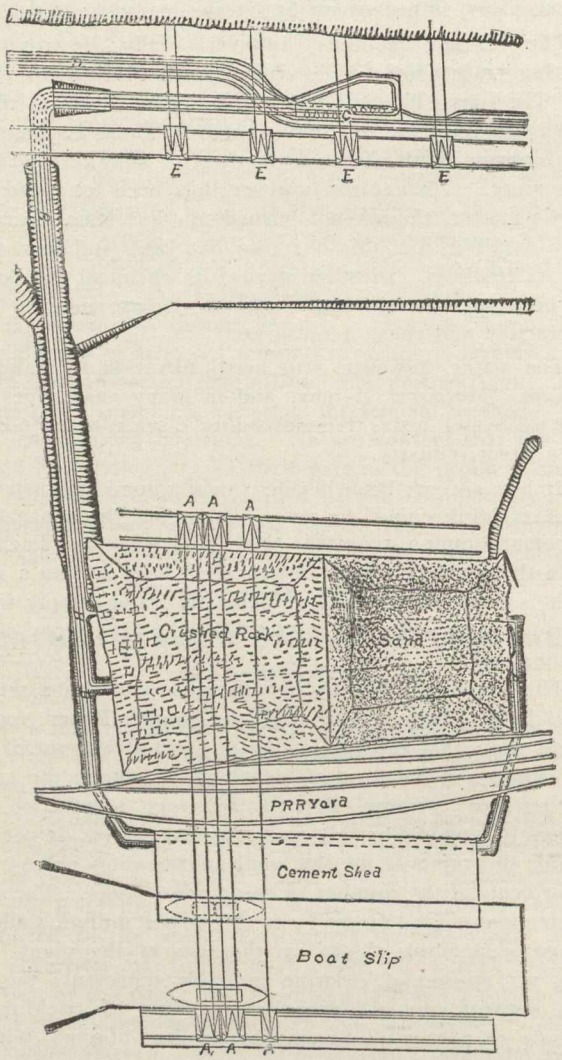
000 cubic yards, of which 40,000,000 cubic yards available had been done by the French) had advanced to a point where only 101,000,000 cubic yards remained to be done, which, as officially stated by Col. Goethals, can be finished by August 1st, 1911. The remaining excavation is proceeding at the rate of about 3,000,000 cubic yards per month.

Keeping pace with the speed of excavation are the construction operations in connection with the Gatun dam and locks. A most important part of the mechanical equipment are the 13 Lidgerwood high speed cableways which were especially designed and installed for building the Gatun locks. Upon 5 of these, known as the unloader cableways,



Plan of the cableways showing their relationship to the branch of the old French Canal where the barges arrive, the cement shed, the storage yard, and the automatic railways.

will fall the brunt of the work, and upon the ability of these 5 to handle the amount guaranteed, or more, must depend the question of whether the canal will be finished and in operation on January 1st, 1915, or earlier. These cableways have exceeded their guaranteed capacity by such a large percentage that the engineers in charge of this section of the work are confident that it can be finished at a much earlier date. They are recognized unofficially by Col. Goethals as "that 1913 crowd."

The work of these 5 cableways is to handle the broken stone and sand which will be required for the walls and floors of the locks. There are 6 locks, each 1,000 feet long in the clear of 110 feet wide. They lie side by side in flights of three, making a total length of more than 3,000 feet. Together they provide a total lift of 85 feet with some to spare for changes in the initial water level. In these locks there will be used 2,000,000 cubic yards of broken stone, 1,000,000 cubic yards of sand, and 2,200,000 barrels of cement. The stone and sand arrive in barges on a branch of the old French Canal. The unloader cableway takes it out of the barges with great grab buckets and delivers it 600 feet or more away in heaps in the storage yard. From here it is taken by the cars of an automatically operated electric railway to the mixers and from the mixers the concrete is taken in other electric cars to where the second set of 8 cableways can put it in place in the forms for the walls and floor. Four cableways arranged in pairs on two sets of towers, handle the broken stone and a single cableway with independent towers unloads the sand from the barges and deposits it on a storage pile. Each cableway has a span of 800 feet. In the duplex cableways the cables are 18 feet apart. This corresponds with the distance apart of the transverse bulkheads in the barges. The cableways are all mounted on steel towers 85 feet high. The towers are mounted on trucks and travel on tracks, so that each cableway performs the function of a travelling crane. The unloader cableways travel the length of the storage yard. Those for building the locks travel more than 3,000 feet. They are all moved electrically, each pair in unison. From the carriage of each of the 5 unloader cableways there is suspended an improved special 70 cubic foot iron-ore type of excavating bucket. Each bucket grabs an average load of 54 cubic feet. The load is hoisted 85 feet, conveyed about 600 feet, dumped on the storage pile, and the carriage and bucket returned. This round trip has been made in 1 minute and 8 seconds. The cableways were guaranteed to handle 50 cubic yards an hour each. They have carried 90 cubic yards in an hour and the average operation up-to-date is 60 cubic yards per hour. This ought to be materially increased with practice. The present record is declared to be double that of any cableway previously employed anywhere.

The high speed and consequent increase in the capacity of the cableways is due to the ease with which the operation of the cableways is controlled; the rope-lead that simultaneously raises and traverses the bucket; the high-speed shock-absorber with which the fall-rope carrier is equipped, and a new type of button-stop.

The hoisting and conveying machinery in the head tower is controlled by an operator in the tall tower stationed on an elevated platform commanding a clear view of the bucket at all times and in all positions. He controls two 150-h.p. motors by master controllers of the New York Subway type, and the air brakes by two levers operating magnet valves 800 feet away. The physical effort of operation is so easy that the operator can comfortably maintain the high speed. In all previous cableways this effort was so fatiguing that, although it was possible to attain a speed of 35 round trips per hour with mechanical levers, this could not be sustained for any length of time.

The rope-lead which simultaneously hoists and traverses the bucket causes the latter to move in a curved line corresponding somewhat to the hypothenuse of a triangle, instead of moving on the vertical and horizontal sides. Considerable increase of speed and diminution of travel is thereby effected. The high-speed shock-absorber with which the fall rope carrier is equipped is the invention of Spencer Miller. It permits the carriage to travel at the unusual speed of 2,500 feet per minute, more than double the speed of any previous