

## DARING WORK OF SURVEYORS

Dangers Faced and Overcome by Pioneers  
finders in Mountain Gorges.

EXPERIENCES IN THE GUNNISON TUNNEL

Exploration of a Canyon 3,000 Feet Deep from Which No One Before Had Returned Alive—Huge Irrigation Project.

All the heroes in the employ of Uncle Sam do not wear the uniform of military service. Men on the civilian payrolls, unspurred by martial music or the pomp and panoply of war, carry their messages to Garcia as surely and uncomplainingly, and in the line of duty as serenely meet death as any wearer of shoulder straps or epaulettes.

The reclamation service, that branch of government activity engaged in redeeming arid wastes of western lands, would not seem to offer a fertile field for deeds of daring and heroic sacrifice. Yet its records are replete with the blood-stirring deeds of men whose names the public never hears. The story of the survey for the Gunnison tunnel and the achievements of A. L. Fellows and J. W. McConnell, however, is too good a one to be lost in musty government archives.

Down in southwestern Colorado lies the Uncompahgre desert, a hundred thousand acres of desolation. A small part of it under irrigation has proved fertile beyond all expectations, but in the proving the full capacity of Uncompahgre river had been reached. No more water was available, but there lay beyond the irrigated lands a principality of enormous potential wealth which, it appeared, must forever remain an unproductive desert if no additional supply could be brought into the valley.

## Tapping the Gunnison.

Thirty miles eastward from the Uncompahgre flows the Gunnison river, a powerful stream, just the kind needed in the valley. Why not divert it and use the water for this purpose? A visionary scheme would be the off-hand verdict. The Gunnison along its stretch traverses a box canon 3,000 feet deep. Surely no one could divert water under such circumstances.

One day there came to the resident engineer of the reclamation service at Denver an order from Washington that read somewhat like this: "Advise me if it is feasible to divert Gunnison to Uncompahgre valley by tunnel under Vernal Mesa." Signed "Chief Engineer."

Let us diverge briefly to analyze this order. A tunnel under the Vernal Mesa, which is the name of the mountain through which Gunnison river has cut a narrow gash, would be at least five miles long from the canon to the nearest opening in Uncompahgre valley. This means the longest tunnel in the United States, not so amazing to the Denver offices, if the location of both ends of the proposed tunnel were known country. But in this case the canon where it must begin was unknown. No one had ever passed through it alive, and those who had attempted it and returned were ready to demonstrate beyond all possible doubt that it was an impossibility.

## Measurements on the Spot.

Now, it is axiomatic in engineering work that if you are going to report upon the feasibility of a tunnel you must determine the location of both ends by careful measurement on the spot. Well, orders from Washington directed a report on feasibility.

No one in the service seemed to think it anything unusual when "Fellows of the Denver office" set his square jaw, quietly made his preparations, took along one assistant and went surveying down Gunnison canon. It will be well to remember that in all those days of swimming, climbing, freezing, thawing and hunger he was not sliding through by the easiest path and taking the death-threatening places at a bound, but he was proceeding deliberately and surveying every foot. The next time you go down the street and see a well dressed fellow running a level or a transit along the curb, or staking off the boundaries of a house lot, just notice his polished shoes, his neat notebook, his comfortable, easy attitude, and his graceful signals to the rodman, and then think of "Fellows of the Denver office" down in that roaring cavern, drenched to the skin, hanging on by ropes and squinting through a transit, because Washington wanted to know if the tunnel was feasible.

No man, so far as known, had ever gone through the canon alive. Stoutly built raft of logs launched at the head of the canon had emerged at its mouth smashed into kindling wood. It was popular belief that no man could go down the canon and live to tell of his experiences.

## Lives in Constant Peril.

With their instruments and provisions on an inflated rubber mattress, Fellows and his companions set forth on their expedition. There was hardly an hour of the time they were in the canon that their lives were not in deadly peril; there was not a minute that was not filled with heart-breaking hardships. All ended by Fellows and his companion saving two things—their lives and their note books. Everything else went down with the flood. When the men emerged at the Devil's Slide, weary, bruised and bleeding, friends who had been waiting to pick up their mangled bodies hailed them as if they had returned from the dead.

When Fellows sent his report to Washington there was in it no word of the perils and hardships of survey work in a roaring canon. It was brief and to the point: "Gunnison tunnel project is feasible."

Soon the order came from Washington: "Complete surveys for construction."

The next man on the scene was J. W. McConnell, and better known in the service as "Gunnison" McConnell. Folks out there sized him up a shy sophomore; now they take off their hats to him. They find fault with him for one thing, however, which is that he is not given to talk.

## A Heart-Breaking Job.

McConnell's orders could not be carried out by surveying through the canon; they had to lower him down in there with ropes so that he might make a map of it—a real topographic map, with contour lines, levels and bench marks as clear and easy to trace as the map of any section or ward of your own town. Then he established precise levels at both ends of the proposed tunnel. This was a heart-breaking job. Of course the tunnel could not be built level, because it must carry water and moreover it must carry just the amount of water needed over in the Uncompahgre valley. If it were built without sufficient slope from river to valley it would not carry enough water, while if it had too much slope it would carry too much water. And so McConnell ran levels up over the mountain to the valley and back from the valley over the mountain to the bottom of the canon, out and in repeatedly, checking his measurements each time until he had just the slope required. The fact that he took his life in his hands a score of times each day did not bother Washington in the least. Washington was looking for a set of construction plans.

But McConnell's job was just begun when he had established the slope levels. It was then necessary to measure the length of his tunnel down to the nearest inch. You would probably measure off a house lot by running a 100-foot tape along the boundaries, but that wouldn't do in



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In this case, there is a hill 3,000 feet high between the ends of this tunnel, and the tunnel itself goes straight through. He measured it by triangulation, a weird sort of expedient to engineers who have studied and worked long enough to learn it, but even that was not sufficient for this purpose. The whole distance was "slope-boarded" in addition.

## Slow But Sure.

Slope boarding is easy to understand. If you want to determine the horizontal distance between the head and the foot of a flight of stairs you would start at the top and measure the width of each tread, and allowing for overhang, you would add these measurements together and have the horizontal distance. Now, McConnell and his crew did something similar to this. They had a long board sealed off to hair's breadth—just as long, no more and no less. In the middle of this board was set a spirit level, so that the measuring edge of the board could be set true. With a man at each end of the board and one in the middle to watch the spirit level, they started from a pre-

cisely defined point at the top of the hill and measured down hill each way. One end of the board was placed on this point and the other was directed along the route and raised or lowered until the middle man said "level." Then the man at the outer end would drop a plumb bob and mark the spot directly beneath the end of the board. Then the board would be reversed, the outer man would take the stake, and the stake man would drop the plumb bob. If the plumb bob did not hit the same identical spot that it had marked before something was wrong, and they began all over again. Having agreed upon a precise distance and marked it permanently, this new mark would be taken as a basis, and the process repeated until the whole distance was covered.

Imagine now three men slope-boarding down the steepest state roof you ever saw. Of course, they would need rubber-soled shoes and ropes, just as "Gunnison" McConnell and his men did, but you should remember in this connection that you never saw a slate roof as steep as the walls of the Gunnison canon; builders do not make

them, nor do they perch their ridge poles 3,000 feet above ground.

## Orders to Dig.

McConnell prepared his plans, sent them to Washington and in the course of time came back the order. "Proceed to dig." The men were digging now with the spirit level, digging right with the spirit level, with which they prepared the plans.

About two miles or a little more than one-third of the great Gunnison tunnel has now been completed. Night and day, unceasingly, the drifts are biting their way into the granite through the Vernal Mesa, which divides the watershed of the Gunnison and Uncompahgre rivers.

The Uncompahgre valley, which is to be made fertile by the waters of the Gunnison river, comprises parts of Ouray, Montrose and Delta counties. It has a general elevation above 5,000 feet. Most of the land under the government project is in private ownership, the cultivated areas being largely in orchards, alfalfa and grain. The well-watered orchard lands in bearing are easily worth \$500 per acre, and this fruit has a ready sale in the eastern markets of the United States and in Europe. The

valley is especially adapted to the raising of potatoes, sugar beets and vegetables generally.

The tunnel, which will be cement-lined, will have a carrying capacity of 1,300 cubic feet a second, and will connect directly with an elaborate system of canals and ditches. Owing to the failure of the contractors the government is now constructing the tunnel under force account and expects to have the work completed and in operation in the spring of 1908.

The men have been trained gradually to the work and they go at the tunnel tall like a lot of gophers, three eight-hour shifts a day, and nearly every shift working to beat the others' record.

The completion of this work will add 2,000 homes to the Uncompahgre valley and will increase the taxable wealth of Colorado by not less than \$10,000,000. The estimated cost of the whole is approximately \$250,000, which must be returned to the government in not less than ten years after completion by the owners of the lands which are to be irrigated.—New York Times.

TO CUT COAL BILLS HALF  
Prospects Seem Favorable for Learning How to Burn Dirt as Fuel.

If some one were to discover that ordinary dirt was a fuel, which burned under certain simple conditions, yielded as good or better results than the best Pennsylvania anthracite, it is easy to imagine the popular sensation that would be caused.

"Yes results almost, if not quite, as sensational obtained by the United States geological survey coal testing plant have passed almost unnoticed by the general public.

The experiments at this plant have demonstrated that bituminous coal, heretofore considered less than half as valuable as anthracite, will, when manufactured into gas and burned in a gas engine, produce

worthless, will actually yield more horse power per ton than the best anthracite burned under a steam boiler. It has shown that all grades of coal, from the best to the most worthless, as judged by former standards, can be utilized in this manner, their value for producing gas being, generally speaking, exactly inverse to their value in directly producing steam in a boiler. That is to say, the poorer the coal for direct steam-producing purposes the which power coal has been valued in the past; the more valuable it seems to be for yielding gas for use in the gas engine.

## Few Inches.

"Yes, your husband write me a very abusive letter," said the lawyer. "I don't think much of him."

"You are?" queried the caller hotly. "I wish you to understand that my husband is every inch a gentleman."

"Ah, in that case, madam, you should place him in this museum."

"Why so?"

"Because he must be a dwarf"—Chicago News.