SAWING A BUILDING IN TWO.

Dampness not only makes buildings unwholesome places to live in, but often injures them and hastens their decay. It is due, in many cases, to moisture absorbed from the soil through the foundations and distributed throughout the walls by capillary action. The oldest church in Munich has recently been protected against further invasion of dampness by the radical method of sawing the stone foundations in two, horizontally, and inserting sheets of lead, which dam the capillary channels and form an impassable barrier to the ascent of water. The operation was performed by a specially devised machine, driven by an electric motor, which automatically inserted the sheets of lead as the saw cuts were made in the foundation walls.

No less remarkable was a somewhat similar operation performed on a structure in Paris.

A four-story building was sawn in two, from top to bottom, by means of a twisted wire cable. The building is an electrical substation belonging to the Compressed Air Company, and its four stories are fitted with storage batteries, which serve to regulate the 500-volt direct current furnished by another station. In consequence of the increase in business and the impossibility of placing additional accumulators in the building, the floors of which already bore a load of more than 200 pounds per square foot, it was decided to install in the ground floor, basement, and cellar, motor generators driven by a high-voltage alternating current, for the purpose of furnishing additional current at 500 volts. It was also decided to sever all connections between the station and the adjoining buildings, in order to avoid claims for damage arising from the vibration caused by the powerful motor generators.

There were no party walls to be cut. The station is a steel-frame building, and it was connected with the adjoining buildings only by the front wall and the stone piers of the foundation, but it was a sufficiently difficult task to divide these without endangering the buildings or interrupting the service. The problem was solved very ingeniously by the employment of a twisted wire cable.

The idea of sawing stone with an endless wire cable conveying a mixture of water and an abrading powder is more than fifty years old. In 1854 François Eugene Chevalier obtained a patent which covered all possible applications of metal wires and cables to the sawing of stone. In this patent Chevalier claimed the employment, for the purpose of sawing, of one or more metallic wires, ropes, or chains, operating by a continuous or alternating rotary motion and possessing the properties of flexibility and of change of direction, so that a block of stone can be attacked simultaneously along all imaginable lines.

This interesting method, however, soon fell into oblivion, and there remained until 1880, when it was revived by Gay and Thoner. Four years later Thoner introduced two important improvements, ball-bearing pulleys and a device for cutting large holes for the separation of blocks from the original rock in quarries.

The method still presented a serious practical inconvenience, the liability of the wire to rupture and the difficulty of repairing it. The most carefully executed solderings and brazings proved ineffectual, but at last a workman conceived the happy idea of cutting the strands of broken cable to different lengths and making a splice 12 or 13 feet long. Thenceforth the employment of twisted wire cables became general in marble and granite quarries. This method of sawing stone combines rapidity with economy, avoids the employment of explosives, and, above all, makes unnecessary the excavation of trenches in the rock, an operation which is both tedious and costly. But the method was never, to the writer's knowledge, employed for cutting a building in two until it was applied to the electrical station in Rue St. Roch.

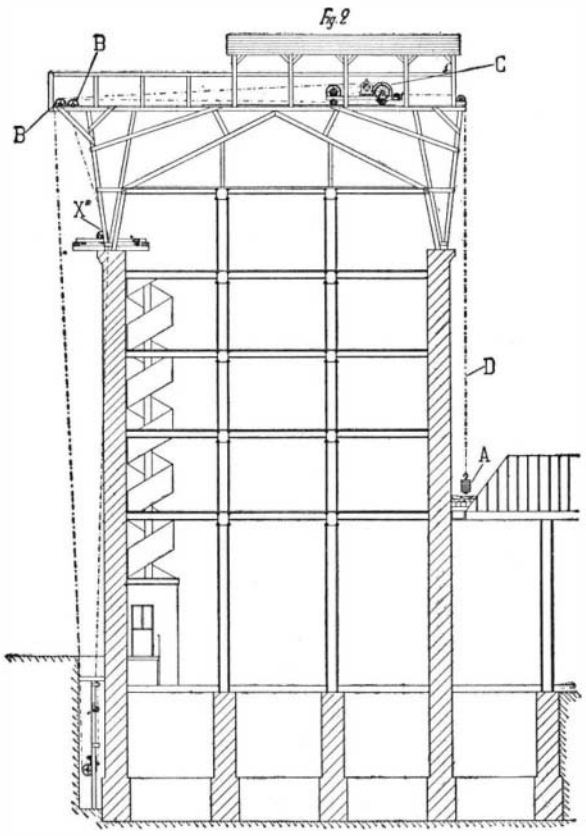

Fig. 4.—Diagram of Building, Showing the Cable Arranged for Sawing the Façade.

The work comprised the sawing of the façade and the foundation piers at each side of the building. It was begun by erecting two wooden towers and joining their tops to the roof by bridges for the support of the tension carriages and motors operating the wire cable. Then two shafts 21 feet deep (the depth of the foundations) were sunk in the street, and a hole about an inch in diameter was drilled horizontally through each foundation pier, immediately beneath the iron plates on which the iron columns of the superstructure rested. The doubled cable was passed through these holes.

The tension carriage *C* (Fig. 1) consists of an oaken frame mounted on four wheels. It runs on rails on the bridge, and carries an electric motor *M* of 4 horse-power. This motor drives the cable by means of the reducing train of wheels *N O*, which gives the cable wheel *P* a speed of 180 revolutions per minute, and the cable a linear velocity of about 22 feet per second. The carriage is drawn back and the sawing cable kept taut by means of the winch *T* and a fast and loose pulley and clutch operating on the cable *D* (Fig. 4) which hangs vertically over the yard of the building and bears at its lower end a weight of 440 pounds. Bags of sand are placed at a little distance below this weight, to receive it without shock in case of rupture of the sawing cable.

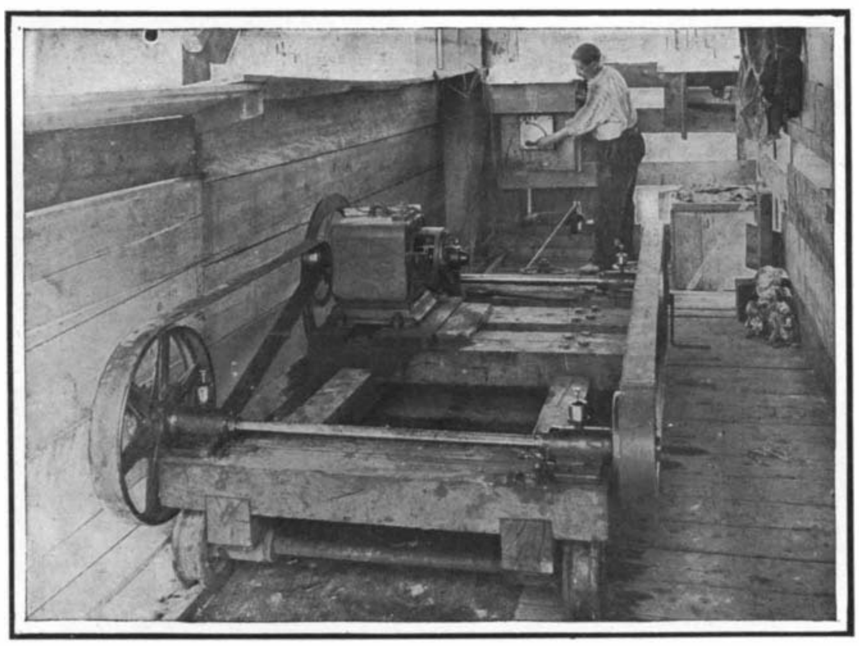

Fig. 5.—Electric Motor and Tension Carriage.

The sawing frames, which are shown in operation on the foundations in one of the photographs, are very similar to those used in stone yards. A carriage slides between two parallel iron guides connected by cross pins at their ends and by a stirrup in the middle. This carriage bears a wheel which presses against the sawing cable and guides its movements. The carriage and wheel are raised and lowered by an auxiliary wire cable and a winch. In the shaft in the street is a second guiding frame, consisting of a carriage and fast and loose pulleys.

In sawing the foundation piers the sawing cable runs from the wheel *P* of the motor, over the wheel *B*, descends thence into the shaft to the street, and, guided by the frame described above, passes through the small holes drilled in the piers. After traversing the entire row of piers the cable passes round a

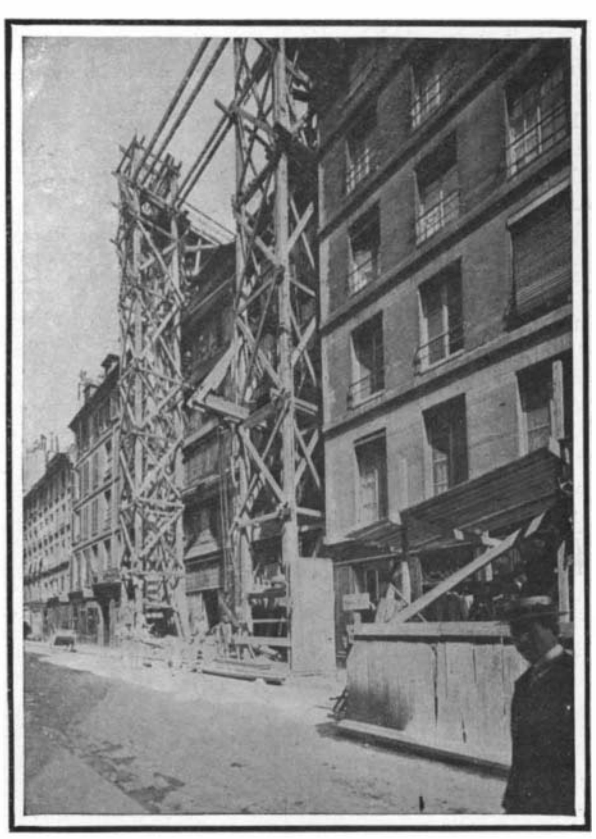

Fig. 6.—Front of Building, Showing Scaffolding.

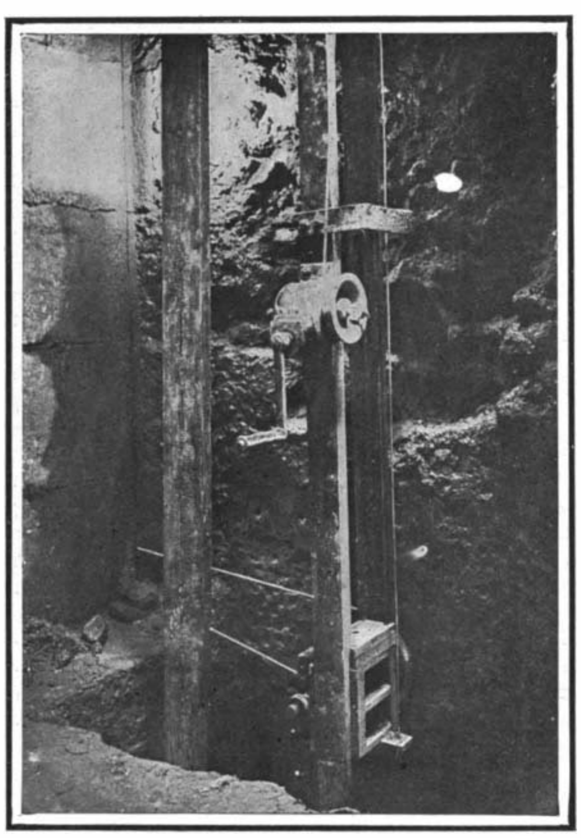

Fig. 7.—Arrangement of Cable at Foundation.

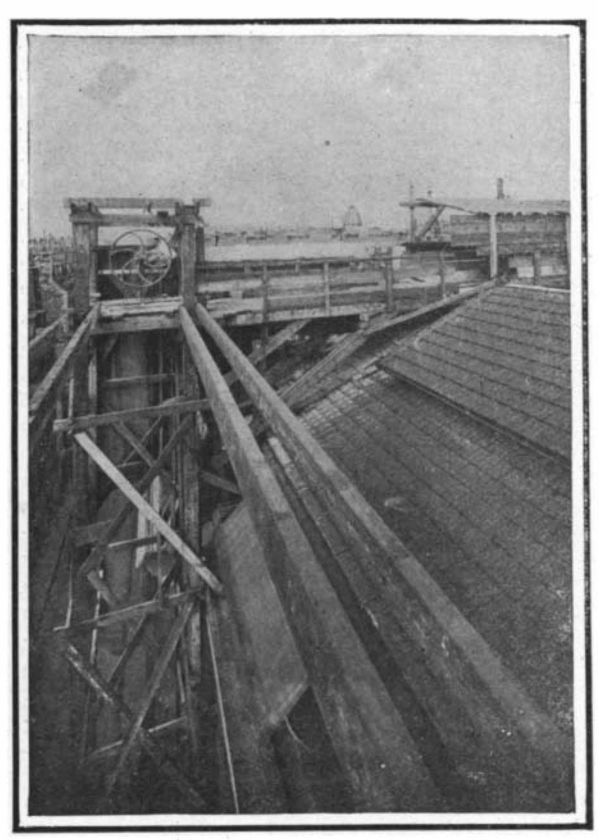

Fig. 8.—Bridge and Top of Tower.

SAWING BUILDINGS IN TWO.

pulley, and returns through the same holes to the shaft in front of the building, and thence ascends to the bridge at the top, and passing round a second wheel *B* returns to the motor wheel *P*. In front of each pier, at the level of the lower or cutting part of the cable, is placed a fine jet of water carrying fine sand in suspension. The sand gradually wears away the stone, the cable serving only to convey it. As the work advances, the pulley frames are lowered by turning the winch, the tension of the cable being maintained constant by means of the carriage *C*.

As a rule, the vertical cut through the line of piers was deepened at the rate of about 5 inches per hour. As the cable returned through the cut, it was abraded very rapidly, so that although it was more than 300 feet long, it was found necessary to replace it at the end of twenty hours of work, which corresponds to an aggregate surface of cut equal to 121 square feet. In the concrete bases of the piers the process was reduced to 3.2 inches in a day of eleven hours by the heterogeneous character of the concrete and the sand and flint which it contained.

When the piers had thus been sawn from top to bottom, the sawing cable was raised to its initial position, immediately beneath the iron bedplates, and a horizontal cut, 2 inches deep, was made by shifting the pulleys laterally to this distance, and forcing the cable against the masonry by a series of iron bars. A second vertical cut, extending to the bottom of the piles, was then made. In this way a vertical slice, 2 inches in thickness, was removed from each pier, on each side of the building.

A slice of the same thickness was removed from each side of the façade by a similar series of operations, in which the cable was pressed obliquely against the façade by means of the pulley *X'''* (Fig. 2). When this oblique cut had advanced so far that the top of the wall was cut through and the cable had begun to attack the middle of the height, the upper pulley was drawn back, the pulley at the base was pushed forward, and the lower half of the wall was sawn obliquely in a similar manner. Then the remainder of the cut, involving the whole thickness of the wall at mid-height and a thickness gradually decreasing above and below this point, was made with the cable vertical. A second cut, 2 inches distant from the first, was made by a similar series of operations, and the intervening slice of wall was removed.

The work of sawing this building in two with a wire cable was accomplished both rapidly and cheaply.

THE NARROWING OF THE GANGES AND CONSTRUCTION OF THE CURZON BRIDGE.

(*Concluded from page 204.*)

training-bund, representing a total quantity of some 50,000,000 cubic feet of earthwork, had to be handled, the magnitude of the task may be realized.

The construction of the bridge proceeded simultaneously with the building of the earthwork revetments, operations being commenced from the right-hand bank. To facilitate these operations and the transportation of the necessary materials to the sites of the foundations for the piers, a temporary railroad was laid on piles on the river bed as soon as the water had receded sufficiently. As already mentioned, the bed of the river is composed of fine sand, which extends on the average to a depth of 100 feet, where impermeable clay is encountered. The pier foundations had consequently to be carried down to a great depth, and this work was carried out upon the well-sinking principle. In executing this part of the work, the engineer made a series of calculations, by means of which he was able to deduce the weight of well required to sink by open dredging to any required depth through sand and the relationship of skin friction to the increase in depth. This is probably the first attempt to indicate such data in advance of operations. In the course of an exhaustive paper, recently communicated to the British Institution of Civil Engineers concerning the construction of the Curzon Bridge, Mr. Gales refers to this question of "sinking effort" at great length.

Owing to the bridge being designed to carry only a single track, the form of well adopted was of the double octagonal type, the curbs being 33 feet 6 inches long by 19 feet wide. The sinking plant comprised steam hoists so disposed as to be capable of serving two wells, so that merely by slewing round the sinking of one well could be carried out while the other was being built on. Taken on the whole, sinking was completed rapidly; but in one or two cases, owing to substrata of hard clay and conglomerate being encountered where only sand was believed to exist, these operations were somewhat delayed, since it was found that the dredges could not make any effect upon certain material which had to be removed by blasting. The wells were sunk until they became stanched in the clay, which was found to be extremely hard, efforts to drive the wells more than a few feet into the strata proving unavailing, even when artificially loaded with iron rails, pig iron, sand, etc., to the extent of 1,000 tons or so, as shown in the engraving. The wells were for the most part built of brick, and were carried up to within two feet of the lowest water level recorded, when the construction of the piers was commenced. The piers are of masonry, two kinds of native stone being used, one for the external walls and the other for the hearting. The wells themselves were filled with sand, ballast, and concrete as follows: The bottom of the well to the top of the cantplate of the curb with sand, followed by 9 feet of cement concrete. Upon this was pure sand for a depth of 41.25 feet, followed by a layer of sand and brick ballast rammed down for another 40 feet (the sand filling the spaces between the ballast), and crowned by 10 feet of rammed concrete. The piers themselves are stepped, so that a slight batter is secured. The bottom layer of masonry is 35 feet in length by 20.5 feet wide, while that carrying the cornice is 29 feet long by 14.5 feet. The height of the masonry piers in each case, with the exception of the shore and training-bund abutments respectively, is 60 feet. The piers are carried up a sufficient height to give a clearance of 31 feet between the normal level of flood and the under side of the girders. Even should the waterway again attain its highest recorded rise of 41 feet, which was registered in 1875, this will still give a headway of 21 feet.

The girders are of the single triangulation N type, having nine bays each of 25.75 feet length center to center, representing 200 feet in clear span, while they are 25.75 feet in height. The total amount of steel work in each span, including the flooring of the public roadway on the top deck, is 320 tons, aggregating 4,800 tons for the whole bridge.

The top deck carrying the public roadway has a clear inside width of 23 feet 2 inches, and is carried at a height of approximately 60 feet above ordinary high flood level of the river. There is a metaled roadway 15 feet in width, flanked on either side by a timber sidewalk 49 inches wide. Access to the top deck is obtained from the approach banks at either end of the bridge over steel viaducts.

The time occupied in carrying out the whole undertaking, from the commencement of the preliminary operations to the running of the first train over the bridge, was exactly three working seasons, and its rapid completion testifies to the energy with which the whole task was carried out. By narrowing the course of the river through the construction of the heavy training-bund, and thereby shortening the length of the bridgework, a saving of over $500,000 was effected. Despite the departure from general practice in the design of the training-bund, the initiative of the designer is evidently completely justified, since no signs of the defects which have characterized previous works of this type have yet developed, though it has been subjected to exacting tests by high floods.

Sven Hedin's Return.

Sven Anders Hedin, the explorer, who started in 1906 from Chinese Turkestan on a journey through Tibet, and concerning whose whereabouts there was great anxiety for many months, has arrived at Simla.

He traveled 4,000 miles or more, mainly in western Tibet, and did not see a white face until he reached the province of Pobo. Dr. Hedin states that he made valuable discoveries, but that there still was ample room in Tibet for future explorers.

Summarizing the remarkable achievement of Sven Hedin, the New York Sun thus comments editorially:

When Sven Hedin reached Gartok in the southwestern part of Tibet, late last year, he gave out that he was going to Ladakh in Cashmere, and in the spring he would travel either to India or to Peking. The event shows that he had in view another long journey in the unexplored part of Tibet. He went north to Leh, the chief town in Ladakh, ostensibly to spend the winter but actually to outfit and push again into northwestern Tibet in order to make another route through the vast unmapped region to the west of his route in 1906.

This secrecy was necessary because the Tibetans were determined to prevent him from renewing his travels in Tibet. He did not even impart his plans to his family, and they were anxious for his safety when they failed to hear from him last spring. But he has reached civilization again and is now going home after experiencing last winter the acutest phase of his privations and losses during his migratory tent life in the bitter cold of the Tibetan winter two miles and a half or more above the sea.

The work of Sven Hedin in these three years, 1906-1908, will rank among the great achievements of exploration. The results obtained are enormous in spite of the active opposition of the Indian and Tibetan officials, who did their best to prevent the explorer from getting into the country at all.

The work, spread over three years, is embraced in three journeys, each distinct from the others. In 1906 Hedin entered the northwestern part of Tibet at Aksai Chin (White Desert), crossed the vast unexplored region of western Tibet from northwest to southeast, traveled 840 miles without touching the routes of any earlier explorers excepting where he crossed the tracks of Bower and Littledale, and discovered mountain ranges, new lakes and rivers and gold fields.

The second journey, which filled most of 1907, was west from Shigatse through the southern part of the unknown area, about 1,000 miles to the southwestern corner of Tibet. On this eventful expedition Hedin discovered the sources of the Brahmaputra, Indus, and Sutlej rivers, and found that the Nin Chen Tangla Mountains, well known south of Lake Tengri, are simply part of a chain extending, he believes, clear across Tibet east and west and at least 2,000 miles long.

The third journey, just completed, carried Sven Hedin again from north to south across unknown expanses he had not seen on his route of 1906. He found everywhere repeated the mountains and valleys interspersed with fresh and salt water lakes that he had discovered two years before. He has proved that the great white expanse on the maps is practically filled with these features, for no part of it has been found to be an extensive and comparatively level plain.

In this last journey Hedin crossed the Nin Chen Tangla three times—he had crossed it five times on his first and second journeys—and he now reports complete proof that the mighty range is continuous to the western border of Tibet. Although the absolute height of all these Tibetan mountains is very great, they are not remarkably impressive as seen rising from plateau surfaces that are 16,000 to 18,000 feet above the sea.

Sven Hedin reports that he has saved his scientific material. No other pioneer explorer has ever produced better surveys for map purposes, and it is certain that his map sheets will fill with accurate details a large part of the regions both in northern and southern Tibet that were marked "unexplored" on the Royal Geographical Society map of Tibet prepared three years ago.

Coming Aeronautic Contests.

The recently-formed Aeronautic Society, mention of which has already been made in these pages, has leased the Morris Park race track in Westchester, and moved its headquarters to the club house adjoining. This fine oval course is 120 feet wide with a 1½-mile circuit, while a ⅞-mile straight track runs diagonally across it. The fences have been removed, thus making the place an ideal one for aeronautic experiments. Altogether, there is a field of 325 acres over which flights may be made. There are ample sheds for the storage of flying machines, and a machine shop will soon be ready. All members may take advantage of the exceptional facilities thus provided for aeronautical experimentation. In addition to these, Mr. W. R. Kimball will loan members the 50-horse-power 150-pound motor (which at present he has mounted upon his helicopter) for the purpose of trying out flying machines which they may have constructed but for which they have no motor. A tower with dropping weight (like that used by the Wrights) has been built for the purpose of launching gliders, and on October 17 it is proposed to hold contests for man-carrying and model gliders, self-propelled model and full-sized aeroplanes, a kite-flying competition, etc. While the Aeronautic Society intends to experiment in all branches of aeronautics, its members are chiefly interested in heavier-than-air machines. Several of these, including the Kimball helicopter, are now being experimented with at the race track. The society welcomes all inventors who are striving to advance the art and science of aeronautics and every facility will be given them to try out thoroughly their machines. For full particulars regarding the contests, address the Aeronautic Society, Morris Park Race Track, Westchester, N. Y.

Energy Consumed for Light.

In a lecture delivered by Sir James Dewar on "Flame" before the Royal Institution in London he showed the large amount of energy expended in the production of a small amount of light. The following figures show how inefficient the various lighting devices now employed are from a scientific point of view: Candle: Percentage of light, 2; non-luminous energy, 98. Oil: Percentage of light, 2; non-luminous energy, 98. Coal gas: Percentage of light, 2; non-luminous energy, 98. Incandescent lamp: Percentage of light, 3; non-luminous energy, 97. Arc lamp: Percentage of light, 10; non-luminous energy, 90. Magnesium lamp: Percentage of light, 15; non-luminous energy, 85. Incandescent lamp: Percentage of light, 99; non-luminous energy, 1.

Fire and Water-proof Cement.—Mix 10 parts of finely sifted unoxidized iron filings and 5 parts of perfectly dry, pulverized clay, with vinegar spirit, by thorough kneading, until the whole is a uniform plastic mass. If the cement thus made is used at once, it will harden rapidly and withstands fire and water.—Werkstatt.