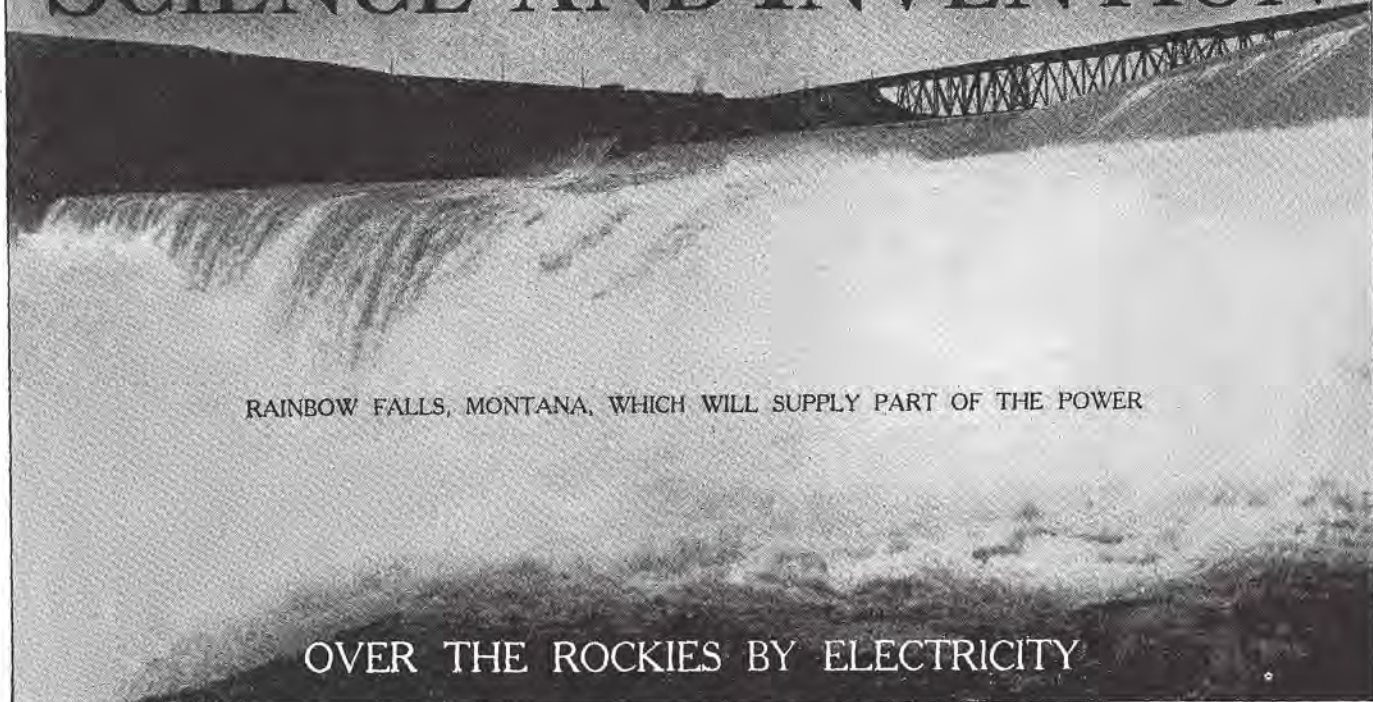


SCIENCE AND INVENTION



RAINBOW FALLS, MONTANA, WHICH WILL SUPPLY PART OF THE POWER

OVER THE ROCKIES BY ELECTRICITY

IT TOOK THE LAW, backed by public opinion, to make the railroads begin the use of electricity in and around our great cities, but that the railroads have taken kindly to it may be seen from the fact that they are voluntarily extending there electrified zones. Now we see another voluntary change from steam to electricity, on an isolated section of a transcontinental road, crossing the Rockies. And instead of a level stretch like the 33 miles of electrified track between New York and Stamford, Connecticut, it will be 440 miles long and will cross three mountain ridges, 4,170 feet, 6,322 feet, and 5,788 feet high respectively.

Travelers have not always realized, perhaps, that the wild and gorgeous scenery they were enjoying was a cause of enormous expense to the railroad. But now the beautiful cascades that have heretofore been busy cutting gorges to baffle the railroad-builder will be made to help pull the trains, and the scenery

will be transformed from a hindrance to an assistant. Engineers expect that the change will save money and improve service, and the company is spending many millions on it. Says *The Electrical Review and Western Electrician* (Chicago, April 18):

"No more important steam-railroad electrification has been developed in recent years in this country than that of the Chicago, Milwaukee & St. Paul Railroad in Montana, considering the abolition of the present motive power from the standpoint of operating efficiency. The company's engineers estimate that electrification will save at least 25 per cent. in operating costs, and it is a foregone conclusion that the quality of service in this mountainous region will be vastly improved by the change. The substitution of electricity will do away with the haulage of coal, at once releasing a large number of coal-cars for revenue service. Coal-storage yards will be unnecessary; water-tanks will be abolished; and it is likely that the length of freight divisions will be increased from the present length of 100 to a maximum of 200 miles. Engine failures, due to poor coal and bad water, with resulting train delays and heavy repair bills, are likely to decrease greatly, and in addition to the ex-

pected savings in maintenance due to the electric locomotive, the traffic capacity of the road is to be much enhanced.

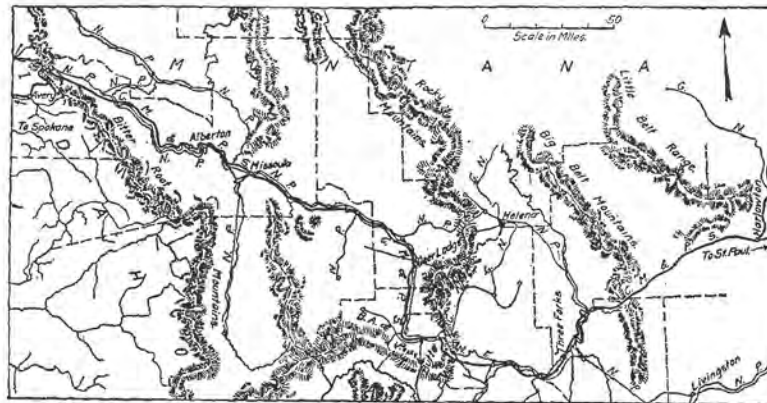
"It is planned to have the new locomotives capable of hauling a gross train-load of 2,500 tons on a one-per-cent. grade at a speed of 15 to 20 miles per hour, whereas the steam-locomotives now in use on the Montana divisions haul only 1,650 tons at a speed of from 8 to 10 miles per hour, and the rate is not uniform. Further economies are to be gained by the use of electric braking on down grades, with regeneration of power for use by ascending trains. It is figured that when the entire 440 miles of line are electrified, 60 electric locomotives will handle the normal traffic, compared with 82 steam-locomotives.

"Wages will be saved through the reduction of overtime work on the part of delayed train crews, and by the purchase of energy from the Montana Power Company at a reported price of about five mills per kilowatt-hour; the problem of power-supply will be greatly simplified, leaving the transportation matters of the road freer to receive the attention of its officials. No fewer than seven plants of the company will serve the railroad, and the danger of an

extended interruption of service will be remote. Poles cut from the railroad company's own timber lands will be used in power distribution. It is expected that the first 113 miles of line, from Deer Lodge to Three Forks, across the Rocky Mountains, will be completed by the end of the present year, and that 16 electric locomotives will be in use on this section of the road. The entire project will cost about \$8,000,000, and the results of the electrification are being awaited by all the northern transcontinental lines with keen interest."

Among further published details of the St. Paul's electrification is the announcement that:

"The trolley system of transmission has been decided upon as more practicable than the third rail. The storage-battery plan, it is considered, never has worked satisfactorily for long distances, and the weight of the storage plant is too great. The trolley system is considered better also because of the lessened danger compared with the third rail. In case of heavy snow in the mountains, moreover, the third rail would be buried and useless, while the trolley-wire will be high up, and, by reason of its



From "The Railway Age Gazette."

MOUNTAINOUS PORTION OF THE ROAD TO BE ELECTRIFIED.

smallness, little likely to suffer from the weight or depth of snow."

Still more interesting is the information, briefly noted above, that the trains will themselves generate some of the electric power. To quote an authoritative statement:

"A conspicuous and striking feature of the new system will be the added economy worked by employment of locomotives of a special type such that power may be generated by trains descending grades to assist in pulling other trains up. The traveler, therefore, not only may know that the beautiful scenery about, in the shape of waterfalls and rivers, is pulling him through the mountains, but that his own train, coasting down-grade, actually is helping to bring the next freight- or passenger-train up the other side of the hill!

"This is to be accomplished by application of the principle that a motor reversed becomes a generator. The locomotives will be so constructed that on reaching the top of a grade the engineer may brake his train downhill by reversing the motor, the air-brakes to be used only in case of emergency. This changing of the motor in the locomotive will transform it at once into a dynamo, which will be operated by the weight of the train as it descends the mountain. Thus will be generated the same quantity of electricity as the motor would consume in pulling the same load uphill. This current will be fed into the trolley-wire above, to be added to its store of energy."

The electric energy will, of course, be taken from the mountain streams in the country traversed by the road. As one writer remarks:

"Millions and millions of horse-power, to measure the energy in man's puny way, are at work among the hills, doing nothing but carving out the gorges. It has been estimated that there is enough water-power running to waste in the Rocky Mountains and in the Cascades to operate every mile of railroad west of a line drawn north and south through the center of the State of Montana and north of a line drawn from the southern border of Colorado to the Pacific coast!"

There are to be at least seven great power-plants, and the power will be delivered at seven points between Harlowton, Montana, and Avery, Idaho, the termini of the electric zone. According to *The Employees' Magazine* of this road, it is expected that there will eventually be developed about 100,000 horse-power, "and that the energy from all the plants will be connected and

form one tremendous reservoir of electrical energy from which may be drawn any amount of power necessary to operate the railway." This editor has something to say of the advantages of the new system of special interest to his readers:

"To the engineer who has had to contend with the difficulties incident to steam-locomotives in all their various phases the prospect of electrical propulsion must seem ideal, since cold weather holds no terrors and there is no danger from frozen pipes, frost in the fire-box or the boiler, and leaky flues, cracked side sheets, disabled crown sheets and broken grates have no place in the electrical vocabulary. It seems probable that the oil-can and monkey-wrench will be known only in the inspection-pit and the repair-shop."

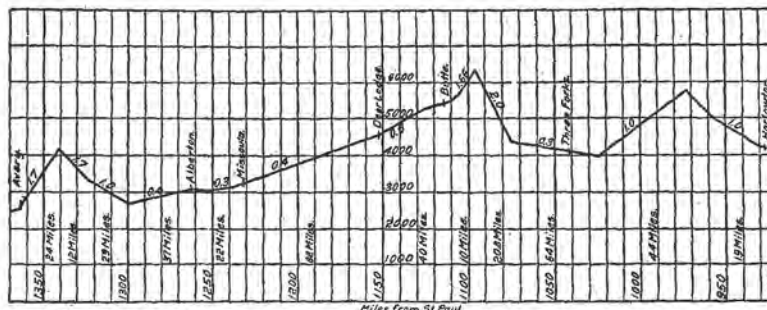
THE AUTOMOBILE AND THE PETROLEUM OUTPUT—
In the year 1900 this country was producing over 63 million

barrels of petroleum. Last year the output had risen to no fewer than 242 millions. In other words, it has nearly quadrupled in thirteen years. This, we are told by a writer in *Oildom* (Bayonne, New Jersey), is due largely to increased demand caused by the consumption of gasoline in motors. Thirteen years ago

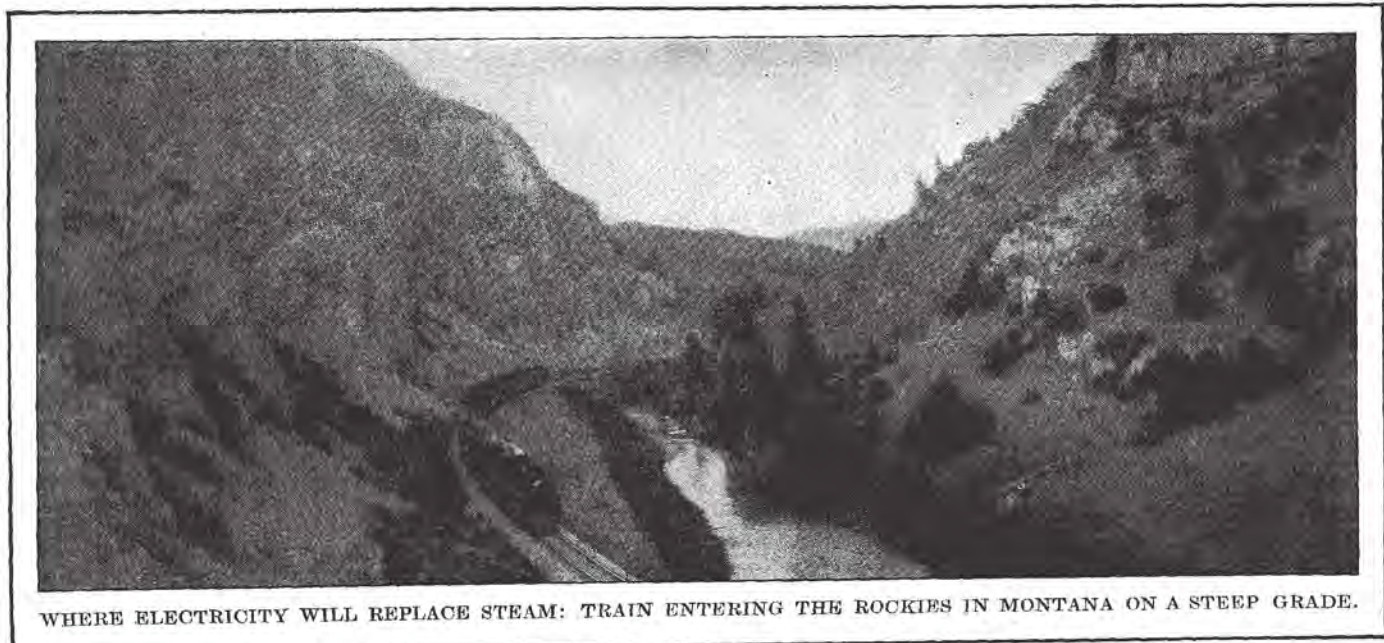
the production was barely equal to the present demand for gasoline, without considering any other oil products. The industry has made similar rapid expansions in many other directions of even greater importance than the great production. We read:

"Thirteen years ago there was a comparatively small demand for gasoline. The demand for this valuable and high-priced commodity in very large proportions is of recent origin. Thus in 1913 the number of automobiles in use totaled 1,127,940, compared with 522,939 in 1911. . . . It is variously estimated that the number of gasoline-engines in use to-day totals 3,000,000 engines. Similar expansions in other directions may also be noted; perhaps one of the most important is the automobile-lubricant trade, which has been developed enormously within the last few years. Another advance that has been rapid within the past ten years is the trade devoted to road materials and road oils, a trade that has followed in the wake of the automobile. . . ."

"In reviewing the production figures it is gratifying to note that the Pennsylvania grade oils, which take in the fields of New York, Pennsylvania, West Virginia, and southeastern Ohio,



From "The Railway Age Gazette."
PROFILE OF ST. PAUL ROAD IN REGION TO BE ELECTRIFIED.



WHERE ELECTRICITY WILL REPLACE STEAM: TRAIN ENTERING THE ROCKIES IN MONTANA ON A STEEP GRADE.