PART III.

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WEIGHING TALL BUILDINGS

Method of Ascertaining the Gravity of Modern Sky Scrapers.

ARTIFICIAL ROCK THE FUTURE FOUNDATION

Strange Influence of the Sun on Big Bridges and Buildings—Effect of the Wind on Properly Reared Structures.

The city of the future will be built upon solid rock. Modern conditions point that way. The solid rock may not necessarily exist at the surface of the earth. If it does, so much the better. If it is deep underground the foundations of buildings will have to be carried down to it. The latter-day skyscraper and the practice of building houses of the very heaviest materials renders this compulsory even now. There are men in New York and other large cities whose sole business it is to test the character of the ground on which tall buildings are to stand. They are experts, and no thorough-going architect would trust to his own discernment in the matter of his groundwork. In fact, the construction of skyscrapers has vastly extended the calling of the architect and compelled him to do some things of which the constructor of bygone days never dreamed. Most interesting of these newly acquired habits is the weighing of tall buildings.

The average person might not fully appreciate the necessity for weighing a tall building. In fact, many people would calmly assert that it could not be done, yet the practice of weighing immense buildings, bridges, heavy ordnance and ponderous objects generally, is a science in itself. It is all done by computation, but the actual weight of the structures is accurately computed. In heavy ordnance not only is the weight computed without putting the gun on a scales, but the center of gravity is determined within such a fine point that when hung on its trunnions the gun is so nicely balanced that it can be moved up and down by the hand of one man. Swinging bridges which move upon a pivot, so to speak, are so accurately balanced that hardly a pound of difference exists between the two outstretched arms.

DETERMINING THE WEIGHT.

It is necessary for an architect to know the weight of his building long before it is put up. The character of his foundation depends upon it. Yet the estimation of this weight is so simple a matter that an under clerk or an apprentice in an architect's office is often given the task of calculating it. His grand total may reach, as in the case of the twenty-one-story Surety building in New York, 50,000 tons, or in the case of some big bridges like the one at Poughkeepsie four or five thousand tons. He will reach it, however, to within a few pounds, and he will also be able to say just where certain heavy parts of the load strain will be most felt. How is it done? In the first place, the weight of every piece of material which is to become part of the structure is furnished by the manufacturers. Whether it be Z-bar girders or white lead, it is all brought into the total. Even such an insignificant thing as a difference in the quality and kind of paint used may make a ton of difference in the general weight of the structure. Every rivet in the building is accounted for and if the ends are fused, hammered down on the opposite side of a girder, instead of being merely bolted on, the fact must be taken into account. If the roof is covered with tin, the solder which holds the plates together is put down as weighing so much per ingot. In laying the tin plates on the roof the edges of each plate are lapped over the adjoining plates to the extent of a quarter of an inch on all sides. This quater-inch of necessary lap adds a large number of pounds to the general weight of the roof. So the process continues through the whole building. The weights of the clapboards, the plaster, the wall paper, the window glass, the gas or electric fixtures, the cornice ornaments and of the thousand and one materials and appurtenances which go to make a building are considered and accounted for. In the aggregate those weights, summing up in the thousand tons, constitute merely the dead weight of the building. The live weight, such as the weight of the tenants, the furniture and their other belongings, must be added to the sum total.

WEIGHT OF TENANTS CONSIDERED.

An office building with a capacity of 3,000 persons would be about 165 tons lighter at night when it is deserted than in the daytime when it is occupied. In office buildings it is customary to estimate about 100 pounds of live weight to the square foot. In residences about seventy pounds to the square foot are calculated upon. In manufacturing establishments it is customary to allow for at least 150 pounds to the square foot. The buildings themselves press down upon the earth at the various rates of from four tons to the square foot to twelve or fourteen tons to the square foot. The tall St. Paul building in New York is estimated at the latter figure. The Surety building mentioned above, is estimated to exert a pressure of six tons to the square foot.

A curious part of this business is the testing of the ground on which tall buildings are to stand. Nearly every tester has his own method of ascertaining earth resistance. Some do it by hydraulic pressure, some by pile driving, some by driving down into the earth a "worm" which picks up dirt and gravel and sand at various distances and conveys them to the surface to be examined. The hydraulic method is pursued by constructing a box or casing, which is fastened tightly in the ground. In it a plunger, operated by water pressure, is made to press down upon the earth. The force with which it presses on the ground is determined by its resistence to the inflow of the water which is ascertained beforehand. In driving piles, they are simply forced down until they will go no farther. This is done at various points over the ground on which the forthcoming structure is to be built. Of course, the depth of this point of greatest resistance can be marked off on the beam of wood which has gone down. The worm resembles a corkscrew. It is hollow, and as it twists its way down through the earth the various strata of the latter are forced up through the screw in the order in which they are encountered. A perfect record of the condition of the ground, with the depths of the various substances unearthed, is obtained. For very large steel buildings, however, it is necessary and safer to rest the foundations on solid rocks.

MAKING ARTIFICIAL ROCK.

This is done by sinking caisson hollow tubes, which are forced or screwed down through the various clays and gravel to hard pan. When these hollow steel tubes strike the rock they are firmly secured to it. Then they are filled with concrete. The latter hardens into rock, which is rendered all the stronger by its steel coating, and the whole affair becomes a pillar of rock, sheathed with steel, and extending from the immovable backbone of the earth itself to the surface. The modern sky scraper may then be said in many cases to stand upon stilts. Nothing can perceptibly alter its solidity—not even the wind, the swaying power of which cannot compete against the truss formation of the structure itself. There is one power which does at times arrest the stability of the sky scraper. This is the sun. The immense amount of iron in the structure is acted upon, and to a certain extent expanded and contracted as the rays of the orb of day change the direction, but not enough to cause any fear of disaster. In bridges, however, this expansion and contraction is very marked. In a concrete floored bridge the whole structure will bend backward and forward as the day passes to the extent of one-quarter of an inch but in an iron bridge such as are used by railroads the "draw" may go several inches out of plumb. This is the reason that on drawbridges the railroad tracks are connected by flaring tracks or what is technically known as a Y.

FOUNDATIONS NEED GREATEST CARE.

In tall buildings the greatest amount of engineering skill is required in the foundations. The building itself is after all a superstructure. It is the foundation that requires the engineer's greatest skill, for sometimes the conditions are most adverse. For instance, in lower New York water is encountered at very shallow depths and it is in this lower section that most of the skyscrapers are built. The Commercial Cable building is eighteen stories high. Its foundation floor is eighteen feet below the surface water level, and at least ten feet below the river level. Yet the lowest subcellars are, so to speak, as dry as punk. It was accomplished by means of the intricate and extended caisson system. The water is entirely excluded. When such low levels are reached the contractor has really as much to do in preserving the integrity of the surrounding buildings and streets as he has in economically carrying on his excavations. The laws are very stringent in regard to a cave-in and municipal lawsuits are sure to drain one's pockets. In some places, however, in spite of the most extended "shoring up," there is sure to be a curve in the nearby street lines. Recently in New York, at a deep excavation, a person could by going some distance up gaze along the car tracks and discern part of an immense quadrant, formed by the tracks where they had followed the sinking of the ground toward the excavation.

Why does not a big building topple over? is the question asked by the observer. It would seem that the action of the winds, rain, sun and elements generally ought to cause it to fall. It could not fall for several reasons. In the first place, every part of the structure is bolted to the adjoining parts by means of steel rivets, which are inserted red hot, and which, as they cool, draw the various pieces of steel together with a force that almost accomplishes molecular adhesion. The building thus becomes a unit above ground. Below ground, as has been pointed out, the caisson system of construction admits of no disintegration. On the other hand, the line inside of which the center of gravity exists lies so far outside the building that it could not possibly topple. The basement construction is such that the whole affair resembles a telegraph pole, which would first have to get out of its hole in the ground before it could fall. The same conditions exist in turnstile bridges. The base or pivot on which the bridge turns is so broad that the outstretched arms could not possibly tilt the whole structure. In the new Third avenue bridge in New York City each arm extends out 120 feet beyond the central turnstile. In order to topple, sufficient weight would need to be placed on one arm to overcome the weight of the other arm and the heavy central base. As the bridge weighs, all told, nearly 3,000 tons, this would be practically impossible.

A piece of heavy ordnance is hung on its trunnions merely by calculation. The center of gravity of every part of the gun is calculated first. Then the relation of these centers to the general center is ascertained by computation. Engineers are able to determine it within a small fraction of an inch. In short, the weighing of ponderous objects is part of a special science—the science of extremely delicate computation.

THEODORE WATERS.

OUT OF THE ORDINARY.

A Kentucky man has named his children as follows: The oldest, Daniel Prophesier Vancaster Busterasquire Hobbob Bush; the second, Charles William Henry Harrison Dalton Houston Austin Bush, and the youngest, John Cornelius Edward Vanderbilt Bush.

One-tenth of the millionth part of a second can now be exactly recorded by photography. The stroke of a hammer, supposed to be instantaneous, takes a long time in this measurement, and a flash of lightning dawdles along as if it had the spring fever.

F. F. McIntyre of Shenandoah, Ia., has a horse with as fine a mousatche as any man. It is about three inches long at present, and has been as long as six inches. It is located on the horse's upper lip, the same as a man. The horse is a coal black, 7 years old and weighs 1,350 pounds. When the moustache gets long enough to be bothersome Mr. McIntyre cuts it off.

J. O. Caskey, who owns a hog ranch five miles east of Phoenix, Ariz., discovered a nugget of gold imbedded in the tooth of a hog, not carelessly imbedded, but inserted skillfully, as if it had been done by a dentist. He doesn't know where his hogs have been getting their dental work done, but he is going to prospect among them for more gold. He regards that hog as a piece of float and thinks that the ledge is somewhere in the vicinity.

The belief that lightning will not strike a feather bed was shown to be mistaken by an incident that occurred in Utica, N. Y. A bolt struck a chimney on the house of Charles Steates, who lives on the Deerfield road. Part of it jumped to the house of Bernard Huss and tore off the conductor pipe. The other part went down the chimney, ripped the plaster and paper from a bedroom and then struck a feather bed. The bed was torn and the feathers scattered about the room.

A young woman living in the country, near Holstein, Ia., has a pet rooster which she claims has more intelligence than the average bird. This young woman also has a friend who calls to spend the evening about twice a week. On other than Sunday evenings when the friend stays later than 12 o'clock the rooster will start to crow and continue to do so until the young man leaves, but on Sunday evening no noise or alarm is given by the pet bird until the daylight hour is at hand. The bird is valued at $100 by the owner.

The medical department of the Arkansas Deaf Mute institute is puzzled over a case which occurred at that place. Two years ago Jennie Childress, aged 9 years, whose parents reside in Izard county, had a severe attack of the measles, which seems to have paralyzed the vocal organs, rendering speech impossible, although her power of hearing was not in the least affected. Last October she was sent to the deaf mute institute. For several weeks she had been under the care of the institute physician, Dr. Gray, but he became convinced a few days ago that there was no hope for the little one, and wrote to Mrs. Childress that he could give no encouragement whatever to Jennie's case. Her power of vocalization seemed to be utterly gone beyond recall. The other day Jennie was with a class of girls, some of whom can speak slightly. They were singing the familiar church hymn, "At the Cross," when all were astounded at Jennie, who broke into the chorus with a clear tone, the first words she had uttered for over two years. Later she pronounced her teacher's name, and remarked: "Mamma will be so happy."

FLOODS OF HALF A CENTURY

Some of the Notable Inundations Recorded in the United States.

HIGH WATER MARKS OF THE MISSISSIPPI

Destructive Overflows in the Ohio, the Missouri and Other Valleys—Great Loss of Life and Property.

Many memorably great inundations have occurred in the United States in the past half century, relates the St. Louis Globe-Democrat. The earliest of these of which there is any accurate record occurred in April and May, 1844, when the Mississippi at St. Louis and vicinity touched a higher mark than has ever been reached at any other time since this region has been settled. Many persons were drowned and the loss of property was large. In 1849 the Mississippi and its tributaries from Alton downward again swept over their banks, causing great damage. No trustworthy figures are at hand of the destruction of life, but the loss of property in St. Louis and its immediate vicinity was put at $5,000,000, while it reached $20,000,000 in New Orleans and its suburbs. It was the most disastrous visitation by flood which the latter city ever had. The inundation reached its most destructive stage on May 12.

A high water record for the Mississippi for St. Louis and its neighborhood was made in the spring of 1857, which was never exceeded except in 1844 and which has never been equaled since. The figures of the losses vary within a wide range, but they must have been large for the period. The four "highests" in the flood record of the Mississippi at St. Louis were these: In 1844 the river at St. Louis rose 44 feet and 9 inches above the mean low water line, in 1851 it went to 36 feet and 5 inches above, in 1857 it went to 36 feet and 9 inches, and in 1892 it scored 36 feet.

The bursting of a reservoir in Mill river valley, near Northampton, Mass., on May 16, 1874, is well remembered by all those old enough at that time to read the papers. It destroyed large portions of several villages and 144 lives were lost. July 24, of the same year, a waterspout and rain storm at Eureka, Nev., drowned thirty persons and destroyed much property. Two days later Pittsburg and Allegheny, Pa., were visited by a tremendous rain storm, which swelled the rivers in that neighborhood and drowned 220 persons. The damage to property was put at $2,000,000.

MIGHTY SWEEP OF WATER.

In 1851 floods in the Mississippi valley, the river at St. Louis reaching its highest point on June 12, did immense damage, especially in Iowa, Illinois, Missouri and Arkansas. The valleys of the Missouri and Ohio also suffered at the same time, the losses being particularly heavy in Kansas and Kentucky. Another destructive freshet occurred in the Ohio and Mississippi basins a year later, culminating on February 22. This time the loss of property and life in Mississippi was greater than had ever been known before in that quarter, and the governor of that state appealed to the country for aid for the sufferers.

The Ohio river valley, in February, 1883, was visited by the most destructive flood known since that region was first settled. On the 15th the Ohio at Cincinnati reached its highest point or sixty-six feet and fourteen inches, covering all the houses fronting on the bank of the river, and extending into the densely built part of the city for a distance of several squares. The direct loss of property in Cincinnati was put at $2,000,000, and in other parts of Ohio and Indiana and Kentucky it was estimated that $5,000,000 was destroyed, while about 30,000 persons were rendered temporarily homeless and dependent.

A year afterward, or in February, 1884, the Ohio reached a greater height than it did in 1883. I drowned forty persons in Cincinnati and vicinity, and made 15,000 people in that locality homeless. The damage in the entire Ohio valley was estimated to have been greater than it was in 1883. As in the previous year, the gas works at Cincinnati in 1884 were submerged, and the city for the time was plunged in darkness. The Ohio at Cincinnati on February 14, 1884, touched the seventy-one-foot mark, which was the highest point ever reached by that river at that place before or since.

LIFE AND PROPERTY SWEPT AWAY.

New England, Pennsylvania, New York and Ohio suffered great damage by floods in January, 1886. That was the year in which Montreal had its memorable inundation, in which 100 persons were drowned and $2,500,000 of property was destroyed. The Montreal calamity occurred, however, three months later than the floods in the United States just mentioned, or on April 17 and 18. The most destructive freshets of 1886, though, took place in Texas on August 20, in which many houses in Galveston were blown down by the hurricane which accompanied the flood. The losses in that city and neighborhood by wind and water were thirty-eight lives and $5,000,000 of property.

The spring rise of the Mississippi in 1888 carried the river in some places to a height not touched before in many years. In Illinois the destruction was great, especially at Quincy and Hannibal. The highest point of that year's freshet was reached on May 17. Mexico had heavy rains and a destructive flood a month later than this, in which the loss of life was put at 1,500 by some accounts, and the loss of property at $3,000,000.

On May 31, 1889, the bursting of a reservoir at Conemaugh lake caused a flood at Johnstown, Pa., recalling that at Mill River Valley, Mass., in 1874, though it was far more destructive. The wall of water traversed the eighteen miles between the reservoir and Johnstown in seven minutes. The Pennsylvania railroad bridge at Johnstown held some of the water back and collected a mass of debris, which caught fire and increased the destruction. Revised figures put the loss of life at 2,142 and loss of property at $10,000,000. About $3,000,000 was received from contributions throughout the world and distributed among the sufferers.

MILLIONS IN THE DRIFT.

In March and April, 1890, the Mississippi and several of its tributaries overflowed great stretches of country along their banks. Thousands of square miles of territory were submerged, many towns were isolated, and communication with scores of small settlements were cut off for weeks. Louisiana was the greatest sufferer among the states in that flood. Congress voted a relief fund at that time of $150,000 for the afflicted throughout the Mississippi valley.

From West Virginia in the east to Arizona in the west, there were destructive freshets in February and March, 1891, Ohio, Tennessee and Mississippi being hit hardest of all the states, and Arizona of all the territories. In Arizona 100 lives were lost, $1,000,000 of property was destroyed and 1,500 persons rendered homeless. The losses in the rest of the country were estimated at the time at 400 lives and $10,000,000 of property.

The high-water record of the upper Mississippi valley for a third of a century was broken in 1892. In early April the river and some of its tributaries began to swell beyond the danger point, but the highest mark was not reached until May. Far greater destruction was committed in and around St. Louis than in any other equal area in the valley. At St. Louis the danger point of the Mississippi is thirty feet above low-water mark. In 1892 the river rose six feet higher than that, or thirty-six feet above the mean low-water line. On May 19 this figure was reached. Never since 1844, except in 1851 and 1857, was this height touched, but in those years it was exceeded. The loss of life in the Mississippi valley by the floods of 1892 was estimated at 1,100, and the destruction of property was $12,000,000.

In 1893 Arkansas, Tennessee and Louisiana suffered severely by flood in March and April, and Missouri and Illinois were also visited, but the damage in the last two states was smaller. Each spring since then there have been overflows in the Mississippi, Missouri, Ohio and other rivers in the Mississippi valley, but in none of them was the destruction of life or property anything like as great as it was in 1892, and as it promises to be in 1897.

SOME LATE NEW THINGS.

A new device for use in the sick room consists of a spoon having a dial in the handle, with the hours and half-hours marked on it and an arrow revolved by a knob, to indicate the time for each dose of medicine.

Among the many new devices to assist the blind one of the best is a typewriter in which the keys have raised letters and which punctures the paper with either letters or the dots contained in one of the blind alphabets.

For the purpose of preventing scarfpins from coming out a handy new device is composed of a small piece of wire coiled into a spring and attached by a chain or cord to the tie, the pin being pressed into the end of the coil.

A recently patented safety check for banks has coupons attached to the upper edge and each end, representing tens, hundreds and thousands of dollars, the larger coupons being detached until the right amount is reached when it is desired to use the check.

One of the most handy wrappers for use in doing up newspapers and the like has a plurality of slots placed in a straight line across the outside thickness of the paper, so that when it is grasped in both hands and given a slight twist crosswise it breaks along this line.

For the prevention of stealing liquids from barrels by attendants in a store a new faucet has an automatic measuring, registering and recording device which will show the amount drawn from a barrel, the mechanism being locked in a metal case to prevent tampering with it.

Barbed wire for fences is made cheaper by a new process in which the barbs are stamped out of the center of a flat strip of metal as it runs through the machine, the barbs being so formed that when the ends of two wires are brought together the barbs interlock to form a joint.

A recently designed trolley-line repair wagon has a folding frame work to which the platform is hinged, the front and back portions of the standard being drawn together by a screw to raise or lower the platform as desired, the whole resting on an auxiliary truck when not in use.

Crutches which can be arranged for either summer or winter use have a rod running down through the center of the lower end of the crutch which can be projected below the rubber point whenever the ground becomes slippery and withdrawn when it is desired to use the rubber tip.

To prevent the spraying of water as it is discharged from a spigot a guard with a reduced lower end is fitted over the end of the spigot, the upper end having rubber washers to prevent leakage and the interior containing two wire gauze diaphragms through which the water runs.

Dr. Isaiah R. Sexton of Sparta, Kent county, Mich., is one of the thirty-three survivors of the war of 1812.