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NEW YORK, SATURDAY, OCTOBER 3, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE FUTURE WATER SUPPLY OF NEW YORK CITY.

The expert commission which was appointed to examine into the question of the available sources of water supply for New York city, and the best methods of conserving and utilizing the same, has made a preliminary report to the Board of Estimate. The commission states that in spite of the decrease in the waste of water by consumers in New York, it is necessary, in view of the rapid growth of the city, that steps be taken immediately to secure a larger supply. According to the preliminary estimate of the eminent engineers who have made this investigation, immediate provision should be made for storing and introducing into the city an additional daily supply of 200,000,000 gallons, to be delivered by gravity at an elevation of 300 feet above mean tide level. The cost of this portion of the scheme, including the necessary dams and aqueduct, will be $50,000,000. Acting on the advice of the Corporation Counsel, the investigation was confined entirely to those streams of water which lie within the State of New York, and the commission discovered that there are three available sources of supply. First, from certain of the eastern tributaries of the Hudson; secondly, from a portion of the eastern tributaries combined with the headwaters of Esopus Creek on the easterly side of the Catskill Mountains; and, thirdly, by pumping and filtering water taken from the Hudson River, at a point a few miles above Poughkeepsie. Although any one of these sources can be developed to maintain a constant supply of 500,000,000 gallons daily, the Commissioners are unanimous in recommending the upland waters in preference to water taken from the Hudson River, although they admit that the latter can be made pure by filtration and, indeed, must be regarded as the ultimate reserve for the demands of the more distant future. It is recommended that in any case the city begin at once the construction of filters, both for the present Croton water supply and for all other waters taken from surface streams. The surveys upon which the report is based include about 125 miles of aqueduct location extending from Jerome Park reservoir to the site of the proposed reservoirs, and comprising 80 miles of surface aqueduct following the contour of the ground, 40 miles of aqueduct in tunnel, and about 5 miles of large steel pipe siphons. Although the works that it is recommended to put in hand at once contemplate an additional supply of not over 200,000,000 gallons a day, for obvious reasons the aqueduct has to be built of sufficient size to accommodate the ultimate 500,000,000 gallons daily capacity of the larger scheme, when it shall have been fully developed. The controlling feature as regards speed of construction will be the great line of aqueduct; and as this will take at least five years to complete, it is recommended that immediate steps be taken to initiate this greatly needed work. The conclusions of the report will be found in full in the current issue of the SUPPLEMENT.

The recommendation that immediate steps be taken to increase the water supply of New York is one that will commend itself to every one who has studied the situation. The present margin of consumption over supply is none too large; and when it is remembered that New York adds to itself every year a population equal to that of a first-class city, the urgency of the case is at once apparent. Whatever is done should be done on the most liberal scale. It has too often transpired that water supply provisions that looked over-bountiful when they were projected, have proved meager in proportion to the ever-accelerating growth of the municipalities that they supply. This 500,000,000-gallon aqueduct looks like a gigantic scheme; but the growth of this city is gigantic; and it would take a bold prophet to set a limit to water demands of the future metropolis of the world.

PIPE GALLERIES VS. UPTURNED STREETS.

A contemporary has estimated that on July last, exclusive of the excavations for the subway, there were thirty-two miles of open trenches in New York city. Large as the estimate is, it is probably rather under than over the mark, for it is undeniable that the condition of the streets of this, the metropolis of the Western Hemisphere, is not merely a source of untold annoyance and loss to the citizens of the city, but is a positive blot upon a municipal administration which should be a pattern for the world at large and not a by-word and a reproach. It is to the credit of the Rapid Transit Commission and its engineers that the original plans of the subway contemplated the construction of pipe galleries; and it was simply because of the vicious obstruction of certain Tammany politicians in other departments that the subway plans were abandoned and the pipes laid above the roof of the subway, a few feet below the street surface. But although the mischief has been done on the 20 miles of road now approaching completion, there is no reason why a properly constructed gallery should not be built on either side of every new branch of the subway that is contemplated in the plans for future enlargement of the system. In any case, subways or no subways, there is absolutely no excuse for the shocking condition in which our streets are left when a section of the subway is completed, or the street surface is taken up for the laying or repairing of gas, electrical, or water mains. We presume that there is a clause in the Rapid Transit contract, and a statute in the city laws requiring that when the street surface is broken up for any cause whatever, it shall be restored at once on the completion of such work to as good condition as it was when the work was opened. As a matter of fact contractors and other disturbers of the street surface seem to be permitted to leave the street in just whatever condition of disrepair they may please, with the result that scores of miles of our thoroughfares are left in a disfigured condition for months after the job of pipe laying, sewer construction, etc., has been completed. We commend this matter to the attention of the Rapid Transit Commissioners and the Commissioner of Public Works.

AT LAST, THE SIDE-DOOR PASSENGER CAR.

For many years the SCIENTIFIC AMERICAN has been an urgent advocate of the use of a modified form of side-door passenger car for suburban service. It is a well-understood fact among railroad men that the speed of suburban service, other things being equal, is dependent upon the quick starting and stopping of the trains and the speedy discharge and taking on of passengers. The first has been solved by the electric motor, and the solution of the second lies in the substitution of the side-door for the end-door car. There is no company in America that has had such wide experience in heavy suburban passenger service, or has given so much intelligent thought to the problem, as the Illinois Central Railroad. More than a decade ago, when they had to make special provision for handling the millions that traveled between Chicago and the World's Fair, they designed and built a special side-door passenger car, which was a revelation to travelers in the speed with which it could be emptied and filled, and the marked effect it had upon the frequency of the train schedule and the average speed of the trains. The lesson learned in that successful experiment was not forgotten, and the same railroad has now brought out a large standard passenger coach for suburban service, capable of seating a hundred passengers, and constructed with a dozen side doors, one opposite each pair of seats. By the courtesy of the officers of the road, we are enabled to present in the current issue of the SUPPLEMENT an illustrated description of this interesting and, as we think, epoch-marking car. While we refer our readers to the article in the SUPPLEMENT, we may mention here that the carrying capacity of the new car, per foot of length, is 55 per cent greater than that of the standard end-door cars now in use. The experience gained in the few days that the cars have been in service has shown that their capacity and speed of loading and unloading is greatly in advance of that of the standard type. A careful timing at one of the intermediate suburban stations showed that from one of these cars forty-six passengers were unloaded in two seconds, about half of whom were lady passengers that were riding upon the new type of car for the first time. Contemporaneously with the improvement in the passenger-handling ability of the car, careful attention was given to the subject of indestructibility by fire or collision, and the construction, with the exception of the inside and outside finish, is entirely of steel. The under frame consists of four 9-inch steel I-beams, the end sills and car framing being also steel channels and I-beams, and the whole metal under framing is covered with a continuous steel floor of ¼-inch plating. The framing of the sides and roof is of steel, and heavy vertical steel trusses are provided in the walls of the car at each end, which will effectually prevent that most frightful cause of death and maiming in collision known as telescoping.

We have drawn special attention to this car because it is our belief that just now, when the extension of the Rapid Transit facilities of this and other large cities are being so thoroughly reorganized and reconstructed, it will be the greatest pity in the world if the capacity of these systems should be limited by an over-conservative adherence to the end-door type of car with its congestion of passengers and its too-slow loading and unloading at stations. In the car under consideration the objections to the English car have been met and cleverly eliminated, the seats, which are arranged transversely of the car, being placed down the center of the car, and two side aisles provided, which extend for the full length of the car. This arrangement allows a passenger to board the car immediately opposite any point on the platform where he may be standing, and look for a vacant seat while the train is in motion, thus avoiding the only cause of delay on the otherwise speedily loaded and unloaded English car. The side doors are so arranged that they may be opened individually by those who wish to leave the train, and shut collectively by the brakeman from the platform.

THE 60,000 HORSEPOWER PLANT AT THE WORLD'S FAIR.

BY LIEUT. GOLFREY L. CARDEN, R.C.S.

The floor space in the Machinery Hall of the World's Fair, St. Louis, 1904, has been applied for some four times over. It is now practically finished and the adjoining Steam, Gas, and Fuel Building is over 60 per cent completed. This latter building is a steel, fire-proof structure, measuring 326 by 300 feet. The total length of Machinery Hall is 1,000 feet and along more than one-half of this distance will be found prime movers constituting the power plant of the Exposition.

It was originally supposed that 40,000 horse power would suffice to perform all the functions devolving upon a power plant at the Exposition; but more than 60,000 horse power is now planned for installation in the Machinery Building, and of this amount a trifle more than 50,000 horse power has been assigned work in the service of the World's Fair.

In a previous number of the SCIENTIFIC AMERICAN, a list was given of the prime movers of the larger sizes entering into the power plant proper, and in reverting to that description it is only necessary to remark that the principal units will comprise gas engines, high-speed steam engines, and turbine engines from various parts of the world. One offering comes from as far east as Stockholm, while still another unit comes from a point as far west as San Francisco. The locations of the prime movers have been definitely decided upon, and the work of installing will commence during the coming month. As planned by Mr. Thomas M. Moore, chief of the machinery department, there has been allotted a good reserve of power for each particular line of work, and the units utilized in common service will be found grouped together. Take for example, the Intramural Railway. This road has a length of about seven miles and is a double track trolley system throughout, with standard gage and standard type of open cars. The motor equipment, the brake equipment, and the power plant for the operation of the road all constitute exhibits, and one of the units of the power plant comes from San Francisco, another from as far east as Berlin. The Intramural Railway power plant will be located in the central portion of Machinery Hall and the prime movers in this plant are as follows: (1) A 1,750 B. H. P. Oechelhauser system gas engine (100 R. P. M.) built and exhibited by A. Borsig, Tegel-Berlin, and supplied with gas from a producer plant built and exhibited by Julius Pintsch, of Berlin; (2) a 900-horsepower Corliss type steam engine (85 R. P. M.) built and exhibited by the Murray Iron Works Company, of Burlington, Iowa; (3) a 750-horsepower modified Corliss steam engine (100 R. P. M.) built and exhibited by the Lane & Bodley Company, of Cincinnati, Ohio; (4) a 600-horsepower four-valve steam engine (150 R. P. M.) built and exhibited by the Harrisburg Foundry and Machine Works, Harrisburg, Pa.

In addition to the foregoing it is proposed to utilize a tangential water wheel built and exhibited by the Abner Doble Company, of San Francisco, Cal. The combination will consist of a steam pump built by the Jeanesville Iron Works Company, which is planned to deliver 1 200 gallons of water per minute at a pressure of 300 pounds; the water is conveyed through a pipe line and delivered against the tangential water wheel. This latter will be directly connected to a Crocker-Wheeler generator. The water wheel will be incased in plate glass, and when making 900 revolutions per minute 1,000 horse power will be developed. Incidental features will be a Lombard governor on the water wheel and a Venturi meter measuring the water delivered through the pipe line.

All of the generators for the prime movers of the Intramural power plant will be of the Crocker-Wheeler type, and in every instance they are directly coupled to the prime movers and deliver current at 550 volts at the switchboard.

As a further instance of work devolving upon the power plant, take the water-pumping requirements. At the Paris Exposition the pumping service called for 45,000 gallons of water per minute; at St. Louis, the requirements are 90,000 gallons of water per minute. This water is to be lifted by three centrifugal pumps of the Worthington type, which pumps are entered as exhibits. Each is planned to deliver 30,000 gallons of water per minute against a total head and suck of 158 feet. Three induction type motors, each of 2,000-horsepower rating, are to operate the pumps. The energy required for the operation of this feature alone equals the total energy had from the Niagara power plant by the Pan-American Exposition, and the total energy availed of for illuminating the Buffalo Exposition.

It may be interesting to note, with reference to the waterways, that the main one consists of a grand basin with lateral lagoons. The water is delivered into this basin from a niche in front of Festival Hall and from fountains in front of two ornate restaurant buildings which flank the Terrace of States. From these three points it flows over cascades, and it is to be illuminated by electric lights placed under the lip of each step which breaks the spill.

Speaking generally, about 80 per cent of the energy developed by the power plant will be in 6,600-volt alternating current, three-phase, 25 cycles, this for the general lighting and hydraulic work of the Exposition; but there will be a material amount of 2,300-volt, 50 cycles, three-phase alternating current, generated by foreign exhibits and used for arc lighting, and there will be the 550-volt direct current, for the operation of the Intramural Railroad. In addition to the foregoing, there will be minor installations for the generation of both alternating current and direct current of standard voltages and characteristics, for the motor service of exhibitors in Machinery Hall.

More than a year ago the claim was made that the steam boiler, boiler appliances, gas producer, and fuel handling propositions would be adequately and creditably housed in a spacious building and that this building would be found in the center of the ground. This claim has been made good, and at this writing a steel structure in close juxtaposition to Machinery Hall proper is rapidly nearing completion, and in outward appearance this latter building, known as the Steam, Gas, and Fuel Building, will be architecturally in full keeping with the main Machinery Hall.

In this annex it is proposed to illustrate the most modern methods and economy in steam and gas generation and the handling and treatment of fuels; and, parenthetically, it may be remarked that the most exhaustive methods will be followed to secure absolute and reliable data as to the performance of every plant under the control of the Machinery Department. The reports will be embodied in the final Exposition reports to the United States government, and will doubtless be availed of by the foreign commissioners in reporting to their respective governments. In this connection, take the announcement of one of the fuel-gas producing companies that they will require, when developing 1,750 horse power in one of the gas engines of the power plant, 1,575 pounds of anthracite coal per hour, and when not operating, 50 pounds of anthracite coal per hour. This means less than 1 pound of coal per horse power per hour, and if the claim is made good as a result of six months of Exposition service, there will be some valuable data at hand from wholly disinterested and capable observers.

Economical illustrations in the Steam, Gas, and Fuel Building will commence with the coal in 50-ton, hopper-bottom, self-cleaning, steel cars controlled and operated by the Exposition. These cars bring the coal from the mine to the Fuel Building, where it is dumped and automatically conveyed to and from bunker and crusher, or either, and thence to the mechanical stokers, gas producers, and briquetting machines. Over 2,200 lineal feet of conveyor lines are required in this automatic coal-handling system. Bituminous coal, anthracite coal, briquettes, and crude oil will all be used for the purpose of providing lines for comparison and to illustrate as fully as practicable the broad subject of the use of fuels for power purposes. Every attention will be paid to the avoidance of smoke, and special facilities will be accorded stoker builders to substantiate their claims in this direction. In this building will be found a line of marine water-tube boilers representing nearly all the more distinguished types in service in the world to-day, and a separate stack will be available if called for by any one exhibit, provided at least 1,500 horse power is involved.

A permit has been granted to the Philadelphia, Washington and Baltimore Division of the Pennsylvania Railroad to build twin tunnels under the United States capitol. Electricity is to be the motive power.

THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D.

Though the part of the sky which can now be well seen in the evening is not a very brilliant one, we may yet find much to interest us in identifying the various constellations which are now visible and the planets which happen to be in sight.

We may well begin with the brightest object of all—the planet Jupiter. At our usual hour (10 P. M. at the beginning of the month, 9 P. M. in the middle, or 8 at the end) he is a little to the east of south about half way up the sky, and cannot possibly be mistaken for anything else.

Above Jupiter is the great square of Pegasus, which is very easy to recognize. Its right-hand side points downward toward the planet. Farther down on the same line is an isolated bright star. This is Fomalhaut, which, with the small stars, nearly forms the constellation of the Southern Fish.

The lower side of the great square of Pegasus, prolonged to the right for about three times its own length, brings us near a bright star in the Milky Way with a fainter one on each side of it. This is Altair, which, like Fomalhaut, is quite near us, speaking from the astronomical standpoint—a mere matter of eighty or a hundred millions of millions of miles. The little diamond-shaped group between Altair and Pegasus is Delphinus, sometimes known to sailors as Job's Coffin.

The bright object below and to the left of Altair is the planet Saturn. The two small stars in between are in Capricornus, and are the brightest in that constellation. Both are worth looking at with a field-glass.

Aquarius, in which Jupiter is now situated, is also lacking in conspicuous stars. Its most characteristic group, resembling the letter Y lying on its side, may be found by prolonging the diagonal of the great square of Pegasus downward and to the right for about its own length.

The opposite diagonal, carried up into the Milky Way, lands us in Cygnus—a very fine constellation, with the familiar "cross" of bright stars—and, extended farther, comes near Vega, the very bright bluish star which marks the constellation Lyra. Below Vega, and more to the right, is Hercules, now well down in the west.

Returning once more to Pegasus, we notice that from the upper left-hand corner of the square there extends a line of fairly bright stars. The first two of these are in Andromeda. The third, at a little greater interval, is Alpha Persei, while the one below, and rather out of line, is the famous variable Algol.

Still farther on is Auriga, with the brilliant Capella. Farther south is Taurus, with the ruddy Aldebaran just rising, and the silvery Pleiades higher up.

Below Andromeda a little triangle marks the head of Aries. The large constellation, Cetus, fills most of the sky lower down, extending from the edge of Taurus nearly as far as Fomalhaut.

Of the circumpolar constellations, Ursa Major is directly below the pole. Draco and Ursa Minor are on the left, and Cepheus and Cassiopeia are above it.

Beta Andromedæ, the first star of the line that runs northeastward from the great square of Pegasus, may be used to help us find a very interesting object. A short distance northward of it, in a direction at right angles to the main line of stars, we come upon a small star of about the fourth magnitude, and then on a second, a little out of line. Just beyond this, and exactly in line with Beta and the first star, is a hazy patch of light, visible to the naked eye, but much more conspicuous with a field-glass. This is the great nebula of Andromeda—the brightest of all such objects and the type of a large class of nebulæ.

Viewed with a small telescope, it appears only as a dull mass of light, with no well-defined boundaries, but concentrated rather sharply to a central nucleus. With large visual telescopes two parallel dark lanes or streaks can be detected near one side of the nebulosity, but this is about all. But long-exposure photographs tell a very different story, and show that this nebula, so insignificant to the naked eye, is really one of the most magnificent objects in the heavens.

So many of these photographs have been reproduced that the majority of our readers are probably familiar with their appearance. They show that the dark lanes visible to the eye are only parts of a much more extensive system, which divides the nebula into a series of concentric elliptical rings. The impression given by the photographs is of a vast, thin, flat sheet of luminous matter, nearly circular in actual form, but much foreshortened by being seen at a high angle. The outer parts of this sheet show a cloud-like structure, and are arranged in spiral streams, which can be followed as they wind gradually in toward the center until they are lost in the glare produced by the over-exposure of the bright inner part of the nebula. The dark lanes seem to be simply the places where we look through between these luminous clouds to the dark sky beyond.

The whole appearance of the photographs suggests strongly the idea of the old nebular hypothesis—a shrinking mass which, as it contracts, throws off rings ready to condense into planets. But we must be cautious in adopting any such view, especially as the theory on which it is based is now being severely criticised upon mathematical and physical grounds.

The real constitution of this nebula, and of the many others which resemble it in general characteristics, is still uncertain. Its spectrum appeared to its first investigators to be quite continuous. This is very puzzling, as it would seem to follow that the light of the nebula comes from glowing solid or liquid matter, or from gas under a high pressure.

More recent photographs of its spectrum have brought out the still more important fact that it contains faint dark lines, and resembles the solar spectrum in general character, though the lines are faint and diffuse.

The existence of these dark lines is not universally admitted, and further observations are desirable, but the writer is disposed to believe in their reality.

Now the only way that we know of by which such dark lines in the spectrum can be produced is by the selective absorption of a highly heated atmosphere like the sun's. It is inconceivable that the nebula as a whole can have such an atmosphere, and so we are led to the conclusion that it must consist of a mass of stars.

Many attempts have been made, from the time of Herschel downward, to resolve this nebula into stars, but even the most powerful telescopes fail utterly to do so. If it really consists of stars, they must be so small, or so enormously far away, that they cannot be seen individually even with the largest instruments, but form a mass of diffused light, just as the stars of the Milky Way do to the naked eye.

This theory appeals keenly to the imagination, for if it is true this nebula may be an assemblage of stars even greater in extent than the whole of the Milky Way, and at a correspondingly enormous distance from us—one which it might take light a million years to travel.

It seems pretty sure that, viewed from such a distance, our own Galaxy would appear as a spiral or a ring nebula, something like the Great Nebula, though without its central condensation, and it is certainly possible that the Andromeda nebula may be of this character—another "universe" perhaps more extensive than our own. But it must be clearly borne in mind that the evidence available at present is too scanty to justify us in making any definite statement to that effect.

THE PLANETS.

Mercury is evening star until the 3d, when he passes through inferior conjunction and becomes morning star. He will not be visible till the latter part of the month. On the 18th he reaches his greatest elongation west of the sun, and rises about an hour and twenty minutes before him, so that he should be seen without much trouble near the horizon, a little south of east, at about an hour before sunrise.

Venus is also morning star, and is very conspicuous, rising an hour and a half before the sun on the 1st, and more than three hours before him on the 31st. During the first part of the month she rapidly grows brighter as her narrow crescent widens, and at the time of her greatest brilliancy, on the 24th, she is twice as bright as she was on the 1st. Later on she slowly decreases in brightness.

Mars is evening star in Scorpio, but is inconspicuous, being faint and far south. On the 3d he is quite near Arcturus—about 3 deg. north of the star. In the middle of the month he sets at about 8 P. M.

Jupiter and Saturn are in Aquarius and Capricornus respectively, as already described, and are both well placed for evening observation. Saturn is in quadrature on the 27th.

Uranus is in Ophiuchus, and has practically disappeared for the year, as he sets at about 8 o'clock. On the 24th he is in conjunction with Mars, being about 1¼ deg. north of the latter. Neptune is in Gemini, and rises at about 9 P. M. on the 15th. It will be a couple of months yet before he can be conveniently observed in the evening.

THE MOON.

Full moon occurs at 10 A. M. on the 6th, last quarter at 3 P. M. on the 13th, new moon at 10 A. M. on the 20th, and first quarter at 3 A. M. on the 28th. The moon is nearest us on the 16th, and farthest away on the 28th. She is in conjunction with Jupiter on the 4th, Neptune on the 12th, Venus on the 17th, Mercury on the 19th, Mars and Uranus on the 24th, Saturn on the 28th, and Jupiter again on the 31st.

On the 6th there occurs a large partial eclipse of the moon, seven-eighths of which is obscured. It is invisible in America, but can be seen throughout Asia and in part of eastern Europe and Africa.

Florence, Italy, September 3, 1903.