the summit of the line, being about 400 feet higher than Maytown, point of beginning, and nearly 600 feet higher than Raymond, the terminus.

The curvature on this last named portion is moderate, the maximum being 8 degrees, and the maximum gradient 1 per cent.

Leaving Sudbury a rapid descent is made on a $2\frac{1}{2}$ per cent gradient and with sharp curvature along the steep slopes of East Creek to P. & E. Junction, where Mill Creek Valley is reached and from there followed with several crossings to a point about a mile and a quarter east of Moose. Here the Willapa River Valley is reached and is from here followed until the line reaches the tide flats in Mile Sixty-three. The gradients and curvature on this last portion are moderate.

The line between P. & E. Junction and East Raymond was built by the Pacific & Eastern Railway Company and was acquired by the P. S. & W. H. Company.

Clearing was fairly heavy on the first five miles west from Maytown. From Mile Five to Mile Forty-two, clearing was generally light, although an occasional piece of heavily timbered land was encountered. From Mile Forty-two to Raymond clearing was generally heavy.

The grading work from Maytown to Chehalis was fairly light, running about 13,000 cubic yards per mile, largely classified. About four miles of this section was built on an old U. P. grade, which had been previously constructed and required considerable regrading and dressing up. The work from Chehalis west to Sudbury was fairly heavy side hill development.

The old U. P. grade was used in the construction of about eight miles of this portion, between Miles Fourteen and Twenty-one. The heaviest work occurred in Miles Fifty-three and Fifty-four, near Sudbury, on which about 155,000 and 135,000 cubic yards were removed respectively. Miles Sixteen, Seventeen, Twenty-four, Twenty-six, Twenty-seven,

and Twenty-nine, were quite heavy, also averaging about 55,000 cubic yards per mile. Between Sudbury and P. & E. Junction, the work consists of heavy side hill development with several high trestle bridges. Along Mill Creek the old P. & E. grade is moderately light, and between East Raymond and the terminus the work consists of fairly heavy grading and a large amount of bridge construction. The average for the entire line is about 35,000 cubic yards per mile, of which a large percentage is classified.

Several channel changes were made on the Elk, Beaver, and Mill Creeks to eliminate bridge work.

A steam shovel was used on the east end in Miles One to Five and on the two heaviest cuts at the end of Mile Ten, and beginning of Mile Eleven.

Teams were used for the light grade construction and to redress the old U. P. grade between Miles Five and Twenty-five, with the exception that the rock cuts were let to station men, and a drag line scraper was used on some of the side borrow work. A steam shovel was used to build the grade from West Adna, Mile Twenty-five, to the South Fork crossing in Mile Twenty-eight. A drag line scraper did the grading work on Miles Twenty-nine to Thirty-one. A steam shovel was used for the heavy cuts in Mile Thirty-three, and teams were used on the comparatively light work between there and the Chehalis River crossing, just west of Doty in Mile Thirty-nine. The work up the Elk and Beaver Creek Valleys was a large percent solid rock and was done by station men.

The summit cut at Sudbury was started by station men, but their progress was slow on account of wet material and a steam shovel was installed. This cut is very wet and has caused considerable trouble both during the early construction period and since track has been laid. It has been widened and the material train hauled for bridge filling and bank widening. The work done on the west slope along East Creek was the heaviest work on the line and was done by station men.

The P. & E. roadbed, purchased by the P. S. & W. H. Co. had been constructed previous to the P. S. & W. H. work, three miles being built in 1907, two in 1909, $\frac{1}{2}$ mile in 1910, and three miles in 1913. A large amount of material has been train hauled to this portion for raising and widening embankments and filling bridges since the P. S. & W. H. have started operation. Several channel changes were built to eliminate bridges built by the P. & E. Company.

The line from East Raymond to Raymond was built by the P. S. & W. H. Company, a steam shovel being used for the heavy cut in Mile Sixty-four, and station men in the cut in Mile Sixty-six.

The bridge work was unusually heavy due to the frequent stream crossings and the pile trestle work on the tide flats in Raymond. The important stream crossings were the Skookum Chuck River bridge in Mile Fourteen; the Neuwaukum River crossing in Mile Twenty; the Chehalis River crossings in Miles Twenty-eight, Thirty-four and Thirty-seven; the Elk Creek crossing in Mile Forty-three; the Mill Creek crossings in Miles Fifty-nine and Sixty; the Willapa River crossing in Mile Sixty-three, and the Ellis Lagoon crossing in Mile Sixty-six. These bridges involved the use of timber Howe truss spans varying in length from 150 feet to 72 feet with pile and framed piers and approaches. Several hog rod trusses were used along the Mill Creek Valley, miles Fifty-five to Fifty-nine, for less important stream crossings.

Five high trestles were built between Sudbury and P. & E. Junction, involving the use of about 80,000 F.B.M. and 7,000 lineal feet of piling. The pile trestle work for the main and yard tracks at Raymond involved the use of about 1,000,000 F.B.M. and about 80,000 lineal feet of piling. The ordinary pile and framed trestles were used for the less important water ways, cattle passes, etc.

The material for the trusses was purchased near Mumby, and shipped via the C. M. & St. P. to Maytown where a framing yard was established and the timber cut and framed ready for erection. After the framing the truss material was taken to the sites by work train, the falsework on the spans having been built of sufficient strength to support traffic during track laying. A large part of the piling was purchased locally, and the squared timber from the closest local mills.

The pile bridges, falsework and foundation for the truss spans were built by contract. The spans were framed and erected by Railway Company forces.

The culverts were built principally of timber, those on the east 40 miles being of squared timber and those on the west end of hewn logs.

Track was laid from Maytown to Doty in the summer and fall of 1914, and was finished into Raymond in the summer of 1915. New 65# rail was laid in the main track and lighter material in the sidings. The work was performed with a Roberts Brothers machine. A material yard was established at Maytown for the first few miles of track material, but after track reached Chehalis, the yard was established at that point.

Ballast was obtained from the Essex Pit in Mile Six.

Frequent crossings with other lines of railroad necessitated special frogs, and in the cases of main line crossings interlocking plants. Interlockers were established at the O.W. R. & N. and N. P. crossings in Mile Thirteen, and at the N. P. crossings in Miles Twenty and Thirty-seven.

Material for right of way fence, telegraph lines, and buildings, was distributed by work train after the track was laid. Right of Way fence with the necessary crossing facilities was built except in inaccessible and isolated places.

Framed passenger depots and separate buildings for freight depots were built at Centralia, Chehalis and Raymond, the freight depot at the latter point having rooms for the Superintendent's offices. These buildings at the two former places were set on concrete foundations, but at Raymond they rest on piles. Combination freight and passenger depots were built at Dryad and Doty, and shelter sheds at the less important sidings. Water stations were established at Essex, Chehalis, Dryad, Bedford, Firdale and Raymond. A two stall engine house and a Wye were built at Raymond. Fuel oil tanks have just recently been built at Maytown and Raymond. A 75 foot single track transfer bridge has been built at Raymond and barge service is maintained between Raymond and South Bend.

The usual branch line equipment is used in the operation of the line.

Until December 31st, 1918, the Puget Sound & Willapa Harbor Railway was operated as a separate organization with the C.M. & St. P. Ry. Co. owning all of the outstanding stock. On that date the railway, property and franchises of the Puget Sound & Willapa Harbor Railway Company were conveyed to the Chicago, Milwaukee & St. Paul Co. and it is now operated as a part of the Coast Division.

MILWAUKEE TERMINAL RAILWAY COMPANY

VALUATION SECTIONS WASHINGTON 1 to 8 INCLUSIVE

At the time of construction of Puget Sound Extension it was found that the competitors of the Chicago, Milwaukee & St. Paul Railway were strongly entrenched in the cities of Seattle and Tacoma, especially in the industrial sections devoted to lumber mills. The distance from terminals, and topography, prevented the St. Paul Company, except at excessive cost, reaching directly some of these important industries. To overcome this condition the Milwaukee Terminal Railway Company was organized on April 7, 1908, and incorporated under the laws of the State of Washington for the purpose of constructing trackage and ferry landings and the operation of car ferries from the main terminals of the Chicago, Milwaukee & St. Paul Railway to reach these industrial sections, and also to reach some of the more important tidewater mills located at points on Puget Sound that had been theretofore without rail facilities. Landings were constructed and service inaugurated also to connect the rail lines at Seattle with the railroad of the then Bellingham and Northern Railway Company at Bellingham, and of the Seattle, Port Angeles and Western Railway at Port Angeles and Port Townsend.

Accordingly, in 1908 an engineer from New York, familiar with car ferry systems there and on the east coast, was employed and an organization effected to design landings and barges and to carry out the system on Puget Sound.

At Seattle a three track transfer landing was constructed in 1909, connecting with trackage of the Chicago, Milwaukee and St. Paul Railway at the Forest Street Slip of the latter company. At the same time one three track and three single track landings were constructed on Salmon Bay at Ballard (now a subdivision of Seattle); Salmon Bay being an arm of the Sound, now used as a part of the Lake Washington Canal system joining Puget Sound with Lake Washington. In the same year a three track landing was constructed in the Chicago, Milwaukee and St. Paul Railway Company's slip at its sound terminal at Tacoma, to be used in connection with the operation of a similar three track landing located on Front Street at Tacoma, and serving industry trackage constructed along Front Street from Old Town (McCarver Street) to the plant of the American Refining and Smelting Company, and serving besides the smelter, various lumber and shingle mills located along its route. In the same year the Milwaukee Terminal Railway Company obtained a franchise from the City of Tacoma and built a line approximately $1\frac{1}{2}$ miles in length connecting with the railroad of the then Tacoma Eastern Railroad Company in the vicinity of A and 27th Streets, and extending easterly to Commerce Street and northerly on Commerce Street to a connection with the Northern Pacific near 15th Street.

in 1911 the trackage built by the Milwaukee Terminal Railway Company on Commerce Street was, together with some trackage already on the street belonging to the Northern Pacific Railway, made the joint property of the two companies.

In 1912 single track transfer landings were constructed at Port Blakely and Eagle Harbor--which are located across the sound from Seattle, these two landings serving the Port Blakely Mill Company and the Pacific Creosoting Company respectively. The three track transfer landing at Bellingham, in connection with the operation thru the Bellingham and Northern Railway Company, was also constructed in 1912. A single track transfer landing was constructed in Port Angeles in 1914, but was replaced in 1915 by the construction of a three track landing at Port Townsend, these landings being used for the transfer of business between the Chicago, Milwaukee & St. Paul Railway Company at Seattle and the Seattle, Port Angeles and Western Railway. In 1915 there were also constructed in connection with the Tacoma System minor landings at plants of the Buffelin Lumber Company and the Northwestern Wooden Ware Company, located on Commencement Bay at Tacoma.

Due to the decrease of lumber shipments by rail from tide-water mills and the construction of the Lake Washington Canal, the landings at Ballard were made inoperative and they were removed. The three track landing at the Sound Terminal at Tacoma was removed in 1916 to make way for the construction of Dock No. 2 and a single track landing installed at another location, across the waterway from the original landing.

At the beginning of operation the transfer of cars between landings was handled by two-three track, twelve car, timber barges built for that purpose in 1909. Two additional similar barges were built in 1912 and in 1914 one two track six car barge was purchased.

In 1917 the steel ferry boat which has been in use by the Northern Pacific for transfer of their trains across the Columbia River at Kalama was purchased and converted into a three track 20 car barge.

Prior to the construction of the tug "Milwaukee" the operation of car barges was handled entirely by the tugs of private companies. The barge service at Tacoma is still handled in that manner.

The tug Milwaukee is of steel construction 117'6" long with 22'6" beam, and draft of 15 feet and has a gross tonnage of 222 and net tonnage of 101; equipped with vertical triple expansion engine which has an indicated horse power of 898.

All landings were built on tidewater and were so constructed as to permit the transfer of cars from landings to barges at all but the extreme stages of tide. At Seattle, Bellingham, Port Townsend and the Sound Terminal and Front Street landings at Tacoma, the transfer of cars to and from barges is effected from shore by switch engines. At other landings, where switch engines were not available, special haulage systems had to be provided.

This water born traffic, together with the operation of the Front Street and Commerce Street Lines at Tacoma, were operated by the Milwaukee Terminal Railway Company until December 31st, 1918, at which time the property of that company and its operation, was taken over by the Chicago, Milwaukee & St. Paul Railway.

SEATTLE, PORT ANGELES AND WESTERN RAILWAY.

VALUATION SECTION WASHINGTON 1.

The Seattle, Port Angeles and Western Railway extends from a point of connection with the Port Townsend and Puget Sound Railway (formerly Port Townsend Southern Railroad) at Discovery Junction in a general westerly direction near and paralleling the water front of the straits of Juan de Fuca, thru the City of Port Angeles to a terminus at Deep Creek, west of Twin River Station, a distance of approximately 71½ miles.

The beginning of this project was by the Port Ludlow, Port Angeles and Lake Crescent Railway Company, incorporated in November 1911, under the laws of the State of Washington. In December of the same year its articles were amended changing the name to the Seattle, Port Angeles and Lake Crescent Railway Company, in January 1915 this Company was succeeded by the Seattle, Port Angeles and Western Railway Company, the capital stock of which was owned by the Chicago, Milwaukee and St. Paul Railway Company.

Preliminary examination and some surveys were made by the promoters of the project prior to and during the year 1912. In November 1912 more systematic and complete surveys were begun of a route from Port Ludlow on Puget Sound, via Sequim and Port Angeles to near Piedmont, on Lake Crescent.

Subsequently the project for a terminus at Piedmont was abandoned and instead the route was extended westward from near Joyce, on the line as since constructed, and the eastern terminus was tentatively fixed at Oak Bay on Puget Sound, near the town of Chimacum and the surveys were modified accordingly.

Later a connection was made with the Port Townsend Southern Railroad and the eastern terminus was established at Discovery Junction, which is located on the easterly shore near the southerly end of Discovery Bay. The location surveys were made and completed as far west as Majestic in 1912-13; from Majestic to a point about 2½ miles west of Twin Station in 1916; and from the last mentioned point to the terminus at Deep Creek in 1917. The location and construction provided for ruling grade of 2.5% west bound, and 2.0% east bound, with maximum curvature of 16 degrees, and average maximum curvature of 12 degrees.

The line generally was constructed thru a heavily timbered country. A number of high timber trestle bridges across the deeply

cut streams and water courses were necessary. The construction thru the city of Port Angeles and along the water front there and eastward was difficult and expensive owing to the close proximity of the bluff, involving a large amount of excavation work and some land slides. Further difficulties and expense were occasioned for the protection of the roadbed and track from action of the waves and tides. The early destruction of pile work and parts of the trestle bridge work along the water front at Port Angeles by teredoes required the reconstruction of extensive portions of the bridge. Troublesome and expensive slides in the cuttings and embankments along the bluffs between Majestic and Twin Rivers and west of Twin Rivers added greatly to the cost of construction. The section of the line from Port Angeles west to Majestic was completed and put in operation in 1914; the section between Port Angeles and Discovery Junction was completed in 1915; the extension from Majestic westward to a point about 2½ miles west of Twin Rivers was completed in 1916, and the extension to the present terminus at Deep Creek was completed in 1918.

The track was laid with 65# rail.

Prior to the completion of the line between Port Angeles and Discovery Junction a car ferry landing was constructed at Port Angeles by the Milwaukee Terminal Railway Company for the purpose of transferring cars by barges to the Chicago, Milwaukee and St. Paul Railway at Seattle. After the connection with the Port Townsend and Puget Sound Railroad at Discovery Junction had been established this transfer of cars by car ferry was made at a landing constructed by the Milwaukee Terminal Railway Company at Port Townsend and the landing at Port Angeles was discontinued and removed.

On December 31st, 1918, the property of the Seattle, Port Angeles and Western Railway Company, and its operation, was taken over by the Chicago, Milwaukee & St. Paul Railway Company and subsequent to that time operated by the latter as the Olympic Division.

BELLINGHAM & NORTHERN RAILWAY

VALUATION SECTIONS WASHINGTON 1, 1A, 1B.

The Bellingham & Northern Railway, which extends from Bellingham, thru Sumas to Glacier, had its inception about 1872 in the construction of a rail line from coal mines, long since abandoned, located about where the present enginehouse and shops are situated in Bellingham, to bunkers at tidewater in the vicinity of Sehome Dock. This line was one of the first railroads built in the Puget Sound Country.

Mr. D. O. Mills, then of San Francisco, later of New York, who with other San Francisco men were the operators of the Northern Commercial Company, which was widely known in the trade of the early days of Alaska, controlled the operations under which this railroad originated and had acquired great quantities of land and coal and timber properties in Whatcom County.

The Bellingham Bay and British Columbia Railroad Company was incorporated under the general laws of the State of California in 1883, and under this corporation was built the line from Bellingham to Glacier. The Waterfront, or Belt Line Railroad, extending from a connection with the Bellingham Bay and British Columbia in the vicinity of Sehome Wharf to Squaticum Junction, was built by the Bellingham Terminals and Railway Company, also a California Corporation, for which articles were filed in 1909.

By deeds executed on October 21st, 1912, both the Bellingham Bay and British Columbia Railroad Company and the Bellingham Terminals and Railway Company conveyed their property to the Bellingham and Northern Railway Company, a Washington corporation, under articles filed October 17th, 1912, controlled by the Chicago, Milwaukee and St. Paul Railway Co. This latter company on December 31st, 1918, conveyed its property to the Chicago, Milwaukee and St. Paul Railway Company, after which time the lines in question have been operated as the Bellingham Division.

The Bellingham & Northern is located entirely in Whatcom County, Washington, extending from Bellingham, thru Sumas on the International Border, to a terminus at Glacier.

There is no owned rail connection between this line and the C.M. & St.P. tracks. Cars are transferred to Seattle by means of car barges operated in connection with car ferry landings, the landing at Bellingham having been established by the Milwaukee Terminal Railway Company in 1912.

Consideration has been given to matter of making rail connection but nothing has been done to this end except that reconnaissance surveys have been made with view of connecting with the Everett Branch at Everett. Rail connections may be

had with main line thru either the Great Northern or Northern Pacific Railways.

The records of early surveys and of construction by the original companies are not available and very little information can be given on this subject.

The town of New Whatcom was platted by the Railway Company in 1883 and in 1890 the Bellingham Bay and British Columbia conveyed its holdings, other than railroad property, to the Bellingham Bay Improvement Company and thereafter, so far as records show, confined itself mainly to constructing its railroad to open up timber, coal and mineral property.

Sometime after the railroad was incorporated the original coal mine track was extended as far as Strandell. The date of this construction is not definitely known but deeds for numerous parcels of right of way show date of 1889. In the year 1891 the railroad was extended from Strandell to Sumas in order that a connection might be made with the Canadian Pacific and thereby permit of thru service by that Company thru the use of this railroad from Sumas to Bellingham, and what is now the Great Northern from Bellingham to Seattle. The Canadian Pacific's thru freight service was inaugurated in either the latter part of 1891 or the early part of 1892. Their thru passenger service was inaugurated in July 1892. Inauguration of this thru passenger service was made the occasion of a great public celebration in New Whatcom and it was in anticipation of this, and of future business, that the Bellingham Bay and British Columbia erected its hotel building adjacent to its depot on Railroad Avenue, which building was demolished in 1924.

The owners of the property also had in mind a line to Spokane, and an extension was built from Sumas to Maple Falls in 1901, and in 1902 and 1903 was built on to Glacier. Surveys were also made beyond Glacier, following up the north fork of the Hocksack River, crossing the divide and reaching the headwaters of the Methow River. After some months of investigation and the expenditure of considerable money the route was abandoned. The branch line from Hampton to Lynden was also constructed in the year 1903. The Waterfront, or Belt Line Railroad in Bellingham, was built in 1909 and 1910 by the Bellingham Terminals and Railway Company, and in 1915 and 1916 the Bellingham and Northern Company constructed the branch line from Goshen to Kulshan (formerly Welcome). In 1916 the latter Company also built a connection at Sumas with the British Columbia Electric Company.

As originally constructed the main line extended from Sehome Dock easterly thru the now city of Bellingham, with maximum grade east bound of 2.53% to Squaticum Junction, west bound maximum grade being 2.06%. From Squaticum Junction to Sumas the line passed thru heavily timbered country now cleared and devoted to farming, dairying and poultry raising. From Sumas the line climbs to Hilltop Siding, in the vicinity of Columbia, on varying grades, the maximum of which is 3.19%, dropping down to the valley of the north fork

of the Nooksack River, in the vicinity of Maple Falls, following this valley to the terminus at Glacier. The principal commodities handled are logs and forest products, with some limestone from Balfour and Limestone Junction, located between Sumas and Maple Falls, destined to the plant of the Olympic-Portland Cement Company at Bellingham.

The Utah-Idaho Sugar Company have located a plant at Bellingham and the raising of sugar beets in the valley between Bellingham and Sumas, has been added to the agricultural activities.

The line was originally laid with light steel, some portions of which on the heavier grade, between Lambertson and Hilltop, having been replaced in 1923 with 85# relay rail from the main line. The Waterfront, or Belt Line, between Bellingham and Squaticum Creek, was originally laid with 70# rail and the branch line from Goshen to Kulshan with 65# rail. The Goshen-Kulshan Branch crosses both the main stream and the north Fork of the Nooksack River. The main line likewise crosses the main stream near Everson and the north fork at Warnick; all crossings being by means of timber Howe truss spans.

The Nooksack River and its forks are turbulent mountain streams, carrying in flood stages considerable volume of water and debris, and occasioning great expense in protection work.

The first locomotive used on the Bellingham Division was one which came around Cape Horn in a sailing ship. It was used by Mr. Mills in grading the sand lots in San Francisco in the early fifties. It had been modernized to some extent and was still in use as late as 1910. It is said that Mr. Mills considered this the foundation of his fortune and would not permit it to be scrapped as long as he was in charge of the railroad.

The Bellingham Division is now operated under the supervision of a Superintendent with headquarters at Bellingham.