Munsey's Magazine
October, 1899

The Modern Skyscraper

"A STEEL bridge standing on end with passenger cars running up and down within it."

This is the engaging definition of a "skyscraper" given me by an architect who is as famous for his quaint conceits of speech as he is for his tall buildings.

It seems odd to speak of any building as a new invention, since there have been buildings almost as long as there have been men; and yet the very fact—and curious enough it is when you come to think of it—that the skyscraper is truly more a bridge than a building, and that cars do actually run on perpendicular tracks within it, makes it not only one of the latest feats of the inventor, but one of the very greatest. For thousands of years every large building in the world was constructed with enormous walls of masonry to hold up the inner framework of floors and partitions. It was a substantial and worthy method of construction, and there seemed no need of changing it. But one day a daring builder with an idea astonished the world by reversing this order of construction, and building an inner framework strong enough to hold up the outside walls of masonry. The invention was instantly successful, so that today the construction of a tall building is "not architecture," as one writer observes, "but engineering with a stone veneer."

Ten years ago, in 1889, there was not a steel frame building in the world; today there are scores of them in American cities, the heights varying from seven stories up to thirty, making them by all odds the greatest structures reared by the hand of man. The idea of constructing a building like a bridge is said to have originated in Chicago; it has, indeed, been called the "Chicago construction." Some of the earliest buildings embodying the steel cage idea were the Tacoma Building of Chicago and the Tower Building of New York, both completed in 1889.

Nearly all of the earlier skyscrapers were constructed in spite of opposition and prophecies of failure from scores of experienced builders, often including the building commissioners who issued the permits.

Every invention has its reason for being. Unless it is needed, it does not appear. So with the skyscraper. Great cities had grown with a rapidity unknown anywhere in the world; business centers were much overcrowded; progressive professional men wished to be within easy reach of the districts where money was making fastest. Property owners said: "We can't spread out, so we must go up." In New York single acres are worth more than $7,000,000. Land of this value covered with buildings of ordinary height could not be made to pay; again the conclusion was resistless: "We must go up." Moreover, engineering and the various processes of steel construction had been advancing at great strides, steel was comparatively cheap, and a light skeleton framework cost less in the beginning and required less room than immense masonry walls. And lastly, and by no means of least importance, the modern elevator had been invented. I remember talking one day with a grizzle headed elevator man in what is now an old skyscraper. He had evidently done some quiet thinking as he traveled up and down, year after year, on his perpendicular railroad.

"Did you ever think," he asked, "that skyscrapers would be an impossibility without elevators? It's a fact. Nothing above seven or eight stories without 'em. You'd never catch any business man climbing eight flights to his office."

And yet if the elevator has made the skyscraper a possibility, the skyscraper has in no less degree developed the elevator; both have gone up together, and both would seem to have approached very near to perfection.

The building of a modern skyscraper is a mighty task, full of difficult problems, more difficult even than those connected with a great steamship, a great bridge, or even a railroad line. Knowing how far the building is going up, the architect must determine from the character of the ground on which it is to stand how far it must go down. In New York

many of the greatest buildings have foundations so deep that they rest on the solid rock, seventy-five feet below the surface, and there are two or three stories beneath the street, as well as twenty or thirty above. In Chicago all of the great buildings rest on what may reasonably be called flatboats. Indeed, Chicago is a floating city—floating on a bed of soft sand and mud. These boats are made of great timbers, driven straight down, or else of steel rails or steel girders laid crisscross and filled in with cement until they form a huge, solid slab of iron and stone. And as might be expected, these boats frequently tip a little to one side, so that many of the greatest skyscrapers are slightly out of plumb, like modern towers of Pisa, although they do not lean enough to be at all dangerous.

I remember distinctly how a keen eyed newspaper man made the discovery that one of the most famous skyscrapers in the world—and one of the largest —was out of plumb. He was in the sixteenth story of the building across the street. The doctor who occupied the room had tied a weight to a window cord in order to keep the shade well down, thus making it a plumb bob. It so happened that the newspaper man glanced along this cord and across the street to the corner of the great building opposite. At first he couldn't believe his eyes; the cord was certainly plumb, or else all the school books were incorrect; therefore the building must certainly be leaning to one side. He called several friends, and each of them bore him out in his observation. He rushed off in great feather, secured an engineer, and had careful measurements taken. The building was found to lean nine inches to the eastward at the top, and there was a news "beat" in one of the newspapers the next morning.

All great buildings are expected to settle, and the main effort is to make this settlement uniform throughout. In New York the tall buildings which rest on a foundation of fine wet sand have all settled from one quarter to nine sixteenths of an inch. The Marquette Building, Chicago and the St. Paul Building, New York, have provisions made at the bases of their columns for lifting them up with powerful hydraulic presses and inserting a packing of steel should they settle too much.

And this it will be seen how difficult and delicate a problem the builder must meet in securing a solid foundation for the end of his bridge which goes into the ground. He must know not only just how much the entire building will weigh, almost to the ton, but he must know the weight of each part of it, so that the load may be equally distributed over the foundation, thereby preventing any tendency to tip over. He must also computs the "live" weight which hid building is expected to carry—that is, the furniture, the safes, the tenants themselves. And in Chicago, where the foundation is clay, he must not put a weight of more than one and one half to two tons on every square foot of surface; the moist sand and rock of New York will bear more.

Moreover, he must determine exactly how much straight each steel girder, each column, even each rivet, will bear. If he overloads any single girder, he endangers his whole building. Then he must calculate how much wind is going to blow against his building, and from what direction most of it is coming; he must even calculate on the pounding of horses' hoofs and heavy wagons on the street outside; he must make provisions for supplying water to the top stories, where the city cannot pump it; he must provide amply against possible fires—and that is one of the most difficult of all the problems; he must see to the prevention of rust in his steel work; he must secure proper ventilation and lighting, so that every room has its windows with a street front, if possible; and, more difficult than all else, he must keep within the hampering limits of the city's building laws. These are only a few of thousands of intricate details, not to consider the tremendous question of cost, with which the builder must grapple. And then it sometimes happens that he is blamed if he does not make this tower of steel, with its hundreds of rectangular windows, a thing of architectural grace and beauty.

Perhaps it will be possible to give the best idea of what a modern skyscraper really is, when completed, by relating some of the important facts concerning what is now the greatest modern building –indeed, the tallest inhabited building in the world—the Park Row Building in

New York City. It was designed by R.H. Robertson, and it stands as one of the greatest monuments to the daring and enterprise of the American builder. It can be seen from far out in New Jersey, from Staten Island, from Long Island, and the lookout of every ship that enters the harbor sees it looking like a huge tower above its neighbors.

To begin with, it has twenty-nine stories, and in height, from the bottom of the foundation, fifty-four feet below the street, to the top of its flag poles, the new building spans 501 feet, or nearly one tenth of a mile—exceeding by fifty feet the extreme height of the Great Pyramid.

It need not be said that a vast amount of steel and stone, glass and other material, enters into the construction of such a building. As a matter of fact, the building weighs about 20,000 tons. Several acres of timber land were denuded to furnish the 1,200 great pine piles, some of them 40 feet long, which were driven into the sand of the site. These piles are in rows, two feet apart, under the vertical columns which support the building. They were driven into the ground as far as they would go under the blows of a one ton hammer. They are thus prepared to sustain a weight of 20 tons, although the most that will be put upon them is about 15 tons, a margin great enough to give any builder a sense of safety. Moreover, they are below the water line, so that they are indestructible by the ordinary process of decay.

When the piles were driven as far as possible, their tops were cut off, the sand was cleared away for a foot drawn around their upper ends, and concrete was poured about them, forming a solid rock surface resting securely upon the piles. On this concrete base were laid large blocks of granite, and above them the brick piers of the building.

The weight of the building is not allowed to come directly upon the granite capstones which surmount these piers. Instead, it is distributed by the system of steel girders, some of them eight feet in depth and forty seven feet long. These are in effect big bridges placed between the foundations and the footings of the vertical columns to distribute the weight evenly. The heaviest girder in the building, which lies deep beneath one of the walls, weighs more than fifty tons.

Above the surface the building is a mere steel framework—a big steel box—built like a cantilever bridge. The walls **are comparatively light, being hardly more than thin sheeting for the skeleton, and, curiously enough, the stonework of the second and some of the higher stories was constructed before the wall foundations were laid, being entirely supported by the steel framework.**

As I said before, the dead weight of the building itself is about 20,000 tons. But with the addition of the maximum load which the twenty nine floors are calculated to carry, the total weight of the structure will amount to about 61,400 tons.

There are 950 rooms in the building. Counting four persons to each office, this will make the permanent population of the building nearly 4,000, or equal to that of many a flourishing county seat. To this must be added a large transient population amounting probably to one person for each resident at any given time during business hours. This would make an ordinary population, resident and floating, of 8,000 for thus one building. If twenty persons visit each office during the day, there would be 27,000 persons using the building every day. The various elevators have a daily passenger traffic of 60,000, or more than that of many a railway line.

The cost of the building was $2,400,000, but it will collect more in revenues every year than many a populous county. If a building as high and as large could have been constructed by the old solid masonry process, it would have cost fourteen times as much, and the walls would have been so thick at the base that there would have been no room for offices and stores.

The time may come, and come soon, when buildings higher even than this one may be built. There is nothing in the engineering problem to prevent the construction of a fifty story building, but such a sight will probably never vex the eye of man. Already various American cities are passing laws limiting the height of buildings. Moreover, many property owners feel that time should be given to ascertain how the skyscraper will endure--whether the steel will weaken with

rust, whether the foundations will hold true, whether the fireproofing is efficient. Most skyscrapers are only a few years old; but examinations of steel columns erected ten years ago and housed in cement, and of foundation beams lying below the water line, have shown that not even the blue black scale from the rolling mill finish has turned color. Wherever it is possible, these steel frames are buried in cement, in itself a rust proofing, and under such conditions the steel constructed building promises to stand as long as the building itself shall be satisfactory to its owner and its tenants.

A great office building is really a city under one roof. It has its own electric lighting plant and sometimes a gas plant in addition; it has its own water works system, with a big stand pipe at the top to supply the upper floors, and sometimes an artesian well underneath; it has its own well drilled fire department, with fire plugs on every floor, and hose lines and chemical extinguishers; it has its own police department, for every great building is now supplied with regular detectives who watch for petty thieves and pickpockets, and prevent peddlers and beggars from entering their domain. It is even governed like a city; for the superintendent is the mayor, and he has a large force of workmen always busy cleaning the streets and stairways of the big structure.

In its elevators it has a complete system of electric railroads, and a very wonderful and intricate system it is, too, with automatic arrangements for opening and shutting doors, for indicating exactly where the car is in its ascent and descent, and for preventing accidents from falling. And there is in many of the greatest buildings a complete express service of cars, some cars not stopping below the tenth or some other skyward floor. A number of buildings there are that have their own telephone system as well as connections throughout with city lines, their pneumatic tube parcel and message delivery systems, and at least one has a network of pipes conveying compressed air for power, while every great skyscraper is provided with one or more telegraph, cable, and district messenger offices, so that a tenant sitting at his desk can send a message almost anywhere on earth by merely pushing a button call for a messenger. In the modern mail chute—a long glass and iron tube through which a tenant on any floor may drop a letter to the big box in the basement—the skyscraper has its own mail system. A young Englishman, a friend of mine, who was on his first visit to New York, stood for half an hour watching the letters flit downward through one of these glass tubes.

"That is the most wonderful thing I've seen in America," he said; "that, and the little tube with red oil in it which tells when the lift is coming."

Many of the modern buildings now have a bathroom on every floor, a regular barber shop, a restaurant on the roof, a stand where the latest newspapers and magazines, cigars and candies may be obtained, with frequently a library to which a tenant may go when looking up references or to while away an idle half hour. In the basement there is frequently a safety deposit vault and a place for storing bicycles; on the first floor, a bank where a business man may keep his money; and somewhere up at the top, not so frequently, a social club. And of late some of the great buildings have actually been provided with bedrooms and bachelor apartments, so that a tenant may sleep near his offices if he is busy. Indeed, a man might live in a modern skyscraper year in and year out, luxuriously, too, with every want richly supplied, and never pass beyond the revolving storm doors at the street entrance.

As to the future of the skyscraper no one knows definitely, but all the architects prophesy greater beauty. They are learning how to treat these great slim towers so that the effect is pleasing to the eye. In times past the necessity of a facade from 250 to 350 feet high has often resulted in the bold, staring resemblance to a chimney. But the architect is learning to relieve this tendency by treating the stories in groups of four or five. This lessens the effect of extreme height. At the same time the width is made to seem greater than it really is by the addition of cornices and projecting balconies.