STRAIGHTENING A LEANING CHIMNEY ONE HUNDRED FEET HIGH.*

It will perhaps be interesting to those having similar property, or to any who may have similar work to do, to know how a brick chimney 100 feet high, which leaned about 28 inches, was made plumb. This chimney is that of the Ormsby Textile Company, of Waterford, N. Y.

It was erected in 1893. Soon after its completion it was found to be considerably out of plumb; and when first measured, in November, was found to lean about 16 inches, and a few days later 22 inches. Then the rate of increase of inclination became less, but in March, 1894, it was 28⅛ inches out of line, and it was decided to attempt to straighten it. The factory to which the chimney is attached stands on the north side of the north outlet of the Mohawk River, and distant perhaps one-third of a mile from the west bank of the Hudson. The underlying rock in this part of the country is the Hudson River shale. Where this rock comes to the surface it is very irregular in shape, and is probably equally so where it has been covered by the earth deposit.

The chimney proper is rectangular in plan, is built of brick, is 9 feet 6 inches square at the bottom and 5 feet 4 inches square at the top; it is 100 feet high and has a central flue 3 feet square. The estimated weight of this is 206 tons. It stands upon a foundation which is 14 feet deep, the lower 4 feet being of concrete about 14 feet square, on which rests heavy stonework 10 feet high, 14 feet square at the bottom and 9 feet 6 inches square at the top. The weight of the foundation is about 149 tons, making a total of 355 tons, resting on 196 square feet—about 1·8 tons per square foot.

Before commencing the work, soundings were made on all sides of the proposed site. These varied from 20 to 38 feet in depth below the natural surface of the ground, and indicated the same character of soil as its surface—a soft alluvial deposit with streaks of sand, but with no hard material or rock or bowlders. The chimney was built upon this soil, without the use of any piles. Two similar chimneys have been built in the immediate vicinity on what appeared to be similar material, and no trouble had been experienced with these. The bottom of the concrete is about 2 feet above normal summer level of the Mohawk River, but at the time of sounding in March it was submerged about 4 feet, it being found that the water rises and falls in the soil in the vicinity with the rise and fall of the river.

The work of straightening the chimney commenced on the 19th day of March, 1894. A scaffold was erected about the chimney, and eight oak timbers, 6 inches by 10 inches by 10 feet were placed vertically at the corners, at a height of 42 feet above the stonework and 4½ feet below the center of gravity of the brickwork; the object of the oak timbers being to spread the bearing of the wire ropes over as large a section as practicable.

Wire ropes were passed around the timbers, and another wire rope two and one-half inches in diameter, with an eye in each end, was fastened to the first mentioned ropes at its upper eye. The lower eye was connected with a system of pulleys secured to the dock at the river edge at a point 78 feet distant and directly opposite the direction in which the chimney leaned, the pulleys being made up of three sets of double and single blocks connected together in series, having three points of fastening to the dock and having eleven pulleys in the system. Cables were also put out from the chimney on each side at right angles to the main cable, and having turnbuckles to tighten them; also a guard cable in rear.

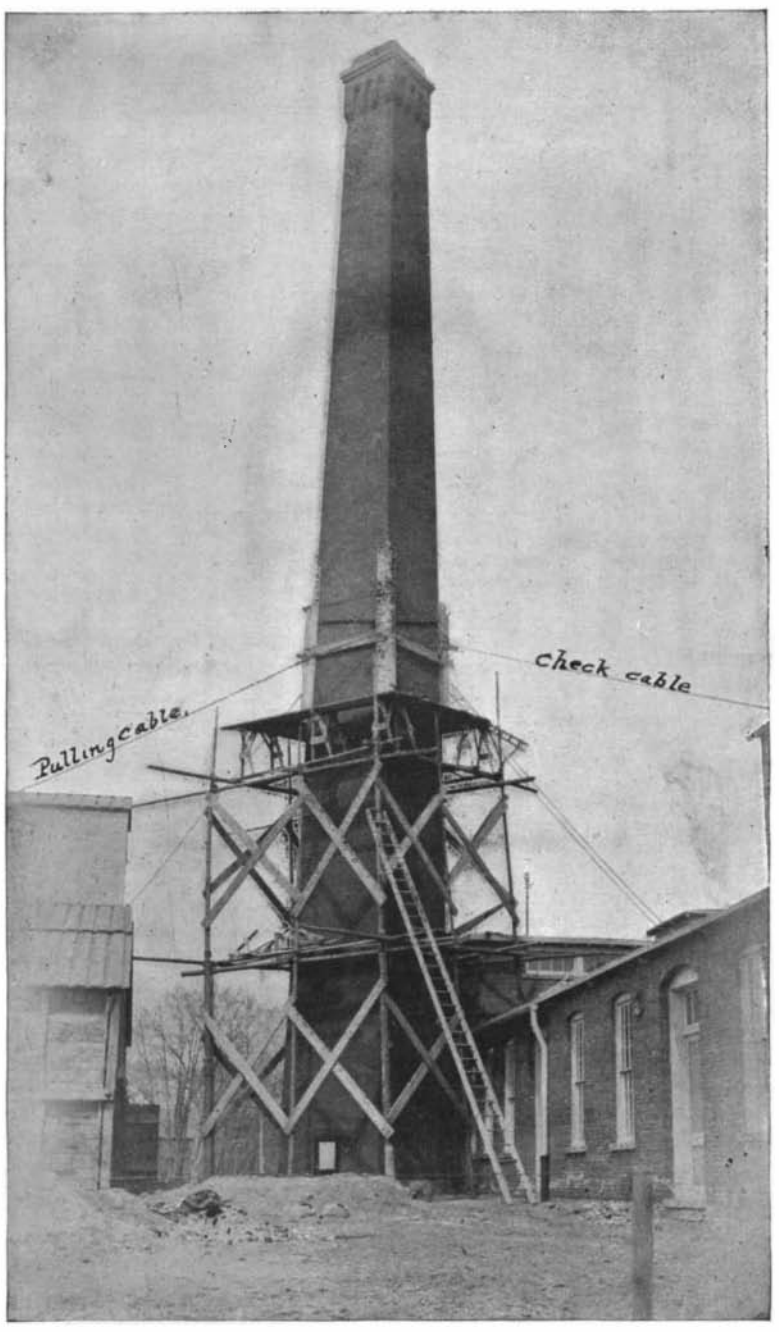
The earth was then excavated on the high side of the foundation nearly half way around to the bottom of the foundation (a depth of thirteen feet) and the main cable put under strain with the pulleys. By this means, in the course of three weeks, the chimney was brought back about four inches. Then, with a post hole digger eight inches in diameter, eleven holes were sunk vertically in the bottom of the trench around the foundation, principally at the highest point, to a depth of five and one-half to six feet. At this time the water in the river stood up to within one and one-half feet of the bottom of the foundation, the ground being soft to a depth of four feet; it then became very hard, showing that the strata supporting the chimney had been reached. No movement or flow of the soil was discovered until the eighth hole was sunk four and one-half feet and the tool withdrawn for clearance, when it could only be reinserted readily about three feet and headway made very slowly. From this removal of the earth there resulted within a few hours a righting of the chimney to the extent of five inches. This increased to eight inches by the next morning. The slack of the pulling rope was taken up as fast as the chimney moved, and the rope was kept under strain. By tightening up the pulley rope two or three times daily, in a week the chimney was brought back to eight and three-quarters inches.

At this point, in similar manner, the post hole diggers being reduced to six inches in diameter, about one-fifth as much more material was removed, immediately followed by righting the chimney to four inches, and from that point, after filling the holes with fine broken stone and gravel thoroughly rammed, by continued daily strain on the main cable the chimney was brought back to plumb at the rate of a quarter of an inch per day. The turnbuckles in the side cables were occasionally used to control any tendency toward lateral inclination.

The work has been accomplished without injury to the structure.

Below is given the record of observations of the movement of the chimney from the first discovery of its extensive settlement until brought back plumb. The figures under AB represent the distance out of plumb at the bottom of the brickwork in a direction parallel with two sides of the base. Those under BC give the distance out of plumb on a line at right angles to the first through the center of the chimney.

In September, 1894, the chimney leaned about two inches toward the river. This inclination came after the trench was filled; it probably results from the weight—eighty tons—of the filling material.



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MEASUREMENTS.

Date, 1893.	AB.	BC.
Nov. 6	16	.....
Nov. 8, 8 A. M	20	.....
Nov. 8, 2 P. M	22	4
Nov. 9	22·5	4·25
Dec. 5	24·25	5·5
1894.		
Jan. 5	26	6·5
Feb. 1	27·375	6·875
Feb. 27	27·875	6·9375
Mar. 17	28·125	6·75
Mar. 23	27·25	6·75
April 5	24·875	6·375
April 9	24·5	5·8125
April 10, 10 A. M	22·3125	5·75
April 10, 1 P. M	19·375	5·4375
April 19	16·125	4·75
April 20	13·6775	4
April 21	11·75	.....
April 22	10·25	2·625
April 23	9·875	2·4375
April 24	9·1875	2·4375
April 25, 7 A. M	8·75	2
April 25, 11:30 A. M	5·625	0·875
April 25, 1 P. M	4·4375	0·875
April 25, 1:40 P. M	4·625	0·375
April 26	2·625	0·25
April 27	2·125	0·25
April 28	1·4375	0·0625
April 29	1·125	0·0625
April 30	0·875	.....
May 1	0·625	0·125
May 2	0·5	.....
May 3	0·125	0·1875
May 4	0·0625	0·0625

*Abstract of a paper by Joseph C. Platt, published in vol. xvi of the Transactions of the American Society of Mechanical Engineers.

Some Work of the Glass Institute at Jena.

At a recent meeting of a scientific club at Hamburg, a number of statements were made regarding the work of Dr. Schott's experimental glass institute at Jena. This institute is under the patronage of the Prussian government, and its purpose is the carrying out of scientific and practical experiments in glass. That it has been fully successful in both is certain. The reputation of the optical and chemical glass made here, and the value of the additions which Dr. Schott and his associates have made to the literature of glass, give this institute a unique position in the scientific and the commercial world. The success of the glass made here, says the Pottery Gazette, is to be attributed first to the fact that the number of the elements which may enter into glass as its principal constituents was greatly increased. It was found to be possible to introduce boric and phosphoric acids in place of silica in amounts up to 70·5 per cent, and to make good, durable glass, although the introduction of new bases was also necessary in using these acids. In place of the five elements used for so long a time, the experiments have led to the use of no less than twenty-eight which can be contained in glass in quantities up to 10 per cent at least. The experiments have been made almost entirely with optical and chemical glass, the endeavors being to find the very best glass for the purpose desired and at the same time to establish the connection between its properties and its composition. Samples of glass made in Jena have been tested by a number of eminent scientists to ascertain the coefficient of expansion. The extremes of the cubical coefficient of expansion have been thus found to be 0·00001097–0·00003369. Dr. Schott has, however, made glass with an infinitesimally small coefficient, and on the other hand, glass whose coefficient is about that of wrought iron. Up to this time the linear coefficient had been put at 0·00000883. It has also been shown that there is a relation between the coefficient of expansion and the kind of materials in the glass, though the proportions of the same do not always exert a great influence. A large percentage of borax in the glass greatly lowers the coefficient of expansion. The great difference in the coefficients of various kinds of glass has been used by Dr. Schott to good advantage in the manufacture of his chemical glass and gages, and also for thermometers. The glass tubes for the latter purposes are made of two layers of glass, one outside of the other, and these layers are of glass having different coefficients of expansion, that having the smaller coefficient being on the outside. There is a tension, then, away from the point where the two layers join, and if the glass be suddenly heated, it will be far less liable to burst than a tube made of ordinary glass. For the manufacture of gages a similar glass is used, only in this case the glass having the smaller coefficient is placed on the inside and that having the greater on the outside, as the force to be counteracted in this case is not heat, but pressure. In addition, the glass used for the inside of such tubes must be of a composition that will resist water and steam under pressure and at comparatively high temperatures. These gages are used in the German navy.

The resistance of the Jena glass to sudden changes of temperature is no less noteworthy. It may be heated to a temperature of 300°–400° Fahrenheit and then plunged into cold water without cracking.

Another specialty of the Jena Institute has been thermometer glass. After laborious experiments, Dr. Schott brought out a glass that is the most satisfactory for this purpose of any yet made; especially with regard to giving a thermometer with a zero point that does not change. His boro-silicate glass, the latest he has brought out, is about the ideal of thermometer glass.

Other ware, principally for chemical use, is made in large quantities here, such as combustion tubes, beakers, and bottles of highest standard of quality.