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.

Automobile News.

A service of steam motor wagons is now running between London and Tunbridge Wells.

It is said that the cartage bill of Boston in the course of a year is not less than ten million dollars. This shows there is an enormous field for automobiles.

Motor carriages in France are to be taxed according to their power. They put a tax of $1 per horse power in addition to the ordinary tax of four-wheeled carriages.

Arrangements are now being perfected for the automobile road test between New York and Buffalo, which will commence on September 9. The average stages will be from 88 to 90 miles in length. The total distance to Buffalo is 500 miles. Great care is being taken so that the route will include all conditions of roads likely to be met with in a general tour of the State. The regulations are now being framed.

The following prizes were bestowed on the occasion of the Paris-Berlin race: M. Fournier received the prizes given by the German Emperor, the King of the Belgians, the Grand Duke of Luxemburg, and the city of Hanover. Herr Werner received a prize given by President Loubet; M. Giraud the prize given by the Grand Duke of Mecklenburg, and M. Renault the prize given by M. Millerand, the French Minister of Commerce.

In future races the Automobile Club of France will require that cars, when fully equipped, shall weigh only about two thousand pounds. Modern racing cars weigh a ton and a half and over. The policy of builders of racing cars has been encouraged by the absence of any weight limit in races. If the new regulations are enforced, it may result in a revolution in automobile-building, but a worthy revolution, as the latest types of racing cars have been fully developed enough for all practical purposes.

Mr. S. F. Edge, who was the only English competitor in the Paris-Berlin motor race, experienced a curious accident which rendered him *hors de combat*. He was driving a 70 horse power Napier car. The vehicle traveled splendidly, and prior to his first puncture he drew up from twenty-fifth position, at which he started, to ninth in the first 50 miles. His tires then punctured no less than seven times. The final accident that caused his retirement was while passing another competitor. He could not see his way, owing to an enormous cloud of dust, and while traveling at about 70 miles an hour he struck the arched curve of the road over a small bridge. The car leapt into the air and bounced down upon the ground again like an India rubber ball with terrific force. The back carriage spring broke under the impact, and as its replacement would have occupied two days, Mr. Edge withdrew from the race.

New Element: Europium.

BY OUR PARIS CORRESPONDENT.

M. Demarçay, in the course of his spectrum analysis work, claims to have discovered a new element, to which he proposes to give the name of *europium*. In the account which he has lately presented to the Académie des Sciences, M. Demarçay brings out the following points. Sir Wm. Crookes, while pursuing his vacuum tube researches, observed in 1885 a band which he attributed to samarium and which on account of its disappearance in the presence of lime, and other peculiarities, he called the *anomalous ray*. Later on he distinguished it, together with a great number of other bands, each of which appeared to characterize a special meta-element. He called S δ the hypothetical meta-element which corresponded to the *anomalous ray*. In 1892 De Boisbaudran described a series of three brilliant blue lines, which he discovered in the spectrum of the samarium spark. These lines could be brought out more strongly by a fractional treatment of the material and he concluded that they were due to a special element, which he called Z ζ. In 1896 M. Demarçay announced the presence of an element intermediate between gadolinium and samarium, which was characterized by several strong violet and ultra-violet rays. He also showed that the new element was identical with that of De Boisbaudran, and no doubt accounted for the anomalous band of Crookes, as well as other rays not yet described. At that period M. Demarçay could not obtain enough of the material to make further experiments, but at present he has accumulated a larger quantity of it by a fractional treatment of nitrate of magnesium, and finds that its characteristics, namely, line and absorption spectra, electric fluorescence of the sulphate in vacuo, etc., accompany it constantly and are proportional, thus evidently belonging to one and the same element. The purity of the few grammes of the new oxide obtained was sufficiently great to exclude all the samarium rays, and only the stronger gadolinium rays were visible in the electric spectrum. If the product was added in traces to sulphate of calcium, it gave a brilliant spectrum of fluorescence in which the *anomalous ray* predominated. This spectrum includes three principal bands, $\lambda = 609$, very strong; $\lambda = 576$, considerable and wide; $\lambda = 593$, strong and very wide (the figures are approximate). The degree of calcination of the sulphate caused variations in the bands; the strongest seems to change to a double ray when the calcination is strong. The author proposes the name *europium* for the new element, with the symbol eu = 151 (about). He then gives a list of forty of the principal rays of its spectrum comprised between $\lambda = 500$ and $\lambda = 350$; the strongest of these are as follows: $\lambda = 4{,}662.6$; 4,627.8; 4,594.5; 4,435.8; 4,205.4; 4,130.0; 3,972.0; 3,930.7; 3,819.5, etc.

In this spectrum the samarium rays were entirely absent and the strongest gadolinium rays were scarcely visible. Besides the rays given, which no doubt belong to *europium*, a great number of feeble rays are seen, which may belong to this element or perhaps to an unknown element even more rare; this the author proposes to study later.

A NEW KIND OF WATER-TANK.

To provide a construction which will prevent leakage and bruising and warping of the wood of water-tanks and which will keep the water in the tank cool and clean is the purpose of an invention patented by Dr. Edwin F. Evans, of Fredericksburg, Tex.

The tank has an outer wall and an inner wall spaced apart to form an annular chamber, into which a water-inlet extends. Apertured segmental rings serve to space the outer wall from the inner wall and are received in grooves in the opposing faces of the walls. As shown in our illustration the tank is provided with four such segmental rings at different levels.

At the bottom of the chamber a series of vertical segmental blocks are located, which are chamfered at their lower periphery. Vertical perforations in these

A WATER-JACKETED TANK.

blocks place the bottom chamber thus formed in communication with the chamber formed by the side walls. Bolts provided with washers hold the blocks in place. An outlet cock allows water to be drawn from the chamber between the side walls.

Water flowing into the chamber between the side walls rises in the chamber and finally flows over the inner wall and into the tank. The inner and outer walls will, therefore, always be kept moist, so that leakage, shrinkage, and moving of the hoops is avoided. The main body of water is protected and kept cool by the outer jacket of water. The water in the chamfered blocks on the bottom of the tank keeps the bottom joint in good condition.

Owing to the widespread popularity with which the Central London Electric Railway is regarded, and in order to cope with the exigencies of the passenger traffic, the railroad authorities propose to carry out several improvements which will enable them to run their trains at faster intervals than is possible at present. The service now is a train every 2¾ minutes. The service, under existing conditions, cannot be accelerated, owing to the time that is lost in shunting the trains at either end of the railroad. The latest proposition to overcome this difficulty is to construct a large loop at each terminus, so that the trains will simply run round from the up platform to the down platform. At the city end the loop will be a large one, so that a station may be provided at Liverpool Street, one of the busiest trunk railroad termini in the city. By this means the service will be accelerated to a train every minute and a half. It is also proposed to try some geared motors with a view to overcoming the vibration, over which such an outcry has been raised. It is thus anticipated that the locomotives, being fitted with springs, will break the force of the impact upon the rails and the earth, and also insure comparative silence in running.

Engineering Notes.

Gas is about to be made in Canada from peat fuel.

In some trials of steam pumps in England recently the efficiency is asserted to have been from 95 to 99.8 per cent, the pump cylinder being taken as full in the estimate.

At the Germania yards at Kiel, one of the establishments of the Krupps, hereafter all ships will be constructed in large covered slips. The idea of building ships under cover is not new, having been practised in England for a long time.

A Chicago boy recently went around the world in competition with a boy from New York and one from San Francisco to see which one could make the journey around the world in record time. As was almost to be expected, the wideawake young man from the Middle West, whose name is Charles Cecil Fitzmorris, was the winner. He made the globe-encircling journey in sixty days, thirteen hours, twenty-nine minutes and forty-two and four-fifths seconds, thus beating the best previous record by many days.

A set of triple expansion engines of 1,400 horse power recently erected in an English electric lighting station have shown remarkable results as regards economy, the weight of steam used per horse power per hour being but little over 10 pounds. Steam at 200 pounds per square inch is used and superheated 100 degrees Fahr.; the valve gear is of the Corliss type, and no variation in speed over two per cent is allowed; from full load to no load speed must not exceed five per cent variation. This last is not very difficult of attainment, many American engines running much closer than these limits.

The influence of improved appliances in marine engineering has been very marked in the past fifty years, for where in 1854 it required 7.69 men per 100 tons of shipping, in 1900 it required less than 3½ men. The economy resulting from inventions follows in all lines of operation, particularly in fuel, which has fallen from 5 pounds of coal per horse power per hour to under 1½ pounds, with a corresponding increase in the speed, so that, with the reduction in space required for coal, much more cargo can be carried. Where it cost nearly four cents to carry a ton of grain one mile on sea, it can now be delivered for about one-fiftieth part of that sum.

Owing to the remarkable increase in the importation of petroleum into Europe, via Antwerp, extensive alterations are contemplated at that port in order to cope with the exigencies of the augmented traffic. It is intended to construct a series of new docks equivalent in length to 2,000 yards, together with necessary wharves and buildings. This increased accommodation is to be situated to the south of the city, and as sufficient dwellings are to be erected there to house the employes working at the new docks, the nucleus of another town will thus be formed. It is anticipated that Antwerp will then become the general depot for petroleum for the whole of Europe. The fulfilment of the scheme will involve the expenditure of several million dollars, and this is to be voted annually in installments by the Municipal Council.

The water-tube versus fire-tube boiler for vessels of war still occupies a great deal of attention abroad, and two vessels in the English navy, the "Hyacinth" and the "Minerva," have been, and are being, tested to settle certain moot points; the experiments can, at the best, prove conclusive only as to the particular voyage undertaken, the action of the two types for long periods and under all conditions being the only verdict of practical value. It is undeniable that both types have special features of merit, and it remains to be shown what can be dispensed with and what is essential. Economy in the use of fuel is perhaps the least consideration as compared with immediate availability in steaming at full power, and reliability as concerns continuous action; no one type possesses all of these features, and long experience of all the service required is needed in selection of boilers for certain classes of vessels.

During the progress of the construction of the reservoirs for the enlargement of the London water supply, a splendid specimen of an ancient ship has been discovered in the bed of the old River Lea, the course of which has been diverted in order to permit the excavations. The vessel was found at a depth of seven feet below the surface. It is about 50 feet long and is constructed of oak throughout, with the exception of the keel, which is of elm. The ribs of the boat are secured to the sides by trenails, while the timbers are secured with crude and primitive, though well-made iron nails. The floorboards are also fastened together with nails and the calking is done with felt. Many antiquarians, who have examined the relic, think that it constituted a part of the fleet with which King Alfred the Great fought against the Danes. Another curious dugout boat, estimated to be about 2,500 years old, was also unearthed and is to be deposited in the British Museum.