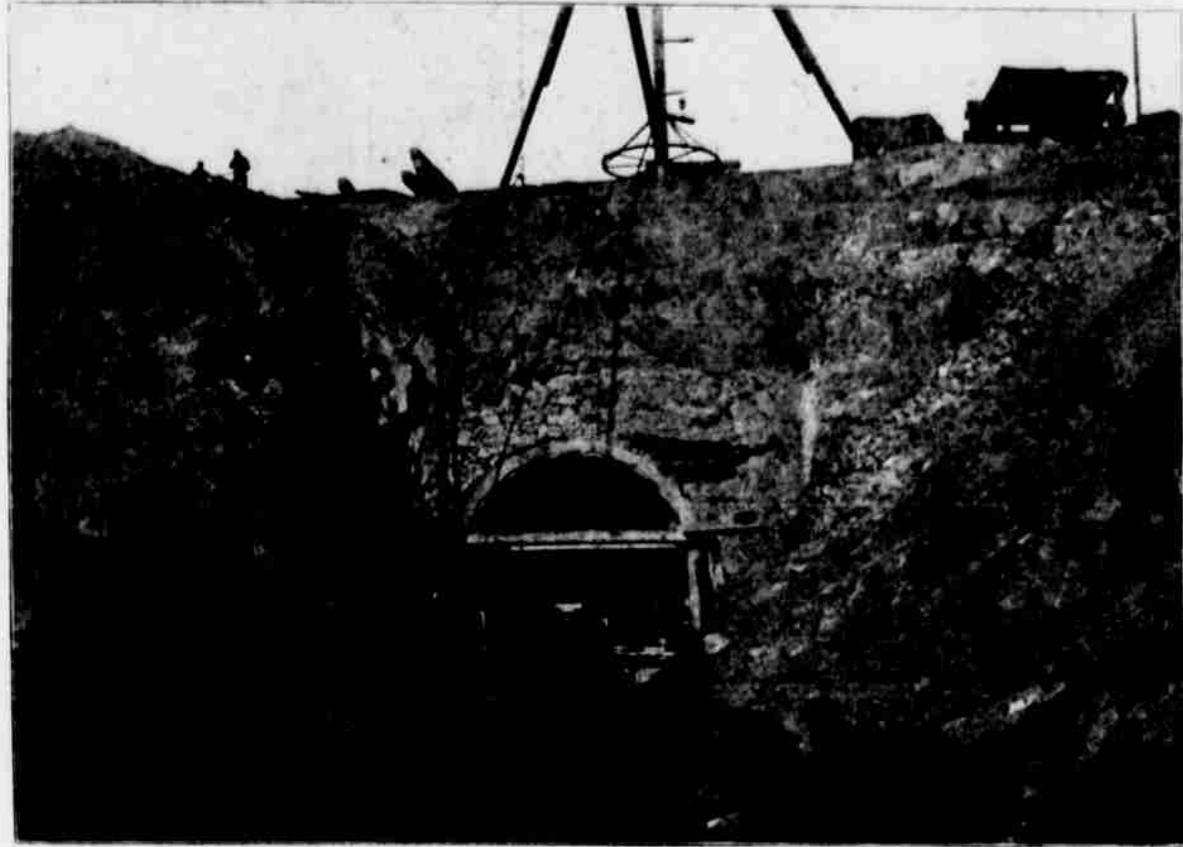


# Stupendous Engineering Triumphs Wrought at the Demand of Modern Commerce



WEST END SHERMAN TUNNEL, NEW LINE OF UNION PACIFIC.

WE HAVE in times past been told much of wonderful feats in railroad building, and much has been written of the engineering skill and daring that directed the course of the iron horse across the plains and mountains that lie between the Missouri river and the Pacific ocean. Little, it would seem, had been left for the builder's

affected, and some new method was demanded to keep the income above the expenses. Two ways are open to increase the earning capacity of a railroad. Each demands an open path between the engineering and traffic branches of the administration. One is to haul more pounds in a car; the other to haul more cars to the train. Supposing the road to have been operated to the limit of its power plant, neither of

Union Pacific line, as well as the heaviest grade.

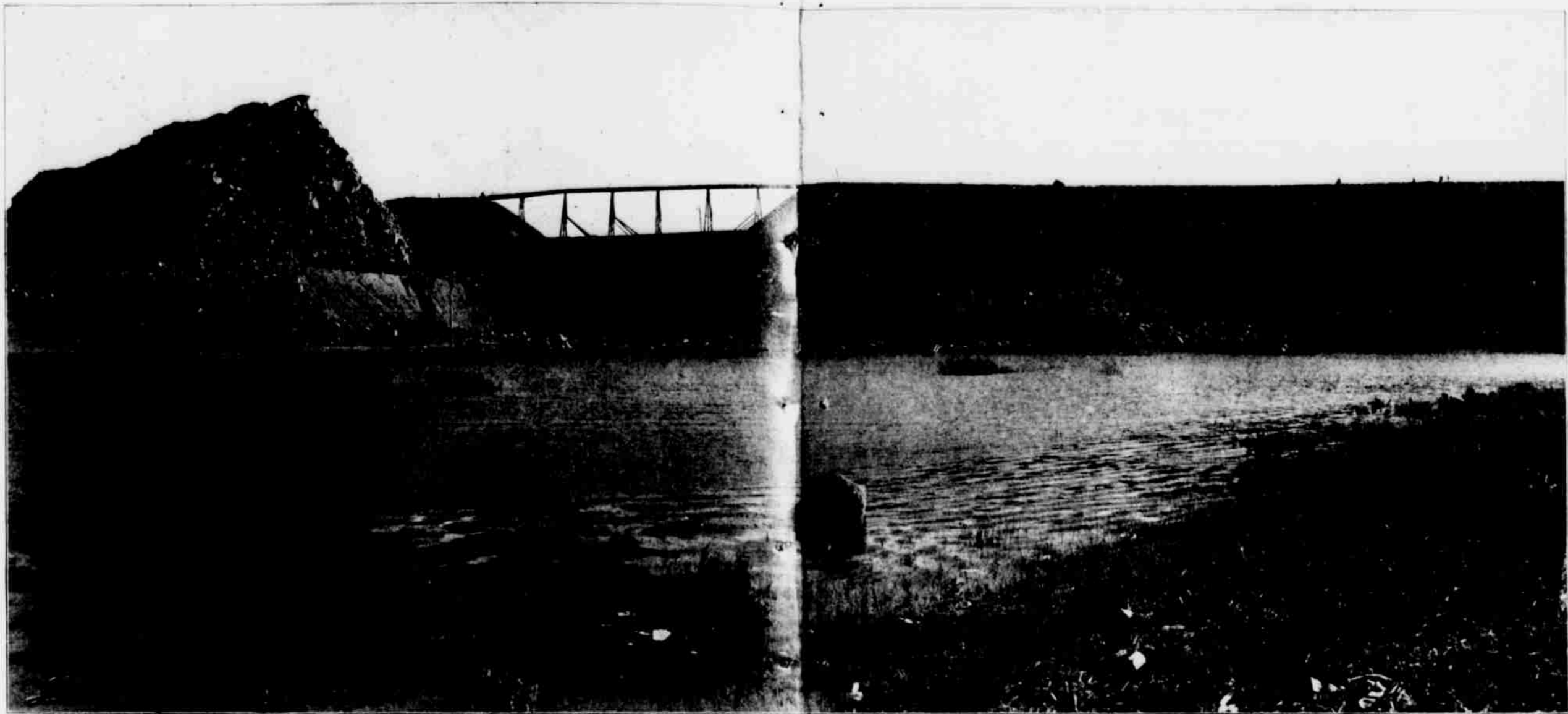
General Sherman once remarked in talking over the matter: "By a stroke of genius the builders of the Union Pacific surmounted the Rocky mountains by a grade of about eighty feet to the mile, whereas by any other route then known they would have been forced to grade 200 feet or to adopt short curves through Laramie pass." In this statement more than a measure of truth appears, and yet it may be doubted if it was exactly a stroke of genius that so fortunately located the line. The stubborn fact is that General Grenville M. Dodge, who was in charge of the pioneer work on the line, got lost from his party, and in wandering about discovered the pass that was subsequently used across the Rockies. However this may be, the fact remains that ever since that eventful day in 1869, when the golden spike was driven at Promontory Point, and the Atlantic and Pacific were finally welded together by a line of railroad, the great tide of traffic between the east and the west has flowed back and forth across this grade. Sherman Hill, Dale Creek bridge! Why, these names are almost as familiar to the transcontinental traveler as is that of the Union Pacific itself. Both are zone. Instead of crossing a bridge 600 feet long and 127 feet high, a nerve-racking experience under the best conditions, the trains glide smoothly over what is pronounced by experts one of the most remarkable embankments in the world. Instead of mounting the summit of that granite-ribbed spur of the Black Hills range, of which Sherman Hill was the backbone, the train dives through a tunnel bored through the living rock.

**Triumph for Usefulness.**  
Utilitarianism has triumphed, and the everlasting hills have been humbled to meet the demands of man. While much has been gained on the side of

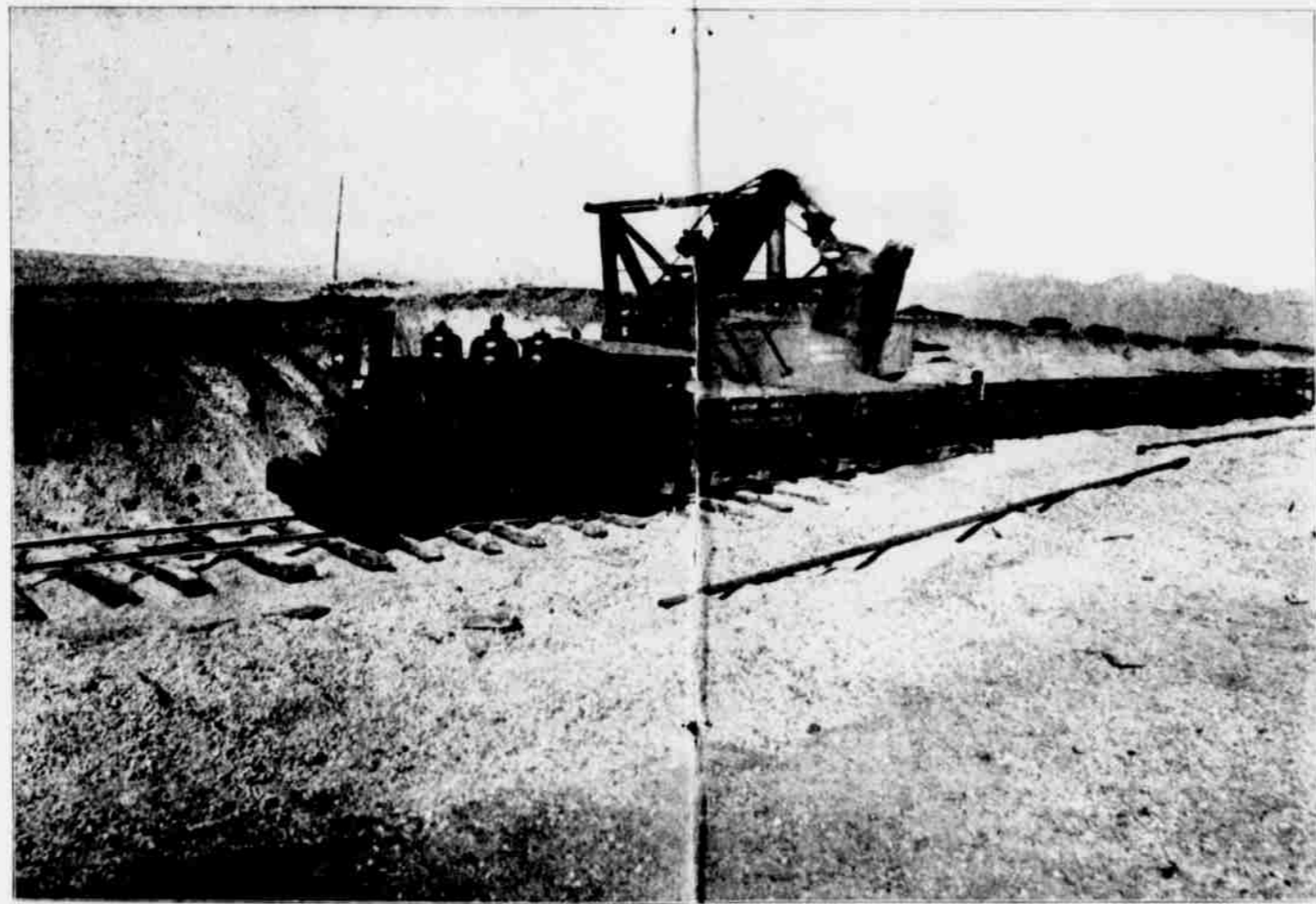
places, and the established route from the Occident to the Orient has been shortened by many miles. Thirty-three years ago there was no time to spend on work similar to that which has just been completed. Then the world was watching what the builders of the Union Pacific and Central Pacific could do. It was a magnificent contest, but nowadays the owners of the road have been brought to consider other problems. One of these necessitated the solution of the lower grade question and the straightening of the track one hundred and fifty-eight and four-tenths miles of new track were laid, reducing the mileage between Omaha and Ogden by 26.47 miles, and reducing gradients which varied from 5.4 to 37.68 feet to the mile to a maximum of 43.2 feet. This is the simple tale of what has been done. It was the doing of it that is interesting.

Ever since the original survey of the Union Pacific, which was itself considered a marvel of the kind, was completed, it has been the understanding that by doing a little heavy grading work here and there, cutting out curves, and the like, the grade could be lowered and the distance shortened. As management succeeded management in control of the road, the proposition received attention, but never took an active form until the present owners took over the property. When their new president, Mr. Bart, assumed charge he began without delay an extensive campaign of betterment. In this was included the improvement of the roadbed, and the Wyoming work was soon determined upon. Several surveying parties were put into the field to determine the possible cutoffs, and about a year ago work was commenced in earnest on what to the lay mind seems a stupendous task, but to the engineer a mere matter of detail.

**First Three Cutoffs.**  
The first three cutoffs authorized and built were those between Laramie and Rawlins. These are known as "Howell to Huttons," "Lookout to Medicine Bow," and "Allen Junction to Dana." Involving the construction of about fifty miles of line and accomplishing a saving in distance of practically nineteen miles, the result is in grades was from seventy-five feet to forty-three feet per mile. All of this was heavy work. Eight miles of the heaviest portion, just west of Hanna, involved the moving of approximately 1,700,000 cubic yards of material, of which nearly 1,310,000 cubic yards was embankment and 310,000 cubic yards a solid rock excavation. Thus,



BIG FILL ACROSS DALE CREEK CUTS IN NEW LINE OF UNION PACIFIC.



STREAM SHOVEL AT WORK IN "BORROW PIT" ON DALE CREEK FILL.

the eight miles of road averaged over 229,000 cubic yards per mile. This was largely concentrated in two miles of work, there being two fills of 500,000 cubic yards each. This is probably the heaviest yardage ever handled for single-track railroad. From a constructive standpoint the line is remarkable for the amount of material required in the construction of immense embankments and the building of large tunnels through solid rock. The construction of the new line between Buford and Laramie alone has involved the excavation of 5,009,000 cubic yards of material, one-third of

which (exclusive of the tunnel excavations) has been solid rock, or something over 1,600,000 cubic yards per mile. Some of the embankments of the new road have been remarkable for their height and the large quantities of material to construct the same over seemingly short distances. The two most difficult embankments were at Dale creek, northwest of Sherman, and across the Sherman branch of the Lone Tree creek, northeast of Sherman. The embankment at the crossing of the Dale creek is 120 feet high, 500 feet long and involved the



VIEW OF SHAFT ON SHERMAN TUNNEL.

handling of 250,000 cubic yards of ballast, or something in excess of 7,000,000 cubic yards within a distance of one mile. At the crossing of the Sherman branch of Lone Tree creek the embankment is 120 feet high at its point of greatest depth and involved the handling of over 550,000 cubic yards.

In one place, the Dale creek fill, as it is known, an embankment 175 feet high and 400 feet long was built by the use of a stream shovel, which plowed and carried the dirt into power dump wagons, in which it was hauled and dumped into the embankment. The equipment employed consisted of five graders and forty dump wagons. The material obtained from the borrow pits was a sandy loam, and the work lasted from May to November, 1929. This piece of work has been pronounced one of the best constructed large railroad embankments that has been built in

which the concrete was to be placed. Depots, water tanks, section and bunk houses were all built in accordance with modern principles and in first-class manner.

#### Built on Best Plan.

The new track is laid with eighty-pound rails and ballasted throughout with nine inches of ballast under the ties. Ballast from Sherman Hill, in the vicinity of the station of Sherman, has been distributed on the Union Pacific railroad as far east as Omaha and for several miles west of Rawlins. This Sherman Hill ballast, concerning which much has been said in the newspapers, is a disintegrated mica granite. It has been chemically prepared by the great fires of nature in prehistoric days, so as to gradually weld together with all the flexibility of asphalt and the durability of granite. Much of it can be excavated with a steam shovel without the use of powder, and, generally speaking, more economical than any other material. The two pits from which ballast is obtained, one two miles east of Sherman and the other one mile west of Sherman, have been worked at the rate of 3,000 cubic yards per day each. The material is excavated with steam shovels and loaded directly into Roder ballast cars, and, as Sherman is the summit, it is distributed as far as possible eastward from the east pit and westward from the west pit. Under favorable conditions this material can be excavated and loaded, including all the expense in the pit, for about 6 cents per cubic yard. The average cost, however, has been higher than this, owing to the impossibility of always having cars ready to load, and on account of breakages to machinery, and various things which are bound to occur

standard train for the "1300" class engine is twenty cars, and with this train twenty miles per hour can be made. The standard form of roadbed consists of ballast level with the top of the tie to a width of three feet two inches outside of the rail, then sloping one and one-half to one to subgrade. The roadbed at subgrade in finished embankment is twenty feet wide, in earth excavation it is twenty-five feet wide.

The firm of Kilpatrick, Brock & Collins, contractors of Beatrice, Neb., had the entire contract from the Union Pacific railway. They did a large part of the work themselves, and sublet the balance to various contractors, both large and small. Some of the larger ones in turn sublet to small subcontractors, with team and scraper outfits. Among the larger ones are the McArthur Bros. company, having 1,200,000 cubic yards at Sherman Hill, excavating about ten miles; Wood Bros., of Minneapolis, interested in about 25,000 cubic yards near Green River and about 500,000 cubic yards at Sherman Hill; Michael Elmore, Alliance, Neb., had 400,000 cubic yards near Green River; also at the siding; W. T. Callahan of Omaha had 400,000 cubic yards near Green River; Mahony Bros. of Omaha had 200,000 cubic yards near Green River and the siding; E. A. Marsak of Chicago had 200,000 cubic yards at Creston, Wyo., and about 550,000 cubic yards near the siding; B. J. McDonald of Kansas City had about 1,000,000 cubic yards at Laramie and Red Butte, Wyo.

The tunnel at the siding was constructed by Kilpatrick Bros. & Collins, with Frank Woods in charge of the work. This tunnel is 1,300 feet long and measures sixteen feet wide and twenty-two feet high inside; the interior is brown rock. The first tunnel of the line, at Aspen, Wyo., which is about 600 feet long and two by two feet by a center foot inside. It is a pattern had charge of this work. The small steam shovels were used in the tunnel to excavate the material, loading it into small dump carts.

**Excavation Along the Line.**  
Section of the construction work in engineering as produced here at the high machine station. The huge hills at Lone Tree, Dale and Dale creek, just before reaching the



VIEW OF CUT JUST WEST OF SHERMAN TUNNEL—STREAM SHOVEL HANDLING ROCK.

of concrete. Two complete plants, consisting of a crusher and a gas engine, both portable, were kept constantly at work crushing stone for concrete, using the suitable stone nearest to the point at

the dust and dirt that makes a trip over the lines of its less fortunate rivals so annoying. This material is hauled down the hill to Laramie or Cheyenne in trains of forty cars each, which are loaded with ballast. From almost the first considerable trouble was experienced from the fact that the ballast was not properly broken up. The ballast was broken up by the use of a steam shovel, and hauled over the lines with an enormous amount of trouble. The



TRACK-LAYING MACHINE AT WORK ON NEW LINE OF UNION PACIFIC.



EAST ENTRANCE TO ASPEN TUNNEL—NEW LINE OF UNION PACIFIC.

In the way of the spectacular. Yet the Union Pacific has just completed a most stupendous undertaking, one which ordinarily would call for plaudits from the public, but has done it so quietly that nowhere outside of the technical publications devoted to railroad and engineering topics has any special mention of the work been made. Stupendous is the best word to use in describing the work. It may contain the elements of the marvelous, but so quiet and so business-like were the proceedings that marked the inception, progress and completion of the undertaking that it hardly seemed more than the laying of a sidewalk at a country station. A mountain removed and lost into a chasm; huge holes bored hundreds of feet through solid granite; an underground river encountered and overcome; an army of men, with all sorts of mechanical aids, engaged in the work for nearly a year; the great Union Pacific track between Omaha and Ogden made thirty miles shorter, a great grade eliminated, old scenery been changed for new, and the business of the great Overland route flowing through a new channel, without the slightest interruption, for during this gigantic undertaking the traffic of the road has not faltered in the least degree.

It is a most remarkable tribute to the excellent organization of the engineering department of the Union Pacific that such a task could be conceived and carried through with so little apparent effort. Only when the figures are carefully considered does the magnitude of the undertaking really present itself.

**Why the Work Was Done.**  
To understand why it was done, one must take a look at the general organization of a railroad's working force. Primarily railroads are built to earn money for their owners. This is certainly the mission of the Union Pacific under its present management. To earn money the road must be properly constructed, equipped and manned. When the fierce competition of modern business forced a reduction in rates the earning capacity of the road was

these remedies is available unless the engineering department can make it possible for the locomotives to drag heavier loads at higher speed. Only in one way can this be done. That is to reduce the grades. The power of a locomotive, like that of a horse, is limited by the maximum activity of the route over which it travels. If this maximum be reduced, then the power is increased. The question is one for debate



FISH CUT, WHERE THE FOSSILS WERE FOUND—LOOKING EAST.

and adjustment between the departments of the road, on the Union Pacific it was resolved not long after the accession of the present management by the determination to cut down the almost inaccessible ascent to Sherman Hill, the highest point on the

view and safety, new vistas open to the tourist, but with the side of the track, views as beautiful as any mountain scenery can be. Some old familiar names have been swallowed up, but others as euphonious and as romantic have taken their