important factor in the result—there will be no difficulty experienced from leakage and the structures will have been damp-proofed at very little extra expense.

Summary of Conclusions

The following conclusions as to the effect of the oils used in cement and concrete may be drawn from the investigations into the physical properties of oil-mixed concrete:

(1) The tensile strength of 1:3 oil-mixed mortar is very little different from that of plain mortar, and shows a substantial gain in strength at 28 days and 6 months over that at 7 days.

(2) The times of initial and final set are delayed by the addition of oil; 5 per cent of oil increases the time of initial set by 50 per cent and the time of final set by 47 per cent.

(3) The crushing strength of mortar and concrete is decreased by the addition of oil to the mix. Concrete with 10 per cent of oil has 75 per cent of the strength of plain concrete at 28 days. At the age of 1 year the crushing strength of 1:3 mortar suffers but little with the addition of oil in amounts up to 10 per cent.

(4) The toughness or resistance to impact is but slightly affected by the addition of oil in amounts up to about 10 per cent.

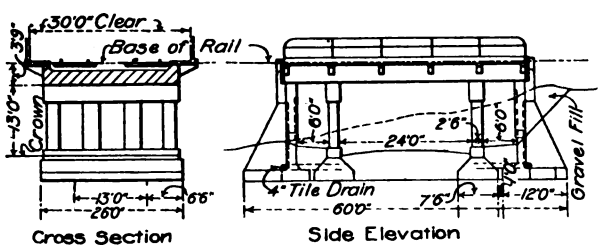
(5) The stiffness of oil-mixed concrete appears to be but little different from that of plain concrete.

(6) Results of tests for permanent deformation indicate that no definite law is followed by oil-mixed concrete.

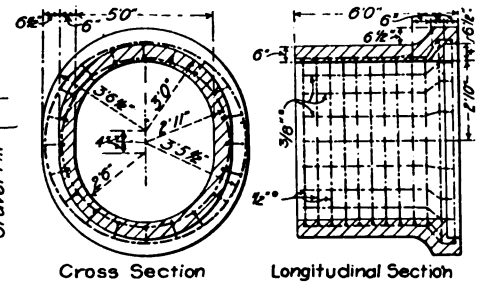
(7) Oil-mixed mortar and concrete containing 10 per cent of oil have very little absorption and under low pressures both are waterproof.

(8) Oil-mixed mortar containing 10 per cent of oil is absolutely water-tight under pressures as high as 40 lb. per square inch. Tests indicate that oil-mixed mortar is effective as a waterproofing agent under low pressures when plastered on either side of porous concrete.

(9) The bond tests show the inadvisability of using plain bar reinforcement with oil-concrete mixtures. The bond of deformed bars is not seriously weakened by the addition of oil in amounts up to 10 per cent.



Concrete Construction for Street Subway



Reinforced-Concrete Pipe Culvert

Water Sterilization at Erie, Pa., is being carried on by means of the hypochlorite plant which was placed in operation March 15, 1911, and described in this journal on July 22, 1911. In the 1911 report of Mr. J. S. Dunwoody, chemist, it is stated that the amount of available chlorine added to the water has varied from 0.25 to 0.35 part per million, equivalent to from 6 to 8 lb. of the dry hypochlorite per million gallons of water. It has been found that with the hypochlorite of lime averaging 36 per cent of available chlorine, 7 lb. of chemical per million gallons will sterilize the water in its worst condition. The average cost of operating the sterilization plant, together with the maintenance of the laboratory, was approximately $1 per million gallons of water treated during 1911.

Building a New Coal Road Across Iowa

Allerton-Carlisle Line of the Rock Island System Will Also Provide a Cut-Off Between St. Paul and Kansas City

The St. Paul & Kansas City Short Line Railroad Company, a subsidiary line of the Chicago, Rock Island & Pacific System, now has under construction a new line extending 65 miles southward from Carlisle, which is just south of Des Moines on a branch from the main line between Chicago and Omaha, to Allerton, which is on the main line between Chicago and Kansas City. This line is being built primarily as a coal road to gain access to the coal fields lying near Dallas, which is about 25 miles south of Carlisle, but it will also provide a cut-off for through traffic between St. Paul and Kansas City, shortening the distance between those two cities by 43 miles.

Coal and Other Traffic Developed

At the present time a large part of the coal used on the northwestern lines of the system comes from Indiana, passing through or near Chicago. The opening of the new fields, where the company has extensive holdings, will shorten the haul of fuel for all divisions. The coal is of a high grade, but the territory producing it has not previously been tapped on account of the expense involved in building a line. The present line runs near property owned by other railroad companies and coal companies and its traffic will therefore include the carrying of coal for commercial purposes as well as for the company's own use.

In addition to the coal traffic it is expected that stock and other commercial shipments will be made to Chicago, Kansas City, St. Paul and Minneapolis, and that the agricultural country traversed will provide traffic in its products. It is expected that freight service will be inaugurated early in November of the year and that first-class passenger service will be started about the first part of 1913.

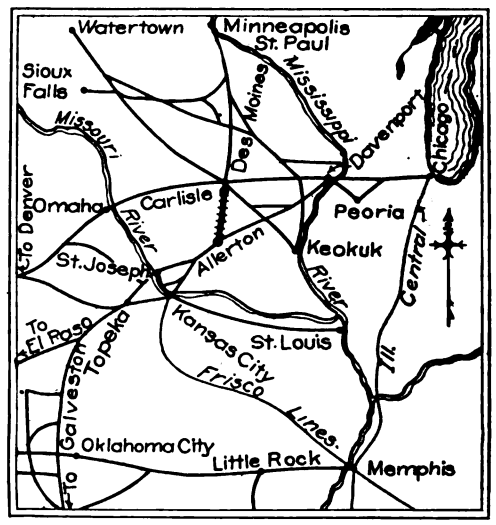
Location of the Line

The line has been located on the basis of an 0.8-per cent. maximum grade, equated for curvature, and a 3-deg. maximum curve. This has resulted in grading, which is heavy for that section of the country, and has required a large amount of heavy equipment in construction. All of the bridges and other structures have been designed to carry the heaviest type of locomotive used on this part of the system, which is equivalent to Cooper's E-55 loading. Grade crossings have been eliminated throughout the line, whenever possible, most of the crossings being railroad bridges over street subways.

The located line is nearly parallel to the Des Moines River in its northern part, crossing its subsidiary drainage at right angles, and turning at Chariton, about Mile 40, to follow the direction of the Chariton River, which flows into the Missouri. This requires several bridges over small rivers, principally in the northern section, and a large number of culverts. The longest crossing is over Middle River, having a length of 675 ft. and a height of 40 ft. above the river bed.

Roadway Standards and Structures

The roadway is built for single track, having a bottom width of 34 ft. in the cuts, with side slopes of 1¼:1. On fills up to 10 ft. in height the top width is 18 ft., and for those over 10 ft. the top width is 20 ft., with side slopes of 1½:1. The track is laid with 90-lb. A. R. A., section A rails on 6 x 8-in. creosoted pine ties. Tie-plates are used, and continuous rail joints are made with 26-in. plates connected by four bolts. The track has a sub-ballast of sand and will be fully ballasted with crushed stone. The right-of-way is fenced with two types of fence, one for stock only and the other for hogs, as the nature of the land requires, and in accordance with a State law of Iowa.



Relation of Cut-Off to the System

Reinforced concrete posts are used in both types, spaced 20 ft. on centers, and the gates are of iron. A plant for manufacturing the concrete posts is being installed at Carlisle, having an estimated capacity of 500 per day.

The principal bridge structures are being erected with main spans of steel on concrete piers and creosoted timber pile approaches, but it is expected that the approaches will eventually be replaced by permanent spans. The steel bridges are made up principally of deck plate-girders, but prior to the erection of the steel the line has been opened up by temporary pile trestles. The creosoted bents which are to form the approaches to the permanent bridges are erected as parts of these trestles.

The street subway bridges, of which there are several, particularly in Chariton, are of heavy reinforced-concrete slab construction, carried on concrete abutments and concrete pier bents at the curb line. The slabs are reinforced under the tracks with I-beams. The pier bents consist each of a row of concrete columns, spaced 4 to 6 ft. apart, running transversely under the tracks on a concrete footing and capped by a concrete beam, giving direct support to the track slab. One of these subway bridges in Chariton has a total width of 175 ft., carrying three pairs of tracks, two pairs of which are team tracks, and two inter-

mediate platforms 30 ft. wide and 27 ft. wide respectively. The span over the street, between the faces of the abutment, is in this case 41 ft.

CULVERTS INCLUDE REINFORCED CONCRETE PIPE DESIGN

All of the culverts on the line are of permanent construction, several types being employed. Cast-iron pipe is used for sizes up to 36 in. and then reinforced-concrete pipe culverts from 36 in. to 60 in. in diameter. Above this box culverts are used, and box construction is also adopted for small passageways for stock and for farm roads. The boxes vary from 5 x 5 ft. in the culverts to 12 x 12 ft. in the other passageways.

A feature in the design of the reinforced concrete pipes is that they are made slightly elliptical by introducing a short flat section at the sides. This was done for construction purposes, enabling the contractors to use a circular reinforcing ring and to have it fall readily into the proper position, near the inside at the top and bottom and near the outside at the sides. The pipe is designed to be laid with the long diameter vertical. The length of the unit varies from 8 ft. over all in the 36-in. size to 5 ft. in the 60-in. size. In each size there are two classes of design, a light one for a fill of 20 ft. or less and a heavier one for fills from 20 to 40 ft. A letter indicating the class is painted on the end of the bell and on the side of the pipe. These concrete pipes are made at Des Moines, by the American Reinforced Concrete Pipe & Culvert Company, a special plant being built at that point for the purpose.

The construction of the new line requires some additional yard tracks and revisions at both Carlisle and Allerton. The division terminals for the line will be at Trenton, on the Missouri Division, on the south and at Des Moines on the north. Engine terminal facilities are provided at Valley Junction near Des Moines. A new coaling station will be maintained at Allerton, and water facilities are also provided at that place and at two other points on the line.

WATER SUPPLY A DIFFICULT PROBLEM

The problem of sufficient water supply was a difficult one, due to the fact that only a small amount of water can be obtained from wells in this region on account of the very small reservoir space in the clay, which is the predominating material in this part of Iowa. A number of tests were made by the railroad company in drilling for water and have also been made by other roads in the vicinity. This condition necessitated the construction of reservoirs at the three points mentioned, the sources of supply being located 1½ to 2 miles away from the watering station, requiring pumping plants at the reservoir sites and 8-in. iron-pipe lines to the tanks. The capacities of these reservoirs range from 125,000,000 to 150,000,000 gallons each. The dams for these reservoirs are built of earth with reinforced-concrete core walls. The dams have waste weirs of reinforced concrete on pile foundations.

CHARACTER OF GRADING AND METHODS

The general contract for the construction of the entire line was let to MacArthur Brothers Company, of New York and Chicago, and these contractors sublet the work in a number of short sections. A large part of the grading was handled by steam shovels and train outfits, seven steam shovels being distributed along the line. The character of the topography was such that all of the excavated material went into the fills, a maximum haul of about 2 miles being made. Both narrow-gauge and standard-gauge equipment was used on the grading work, the filling being done from temporary trestles. In some of the heavier cuts rock was encountered.

In addition to the steam shovel outfits, 34 grading machines were employed on the line, these machines being drawn by steam and gasoline engines as well as by horses. Engines were used for this purpose by some of the contractors who found it difficult to obtain horses for such work during the very hot weather. The distance to which hauls were made with teams reached about 2500 ft. The amount of payment for overhaul was determined by equating against the purchase price of the land necessary for borrow pits and waste piles.

Steam shovels for this work were hauled across country an average distance of about 10 miles, and in some places as much as 14 miles. Since the topography is quite rough, the expense of this work was in some cases quite large. The construction materials, including crushed stone, sand, cement, reinforcing bars, pipe, timber and piles, were also hauled across country from the railroad station by teams. Some of the material, particularly the reinforced concrete pipe, was carried on specially constructed wagons.

About 1000 men have been employed in the construction of the road, this labor being for the most part American, partly because a large part of the construction was machine work.

At the present time the bridge and grading work is about 90 per cent completed and track laying has been started. The track is being laid by a Harris track-laying machine. Track material and other construction supplies are delivered along the line from extra yards located at Carlisle and at Allerton.

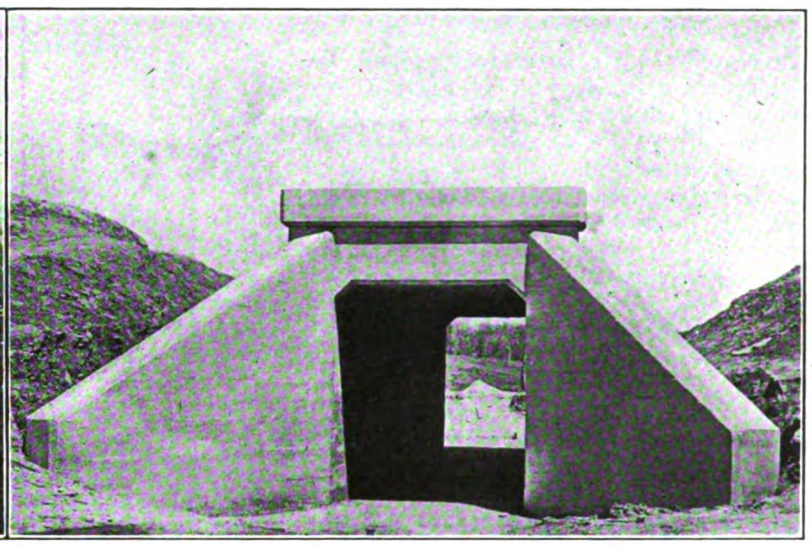
RELATED IMPROVEMENTS

In connection with the construction of the new cut-off, the old branch line which has heretofore connected Carlisle with the main line at Des Moines is being reconstructed. This branch has a length of 11 miles. Curvature has been reduced on this line, the grades cut down and the track is being laid with 90-lb. rail of the same section as that used on the new line. New bridges have been put in at some points and the old bridges have been strengthened so that they will meet the requirements of the new service.

Recently the Rock Island Lines purchased the St. Paul & Des Moines Railroad, a 121-mile line between Des Moines and Mason City. This piece of track will form one of the links in the new direct line from Kansas City to St. Paul.

The construction of the new Carlisle-Allerton line has been carried out under the direction of Mr. J. B. Berry, chief engineer of the Chicago, Rock Island & Pacific Railway. Mr. J. C. Beye is locating and construction engineer, while Mr. W. C. Beech is engineer in charge of the work, having under him a corps of eight resident engineers.

Laying a 48-In. Concrete-Pipe Culvert



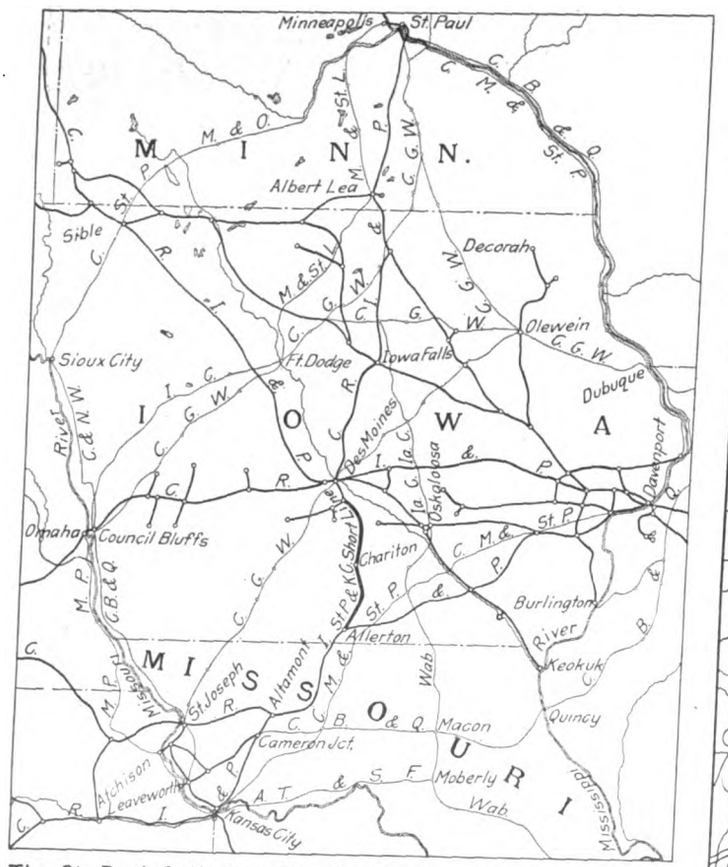
Cattle Pass Typical of Box Openings

ERECTING A TWENTY-STORY BUILDING in eight weeks was recently accomplished in the case of a steel structure with outer walls of brick and stone, located at Thirty-first street and Fourth avenue, New York City. This work included the placing of the concrete in most of the footings, and the completion of the outside walls. Bricks were supplied to the workmen by means of an electrically operated hoist at the rate of about 180 per minute, while a specially designed collapsible platform was employed in place of the ordinary wooden horses on account of the unusual height of the stories. A feature of the construction was the removal of about 1500 cu. yd. of rock excavation for the basement vaults and elevator pits, after the steel frame and outside walls were in place. According to the contractors, the Hedden Construction Company, in order to expediate the progress of the work only the required excavation for the column piers was made in the early stages of the construction.

CONSTRUCTION OF THE ROCK ISLAND SHORT LINE.

Description of the Building of the Closing Link in a New Direct Route Between Kansas City, Mo., and St. Paul, Minn.

The St. Paul & Kansas City Short Line, which, exclusive of directors' shares, is owned entirely by the Chicago, Rock Island & Pacific, was organized in 1911 to establish a short direct connection between Kansas City and the Twin Cities by securing the ownership of the St. Paul & Des Moines and building a new line from Carlisle, Ia., to Allerton. The St. Paul & Des Moines, which was organized in 1903, purchased the line of the Des Moines, Iowa Falls & Northern from Des Moines to Iowa Falls,



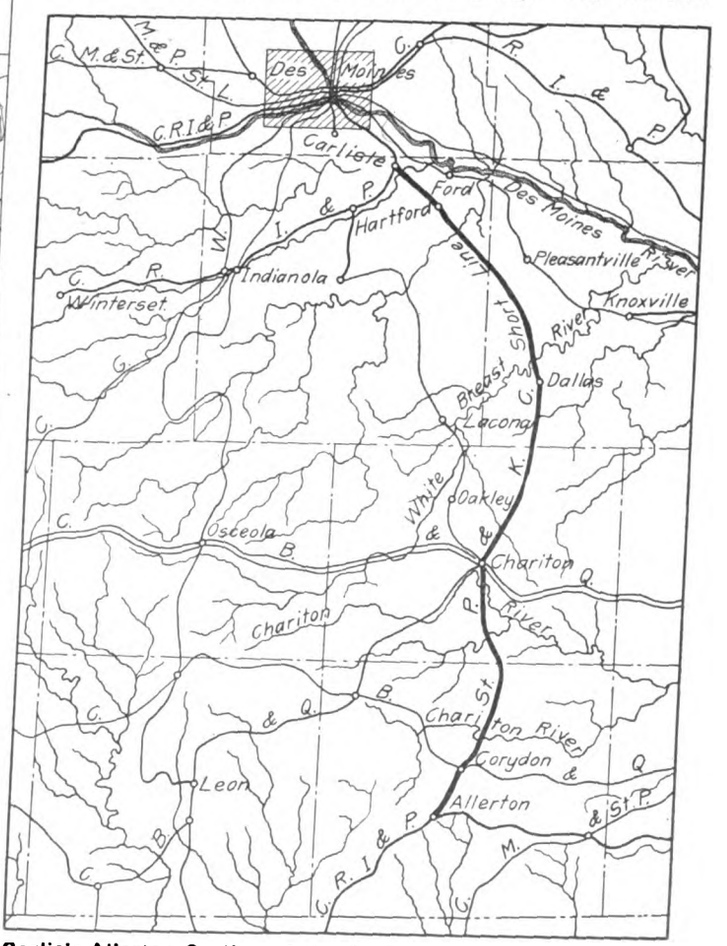
The St. Paul & Kansas City Short Line and Other Railways Connecting Kansas City and St. Paul-Minneapolis.

70.44 miles, and extended it from Iowa Falls to Mason City, 43.8 miles, in 1908. With the terminal trackage at Mason City and Des Moines this company operated 121 miles of line. A through train service has been opened between Minneapolis and Des Moines, using this line to Mason City, the Chicago, Milwaukee & St. Paul from Mason City to Plymouth Junction, 7.3 miles, and the Rock Island line, from Plymouth Junction to Minneapolis, 144.4 miles. The new service to be established by the St. Paul & Kansas City Short Line will use the same route from Minneapolis to Des Moines. South of that point it will operate about 10½ miles of the Winterset branch of the Rock Island to Carlisle, Ia., from which a new line is being built south to Allerton on the Rock Island's main line between Chicago and Kansas City. The Carlisle-Allerton section is about 65.1 miles long and the distance from Allerton to Kansas City on the present line is 152.5 miles, making a total distance of 501 miles from Minneapolis to Kansas City, which is 43 miles shorter than the present shortest line between these points.

By reducing the distance between Kansas City and the Twin Cities, the Rock Island expects to be able to participate heavily in the through traffic for the Northwest, which is distributed from St. Paul and Minneapolis. Heretofore it has been obliged to haul such traffic by an indirect route as far east as West Liberty, Ia. This line will also make possible a direct north and south haul between the Twin Cities and the Gulf of Mexico entirely over Rock Island Lines, which may be of importance in view of the expected development of such traffic following the opening of the Panama canal and will be of very direct importance in relation to the fruit and vegetable traffic from the Southwest which requires expedited service.

While the new line has been built principally for the purpose of handling through traffic, it will also develop an important local traffic. The line of the St. Paul & Des Moines passes through a rich agricultural section. There is also a large acreage of coal land tributary to the line, including two commercial mines already operating at Enterprise, 14 miles north of Des Moines.

Mason City is an important shipping center, containing several jobbing houses, eleven brick and tile works and the plants of the Northwestern States Portland Cement Company and the Lehigh Portland Cement Company. The latter two plants have a combined capacity of 15,000 barrels a day. The line now



Carlisle-Allerton Section of the St. Paul & Kansas City Short Line.

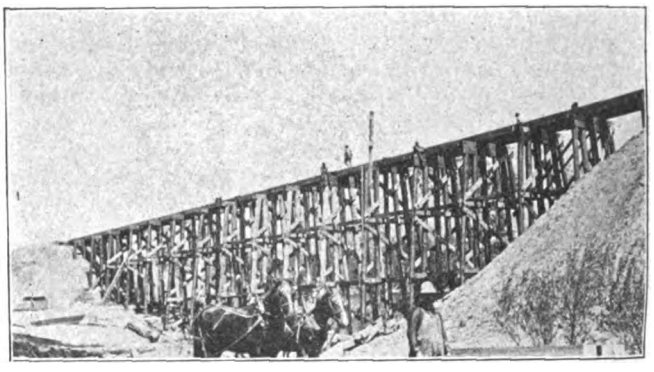
under construction from Carlisle to Allerton passes through a country which has not heretofore enjoyed adequate railway facilities, in which coal mining will produce the principal traffic. The Rock Island owns about 8,000 acres of coal lands near the middle of the section under construction which will furnish an important source of fuel supply when made accessible by the completion of the line.

In addition to the freight traffic, the line presents interesting

possibilities for passenger traffic. A sleeping car service has been operated between Des Moines and the Twin Cities for the past six months, and it is expected that eventually a train may be operated from the Twin Cities with through cars for Omaha, Kansas City and California, connecting with the Rock Island Limited at Des Moines and with the Golden State Limited at Kansas City.

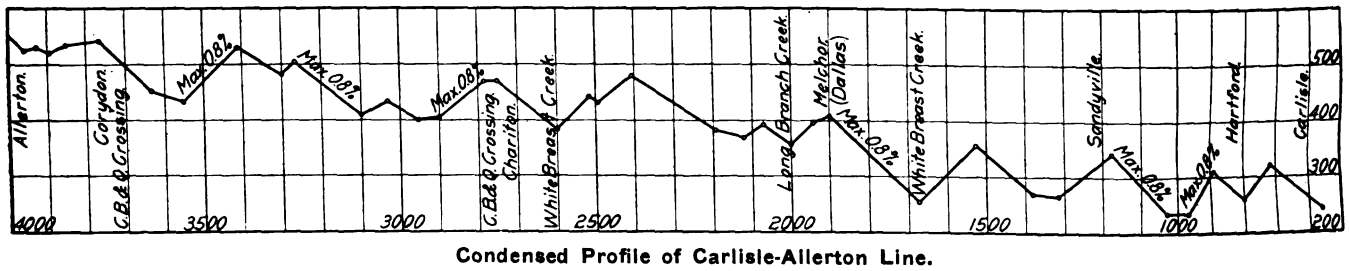
The operating headquarters of the First district have been moved from Chicago to Des Moines since the purchase of the new line on account of its central location with reference to the lines east of the Missouri river. In the interests of economical operation the present division terminal is to be removed from Albert Lea, Minn., to Manley Junction, Ia., where a roundhouse, yards and water service facilities will be built. Eventually the division headquarters of the Minnesota division may be moved to that point from Cedar Rapids.

In view of the high class of service which will be installed as soon as the section from Carlisle to Allerton is completed, the entire line is being put in excellent physical condition. The line now operated by the St. Paul & Des Moines has been considerably improved by the Rock Island, but it is planned to still further improve it by reconstructing some portions and by replacing a number of the bridges. The portion of the Winterset branch between Des Moines and Carlisle, which forms a part of the new line, is being entirely rebuilt, the work including grade and line revisions, the replacing of bridges and relaying of track. The new line south of Carlisle is being built to the Rock Island main line standards and when completed will be in condition to handle traffic economically. The new line is being built as a single track road. The line crosses the general direction of drainage, the country being quite rough considering that it is scarcely more than 100 miles from the Mississippi river in the heart of an agricultural state. On the mile which includes the largest amount of heavy grading the earthwork moved totaled about 165,000 yards, with maximum cuts and fills of about 50 ft., and at a number of points along the line there are short sections for which the yardage averaged considerably higher than the figure given. No large bridges are necessary as no important streams are crossed. There are 8,770 lineal ft. of bridge openings, most of which are wooden trestles with deck girders over the larger streams and over some of the highways. The maximum grade is 0.8 per cent. compensated in both directions, and the sharpest curve is 3 deg., with spirals on all curves 2 deg. or sharper. In general the grade line is rising southward, the highest point reached, which is at the main line connection in Allerton, being more than 300 ft. higher than the lowest point on the line, which is near the Carlisle end. The maximum grade had to be used frequently in both directions, and in some cases it was difficult to get a satisfactory location on this grade.

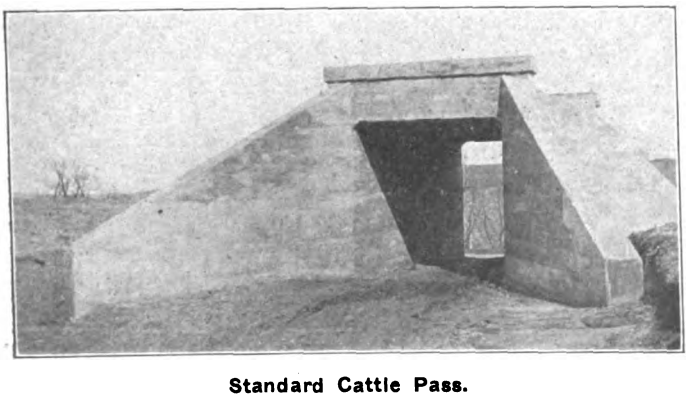


Creosoted Pile Bridge.

The roadbed standards called for an 18-ft. width on fills and 34 ft. in cuts, the latter width providing for use of steam shovels and grading machines, additional material for fills, reducing the chances of slides interfering with traffic and allowing for possible future double-tracking. Practically all material handled is clay with some gravel and a small amount of rock. Standard slopes are 1:1 for heights up to 20 ft., from 1:1 to 1¼:1 between 20 ft. and 30 ft., and 1¼:1 for all heights over 30 ft. In general, the material stood up very well at this angle, only one or two fills causing any trouble. In several cuts, however, the sloughing was quite serious. Drainage was not difficult to secure in most places and no special problems developed.



Condensed Profile of Carlisle-Allerton Line.



Standard Cattle Pass.

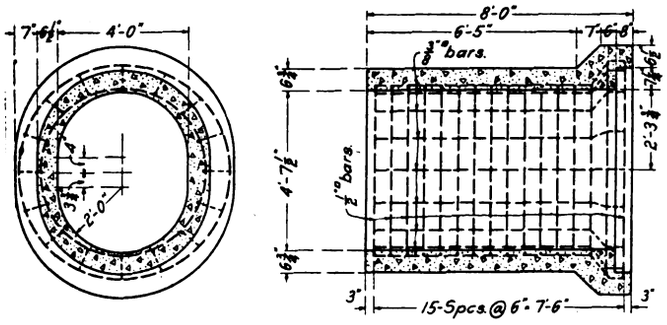
Concrete culvert pipe in 36-in., 48-in. and 60-in. sizes are used for small waterway openings, with concrete box culverts for larger waterways and cattle passes, and trestles for long stream crossings and some of the undergrade highway crossings. Some of the highways are carried under steel girders resting on concrete abutments, and the overhead highway bridges are timber structures on framed or pile bents. The topography made it possible to separate grades at more than two-thirds of the highway crossings, and every effort was made to eliminate grade crossings.

The standard culvert pipe is made in two classes, one for fills up to 20 ft. and the other for fills between 20 ft. and 40 ft., this height being measured from base of rail to flow line. No concrete culvert pipe is used in fills higher than 40 ft. The cross section of the pipe is elliptical, the vertical diameter being 4 in. greater in the smallest size pipe and 9¾ in. greater in the largest size. The walls are from 4 in. to 7½ in. thick, depending upon the size of the pipe, and are reinforced by ⅜-in. square bars placed longitudinally and ½-in. square bars placed circumferentially. The pipes are made in sections 8 ft. long for the 36-in. and 48-in. sizes, 6 ft. for the light design in the 60-in. size, and

5 ft. for the heavy design in this size. The heaviest section weighs 5.9 tons. The concrete box culverts are of the standard design used on the Rock Island and are very similar to those built by several other roads.

All pile trestles were built to the Rock Island standard, using creosoted piling, posts and caps. In the structures which include girder spans a continuous trestle was first driven across the opening in order to allow track to be laid, and the girders will be placed as soon as they can be brought in by rail. The portions of the trestles which will be replaced by the girders are made of untreated material. The pile driving was done by three land roller drivers, one working from each end of the line and one near the middle.

The earthwork was handled by a variety of methods, various contractors using scraper outfits, heavy steam shovels and light automatic shovels, with both cars and dump wagons, and grading machines with both gasoline engines and horses. The



Details of Elliptical Concrete Culvert Pipe.

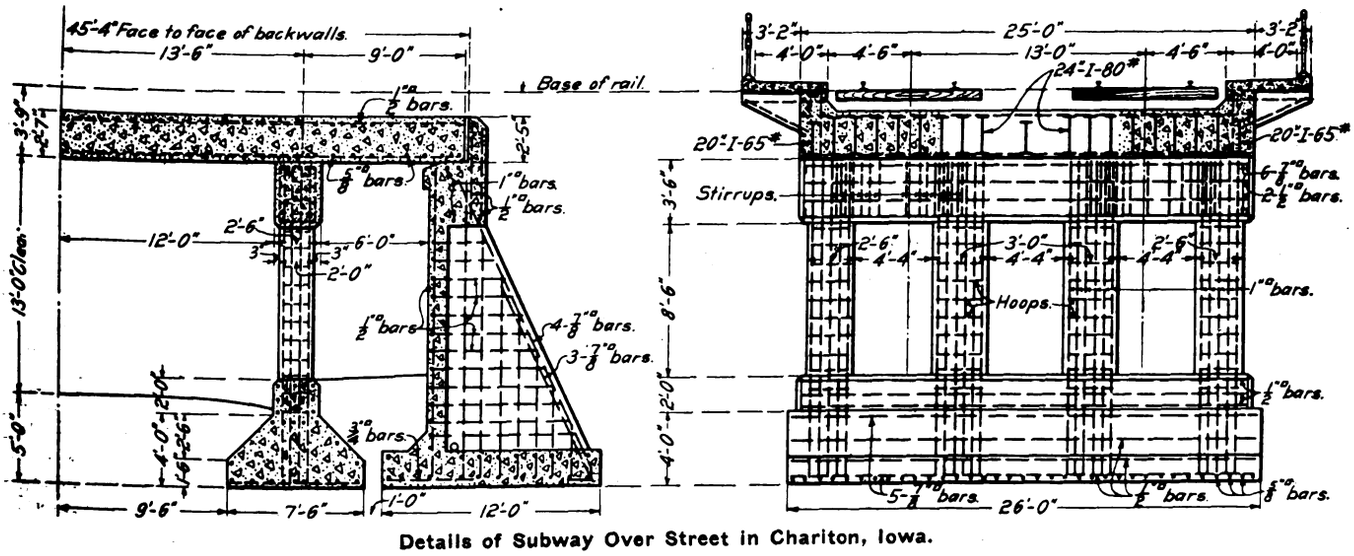
material was all comparatively easy to handle and no unusual methods were developed.

The hauling of bridge and culvert material and contractors' outfits was comparatively easy, as, in addition to the two Rock Island terminals, the new line is crossed by two lines of the Burlington and approximately paralleled by two others of the same road. The maximum haul necessary was 13 miles, the roads being in general very good. Bridge and culvert material was shipped to nine points, Carlisle at the north end of the new line, Ford and Pleasantville on the line of the Burlington east of the new road, Knoxville at the end of a Rock Island branch, Lacona and Oakley on the branch of the Burlington west of the new line, Chariton and Corydon where the new line crosses two branches of the Burlington, and Allerton, the southern terminal of the new line. One of the most difficult materials to haul was the heavy concrete culvert pipe. Short-coupled wide tread wagons p'l'ed by six horses were used for this work, but on account of the steep hills and the great weight of the pipes the hauling contractor who undertook to deliver these pipes had considerable difficulty, caused by the damage to roads, injuries to horses and accidents to wagons which caused several pipes to roll down into ditches and streams.

In the town of Chariton the line crosses three streets on subways. These structures have I-beam concrete floor slabs supported on reinforced concrete bents at the curb lines and reinforced concrete abutments. The two sidewalk spans are 6 ft. in the clear, and the roadway span is 24 ft. The details of a typical subway are shown in one of the drawings. The main wall of the abutment is only 15 in. thick, but it is heavily reinforced and is supported from the back by buttresses spaced 6 ft. 6 in. center to center. The bents have four columns each, two of which are 2 ft. x 3 ft., and two 2 ft. x 2 ft. 6 in. They are supported on a continuous concrete footing which is spread to 7 ft. 6 in. wide and are capped by a concrete beam 2 ft. 6 in. wide and 3 ft. 6 in. deep. The slabs have a minimum depth of 2 ft. 5 in., with eight 24-in., 80-lb. I-beams under each track, and 20-in., 65-lb. I-beams between tracks and in the parapets. The slabs also have bar reinforcement in both directions in both the upper and lower surfaces. Sidewalk slabs are supported along both sides of the subways on cantilever brackets cast on the floor slabs, the inner edge of the small slabs resting on the parapet of the large slab. In the construction of these subways 12 hours were allowed after the completion of the columns for shrinkage before the caps were placed, the bents were allowed to season 20 days before the slabs were cast, and the slabs were allowed to set 60 days before any live load was allowed on the structure. The upper surface of the slabs is sloped to drain the water over the back walls, and 4-in. drain tiles are provided on top of the abutment footings. The fills behind the abutments were required to be of gravel or other coarse material. A waterproof membrane protected by mastic covers the surface of the slabs, all joints between the ends of the slabs and the faces of the parapet walls on the abutments being filled with oakum and mastic. Along the edges of the slabs the waterproof membrane was carried up under the edge of the sidewalk slab and a watertight joint made by sealing the cracks with asphalt.

There are two railway crossings on the new line, both of which are with the Chicago, Burlington & Quincy. At the crossing in Chariton the Burlington is high enough to allow the new line to pass under its tracks easily. In Corydon, however, the Burlington is near the ground surface and a grade crossing was first considered. It was found, however, that by a slight realinement of the Burlington's tracks the grade could be raised to allow the new line to pass under, and this work will be undertaken. The structures for these crossings have reinforced concrete spans for two tracks.

The track standards for the new line call for 90-lb. rails,



Details of Subway Over Street in Chariton, Iowa.

creosoted hardwood ties and crushed rock ballast. A Harris tracklaying machine operated by company forces is being used for track construction. Passing tracks are 3,000 ft. long.

A supply of water for locomotives will be secured from three reservoirs that are being constructed about 1½ miles from the new line. Two of these will have a capacity of 125,000,000 gallons each, and the third will be somewhat larger. Earth dams with concrete core walls are used to back up the water in natural water courses. A coaling station will be built at Allerton, serving both the Missouri division and the Short Line.

The surveys for this line were begun in July, 1910. One party covered the territory very thoroughly with preliminary lines, and as soon as the location was decided upon the same party located the line north from Allerton. It was desired to hurry the work as much as possible, however, and another party was started south from Carlisle. These two parties met in May, 1911. Estimates were already well in hand and contracts were let during the same month. A construction office was established at Chariton and a good start was made during the summer of 1911. The line is now practically completed and will soon be ready for operation. The rapidity with which the surveys and construction work have been carried on is largely due to the tact and judgment shown by the railway company in dealing with property owners and residents along the line. As an evidence of the good will that prevails, only four condemnation suits were required to secure the necessary right of way; two of these being against non-residents and one against an insane man. There has been very little delay in getting road crossing and under-pass agreements settled, with the result that the construction work has been materially accelerated.

This work is being done under the direction of J. B. Berry, chief engineer of the Chicago, Rock Island & Pacific, and J. C. Beye, locating engineer. The late W. C. Beach was in charge of construction until his death on August 23, when he was succeeded by J. W. Waber. The McArthur Brothers Co. are the contractors for grading and bridging.

RAILWAY ELECTRICAL ENGINEERS' ASSOCIATION.

The fifth annual convention of the Association of Railway Electrical Engineers was held in the Auditorium Hotel, Chicago, October 20-25. F. R. Frost, electrical engineer of the Atchison, Topeka & Santa Fe at Topeka, presided. The secretary-treasurer reported a cash balance of $1,044 and a total membership of about 550. During the first day of the meeting about 175 members registered.

DATA AND INFORMATION.

A report on this subject was submitted by a committee of which E. W. Jansen (Ill. Cent.) was chairman. Following is an abstract:

One of the most important points to be considered in placing axle light equipment on the car is a good suspension and the method in which the suspension is attached to the truck. On cars with steel trucks the suspension should be secured to the truck without any chance of vibration. A diagram of a substantial suspension brace is shown in Fig. 1. This should be bolted, or preferably riveted, to the side of the truck and can be secured to the suspension iron at its outer end on any of the standard equipments. These side braces may be ¾ in. or ⅞ in. thick and will be found stronger than the suspension iron proper.

It is advisable, where possible, that large axle and dynamo pulleys be used. This will increase the life of the belt. A statement of belt mileage made on different classes of cars using the highest grade of 5-in. 4-ply rubber belt with 11-in. dynamo pulleys and 21-in. axle pulleys, is given as follows:

	Jan.	Feb.	March.	April.	May.	June.
Cars	117	118	121	117	109	117
Belts	48	26	34	19	28	19
Average mileage per belt	25,952	44,032	37,192	59,702	45,155	79,878

The reason for the low mileage in winter months is because of the ice and extremely cold weather.

From a report of the light failures, that is, those cars which arrived at a terminal with less than 25 volts, or 35 volts where tungsten lamps are used, it was shown that out of 120 cars, 14 failures were shown in January, or 88,900 miles per failure; six failures, or 199,000 miles per failure, in February; 13 failures, or 101,000 miles per failure, in March; 11 failures, or 107,000 miles per failure, in April; seven failures or 187,000 miles per failure, in May, and two failures, or 661,000 miles per failure, in June. It may be said of this also that the reduction in miles per failure in January, February and March was due to the cold weather. From the statistics of 58 different roads it was shown that 13,736 cars were lighted by electricity and 29,075 were lighted by other means, or about 32 per cent. are lighted by electricity. Of these 1,673 have straight storage; 481 are lighted with turbines; 2,073 have the head end system and 7,100 have the axle generating system.

A formula for the power required by engine lathes is as follows: Horse Power = feed in inches × depth of cut in inches × inches cut per minute × number cutting tools × constant for material.

The constants for the various metals are as follows:

Brass	0.1
Cast iron (soft)	0.3
Wrought iron and cast iron (hard)	0.35
Mild steel	0.4
Medium steel	0.5
Tire steel	0.6

TRAIN LIGHTING PRACTICE.

The report of the committee on train lighting practice, F. E. Hutchinson (C. R. I. & P.), chairman, included the various

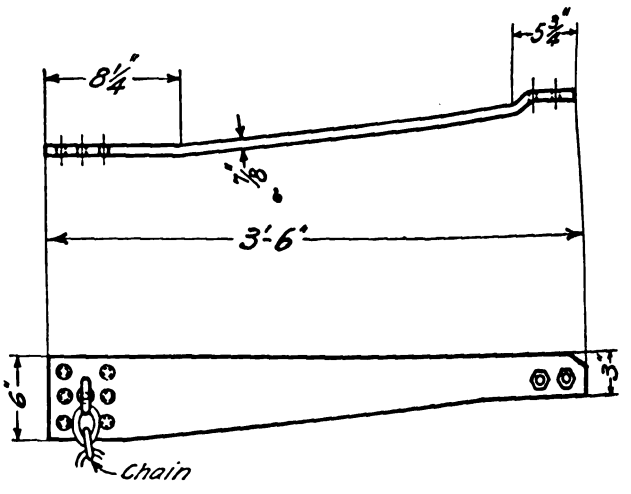


Fig. 1—Diagram of Suspension Brace.

methods of operating electric lighted cars, the cleaning of batteries, and reports on electric lighted cars. It was stated that the sediment removed from the batteries could be sold for $40 per ton. The following was recommended for the form of inspector's report.

A book form with a carbon copy, original going to the chief electrician and carbon left in the car for the information of the inspector at the other end of the line. These originals can then be filed in date order in pigeon holes under car number and held for thirty days or longer and afford a ready reference without any copying being done. A card file can also be kept in connection with this book form on which the history of the car can be kept, such as the time car was delivered from the car builder, dates car goes in and out of shop, record of accidents to car, dates batteries were changed, dynamo removed for overhauling, equipment failed, etc. This can be kept in a separate card file or in the pigeon hole with the other reports for ready reference. This system has many advantages, as it keeps inspectors at the opposite ends of the line thoroughly familiar with what work

the inspector does at the other end of the run, and it is recommended for adoption.

FORM OF INSPECTOR'S REPORT.

Car..... Train In..... Out.....
Place..... Date.....
Apparatus Working..... Lights Fail.....
Sp. Gr..... Height of Acid.....
Volts Battery..... Volts Lights.....
Battery Charged.....Hours.....Amps.
Belts..... Train Conn..... Fans.....
Lamps Missing..... Burnt Out..... Applied.....
Oiled Generator..... Cond. Eg'pt on Departure.....
.....
Cause of Failure and Material Used.....
.....
.....
.....
.....
Signed .....
.....Inspector.

SHOP PRACTICE.

The committee on shop practice, C. J. Causland (Penn.), chairman, presented a report of what is considered good practice by shop engineers of the leading railways. In connection with this subject the paper on Electrical Equipment of Railway Shops, by G. W. Cravens, presented before the Western Railway Club and reported in the *Railway Age Gazette,* September 20, page 515, was mentioned. An abstract of the committee report follows:

Power Plant.—Steam turbines are being used to a very large extent in railway power plants, due to their smaller size and greater economy than reciprocating engines, but there is still much to be said in favor of the latter. They are favored by many engineers for driving direct current generators, with the turbine as the favorite for alternating current machines. One point which has always been mentioned in favor of the reciprocating engine is the use of its exhaust steam for heating the shops, but this applies only to non-condensing engines, usually. Recent developments in steam turbines have brought about a type designed especially with a view to using it in connection with steam heating systems. The large amount of glass used in railroad shops, with the consequent great radiation of heat, makes the heating problem an important one, but beyond the province of this report.

The switchboard should not merely contain panels enough for all of the generators and feeders, but each panel should have a complete equipment of meters, switches, etc., in order to allow of the fullest knowledge and control of conditions in each circuit.

If the power is to be transmitted over any very great distance, which seldom happens in railway shops, the voltage should be as high as possible for safety, in order to reduce the amount of copper required for the lines and to keep the terminal voltage up to as nearly normal as possible. Either a. c. or d. c. distribution can be made safely at 440 volts and this is high enough for any railway shop at present constructed, and if the power plant is properly located it will do for any plant that will probably ever be constructed.

The electric distribution system should be kept away from the heat of the steam pipes and the practice of putting the cables in ducts placed alongside a pipe tunnel, instead of having them in it, is better practice. This plan is followed in the Big Four shops at Beech Grove, Ind.

Where alternating current is used it is customary to locate transformers at the various distribution centers for stepping down the voltage to that required for the lights or motors. Usually these are located on poles outside the buildings, sometimes inside, but when the distribution system is underground the transformers must be inside the buildings or in manholes. At the Pullman shops manholes are placed at each of the principal distribution centers, outside the buildings, with the step down transformers therein for reducing the voltage from 2,300 volts to 110, 220 or 440 volts as required.

Shop Equipment.—Each shop presents conditions of its own. One of the most important things is a good set of accurate records of time, operations, materials, machines, men and methods. Another is as to whether group drive or individual drive is going to be best for any one department or the entire shop.

There is practically no argument as to the use of anything but electric motors where they are at all applicable, and that means practically any place where power is used to produce motion. Among the benefits gained through their use are decreased transmission shaft losses, increased production through easy speed control, accurate knowledge of power required for any given purpose, ease of power control and distribution, flexibility of machine arrangement, reduced vibration of buildings and machines and the elimination of most belt troubles.

The present tendency in locomotive shop equipment is to increase the number of machine tools per pit. The average is between 6 and 8 per pit with many shops having from 5 to 6, but the tendency is towards from 8 to 10 per pit in several of the newer shops. There is no fixed rule, apparently, as to how many tools of each kind will be required per pit, but an average of a large number of shops shows the following proportions:

Turning tools	50 per cent.
Cutting tools	25 per cent.
Drilling tools	11 per cent.
Grinding tools	7 per cent.
Miscellaneous	7 per cent.

Nearly all wood-working machines in electrically operated shops are fitted with individual motors because of the comparatively large amount of power required. Induction motors with squirrel cage windings are used for this purpose on account of the freedom from sparking and the constant speeds.

The use of the automatic controlling devices is increasing. Suitable devices for both variable and constant speed motors are now available, most of them being arranged for push button control. The use of push buttons reduces the chances of injury to both workmen and tools, and makes it so easy to start and stop the machines that the men will stop them during idle periods instead of allowing them to run and waste power. The automatic starters also have certain protective features which are valuable, most of them opening the circuit on overload.

Another useful practice is being followed in regard to compressed air supply. This is the placing of small motor driven air compressors in all shops requiring air outside of regular working hours. In this way a small amount of compressed air may be provided without operating the large air compressors in the main power houses.

The use of electrically operated safety devices of a variety of kinds could be extended to good advantage, and a new system for this purpose will soon be placed on the market. This is designed to stop the machinery instantly in case of accident and may be operated from any part of the shop. Automatic fire alarm systems are also being neglected and the risk greatly increased as a result, with no good excuse. This is also worth consideration and improvement.

Other reports and papers were read which will be abstracted in the next issue of the *Railway Age Gazette.*

PROPOSED RAILWAY CONSTRUCTION IN NEW SOUTH WALES.—The public works committee of New South Wales has resolved that it is not expedient to build a line from Wyalong, in southern central New South Wales, northwest via Rankin's Springs to Hillston, about 80 miles, but recommends that consideration should be given to the construction of a line from Barmedman, about 10 miles south of Wyalong to Hillston. As a result of personal inspection of the country along the route proposed, the chief commissioner of railways is opposed to the construction of this line and recommends one from Hillston southeast to the railway system from Mirrool. As far as the country between Wyalong and Rankin's Springs is concerned the chief commissioner does not consider that the construction of a line is of immediate importance, and suggests for future consideration a connection between Barmedman and Rankin's Springs.