

will not pass through air, although they will through fluorite and partly through quartz. It produces small ions of both signs, neutral centers, large ions, and ozone. It is extremely sensitive to minute traces of impurities in the gas, traces which cannot be detected by other means. It can be distinguished from the Hertz effect and become very much greater. All these conclusions are drawn from the researches of Hughes,⁷⁶ Canegietter,⁷⁷ Lenard and Ramsauer,⁷⁸ and Leon and Eugene Bloch.⁷⁹ The latter have shown also that the radiation transmitted by quartz and coming from a mercury arc ionizes the air feebly in the neighborhood of the arc and seems consequently to emit a small amount of Schumann rays. In place of the usual source of Schumann rays, a hydrogen tube furnished with quartz windows, Lenard and Ramsauer used a very powerful spark between electrodes of aluminium. Then the ionization takes place even through air and quartz and the experimenters attribute it to rays of wavelength less than 0.1 μ , the smallest ultra-violet rays known, and which were discovered by Lyman. As no measure of these wave-lengths was made, it seems as probable that the effect is due to ordinary Schumann rays which have been partially transmitted by media generally opaque to them because of the great original intensity of the light. This question remains to be studied as well as the Lenard effect in general, the knowledge of which is yet very limited despite the great number of interesting problems connected with it.

The Problem of the High Building

By Prof. Charles Peck Warren, Assistant Professor of Architecture, Columbia University

THE question is frequently asked, Will America ever develop a style of architecture? Probably the nearest we have come to it is in the erection of the skyscraper—the most striking and characteristic feature of American architecture—although this is but a step in the development.

The demand for the skyscraper is an outcome of conditions peculiar to New York, although Chicago claims the honor of having erected the first steel skeleton building. Manhattan Island is so narrow and its trade center is so near one end that the rapid increase in trade since 1870 has necessarily been confined in a limited area, and in consequence the land there has advanced rapidly in value.

The first direct result of the menace in the height of buildings was the invention of passenger elevators for commercial buildings, for it was soon discovered that tenants would not mount stairs above four, or, at the most, five stories. Elevators were employed for the first time in the Fifth Avenue Hotel in 1856, and later on, in 1868, in the old Equitable Building, destroyed by fire in 1911. The gradual development and improvement in high speed made vertical travel easy and comfortable, and the erection of six, then seven, eight, and finally nine-story buildings became possible. So that the problem of making downtown real estate investments profitable was thus temporarily solved.

As years went on, however, even nine-story buildings in which the cheapest offices rented for \$2 per square foot of floor space ceased to yield sufficient revenue, owing to the constant rise in real estate values, so that the height of buildings had to be raised to ten and twelve stories. It was soon discovered that these tall buildings, constructed as they were of combustible materials in the floors, stairs, and elevator wells, could not be controlled in case of fire, so the Building Department in 1882 passed a law requiring buildings exceeding eighty-five feet in height to be fireproof.

This gave a great impetus to steel construction, and buildings such as the Mills, Morse, and Post were erected, in which, for the first time, the floor beams and interior columns were made of iron or steel. The further development of steel construction made it possible to erect a safe and economical building rising to a greater height.

A new difficulty here presented itself. Under the old system of construction the outer walls became so thick at the base, when the building was carried up twelve or fifteen stories, as to cause a loss of income to the owner, as, on a narrow lot, little more than an entrance hallway would be left. It became necessary to make the walls thinner, and this resulted in the construction of curtain walls and skeleton frames.

The masonry walls are not needed for strength; they are divided into sections and supported by the steel frame. A twelve-story building, for instance, would require 36-inch bearing walls on the first floor, but only 20-inch skeleton walls, saving nearly three feet in the width of the building, or over 10 per cent on a lot 25

feet wide. The walls of the Woolworth Building are 4 feet 4 inches thick at the base. Under the old method they would have been 10 feet 4 inches.

What is the limit to the height of buildings? The answer is the height at which the building ceases to yield a sufficient income on the investment. There is no doubt of the possibility of erecting a building 1,000 feet high—say, seventy-five stories—but would it pay?

An examination of the records of the Building Bureau shows that the increase in the height of buildings is not represented by a steady upward line of growth, but by an irregular line in which the upward tendency is interrupted at intervals by lines of depression.

Starting with the year 1890, which marked the beginning of the development of the steel skyscraper, the height rapidly increased to eighteen stories, reached by the Mutual Life Insurance Building in 1892. Then followed a reduction lasting two or three years, and then an upward movement culminating in 1896 in the twenty-four-story Park Row Building. The following decade witnessed a slight repression until about 1900, and then a rapid turn upward to forty-two stories attained by the Singer Building in 1906. Another ebb followed, and then a rise which was topped in 1912 by the Woolworth Building with its fifty-five stories.

A congestion of skyscrapers in any community is objectionable for several reasons; it is dangerous to life, menace to health, and it impedes traffic. It is quite true that the modern building can be made fireproof, but when filled with inflammable material, it becomes, in effect, merely a stove or a furnace in case of fire. A large percentage of so-called loft buildings are used for manufacturing purposes, for which they were not designed. Under the present building code it is still possible for owners to pervert the uses of their buildings. When the new code is adopted the provision requiring a certificate of occupancy to be filed with the plans will operate to prevent this condition.

In regard to the second cause, the dark rooms in which thousands must work, cut off from light and air by the adjoining tall buildings unquestionably have a damaging effect upon the health of the occupants. This, however, might not have any effect in limiting the height of buildings, but the fact that these darkened lower floors yield a smaller revenue will have its effect.

Concerning the third cause, it does not need any elaborate explanation to show that tall buildings bring about a thoroughly undesirable congestion of population. Start to walk up Fifth Avenue from Fourteenth Street any day at the noon hour. It is almost impossible, because of the tremendous outpouring of the occupants of the adjoining loft buildings. The result is the neighborhood is shunned, and shops become undesirable, rent falls and the buildings fail to return a proper percentage of profit on the land. When this happens either the building must be torn down and be replaced by a more remunerative one or land values will decrease.

The future uncertainty of land values in New York city will also have a tendency to discourage the erection of high buildings. Hitherto the tendency of values has been almost uniformly upward, but in the last few years there has been in some quarters, notably in the Broadway section above City Hall up and in lower Fifth Avenue, a tendency in the opposite direction. Who can foretell with any certainty the effect of the future subways and tunnels upon land values? Suppose the vast outlying area should be developed for manufacturing purposes, of what use would be the loft building?

A skyscraper is not necessarily a money-making investment. The majority return rents less than many other forms of investment, and some of them actually lose money. It is a sad commentary on the life of a skyscraper that the first, the Tower Building, 52 Broadway, erected in 1888, was torn down in 1913. Why? Because it did not pay, and on its site is being erected a low arcade stone structure equivalent in height to the average four-story building.—*New York Times*.

New Instruments of Precision

THE work of Dr. W. Rosenhain, F.R.S., of the National Physical Laboratory, is very well known to engineers, particularly through his clear and comprehensive reports to the Alloys Research Committee of the Institution of Mechanical Engineers. Besides being a scientist of international repute Dr. Rosenhain is an inventor, and three of his latest instruments are described in his recent Institute of Metals paper on "Some Appliances for Metallographic Research." All three were worked out in the metallurgy department of the National Physical Laboratory in order to increase the accuracy and convenience of research work of the highest kind. The simplest is a little optical device for the accurate leveling of metal specimens for the microscope. A beam of light, reflected from the polished surface of the metal, is used as an index whereby the surface can be quickly and easily set truly horizontal. The

other two instruments deal with problems which arise in the preparation of accurate cooling and heating curves. One of these problems is that of heating and cooling specimens of metal at any desired rate which shall remain constant over a wide range of temperatures. This is attained by the use of vertical tube furnaces so arranged as to be hot at one end and cold at the other, with a uniform gradation of temperature between the two ends. The specimen is raised or lowered in this tube, and is heated or cooled accordingly, the rate being easily varied by altering the rate of raising or lowering. A "blank" heating curve reproduced in the paper shows a maximum variation for 2 deg. Cent. ranging only between 12 seconds and 20 seconds over a temperature range of 700 deg. Cent.

The third appliance described, says the *London Daily Telegraph*, is a "plotting chronograph," by means of which the "inverse rate" curves, so freely used in metallographic research, are plotted automatically to a very large scale, the observer merely tapping a key as the various temperature intervals are passed. The instrument, which thus not only acts as a chronograph, but at once plots the readings in the shape of a curve, is somewhat complex. Its accurate and satisfactory working, however, is testified by the curves with which the paper is illustrated.

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⁷⁶ Hughes, *Proc. Cambr.*, vol. 15, p. 483, 1910.

⁷⁷ Canegietter, *Proc. Amst.*, p. 1,114, 1911.

⁷⁸ Lenard and Ramsauer, *Sitzungsber. Heidelberg*, 1910-1911.

⁷⁹ Leon and Eugene Bloch, *Comptes Rendus*, vol. 155, pp. 903, 1,076, 1912.