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Modern Skyscrapers in the Late 19th Century

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Abstract

Skyscrapers are often seen as a typically American phenomenon. This paper aims at demonstrating that in terms oif technology major developments are European and that, albeit in lesser number and not as high as in the USA, skyscrapers were also built in the late 19th century in countrries other than the USA. The paper concludes with an overview of late 19th century non-US skyscrapers.

Keywords: Skyscrapers, 19th century, Elevators; Canada, United Kingdom, The Netherlands

1. Introduction

In the last decades of the nineteenth century a new phenomenon caught the world's attention: the skyscrapers of New York, Chicago and other American cities. The skyscraper was introduced as an American invention, as a symbol of the modern times that had started in United States in America. American other authors were quite happy to underline the Americanness of the skyscraper. W.A. Starrett's book Skyscrapers and the men who build them (1928) did so with more than a touch of chauvinism.

The skyscraper is the most distinctively American thing in the world. It is all American and all ours in its conception"

Col. W.A. Starrett: Skyscrapers and the men who build them (1928)

Non-American authors too stressed the American origin of the skyscraper. The Peruvian-born architect Francisco Mujica was one of them in his book "History of the Skyscraper" (1929) he identified several American architects who, in his view, had been instrumental in the invention of the skyscraper and concluded that the honor which falls to all of them together as inventors and initiators of the steel skeleton skyscraper, belongs to the United States of America.

Even now, at a point in time when Asia builds more and higher skyscrapers than any other region of the world, including the United States, most skyscraper-books still emphasize the Americanness of the skyscraper.

Notwithstanding the general view in the early twentieth century that skyscrapers were an exclusively American invention, there were some authors with differing views. The German engineer Karl Fritz Stöhr was one of them. From 1912-1914 he lived and worked in Chicago; one of the companies he had been attached to was the architectural firm D.H. Burnham and Co. The start of World War I forced him to return to Germany; the war also delayed the publication of the book he wrote about his experiences in the building industry of Chicago: "Amerikanische Turmbauten" (American tower buildings, 1921). His book radiates a sincere admiration for the American spirit of enterprise and willingness to develop new approaches and technologies. He nevertheless reached the conclusion that not all that was new was American, that the skyscraper was not an exclusive American invention. In his view European innovations had also been essential for its development.

"America has understood how to appropriate the important European inventions, to further develop them, and to adapt them to the American context that is different from European circumstances. In addition it has offered high payments to some of the best engineers, technicians and craftsmen from Europe, and especially from Germany, and has allowed them to come to the United States where they were given full freedom to further develop their ideas."

Karl-Fritz Stöhr: Amerikanische Turmbauten (1921)

Stöhr's observations raise several questions. Which European inventions had been important for the development of skyscrapers? Is the skyscraper really as American as we have been made to believe? And, last but not least, was the USA the only country where skyscrapers were built in the last decades of the 19th century?

This article will focus on two of these issues:

-non-American inventions that have been essential for the development of the modern skyscraper, and

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-countries other than the USA where skyscrapers have been built in the last decades of the 19th century.

Before doing that, it is necessary to dwell a little on the definition of skyscrapers.

2. Skyscrapers?

A definition of a "skyscraper" should, of course, be based on the shared characteristics of those buildings that inspired the use of the word "skyscraper" for those buildings. A definition should also reflect the notion that it stems from the perception of exceptional height, that it stems from seeing buildings that were considerably higher than most others, buildings with a height that was an exception to "normal" heights.

The early 1880s (or possibly even the late 1870s) mark the first time the word 'skyscraper' was used for exceptionally high buildings. Several newspaper articles from 1883 bear witness to that.

The Chicago Daily of February 25, 1883 was one of them. It was not about Chicago's skyscrapers but about those in New York. The article was called "New York Gossip", the heading of the relevant paragraph was "Our Skyscrapers". It mentioned "a twelve-story building at Madison avenue and Fifty-third street", "another twelve-story pile of flats on the West Side" and "twenty or thirty piles of eight-story flats". In addition to that, several New York skyscrapers were listed by name.

In an article titled "High towers and Buildings" the Real Estate and Building Journal of August 2, 1884, wrote about Chicago that "(…) veritable skyscrapers have been springing up here during the past couple of years almost with mushroom rapidity". And in this article too, several of those skyscrapers were listed by name.

These buildings share three important features that everyone could see: they are exceptionally high, they have many floors where people work (mostly in offices) or live (the multi-story flats). These features should be part of a definition of skyscrapers.

There is also an important difference. Most of these skyscrapers are "tall", i.e. slender. But some are "big" with, compared to their height, a relatively large frontage. Hence, the shape of a skyscraper should not be part of a definition of skyscrapers.

This then leads to the following definition.

"A skyscraper is an exceptionally high building with many floors that can be used to work, live or stay"

This definition still leaves open two questions: how high is "exceptionally high" and "how many" is many floors?

2.1. Exceptionally High? - Many Floors?

Looking at the skyscrapers featured in the Chicago Daily of February 25, 1883, and in the Real Estate and Building Journal of August 2, 1884, a height of 35 meters appears to be the minimum fort hat time. The minimum number of floors would then be 8.

3. Skyscrapers – before 1870

The fact that, in Chicago and New York, exceptionally high buildings constructed in the late 1870's and early 1880's were the first to be called "skyscraper" does not necessarely mean that these were the first buildings to fall with the definition of a "skyscraper". In fact, several such buildings had already been built in the centuries before

Table 1. Skyscrapers in New York, listed by name in the Chicago Daily of February 25, 1883

	Completed In	Demolished In	Height	
			Meter	Floors
Equitable Building	1870	1912	43	8
Western Union Building	1875	1914	70	10
Tribune Building	1875	1966	79	10
Boreel Building	1879	1905	n.i.	8
Mills Building	1883	1926	47	10
Temple Court	1883	-	45	10

n.i. = no information available to the author

Table 2. Skyscrapers in Chicago, listed by name in the Real Estate and Building Journal of August 2, 1884

	Completed In	Demolished In	Height	
			Meter	Floors
Montauk Block	1882	1902	39	10
Calumet Block	1883	1913	n.i.	9
Royal Insurance Building	1884	1920	n.i.	13
Counselman Building	1884	1920	44	9
Pullman Building	1884	1958	49	10
Home Fire Insurance Building	1885	1931	44	10
Marshall Field Building	1886	1930	39	7

n.i. = no information available to the author

that. None of them were called "skyscraper" in their time. Now, with hindsight, some are.

3.1. Early Residential Skyscrapers

The very first skyscraper may well have been "Insula Felicula" in Rome. This residential building was first mentioned in the 2nd or 3rd century by the Roman author Tertulian who suggested it had 12 floors. The 4th century produced two lists of important buildings in Rome. These lists both mention this building as well, indicating that it truly must have been a remarkable building. Whether it really existed is uncertain. There are no archeological finds to confirm its existence.

Other early residential skyscrapers, 12-14 stories high, were built in Cuenca (Spain) in the late middle ages, and in Edinburgh (United Kingdom) in the 17th and 18th century. These skyscrapers benefitted from the fact that they were built against a slope, allowing for an additional entrance from the street at about half the height of the building.

Other residential skyscrapers were built in Shibam (Yemen), the first of these most likely built before 1870. The first European traveler to write about these skyscrapers was Hans Helfritz from Germany in the early 1930s. His book about his travels in Yemen was called 'Chicago der Wüste' ('Chicago of the Desert'). He was clearly impressed: "None of the cities [in Yemen] makes such an outspoken impression of a skyscraper city as the great city of Shibam. (…) one sees from a distance of many miles how this skyscraper city with its twelve storied houses rises from the plain".

3.2. Castles and Palaces

From the Middle Ages and onward several castles and palaces have been built in Europe and Asia that, in part or completely, comply with the definition of "skyscraper".

The first of these may well have been Ghamdan Palace in Sana'a (Yemen) that was built even before the Middle Ages, in the 3rd century. There are different accounts as to its height, most of these accounts made it high enough to be a "skyscraper". It was destroyed in the 7th century.

Medieval castles in Europe developed from so-called donjons or castle keeps; high towers with several floors. Some of them were higher than 35 meter, some of them had 8 floors or more. The Tour de Crest (France) is 52 meter high and one of the tallest in Europe, but it is difficult to assess the number of floors it has. The Hermann Tower of Narva Castle (Estonia) is 51 meter high and appears to have 8 or 9 floors.

In the 16th and 17th century, several castles were built in Japan. Of these, Osaka Castle is the highest: it has 8 floors.

A giant among the castles and palaces is the Potala Palace in Lhasa (Tibet, China) with 13 floors, completed at the end of the 17th century.

3.3. Observatories

Last but not least among the early skyscrapers is the Mathematische Turm in Kremsmünster (Austria), an astronomical observatory. Completed in 1758, 49 meters high and with 8 floors. It was and is a building for science and, at that time, a product of the age of enlightenment, an age that provided the scientific cornerstone for the industrial revolution.

4. Modern Skyscrapers – 1870 and Beyond

The first skyscraper that truly benefitted from the fruits of the industrial age was built in New York in 1870: the "Equitable Life Assurance Society Building" in New York. Winston Weisman "crowned" this building as the world's first skyscraper, being "the first business building in which the possibilities of the elevator were realized". However, it was not the world's first skyscraper; it was the world's first modern skyscraper.

4.1. Elevators

The elevator, or better, the safe passenger elevator is the key to the development and success of the modern skyscraper. It changed the economy of high buildings. In times when stairs were the only way up, the top floors yielded limited financial gain (if any). Elevators made it easy to comfortably reach those top floors making them increasingly attractive. Elevators turned additional height and floors into the promise of a handsome return on investment. Height followed finance. Therefore the safe passenger elevator was the main catalyst for the construction of ever more and ever higher buildings, of skyscrapers. Or, as Montgomery Schuyler wrote in 1909: "(…) it is certain that the earliest and most indispensable of the factors which have enabled the construction of these mighty monsters was 'the passenger elevator'".

Nobody knows who invented the elevator or where it was invented, but the elevator has a long history. In Roman times, the Collosseum had elevators to bring people, animals or scenery from the underground levels into the arena. The industrial revolution brought machines to replace animals or men to take the elevators to higher levels. These elevators had one serious problem: safety. And then, an American engineer, Elisha Graves Otis, invented a "safety hoist" that prevented elevators falling down if and when its hoisting cable failed. With Otis' invention the safe passenger elevator became reality. Stairs and unsafe passenger elevators were no longer an obstacle in reaching ever higher floors in ever higher buildings, thus making the construction of skyscrapers an attractive option.

Otis' invention was not enough to make the elevator the backbone of skyscrapers. Solutions needed to be found to further increase safety, to allow for these ever greater heights and to increase the speed of elevators. Two major innovations (partly) solving those issues came

from Germany.

In 1877 Friedrich Koepe, a mining engineer, developed an alternative for winding cables onto large drums. He introduced a friction driven hoist: a large wheel with a dove-tailed groove in which the hoisting cable was laid. This friction driven hoist subtantially reduced the risk of cable breakage and allowed for greater heights. His first friction driven elevator was developed for a mine shaft of 234 meters deep.

One year later, in 1878, the German inventor and industrialist, Werner von Siemens, designed, built and presented the first electric elevator. This invention opened the door for high-speed elevators and reduction of time spent in cramped elevator-spaces. And this too was a catalyst for the construction of increasingly high skyscrapers

4.2. Construction

Whereas the opportunities offered by elevators fueled the ambition to build ever higher skyscrapers, new construction methods were needed to make that possible. Many of these inventions and the knowledge how to use them came from Europe before they were further developed in the USA.

Some of the first modern skyscrapers were still built with load bearing stone walls, but the limitations of these stone walls were apparent. The development of skyscrapers towards higher realms required a frame construction and building materials other than stone.

4.2.1. Iron frame

The "Ditherington Flax Mill" in Shrewsbury, England, is considered to be the first building using structural iron and a pioneer in the development of fully-framed, multi-storeyed buildings. It was completed in 1797 and has 5 storeys. Whilst it is not a skyscraper, it is refered to as the "grandfather of all skyscrapers". In England that is.

France may not be the birthplace of the iron frame, it certainly appears to be its nursery. In Eugène Emmanuel Viollet Le Duc it had an influential architect with strong ideas about the use of iron and iron structures in architecture. He was also responsible for the first design of the iron structure for the statue of Liberty but he died before that statue was completed.

Gustave Eiffel completed Viollet Le Duc's design for the iron structure of the Statue of Liberty. The statue, including its internal iron construction, was completed and assembled in Paris between 1881 and 1884. It subsequently disassembled, put in crates and shipped to the USA where it was finished in 1886. Eiffel's iron structure for the Statue of Liberty can be seen as a precursor of the iron frame used for America's skyscrapers.

The first design for a real iron-framed skyscraper also stems from France. In 1865 and 1867, Henri-Jules Borie presented proposals for the construction of several so called "Aérodomes", 10 storey apartment buildings with a height of 40 meters. They were never built.

4.2.2. Steel frame

The properties of cast iron as well as the cost of wrought iron put limitations on the use of iron frames for the construction of skyscrapers. In the last decades of the 19th century, however, steel replaced iron, steel frames succeeded iron frames.

A major innovation that allowed steel to replace iron was the mass-production of steel, made possible by the so-called "Bessemer process", patented in 1856 by the English engineer and inventor Henri Bessemer.

The properties of steel were, with respect to the construction of skyscrapers, a substantial improvement, to those of cast and wrought iron. Lower costs were, thanks to its mass-production, one of these improvements.

The first steel-framed skyscraper was Chicago's Rand McNally Building with 10 storeys It was completed in 1889. "Rand, Mc Nally & Co's Bird's Eye Views and Guide of Chicago", a guidebook to Chicago published in 1893, provides the following lines about this building: "The steel cage, which is really the building" and "This steel building, the first that ever stood free of brick walls".

5. American?

Both the world's first skyscraper with a safe passenger elevator and the first steel-framed skyscraper were built in America. Neither of them, however, could have been built without technological innovations originating in Europa. It is, as Karl Fritz Stöhr wrote in 1921: "America has understood how to appropriate the important European inventions, to further develop them, and to adapt them to the American context".

Out of three major innovations with respect to safe passenger elevators, one was American, two were German. The iron-framed building originated from England and France. Steel was an English invention.

Stöhr also noted that the USA "has offered high payments to some of the best engineers, technicians and craftsmen from Europe, and especially from Germany, and has allowed them to come to the United States where they were given full freedom to further develop their ideas." There is more to that notion. Many American architects of early skyscrapers were educated in France and brought knowledge and ideas from France to the USA. Among them William LeBaron Jenney and Louis Sullivan.

6. Diaspora

6.1. Modern skyscrapers in the late 19th century

There is a good reason why most books about skyscrapers, especially those skyscrapers built in the late 19th and early 20th century, are dominated by skyscrapers from the USA. In those times the highest and most

Table 3. Cities in the USA with modern skyscrapers

As at 31 December	
1879	4
1889	11
1899	34

skyscrapers were built there. By the end of the 19th century, sky scrapers had been built in 34 US-cities.

But that is not to say that there were no skyscrapers in countries other than the USA. At 31 December 1899 there were at least 8 cities in the world outside the USA with modern skyscrapers.

6.2. London, United Kingdom

London's first skyscraper was the "Midland Grand Hotel", part of the buildings of St. Pancras Station. It is situated above and on both sides of the main gateway to the railway tracks of that station. It had hydraulic passenger elevators (ascending chambers). No one ever called this building a 'skyscraper' most likely because the word 'tower' sufficed as it did for the Houses of Parliament's Victoria Tower. The Midland Grand Hotel nevertheless completely falls within the definition of a modern skyscraper.

Given its height of 98.5 meter and its 8 storeys, the Victoria Tower (completed in 1860 as part of the Houses of Parliament) was London's first skyscraper. Whilst the tower itself has load bearing stone walls, its floors and archives are supported by an iron frame within these walls. But, it had no passenger elevator. Hence it was no modern skyscraper.



Figure 1. Midland Grand Hotel (1876), ±65 meter, 8 storeys.



Figure 2. Queen Anne's Mansions. (1879, demolished in 1973), 47 meters Drawing by Joseph Pennell, as published in Henry James' English Hours. (1905)

London's second modern skyscraper was "Queen Anne's Mansions", a big apartment building in Westminster, halfway between Buckingham Palace and the Houses of Parliament. Due to its height, 47 meters, it stood at the centre of debate at the highest levels as related by S.E. Mangeot in the Architect & Building News: "Gazing across St. James's Park from Buckingham Palace, Queen Victoria was one day confronted by a building which eclipsed the royal view of the Houses of Parliament. With customary firmness she sent there and then for her Minister and insisted upon the inclusion in the new Building Act of a clause to limit the height of metropolitan buildings". The new Building Act, with a 80 ft elevation clause was passed in 1894.

Queen Anne's Mansions was built at intervals from 1873-1889 by Henry Alers Hankey, acting as his own architect and building contracter. Its highest part was completed in 1879. Real architects did not welcome this effort from a non-architect and also entered the debate. An article in "The Builder" in 1888 described it as "the loftiest and ugliest of any similar structures in the metropolis". Others noted that the building had "not a seintilla of architectural character and not a trace of artistic merit". The building nevertheless appears to have been a success with its occupants. The composer Edgar Elgar and the explorer Ernest Shackleton were among

them.

Queen Anne's Mansions was not the last skyscraper built in London before 1900. The present "Mandarin Oriental Hyde Park Hotel", originally called "Hyde Park Court" with a height of 42 meters was one of those.

6.3. Montreal, Canada

Canada's first modern skyscraper, the "New York Life Insurance Building" (completed in 1888) can also be seen as the first US-skyscraper in Canada. It was built for a company from New York by architects Babb, Cook and Willard, also from New York. It has load bearing walls in stone combined with iron columns, beams and girders.



Figure 3. New York Life Insurance Building (1888), ±45 meters, 10 storeys.

6.4. Melbourne, Australia

In a book about Melbourne's history, Miles Lewis describes how the discovery of gold in the 1850's "catapulted [Melbourne] to city status". In the 1880's Melbourne had developed into a city where the price of land provided, in his words, a '(un)healthy' incentive for the construction of skyscrapers. Several skyscrapers were completed in 1888. Lewis provides some words for one



Figure 4. Australian Building (1888, demolished in 1980), 53 meters.

of them: "The tallest was the Australian Building in Elizabeth Street [demolished in 1980], and it was stylistically far closer to the London works of Norman Shaw than to the innovative treatment of Chicago skyscrapers like the Reliance Building. Moreover, whilst the idea of building so high was an American one, the technology which made it possible was still largely British. American Otis elevators competed with British Waygood lifts, and it was the latter which served the Australian Building". In 1900 Melbourne had close to 20 skyscrapers.

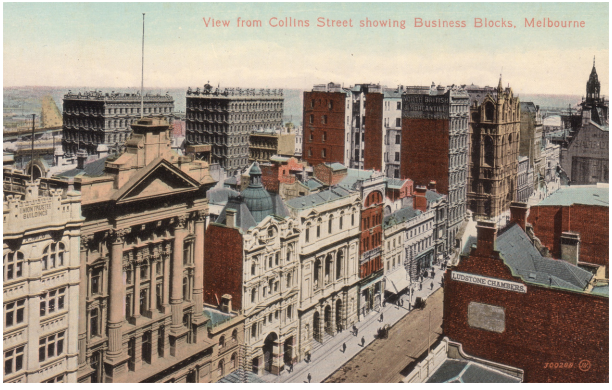


Figure 5. Prell's Buildings at Queen Street (1889, redeveloped or demolished in 1929, 1965 and 1967), 42, 41 and 41 meters.



Figure 6. Federal Palace Hotel (1890, demolished in 1972), 50 meters.

"The Melbourne Guide Book, third edition", published around 1902, provides the following description: "Among all the conspicuous buildings in this part of Collins Street non is more substantial than the Federal Palace Hotel, with its six stories of massive yet highly ornamental design. It was one of the outcomes of speculative excitement (..)".

6.5. Tokyo, Japan

Ryōunkaku (a word that translates into 'cloud-surpassing tower') was a twelve storey brick tower (skyscraper) in Asakusa, at that time an important entertainment district of Tokyo. It had the first passenger elevators in Japan. Its floors housed shops, space for exhibitions and, on the top floor, an observation deck.

Several authors and poets wrote about Ryōunkaku. On page 71 of his book "Low City High City", Edward Seidensticker quotes Mantarō Kubota, who had lived in Asakusa. He gave the following words to his memories: "In days of old, a queer object known as the Twelve Storeys reared itself over Asakusa. From wherever you looked, there it was, that huge, clumsy pile of red bricks. From the roof of every house, from the laundry platform, from the narrowest second-floor window, there it was, waiting for you. From anywhere in the vastness of Tokyo - the embankment across the river at Mukōjima, the observation ris at Ueno, the long flight of stone steps up Atago Hill, there it was, wainting for you, whenever you wanted it".

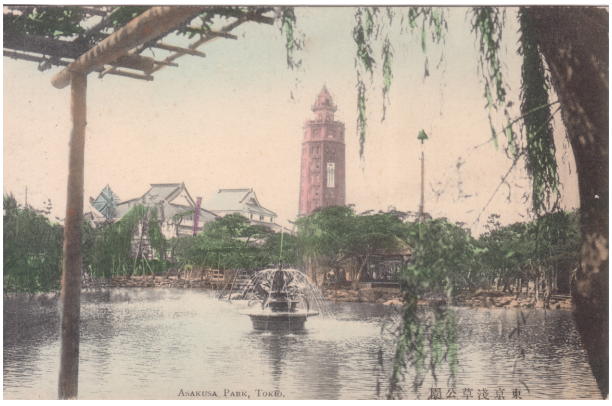


Figure 7. Rÿounkaku (1890, demolished in 1923), 68 meters.

It was the first and only skyscraper built in Tokyo before 1900. The Kanto earthquake in 1923 spelled the end for Rÿounkaku.

6.6. Sydney, Australia

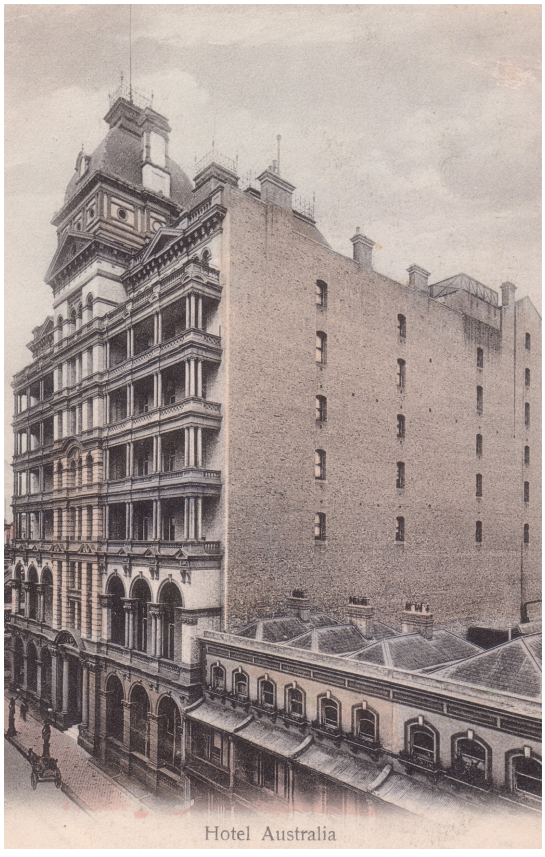


Figure 8. Hotel Australia (1891, demolished in 1972), 44 meters.

6.7. Hamilton, Canada



Figure 9. Bank of Hamilton (1892, demolished in 1985), 10 storeys.

6.8. Toronto, Canada

Toronto's first skyscraper was the "Temple Building" completed in 1896. At that time it had 9 storeys; a tenth storey was added in 1901.

6.9. Rotterdam, the Netherlands

Continental Europe's first modern skyscraper was, when it was completed, considered as "so American", not just because of its height and style, but also because it housed the Netherlands' first modern office, modeled after American offices.



Figure 10. Temple Building (1896, topped up 1901, demolished in 1970), 40 meters.



Figure 11. Witte Huis (1898), 42 meters, 11 storeys.

Illustrations

All illustrations are form the author's collection

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