

Nearly all the classes of work outside of bridge construction were done by contract. Contract work was tried on bridges also, but the results were not satisfactory. As the Chinese had never heard of overhaul we did not enlighten them. In practice it very seldom existed, for though the grading contracts called for every yard of material from cuts being placed in embankments, regardless of haul, the chief engineer did not insist on this being carried out. Contractors were allowed to waste and borrow; the company acquiring extra right-of-way for this borrow in many cases. First contract price for earth work ranged from 14c. Mex. to 20c. per C.Y. ordinarily, although one firm got as high as 43c. on about 600,000 C.Y. of work.

Rockwork was very badly handled in the open cuts. Holes were usually drilled indiscriminately over a large area and then sunk only 2 to 3' deep. No attempt was made to keep a proper face, or series of faces and benches in open cuts, and consequently the consumption of powder was needlessly great. In sandstone cuts the contractors usually shot up the rock very fine so that two men could carry out the largest fragments. Most of the rock cuts were, like the earth cuts, and the side-borrow, carried out in baskets.

Granite rock would not break up so fine, and in some of these cuts native wheelbarrows were used and in other cases Koppel dump cars and light tracks where the haul exceeded about 200'. It was practically impossible to induce the natives to alter their own methods of rock handling. First contract prices for rock excavation varied from \$1.50 to \$2 Mex., i.e., 75c. to \$1.25, gold, per cubic yard.

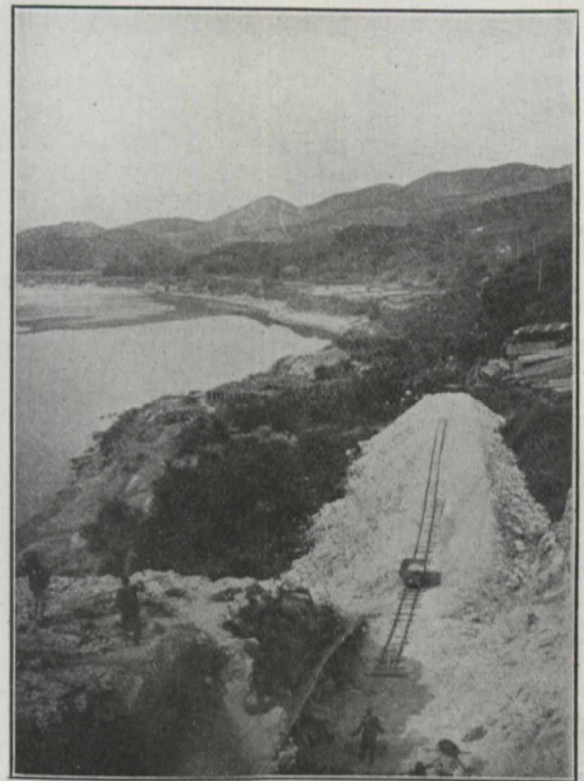
Tunneling contracts were let at so much per lineal foot for excavation and so much per lineal foot for lining. All material for forms and timbering where necessary, was supplied free of charge by the railway company at the work. Prices ranged from \$57 to \$75 Mex. per lin. ft. for tunnel excavation. The area of the standard tunnel section was 400 sq. ft., giving about 14.8 cu. yds. per foot run. At \$75 per lin. ft. this is equivalent to \$5.07 Mex. per C.Y., and at \$57 is equivalent to \$3.85 Mex. Prices for concrete lining ranged from \$17 to \$42 per lin. ft. of tunnel. Very little temporary bracing was required in any of these tunnels.

The method employed was that of piercing a top drift in advance of the bench; widening this drift out to the full arch section, and afterward removing the bench. Material was loaded by hand into small dump cars and run out by man power. In some cases a wooden chute or trough was used for loading material from the drift and arch section into the dump cars.

The resident engineer arriving in China for the first time finds he has innumerable little things to contend with that have never occurred to him before. Though the country is at peace, he is not allowed to proceed to his residency until a guard of twenty soldiers has been provided, and rifles and revolvers and ammunition are on hand. He asks who are to be his rodmen and chainmen and is told to pick up and train some natives on the work. The engineer is also instrument man, back flag, head and rear chain and rodman, rolled into one. The interpreter provided by the company usually becomes the "stake artist," since he is probably the only one on the party who understands foreign figures or perhaps who has ever seen a white man. The interpreter usually starts out on line wearing silk slippers and carrying an umbrella and a fan, and with a fixed idea that his work consists in repeating in Chinese to the coolies as much or as little of the engineer's instructions as he may think necessary. It becomes the painful duty of the engineer to instil quite other ideas into the mind of this future celestial railroad builder.

A residency party consists of an interpreter and a clerk, both of whom know a little English, a store-keeper and a time-keeper who knows less, a pay-master who knows none at all, and foremen and survey coolies as required, who usually know no English and very little of anything else. The rodmen and chainmen, picketmen and axemen all come under the head of survey coolies, and are usually absolutely green natives and have to be trained on the work—a process requiring infinite patience.

Running a location survey in a rough and wooded country with a green party of natives, not one of whom has ever before seen a transit or chain, is not my idea of heaven. The axemen disappear into the bamboos and when the engineer leaves his transit and walks ahead he finds them sitting calmly in the shade, smoking cigarettes or talking with the interpreter. They one and all seem to imagine that the foreigner is paid to build the railroad so the responsibility rests with him and the labor too. This is another point on which the natives have to be disillusioned.



Looking North From Ridge Above Tai Mui Hop Tunnel; North River on Left.

The usual order of work on a residency was followed—location and referencing, then cross-sectioning and figuring quantities. After this, right-of-way plans were made up in sections of 1,000 of line, on a scale of 40 ft. 1 in., showing every little rice plot with the area in Chinese Mou. These were traced and prints sent to R. W. Dept. This was very necessary where one acre of land might have 20 to 30 different plots and as many owners. R. W. purchasing agents established offices every 20 or 30 miles and bought enough right-of-way to allow contractors to start. After that they bought as little as possible, or just enough to keep the work going. This caused continual friction with the natives, and frequent riots and delay to the work. The only injunction known in South China is that of the mob, and the wording is generally "Clear out or we will chop off your head." When this is backed up by an entire village, headed by the old women, armed with buckets of sewage and with ladles for