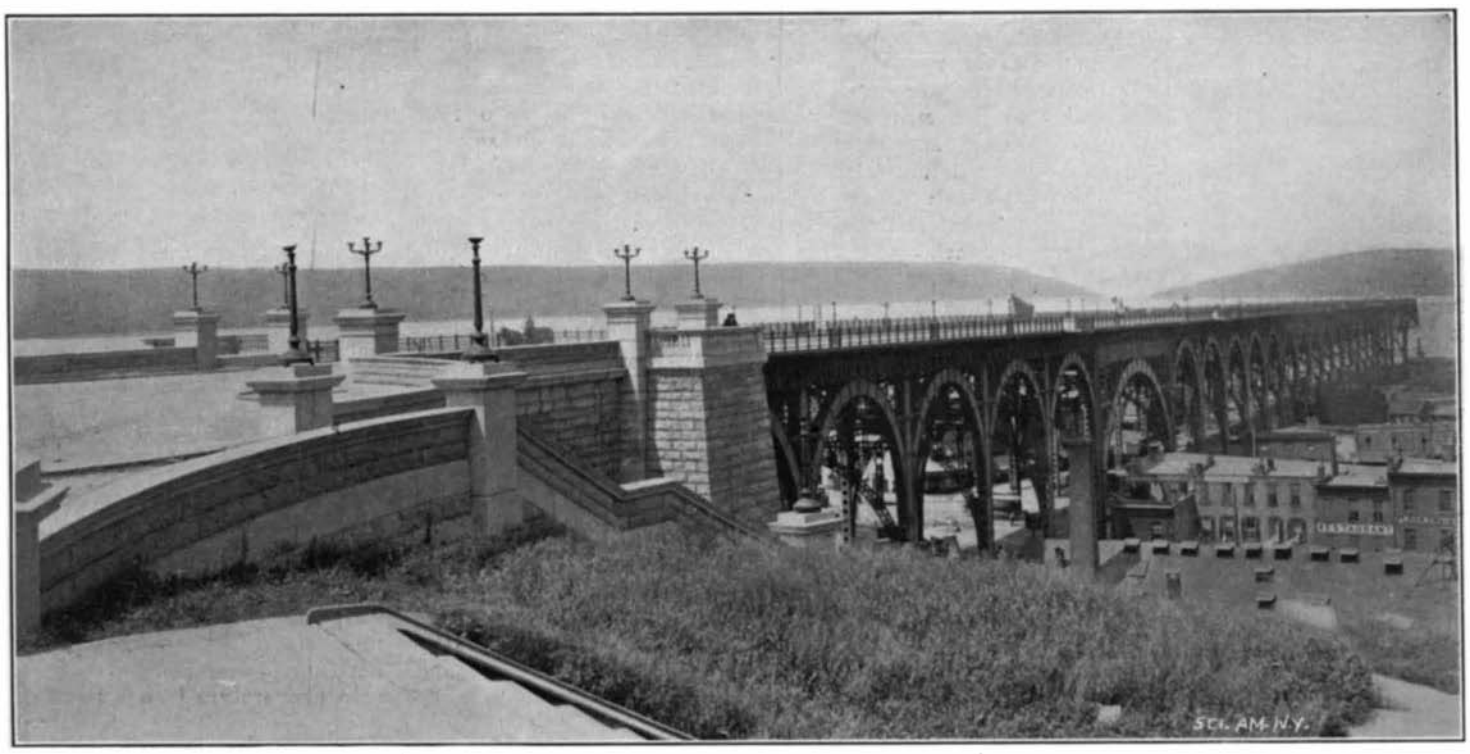
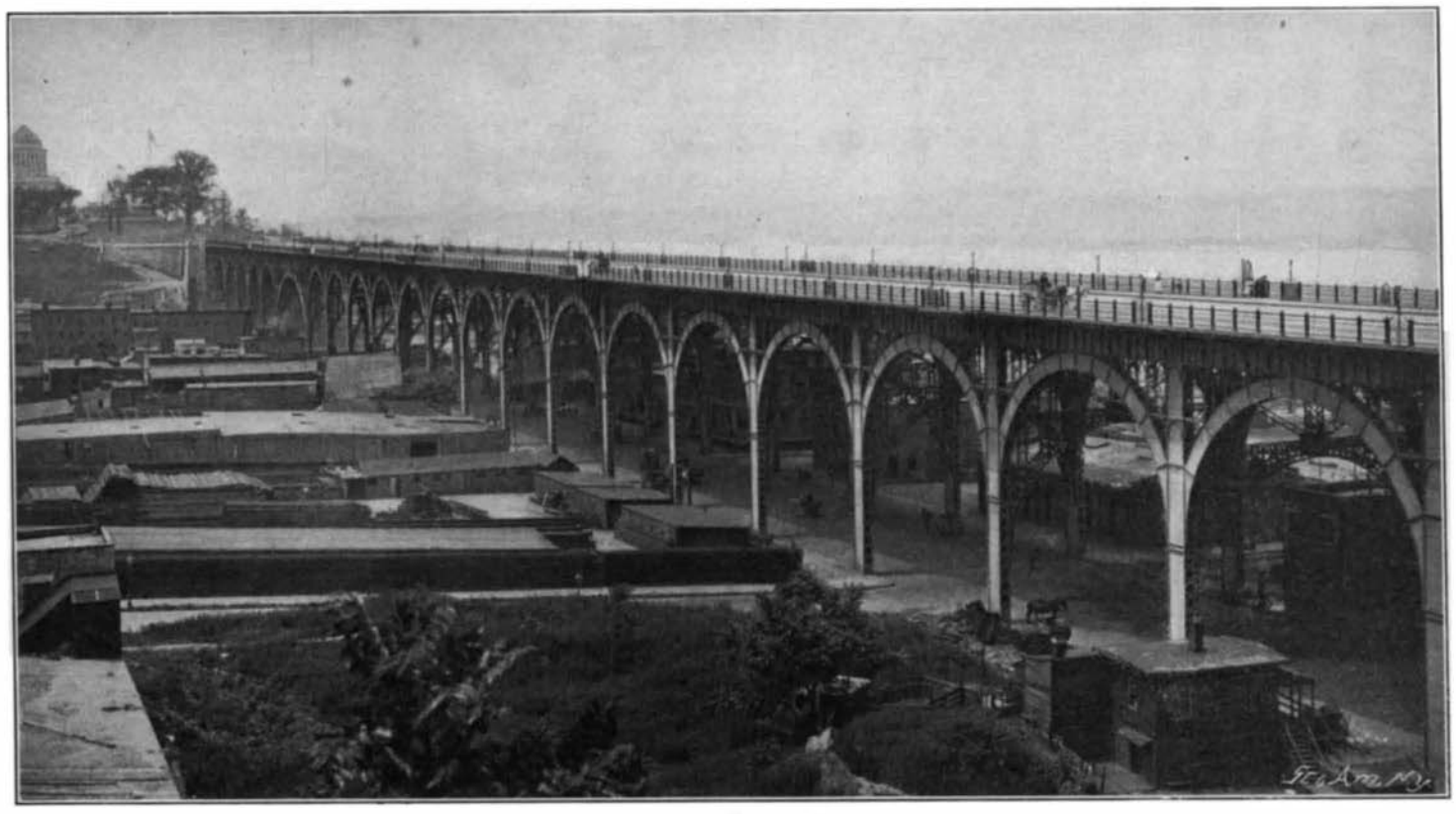
THE NEW RIVERSIDE VIADUCT, NEW YORK.

There has recently been completed one of the most important of the public works which are being carried out for the purpose of providing New York city with a complete system of suburban boulevards and driveways. The work in question is the massive viaduct which, for the past three years, has been under construction across Manhattan Valley. It has been built for the purpose of connecting Riverside Drive with the system of driveways which embraces the northerly end of Manhattan Island. Now that it is completed, there exists a continuous high-level boulevard from Seventy-second Street and Hudson River to the western end of Dykeman Street on the Harlem River, a distance of 7¼ miles. Dykeman Street forms practically a continuation of the Harlem Speedway; and as the latter is between two and three miles in length, the completion of the Riverside viaduct opens up to the people of New York a continuous drive of ten miles along the banks of the Hudson and Harlem Rivers. The new viaduct was built to carry the Riverside Drive at a high level across Manhattan Valley, which has here a width of about a third of a mile, and is intersected by six different streets. One of these forms the main approach to Fort Lee ferry, and is so greatly in use by electric trolley lines and general street traffic as to render the construction of a driveway northward across the valley at street grade very undesirable. By the construction of the viaduct, however, connection is made across the valley, free from the inconveniences of the cross-town traffic. Now that the work is completed, it may justly be said that the roadway from Seventy-second Street through Riverside Drive over Manhattan Valley and by way of Boulevard Lafayette affords one of the most picturesque and unique drives in any great city of the world.



Looking Northwest.



Looking Southwest.

THE RECENTLY COMPLETED RIVERSIDE VIADUCT, NEW YORK.

In designing the viaduct an effort was made to harmonize it in its general appearance with the surrounding country and more prominent local buildings. Its total length, including masonry approaches, is 2,074 feet; its southern approach is just below the historic villa Claremont, to the south of which towers the impressive pile of the Grant Memorial Tomb. The south masonry approach is 262 feet long, and the steel viaduct is 1,564 feet in length. The northern approach faces the Hudson River, the northern end of the viaduct being curved in as it meets the approach. The roadway, which is 60 feet in width, stands at an elevation of 75 feet above the street level. On each side of the roadway are 10-foot sidewalks supported on projecting brackets. The southern entrance, as shown in our engravings, is widened out and bounded by a semi-circular wall, in the center of which stone staircases lead down to the valley below. The arches of the viaduct are of 65 feet span and are of latticed, plate-girder construction, rectangular in section. The supporting columns measure 3 x 5 feet in section and are also of latticed, plate-girder construction. The floor is carried on floorbeams, 5 feet in depth, of which there are six to each span, and upon these are laid thirteen 12-inch, I-beam, floor joists. Upon the joists is a solid floor formed of ⅜-inch buckle-plates, which are covered with a paving composition of coal-tar residuum and broken stone, over which is laid a smooth asphalt surface.

Manhattan Street is crossed by a large semi-circular arch of 130-foot span. It will be noticed that the plating of the columns is carried up, in every case, between the spandrels of the arches to the level of the under side of the longitudinal plate girders which carry the floor system. These plate girders are designed to bear the whole of the dead load of the floor system, and they have been so nicely calculated, that in the completed bridge their under side just touches the crown of the arches. Most of the live load that comes upon the bridge, consequently, will be transmitted directly to the arches, and transferred by them to the columns. In the case of the 130-foot span the two longitudinal plate girders were of massive proportions, being, indeed, two of the largest plate girders ever constructed. They are each 130 feet long, 10 feet deep, and 3 feet wide, and each weighs 62½ tons.

The work of raising these girders into position was accomplished by means of powerful derricks placed upon the completed structure to the south and upon a series of special trestle bents to the north of the crossing. Four hoisting engines were engaged in lifting each span, and the whole work was done with but a few hours' interruption to street traffic.

The Sanitary Arrangements of Stratford-on-Avon in the Time of Shakespeare.

It is not often that we are permitted to draw the veil so as to see the sanitary conditions of mediæval and early modern towns in their true light. In Sydney Lee's "Stratford-on-Avon" there is a chapter devoted to the santitary condition of that town in the time of Shakespeare, from which we glean the following interesting information. The clay floors, whether or not strewn with rushes, attracted all manner of refuse and were rarely swept. A well in the garden may have formed an adequate water supply; but the uses of water were not generally known. The mud walls between the gardens were not conducive to cleanliness. Very few of the ordinary laws of health were, in fact, observed by the householder; and the corporation made very frequent attempts to enforce such of them as, when neglected, created very obvious nuisance. Frequent penalties were imposed on those who failed to scour and clean the gutters and ditches before their residences. But the difficulty of disposing of household waste was very commonly met by "laying" in the streets and lanes, or in these ditches and gutters. John Shakespeare appears to have been fined on one or more occasions for making dirt heaps, and failing to keep his gutter clean. Six places in town were appointed for the massing of the filth in a legalized "muckhill." They were in almost all cases at the rural ends of the small streets; but as they were to be removed only twice a year, that is to say, before the feast of Pentecost and about Michaelmas, they were near enough to human habitations to make them a constant source of danger to health and life. Butchers, it is true, were forbidden to use them, and were ordered under a penalty of twenty shillings to take their refuse out of the town at nine o'clock each evening. The Town Council never supplemented the householder's neglect of cleanliness by any really adequate provisions. It delegated the duty of keeping the streets clean to the townfolk, and as they failed to perform this function the streets remained dirty. The Council only undertook the cleansing of the bridge, the market place and the place before the chapel door and guildhall; but in these days of the glorification of hygiene, there is a ludicrous ring about the details of the arrangements made for this object. For the sweeping of the market place in Shakespeare's day, a widow named Baker was employed at a yearly salary of six shillings and eight pence, and she was provided, at the municipal expense, with a shovel, a broomstick and twigs of trees. The duty of sweeping the bridge was intrusted to a man named Raven, who at times secured the additional service of the Widow Baker. The chapel was rarely defiled by water,

but on the occasion of the repair of its roof in 1604, Anthony Rees and his wife with Goodwife Wilson were directed to sweep away the cobwebs and wash the seats. Fresh rushes were occasionally laid in the Council Chamber and guildhall and the floor of the latter was renewed at intervals with clay. There was little pavement about the town. The market place, in fact, alone was paved, but the bridge and crossway were kept in fair order by a liberal sprinkling of gravel from the guild pits.

THE THREE GREAT SUSPENSION BRIDGES ACROSS THE EAST RIVER, NEW YORK.

The topography of New York city is such as to render the Rapid Transit problem more perplexing than that, probably, of any other city. The configuration of Manhattan Island, long and narrow as it is, and the concentration of business interests at the southern end of the island, cause a congestion of traffic on the north and south lines of travel which it is taxing the energies of the transportation companies, not so much to prevent (they can never hope to do that) as to mitigate and control. Every twenty-story business block that lifts its head "downtown," every "addition" that is laid out by the ubiquitous real estate speculator in the northern suburbs of the Bronx, means so much added to the flow of traffic, and a tightening of the strain upon the means of communication. Were the Hudson River and the East River impassable barriers between Manhattan Island, New Jersey and Long Island, the outlook for the future would, indeed, be very serious, and not even the splendid Rapid Transit System which is being built would avail to prevent, within a very few years, an absolute deadlock on the north and south lines on the island.

The problem of getting the citizens of New York into and out of Manhattan Island in the "rush" hours of business has been greatly assisted by the remarkable service of ferries across the two rivers, a service which has no equal anywhere in the world; and too much credit cannot be given to this feature of the general transportation system of New York. It was inevitable, however, that the question of bridging these rivers should ultimately be raised, and though a formidable difficulty was presented by the great width of the rivers, the Brooklyn Suspension Bridge, which now for nearly two decades has been rendering yeoman service between New York and Brooklyn, is an evidence of what bold and skillful engineering can accomplish, if only the means and money are forthcoming. The main span of the Brooklyn Bridge is 1,595 feet 6 inches, and each of the land spans from the center of the towers to the face of the anchorages is 930 feet, the total length of the bridge from anchorage to anchorage being 3,455 feet 6 inches. The Manhattan approach is 1,562 feet long and the Brooklyn approach is 971 feet. The total height of the under side of the bridge above mean high water is 133 feet. The total width of the bridge is 85 feet, which is sufficient to provide two tracks for a cable road, two tracks for trolley cars, two driveways, and an elevated footwalk for passengers. In 1894-5 work was commenced on another great suspension bridge known as the East River Bridge, which extends from near Broadway, Brooklyn, to Delancey Street, New York. The main span of this bridge has a clear length of 1,600 feet, and compared with its predecessor it is a much larger structure, the suspended roadway being 118 feet in width. It will provide for six elevated road and trolley tracks, and on the outside of each truss will be a roadway for vehicle traffic. There will be no terminal stations for this structure, as there are at the Brooklyn Bridge, the aim of the authorities being to provide a broad, continuous thoroughfare over which trains, vehicles and pedestrians may pass without any interruption. This bridge is situated about a mile and a half to the northeast of the present Brooklyn Bridge.

Our illustrations show a third East River Bridge, the plans for which have now been completed for some months, and the preliminary engineering work started, which is to cross the river from the foot of Washington Street, Brooklyn, to the foot of Pike's Slip, Manhattan. This, like the other two, will be a suspension bridge. It will have a total length between anchorages of 3,165 feet, and a span from center to center of towers of 1,465 feet. There will be four deep, riveted, double-decked trusses, on the lower floor of which will be four trolley roads, two within each truss; while on the upper deck of each truss will be a track for elevated trains. The total width of the bridge will be 120 feet, or 2 feet more than the new East River Bridge. The width of the carriageway between the trusses will be no less than 38 feet, and each sidewalk will be 11 feet in width. At the Manhattan end of the bridge there will be two loops of three tracks each, there being a loop for the tracks on each side of the roadway—a convenient arrangement which will get rid of the dangerous and troublesome crossing of the roadway by pedestrians, which is necessary at the Manhattan end of the present Brooklyn Bridge. The bridge will be carried on four steel cables, each pair of which will be connected with the floor beams of the structure immediately on the outside of the trusses, the suspension cables lying in close proximity to the trusses, as shown in our engraving. The new bridge has features in common both with the Brooklyn Bridge and the new East River Bridge. It will resemble the new East River Bridge in having steel towers, but will differ from it in the fact that the land spans are carried by suspension cables from the main cables—a feature in which it will resemble the older structure.

Another important bridge which is planned and upon which work is commencing is the cantilever structure that will cross the East River at Blackwell's Island.

Further means of transportation between New York and Brooklyn will be afforded by the Rapid Transit Tunnel, which will pass beneath the East River between the foot of Whitehall Street, Manhattan, and Joralemon Street, Brooklyn. The Rapid Transit Commissioners have lately decided that this tunnel shall be constructed. It will enable passengers to ride from any point on the Rapid Transit Subway in Manhattan Island direct to Brooklyn without change of cars. In our illustrations there is also indicated by dotted lines what is known as the Hudson River Tunnel, a scheme which, at present, is only partially completed, and is awaiting the necessary capital to enable it to be put through and equipped with the necessary appliances.

In our bird's eye view of the city, we have shown only those bridges and tunnels which are completed, or are under construction, or have received such authoritative sanction that construction is a matter of certainty. Hence the two proposed bridges across the Hudson River do not appear, for hitherto it has been impossible to obtain the enormous capital which would be necessary to put through even one, to say nothing of two, of these much-needed but long-delayed engineering works. At the same time it should be mentioned that during the past few weeks the question of a crossing of the Hudson River at Twenty-third Street has been revived, and that the Pennsylvania Railroad is apparently interested in the scheme. Should the railroad systems that terminate in New Jersey take hold of the enterprise there will be every probability of its being started and carried vigorously to completion.

Laughter and Long Life.

It may be that some enthusiastic and laborious German statistician has already accumulated figures bearing upon the question of length of life and its relation to the enjoyment thereof; if so, we are unacquainted with his results and yet have a very decided notion that people who enjoy life, cheerful people, are also those to whom longest life is given. Commonplace though this sounds, there is no truth more commonly ignored in actual every-day existence. "Oh, yes, of course, worry shortens life and the contented people live to be old," we are all ready to say, and yet how many people recognize the duty of cheerfulness? Most persons will declare that if a man is not naturally cheerful he cannot make himself so. Yet this is far from being the case, and there is many a man who is at present a weary burden to his relatives, miserable through the carking care of some bodily ailment, perhaps, or some worldly misfortune, who, if he had grown up into the idea that to be cheerful under all circumstances was one of the first duties of life, might still see a pleasant enough world around him. Thackeray truly remarked that the world is for each of us much as we show ourselves to the world. If we face it with a cheery acceptance we find the world fairly full of cheerful people glad to see us. If we snarl at it and abuse it we may be sure of abuse in return. The discontented worries of a morose person may very likely shorten his days, and the general justice of nature's arrangement provides that his early departure should entail no long regrets. On the other hand, a man who can laugh keeps his health and his friends are glad to keep him. To the perfectly healthy laughter comes often. Too commonly, though, as childhood is left behind the habit fails, and a half smile is the best that visits the thought-lined mouth of a modern man or woman. People become more and more burdened with the accumulations of knowledge and with the weighing responsibilities of life, but they should still spare time to laugh. Let them never forget, moreover, and let it be a medical man's practice to remind them that "a smile sits ever serene upon the face of Wisdom."—London Lancet.

There have been no indications of any attempt to use the great Paris telescope seriously for astronomical work. Some photographs of the moon have been taken, but they are said to be inferior. In fact, the telescope is a great disappointment to scientific men; although it was the largest in the world, it has been of no use, and it has evoked a most caustic article in The London Saturday Review.

Correspondence.

Straw as Fuel.

To the Editor of the Scientific American:

Noting the numberless straw stacks standing in the fields in the wheat country, having practically no commercial value, thousands of tons being burned in order to rid the fields for resowing, it seems to me there is need of some machine and process of converting this straw into fuel suitable for cooking and heating purposes. Such machines should be capable of moving about from place to place, as does a thresher, and should do the work cheaply.

It is my belief such a machine would be of great mutual benefit to both farmer and inventor.

Newkirk, O. T., July 18, 1901. N. E. Spencer.

Ice Manufacture in India.

To the Editor of the Scientific American:

Twenty-six years ago, when I first went out to India, if one wanted to enjoy the luxury of ice, residence must needs be in one of the great cities—Calcutta, Madras, or Bombay. It was all brought from the United States, and the old Tudor Ice Company practically controlled the trade. The standard price was two annas for a *seror*, or six cents for two pounds.

In all other sections of the country the people were obliged to cool their drinks with a freezing mixture composed of saltpeter and sal ammoniac. During the hot winds it was the custom to put water bottles in wet straw, and then, by the use of baskets, the carriers could swing them until they were cool. The same practice still obtains in the up-country, and by it the water can be cooled down to 65 degrees Fahr. By using the salts and furnishing continuous fresh supplies, water can even be frozen, but the expense is large and the labor tedious.

After a while science came to our aid. The Scientific American gave details of the sulphuric ether and ammonia machines, and later—in the sixties—of the wonderful Carré machines. Indian enterprise was not slow to copy and import, and "ice in two minutes at a temperature of one hundred" was the cry. But it was expensive. Indian ingenuity saw its opportunity, and grasped it. The system came into vogue somewhat slowly, but it was accentuated from the first, and is in quite large favor. The process depends almost altogether on the production of cold by evaporation, and on the prevalence of the west wind. Ice cannot be made in India when the east winds blow. The essentials for the production are exposed and treeless fields, laid off in squares of four or five feet, and the ground covered several inches deep with coarse straw; numerous flat porous earthen plates, about nine inches in diameter; an unlimited supply of water; an army of coolies and water carriers; and the ice-pit. The last-named is the most important adjunct to the process of manufacture, and is carefully made. It consists of a deep pit, in which is built a huge timber cone, the space between it and the walls of the pit being rammed with charcoal, chaff, and chopped hay. The cone itself is lined with felt blankets and mattings. Over the entire pit is constructed a straw hut, with very thick walls and roof, and a small entrance.

One other thing is also noticeable on the spot, and should be mentioned, and that is a mammoth drum, which is kept standing close to the entrance of the hut.

Weeks may pass without any "cool west wind," and every night, all through those days or weeks, watchmen are on duty, much the same as if an enemy were expected. They are made to understand that it is a question of duty, and they are to watch unceasingly. Sooner or later, at dead of night—one, two, or three in the morning—the breeze is felt. It is rarely felt before midnight. As soon as the watch is certain the great drum is beaten, with both fists and elbows, and the coolies assemble by hundreds. Water is poured into the saucers, and as the evaporation ensues, the coolies dexterously turn the plates, sift in the salts, watch the congelation, and at once on its occurrence run to the pit with the ice. There it is emptied, pounded into a mass, and consolidated by regelation. In many pits thousands of pounds weight is pitted.

It is interesting, and somewhat curious, to talk with these ice-makers. Asked as to the *rationale* of the process, they glibly reply that the cooling is so rapid that the slow influx of air is overbalanced. The ice produced is, of course, very much like "anchor ice," and when it is taken from the pits for use it is removed by nine-pronged hoe-forks.

Westfield, N. J. Giffard Knox.

By the will of the late Jacob H. Rogers, the locomotive builder, the bulk of his fortune, possibly eight million dollars, is left to the Metropolitan Museum of Art, New York, as an endowment fund, the income to be used for the purchase of objects of art. This will place the Museum on a splendid footing.