THE NEW CROTON AQUEDUCT.

For many years the present Croton Aqueduct—the line of which from Croton Dam to the Central Park reservoir is indicated by the heavy dotted line in the accompanying map—has been forced to carry a quantity of water much greater than its builders designed it for, and as a natural consequence it has been so weakened that nothing but the skill and incessant watchfulness exercised by those in charge have prevented it from long ago yielding to the burden thrust upon it. The necessity for quickly providing greater carrying capacity is, therefore, apparent.

It is estimated that, even in years of the greatest drought, the Croton watershed, from whence almost all of the present supply is obtained, can be relied upon to furnish 250,000,000 gallons daily, or 100 gallons per head per day for 2,500,000 people. The building of Quaker Bridge Dam* would increase the available area of watershed to 361·82 square miles, and the reservoir thus formed would have a capacity of 32,200,000,000 gallons—water sufficient to cover 9,400 acres, 10 feet deep. The dam will be built of solid masonry, will be 178 feet high above the bed of the river, and since the foundation will have to extend to bed rock—100 feet—the total height for a distance of about 400 feet in the lowest part of the valley will be about 300 feet; the width of the dam at the base will be about 200 feet, and the extreme length 1,300 feet.

The aqueduct now being built has a maximum flowing capacity of 320,000,000 gallons per day from Croton Dam to a point near the New York city boundary line, where it is designed to construct a large distributing reservoir to supply the annexed district; a part of the supply being there diverted, the remaining portion of the aqueduct has a flowing capacity of 250,000,000 gallons per day. The northern portion, shown in section in Fig. 4, is 13·6 feet high and 13·6 feet wide; the semicircular arch has a radius of 6·8 feet, the concave sides are on a radius of 20·92 feet, and the invert has a radius of 18·5 feet. Where necessary, the rock walls are evened with concrete, and a masonry lining built 12 inches thick at the sides and arch and 6 inches thick at the invert; but where the character of the rock justifies it, no masonry is needed. The other part of the aqueduct, about 6½ miles in length, will be circular in section, as shown in Fig. 3, 12 feet in diameter, and lined with masonry 12 inches thick. Owing to the insufficient elevation of the land, this section will be depressed about 100 feet below the other, as indicated on the profile. The Harlem River is to be crossed by an inverted siphon, the depth below the river being about 200 feet. All the masonry will be of hand made, hard burned brick, laid in cement mortar, one part cement to two parts clean sharp sand.

From Croton Dam to Harlem River the aqueduct is 28¼ miles long, and to Central Park reservoir 33¼ miles; the total length of open cuts—varying from 0 to 40 or 50 feet between the arch and ground surface—north of the Harlem is but about 3,000 feet; all the rest of the line is through solid rock. The method of building the aqueduct is by sinking shafts about one mile and a quarter apart, and working both ways from each. There are 24 shafts north of the Harlem and 8 south of it, varying in depth from 28 to 350 feet. Fig. 1 of the engravings is a longitudinal section through shaft No. 10, showing the heading, the timbering in the shaft, and the location of the hoisting machinery. Fig. 6 is an enlarged view of the same heading. Fig. 8 shows the boilers, air compressors, and hoisting engines. The shaft is 17½ feet by 8 feet in the clear, with the longer dimension parallel with the axis of the tunnel. In the shaft run two cages, operated by a double drum Dickson hoisting engine, on one of which the loaded car is brought to the surface, while on the other an empty car is lowered into the tunnel. Steam for hoisting, pumping, and compressing air is furnished by two 90 horse power Ingersoll return tubular boilers. The Ingersoll "Straight Line" air compressors and "Eclipse" drills are here used; and so well thought of are the products of the Ingersoll Company, that on the line of the aqueduct there are now in use 200 drills, 18 compressors, and 30 boilers of their make. The air compressors at shaft 10 have 18 by 30 inch cylinders, supplying air at 80 pounds pressure per square inch, the air being first discharged into a condensing air receiver, where it is freed from all moisture, and then conducted down the shaft and into the headings through 3 and 3½ inch pipe. Each heading is driven by four 3½ inch drills, mounted two on one column, to which they are attached by means of swinging arms, which can be moved up and down or around the column; thus with two columns and four machines, the entire face is commanded at one setting of the columns. From 19 to 20 holes, 5 to 6 feet deep, are drilled for the center cut and squaring up. Two drills, mounted on tripod, drill from three to five holes 8 feet deep in the bench, some being vertical and others flat or lifting. The holes are then charged with No. 1 giant powder in the cut and No. 2 in the side and bench, and exploded by electricity.

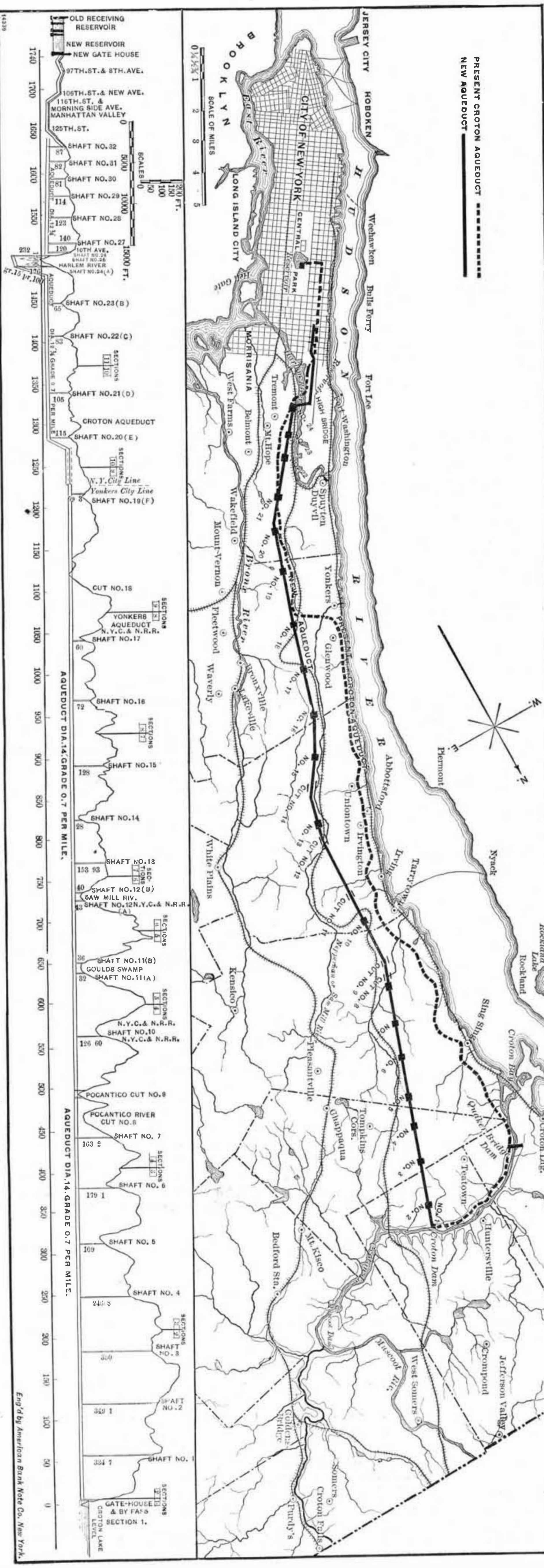
The foremen are required to have a round of holes drilled and blasted once each shift of ten hours, it being left to their judgment to decide the depth of cut they shall undertake to drill, square up, and blast in that time. By this method an average of about 10 lineal feet of tunnel is completed every twenty-four hours in each face through very hard gneiss and granite. This is a higher rate of progress than is attainable by the deep cut system, which does not permit of each shift finishing its own work.

Extending down the shaft is a rough looking square wooden box, which branches at the bottom, one part extending along the tunnel to one heading, and the other part to the other heading. At the bottom of the vertical portion, exhaust steam is admitted; this produces a strong current along the branches and up the shaft. The smoke resulting from each blast is thus drawn into the boxes and delivered at the top of the shaft.

Where the aqueduct is under pressure, special provision is made in the manholes for guarding against the upward pressure, and drain pipes are provided for emptying the shaft and air pipes for the escape of air during the refilling of the tunnel. A general idea of the construction of one of these shafts may be obtained from Fig. 7, which is a section at right angles to the line of the aqueduct.

Fig. 2 is a view of the work as it now appears at the Pocantico cut—the most extensive on the line, as it has a length of about 1,300 feet. The aqueduct here is similar in sec-

MAP AND PROFILE OF THE NEW AQUEDUCT FOR INCREASING THE WATER SUPPLY OF NEW YORK CITY.



* The proposed dam at Quaker Bridge was illustrated and described in the SCIENTIFIC AMERICAN of May 3, 1884

tion to one in rock, as may be seen by comparing Figs. 4 and 5. It has a clear height of 13·53 feet and an extreme width of 13·6 feet. The arch is 12 inches thick at the crown, 16 inches thick at the center of the sides, and 20 inches thick at the spring lines. The concave sides are 8 inches thick and are secured by walls, as shown in the cut. The invert is 12 inches thick, and rests upon a concrete foundation.

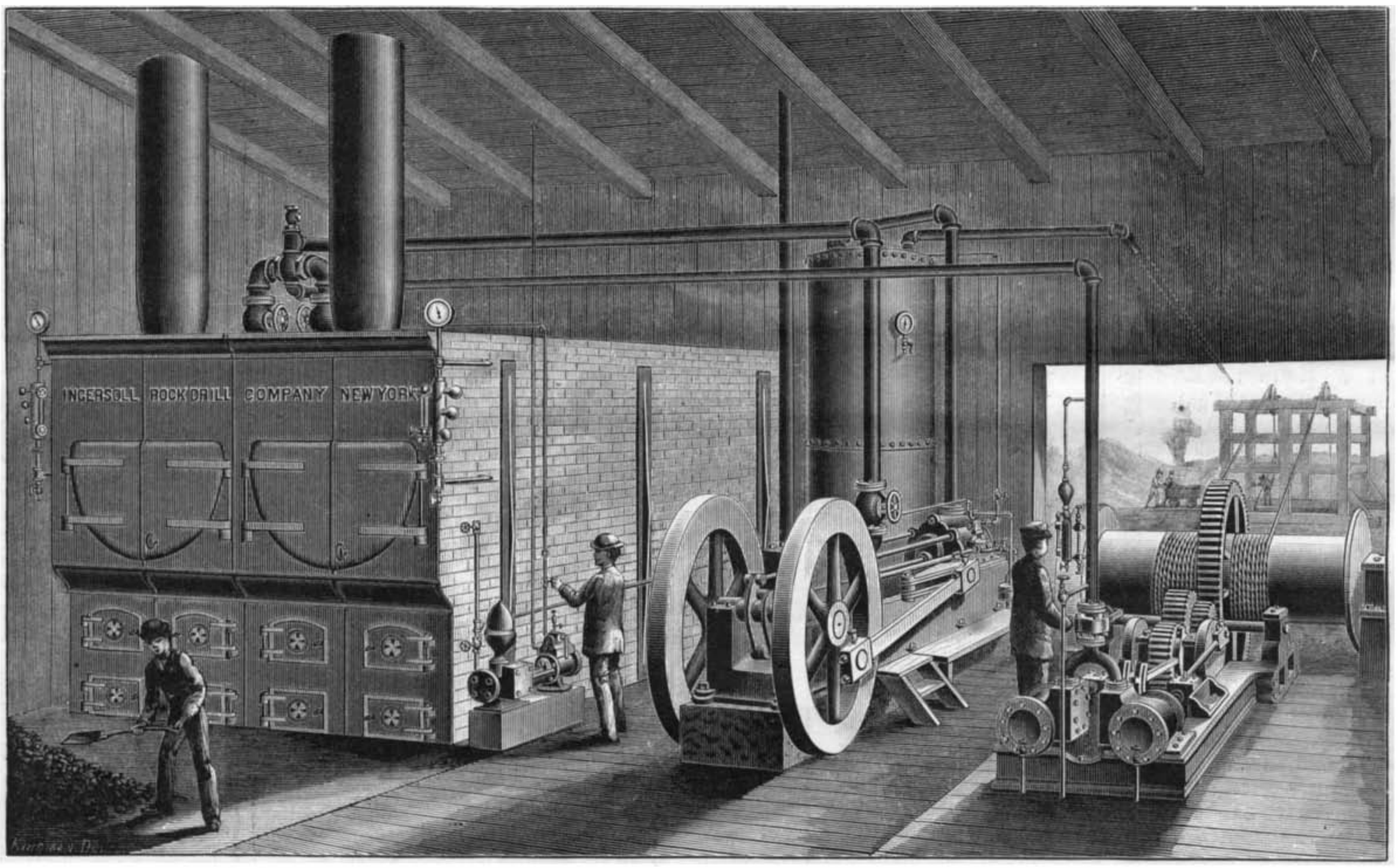


Fig. 8.—THE INGERSOLL PLANT AT SHAFT No. 10, ON THE LINE OF THE NEW AQUEDUCT.

At 135th Street a gate house will be located. Contracts have been let for all the work, with the exception of this gate house and the inverted siphon under the Harlem. The Quaker Bridge project has not yet been definitely settled upon. The contracts have been awarded as follows: Sections A and B to Mr. Heman Clark for $2,147,740; sections 9, 8, 7, and 6 to Messrs. O'Brien & Clark for $4,445,447; sections 5, 4, 3, and 2 to Messrs. Brown, Howard & Co. for $5,297,155; and the gate house at Croton Dam to Messrs. Smith & Brown for $442,000. On the 24th of October the total length of tunnel completed was 22,342 feet, and at the present time the excavation is growing at the rate of one mile per month.

The engineer corps is composed of the following named gentlemen: Mr. Benj. S. Church, chief engineer; Mr. A. Fteley, deputy chief engineer; Mr. H. S. Craven, constructing engineer; Messrs. Chas. S. Gowen, J. B. McIntyre, J. W. Wolbrecht, Alfred Craven, E. S. Gould, F. W. Watkins, and E. Wegmann, Jr., division engineers; Mr. F. S. Cook is in charge of the draughting bureau.

Improved Tent.

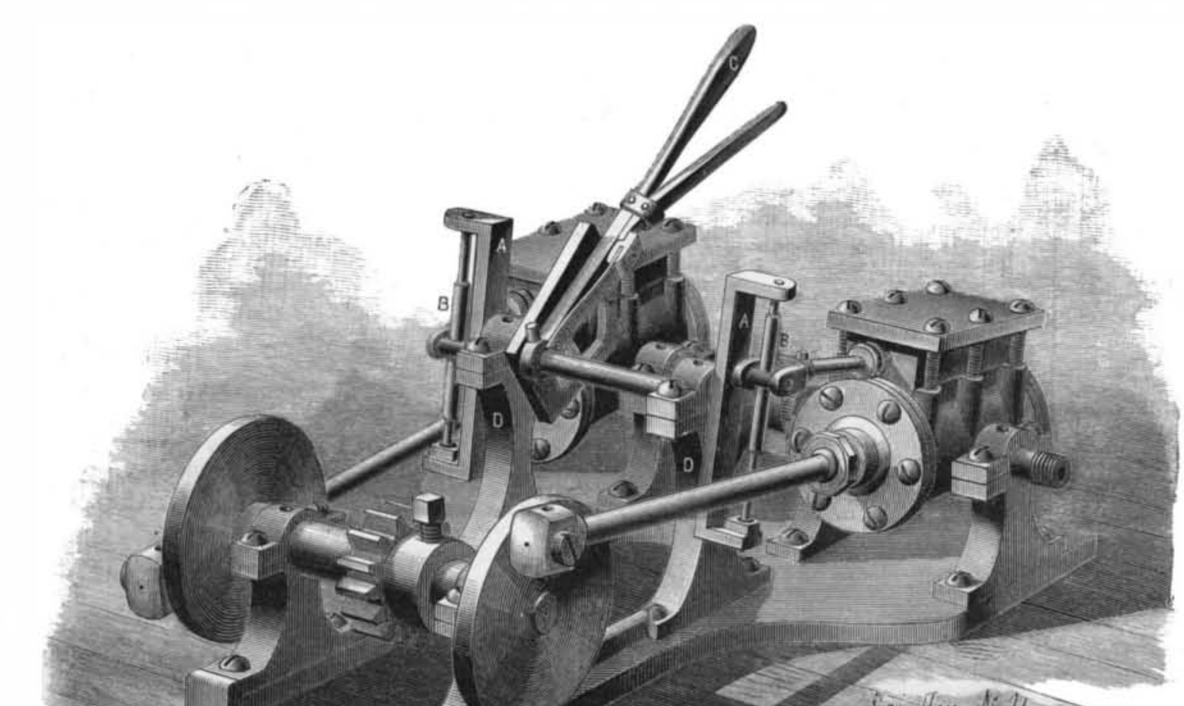
New felt tents were recently introduced in the Danish army. They are composed of rectangular wooden frames, on which felt is tightly stretched. Being of rectangular form with vertical sides, these tents occupy comparatively small space; they are very stable, need not be fastened with ropes to the stakes as is the case with canvas tents, and their erection requires but a few minutes. Felt being a bad conductor, these tents afford a good shelter from cold and heat, and withstand action of moisture better than canvas tents.

TITIAN R. PEALE, of Philadelphia, died on the 13th of March, 1885, in his 86th year. Mr. Peale was one of the naturalists of the Wilkes Exploring Expedition. He was for twenty-four years connected with the Patent Office at Washington.

A NEW LINK MOVEMENT FOR REVERSIBLE ENGINES.

In the reversible engine shown in our engraving, the cylinder is of the usual slide valve order, and operates the valves by its oscillation on the supporting trunnions. The inner trunnions form the inlet pipes, and the outer the exhausts. The slide valve rod is flexibly connected with the sleeve, B, which slides up and down on the rod of the link, A. This flexible connection permits the sleeve to adjust itself to any inclination of the link.

To the ends of a transverse axle supported in the standards, D, the links are rigidly attached, and are thus capable of a backward or forward motion, their position being determined by that of the reversing lever, C, also rigidly attached to the transverse axle. A direct or reverse motion is given to the piston by altering the inclination of the links, and consequently, through the sleeves, of the slide valve rods. Like all other reversing engines, there is a dead center, so that the steam can be cut off by the reversing lever. The action of the links hastens the opening and closing of the ports, and the steam therefore works more expansively than when the ports are operated by an eccentric. This link movement effects a great saving of friction by dispensing with all eccentrics, crossheads, crosshead slides, eccentric yokes, rods, etc., while the first cost of the engine is fully one-third less than that of the ordinary type. The absence of these parts makes the engine compact, and reduces the necessary weight of the bed plate. It is an engine particularly adapted for hoisting, propeller, or traction work; and besides the great advantage of the simplicity of its parts, makes less noise, even when much worn, than the ordinary link movement when new. The motion of the valve being derived from the sliding of the sleeve up and down on the inclined rod of the link, there is no sudden stop, and consequently no hammering. We have shown the movement applied to a double cylinder hoisting engine, but it will also operate with a single cylinder for stationary work.



BAUM'S NEW LINK MOVEMENT FOR REVERSIBLE ENGINES.

Any further information concerning this invention may be obtained from Mr. T. J. Baum, 79–81 Race St., Cincinnati, Ohio.

General George B. McClellan.

Speedily following the death of Gen. Grant has come that of another of the great generals of the Union Army during the late war, Gen. George B. McClellan, who died very suddenly, from neuralgia of the heart, on the morning of October 29, at his home on Orange Mountain, N. J. He was not quite 59 years of age, and his condition was apparently so robust that all who knew him thought there were yet many years of an honored and useful life before him; but his death occurred in about three hours from the fatal attack, after a day of but ordinary business activity. Since the war, besides having served a term as Governor of the State of New Jersey, Gen. McClellan has filled various important positions, in which his abilities as an engineer and a man of broad executive capacity have been conspicuous. Personally, he was loved and honored by all who knew him.

Agee's Improved Corn Planter.

In the SCIENTIFIC AMERICAN of October 24, 1885, we described and illustrated an improved corn planter possessing many excellent features. It is simple in construction and reliable in operation. The present address of the inventor, Mr. George S. Agee, is West Plains, Howell County, Mo.

FRENCH paper makers are highly elated at the Government's resolve to abolish the tax on papers, which has been in force since September, 1871. Though not coming into operation until December 1, 1886, they are still satisfied, as the battle they have been fighting has been a terribly uphill one.