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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.

RAILROADS IN SWEDEN TO USE ELECTRIC SYSTEM.

The Swedish government is thinking seriously of using electric traction on the State railroads, the current to be obtained from the numerous waterfalls which are found in that country. To this end Parliament has been asked to vote a large grant for the transformation of the system. Preliminary trials are to be carried out on a section of the Varta railroad, also on a portion of the line running from Stockholm to Jarfra. The current for this purpose will be furnished by the Stockholm central station and from a temporary plant which is to be installed at Tomteboda. Four large electrical firms have already submitted plans for the trial of their systems, the Siemens-Schuckert, Allgemeine, Oerlikon, and English Westinghouse companies. While the movement is taking place in Sweden, the same question has come up in Switzerland, another country possessing large water power. A conference recently held at Berne, in which were represented the government and private railroad lines and also the leading engineers and electrical constructors, appointed a commission which is to make the preliminary investigations and draw up a series of propositions within one year. In Italy, where a number of electric railroads are working successfully, it is now proposed to use electric trains on the Milan-Venice railroad, using the third-rail system which is at present employed on the Milan-Varese line.

RECENT EXCAVATIONS AT CARTHAGE.

M. Gauckler, whose work in the excavations at Carthage is well known, has lately made an interesting discovery, having found one of the most important constructions of the Roman epoch. This is the theatre where Apuleius held his conferences, which is often mentioned by Tertullian and St. Augustine. It seems that the edifice was built at the beginning of the second century A. D., and was afterward destroyed by the Vandals. No exact indications have been given as to the site of the edifice, which was often confounded with the Odeon, recently uncovered near by, and it was supposed to have been entirely destroyed. The present excavations now elucidate this problem. The first trench which was opened in the supposed axis of the theatre proves that the structure is preserved in a fairly complete state, buried under 25 feet of earth, and that its dimensions are colossal. At the present time the excavators are approaching the stage and are beginning to discover the architectural decoration of the latter, with its capitals and cornices. Before long it is hoped to find statues and various ornaments analogous to those which were discovered in 1900 on the site of the Odeon. At present a very fine oval cameo upon agate has been brought to light. It represents the head of Pallas-Athene, bearing a helmet. The head is in white upon a background of pale yellow.

WAVE-OPERATED CLOCKS AT PARIS.

M. Bigourdan has been making experiments in Paris on a system of wave-operated clocks, and proves that such a system can be practically operated and would be of considerable value in a large city. Paris has already a system in which fifteen electric clocks in different parts of the city are connected with the Observatory. But the system is costly on account of laying the wires, and its use is limited. The wave method is cheaper and more practical. A main clock which operates an electric contact each second, works a relay which sends current into the primary of an induction coil provided with an oscillator. The secondary thus gives an oscillatory discharge for a very short time, which is regular for each second. By using a mast, the signals can be sent to the receiving clocks. Two kinds of receivers are used. The simplest is a radio-telephone of the Popoff-Ducretet pattern, in which a beat is heard each second. The second is the receiver of an ordinary wireless telegraph receiver. Better signals are formed by using a chronograph band and pen to replace the ordinary Morse band. With this apparatus, which unrolls one centimeter of band per second, the time can be read within 0.02 seconds. The experiments were made at 1.2 miles distance, and this could easily be increased. To number the seconds the emissions would occur at the zero second of each minute, and an interruption could be made at intervals of 10 seconds. Such a system would be a great convenience for scientific and industrial establishments, watchmakers, and other places where correct time is needed.

THE GREAT SIZE OF THE ST. LOUIS EXPOSITION.

The American people are credited with a love for big things; and if the mere element of bigness were its strongest attraction, the great Exposition at St. Louis ought to be the most popular and successful of the many exhibitions of the kind to which the country has been treated during the past decade. Yet anyone who is present on the grounds, and takes careful note of the vast throngs which are to be found trying to make the round of the two square miles that are devoted to the Exposition, will be forced to the conviction that if the mere size of the Fair is an attraction, it is an attraction that is more of a sentimental than of a practical character; for it must be confessed that for the average visitor, with only limited time at his disposal, the Exposition of 1904 is altogether too big.

Judged from the merely spectacular side, the vast proportions on which this enterprise has been planned and carried out have served their purpose well; for a view of this wonderful congregation of buildings, taken, let us say, from the steps of the great Festival Hall, is certainly as magnificent, beautiful, and artistically impressive as anything that could well be imagined. But when, after giving himself up to the emotions that are aroused by this splendid panorama, the like of which will probably never be seen again, the visitor sets himself resolutely to the work of inspecting the buildings and their exhibits, the conviction is soon borne in upon him that to gain anything more than a cursory glimpse would be a work calling for several weeks, if not months, of study. The problem is particularly serious, if he is desirous of following up only certain lines of exhibits, which may be, and probably are, scattered throughout several different buildings on the grounds. The exhibition palaces themselves are so immense, the distances between them so great, that it is impossible to follow out a line of investigation of this kind consecutively, day after day, without becoming practically exhausted.

Now we say this, not in any spirit of unkindly criticism, but merely to draw attention to the fact that in the endeavor to make an International Fair of this kind represent, by its vast proportions, the extent of the resources, the range of the industries, of the country which it represents, the limits of practical usefulness have been far exceeded. It must already have forced itself upon the sponsors of this exposition that future exhibitions of the kind must be restricted in their dimensions.

The difficulties of adequately seeing the Fair and inspecting in detail the various exhibits, might have been largely reduced if the Intramural Railway System had covered at least four times as much ground as it already does. At present, as actually built, in making the outside circuit of the grounds it covers a total distance of about eight miles; and when we remember that the Exposition grounds, which are in the form of a parallelogram, measure one mile in width by one and three-quarters miles in length, it can be understood that the distances across the main group of buildings, encircled by this road, are necessarily very great. Had intersecting lines of track been run in gridiron fashion through the main plazas and causeways, the problem of transportation would have been greatly simplified. Nor would the presence of these tracks have marred the landscape and architectural effects. So vast are the various plazas and courts, that the presence of the trains would scarcely have been noticed.

To give some idea of the great scale upon which the place is laid out, let us consider one single building, the Palace of Agriculture. The plan of this structure is a parallelogram, which extends in width for five hundred feet and in length for sixteen hundred feet. It contains eight or nine corridors, each sixteen hundred feet in length, crowded each of them on both sides with exhibits, and it is intersected throughout its full length with numerous transverse corridors. This means that anyone wishing to cover the whole field of exhibits within this single building, would have to walk at least three or four miles. The other industrial palaces, though not so large as this, are every one of them of great proportions. Thus the United States Government Building is 250 feet wide by 800 feet long; the Palace of Mines and Metallurgy is over twice that width and of about the same length. Then we have the Palace of Manufactures, 1,200 feet in length by 525 feet in width; the Palace of Varied Industries of the same dimensions; and the Palace of Transportation of the same width, but 1,300 feet in length. And so it runs, each of these buildings containing a covered acreage that would represent a large proportion of the total area that was under roof at the Centenniai Exposition at Philadelphia.

To those people for whom the theories of Bellamy have an attraction, the problem of attempting to house 5,000 people in a single hotel within the grounds will present a decidedly interesting study. Of course, nothing of the kind, or even approaching it, has ever before been attempted; and considering the ambitious scale on which the hotel is being run, probably the guests are securing about all they can reasonably ask for. But here again the distances to be traversed become a serious problem, as may be judged from the fact that the writer, on starting out for the day, found that a rainstorm was threatening, and in returning to his room for an umbrella had to cover nearly half a mile of walking before he was back at the main entrance.

However, it must, in all fairness to the management of the fair, be admitted that having once planned it upon such a stupendous scale, they have carried out their work with commendable success. And to those who come to the Exposition with time to study its marvelous assemblage of exhibits, leisurely and with patience, it will yield a fund of information and a marvelous range of sights and sounds and impressions that must prove for many a year to come a subject for pleasant and profitable recollection. The number of Americans that have the means and leisure for foreign travel is at best but a small percentage of our population; and every one of this great majority should, if he be able, avail himself of this opportunity to study this "pocket edition" of the great world in which we live.

NEED OF COTTON-PICKING MACHINES.

The high price of cotton in the past year, with little promise of a return to former low prices, has stimulated unusual inquiry into the causes, and made the question of cotton planting, picking, and manufacturing of paramount importance. The part that machinery has played in the development of our cotton industries in this country has greatly affected conditions that existed half a century ago; but to some extent it has still left untouched the most expensive department of the cotton industry. While machinery has been successfully invented for harvesting and planting nearly all of our other agricultural crops of importance, such as corn, wheat, rye, and many of our fruits and vegetables, the gathering or picking of cotton is still done by hand in the most expensive way.

The harvesting of the cotton crop represents the largest item in the cost of production, and consequently the demand for adequate machinery for doing the picking increases each year in proportion to the advance in prices and the steady increase in consumption. The labor item for harvesting cotton is so large that it would seem reasonable to justify the economic need of slaves as in the old days before the war. The early cotton planters claimed that cotton could not be made a profitable industry without slaves, and to some extent their view was a correct one. Unless machinery could be invented to take the place of the cheap slave labor in the cotton fields, cotton growing either could not prove profitable or the consumers would have to pay higher prices for the commodity.

The latter condition has resulted, and it is doubtful if prices for cotton will ever go down to their former low level until some successful cotton-picking machinery has been invented. In picking and harvesting upland cotton about twenty per cent of the entire cost of production is used up in this one item, while it takes even more for harvesting sea-island cotton. In the harvesting season of cotton in the South, the difficulty of getting sufficient pickers is the one great reason why the acreage is not extended. It is comparatively easy for a cotton grower to raise a good acreage of cotton, but when he comes to consider the question of harvesting it, he stops to consider whether it is wise to increase his responsibilities. Thus a farmer with modern machinery for plowing, harrowing, planting, and cultivating can raise thirty acres of cotton without depending upon hired help; but in the harvesting season he would have to employ four men at least to pick the crop during the harvesting months of fall and early winter. It is often necessary that the crop be picked within a month to secure the best results, and in that event the picking force would have to be more than doubled.

Cotton picking to-day is much what it was a century ago. There has been no gain or improvement in the method. The slave darky of ante-bellum days could pick as many pounds of cotton as the free darky of to-day. A fair average day's work for a picker is about 100 pounds of seed cotton. Allowing 130 days for the harvesting season, each picker working steadily would thus gather 13,000 pounds of seed cotton as his share

of work. In 1903 the total Southern cotton crop amounted to 10,205,073 bales, which was only a slight increase over the average for the past five years. To gather such a crop within the harvesting season of 130 days, it would therefore require 1,088,000 laborers if each one picked his quota of 100 pounds of seed cotton per day. The cost of paying this army of pickers at current market wages in the South would amount to more than 10 per cent of the total value of the whole crop. According to statistics last year the amount paid for picking the crop approximated $70,750,000.

What other crop in the country requires such enormous expenditures for gathering? Not even the tea crop of China and India, where picking is done entirely by hand, equals this stupendous item. The tobacco and sugar-cane crop likewise must be gathered by hand, and no adequate machinery for harvesting them has yet been invented; but in their case nothing like 10 per cent of the total valuation of the crop is expended in the harvesting.

Cotton production is thus limited chiefly by this absence of mechanical appliances for harvesting. Prior to the invention of the cotton gin, the culture of cotton was restricted in the same manner as it is to-day; but immediately after this invention the expansion of the industry was noteworthy. Almost within a decade the industry rose from almost nothing to the leading one of the South. It is not too much to expect that the discovery of a successful cotton-picking machine would almost immediately extend cotton culture so greatly that the world's supply would be doubled, and the price reduced nearly one-half, while the growers would enjoy a degree of prosperity not experienced by them for years.

There have been numerous attempts to invent cotton-picking machines; but all of them have revealed such defects in practical operation that they have not been generally adopted by the growers. Yet it is not clear to inventors that these difficulties are of an insurmountable nature.

Prior to the invention of machinery for extracting cotton-seed oil from the waste cotton-seed, the profits to the growers were far less than at any time in the history of the industry. The cotton-seed compressor and extractor almost immediately gave to the waste product of the cotton farm a new value, which has steadily increased ever since. The cotton-seed oil has been found of use as a substitute for olive oil, linseed oil, lard and even for some illuminating oils. To-day there are over seventy-five crude oil mills engaged in handling cotton-seed oil; nearly eighteen refineries; fifteen cotton ginneries; five mammoth cotton-seed oil compressors; ten soap factories; five cottolene and lard factories, and several fertilizer mixing plants, all dependent upon the cotton-seed for their raw material. The various articles manufactured from the oil or the seed-oil cakes used for fertilizers aggregate a value of over twenty millions of dollars a year.

The utilization of a by-product that creates industries valued at millions of dollars is one of the highest achievements of modern invention of machinery. Agricultural machinery invented for simplifying the work of planting, cultivating, and harvesting of crops has added more to the wealth of the country than all other classes of machinery. The planters, cultivators, and harvesters have doubled and tripled the yield of wheat a dozen times over. The American crop of cereals could not be garnered by hand to-day without enlisting the continuous service of ten million laborers during a good part of the summer and autumn seasons. Fully a seventh of the population of the country would thus be required to gather the grain crop, and the other six-sevenths would probably be needed in doing the other agricultural labors of the country, leaving no one to attend to the manufacturing and commercial pursuits.

Hundreds of millions of dollars are invested in the manufacture of harvesting, planting, and cultivating machinery and implements, and they enable the American farmer to secure more from an acre of land at less cost than he could possibly do without machinery. While intensive farming in the United States has never reached the same development as in parts of Europe, the use of improved agricultural and labor-saving machinery for harvesting and cultivating crops has been carried to a much higher point of efficiency than elsewhere on the globe. It is doubtful if the American farms could much more than feed our own population without modern machinery, and our exports of farm products would immediately cease.

In the future of cotton raising the introduction of machinery for harvesting the crop can alone transform present conditions and increase the present output to any great extent. With the high cost of picking threatening them, the southern cotton growers refuse to increase their acreage beyond a point where they can safely count upon getting the cotton harvested within the limited fall season.

The few cotton-picking machines that have been invented have invariably proved inadequate. To do the work rapidly and thoroughly the machinery must be delicate and almost human in its operation. The fiber of the cotton plant is the wing of the seed, and it is soft and fleecy, ready to be blown away by the wind. To pick this fiber requires expert manipulation of hands that can separate it from the boll without injuring the fiber itself. The gathering of the cotton from the boll with the fingers is not difficult, but to invent machinery to do this is complicated.

Modern improvements of cotton by cultivation and selection have lengthened the staple, and made picking far easier, introducing conditions more favorable for machine harvesters. Thus through plant breeding and selection sea-island cotton of our Southern States has been raised from a common wild plant that seldom matured its seeds, and with a staple less than one inch in length, to handsome plants with fiber from two to three inches in length, and strong and fine as silk. In fact, the finest grades of the improved sea-island cotton plants are used to adulterate silks, and the price they bring in the market is double that paid for the ordinary grades. The influence of breeding and cultivation in making longer fibers has also increased the yield. Some of the heavier grades have been made nearly to double their annual yield, and the amount raised per acre is thus increased.

Thus the cotton problem becomes a mechanical more than an agricultural question. The growers have almost reached the limit of improvement, and science has nearly exhausted methods for increasing the yield chemically and culturally; but the inventor's field is still unexploited, and is waiting for the genius to come and claim a rich reward.—George Ethelbert Walsh.

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH.D.

The summer constellations are now well visible, and this is a good month in which to learn to know them.

If we go out at nine o'clock on a clear evening in the middle of August we will see the Milky Way, forming a great arch across the sky and passing almost overhead. Many of the finest constellations in sight lie near it, and we will begin with them.

Near the horizon, a little west of south, is Scorpio, the most brilliant of the twelve zodiacal constellations. Its brightest star, Antares, is fiery red in color, and is accounted the reddest of all the bright stars. A fainter white star flanks it on each side. The vertical row of three stars on the right makes the Scorpion's head and claws, while its tail is formed by the long line of stars which descends from Antares almost to the horizon, and curves back to the end in a bright group, which is conspicuous even at the low altitude at which we see it.

Antares is doubly worthy of attention by those who possess telescopes, as in addition to its splendid color and fine banded spectrum, it is double, having a green companion of the seventh magnitude at a distance of about three seconds. On account of its nearness to the principal star, it can be well seen only when the air is steady.

To the left of Scorpio lies Sagittarius, whose principal configuration is the little inverted "Milk Dipper," composed of five fairly bright stars. Above it the Milky Way is full of bright patches and knots, which afford many fine telescopic fields. Some of the star clusters and nebulæ in this region are distinctly visible in a field-glass.

The bright star higher up, almost on the central line of the Milky Way, is Altair in Aquila. It is one of the nearest of the brighter stars, coming next to Sirius and Procyon in order of distance. The next constellation to the north of Aquila is Cygnus, which is easily identified by the fine cross of stars whose axis lies along the Galaxy. West of Cygnus, and almost overhead, is Lyra, whose principal star, Vega, is the brightest in this part of the sky. The region east of the Milky Way is not so brilliant. The most prominent group is the great square of Pegasus, which is now about an hour high in the east. The constellation is a large one, and extends westward from the square half way to Altair, leaving room between them for the little group of Delphinus.

Aquarius and Capricornus, which are lower down in the southeast, have no very bright stars, but Saturn, which is now in the latter constellation, is decidedly conspicuous. The brightest star in the western sky is Arcturus, which is almost due west, and about half way down to the horizon. The rest of Boötes lies north and east of it. A line from Arcturus to Vega passes first through the semicircle of Corona Borealis, and then through the keystone-shaped figure which is the most recognizable feature of Hercules, whose other stars extend some distance both north and south. Farther down between Hercules, Aquila, Scorpio, and Boötes a large space is filled by Ophiucus and Serpens—two constellations which are so inextricably confused that one must use a star-map to tell which stars belong to each.

Of the circumpolar constellations Ursa Major is in the northwest, to the left of the pole. The fore-parts of the Bear are too low to be well seen, but the Dipper is still conspicuous.

Draco lies above Ursa Major, extending to the meridian. The Dragon's head is marked by a conspicuous group of four stars about one-third of the way from Vega toward the Dipper. His body extends first eastward, then northward, and then bends back in a long curve, inclosing the Little Bear, so that the end of his tail lies between the Pointers and the Pole Star.

Cassiopeia and Cepheus lie in the Milky Way on the other side of the Pole, and Andromeda and Perseus are rising in the northeast.

THE PLANETS.

Mercury is evening star throughout August, and is visible in the evening twilight for most of the month. On the 1st he is close to the bright star Regulus. The two set at about 8 P. M., so they will not be easy to see. Later on the planet is more easily visible. He reaches his greatest elongation on the 19th, when he is more than 27 deg. from the sun—about as far as he ever can be, as seen from the earth. He is, however, some 10 deg. farther south than the sun, and is consequently not as conspicuous as he was in the spring. But as he sets an hour later than the sun all through the middle of the month, he ought to be seen without much difficulty. Venus is also morning star, but is still too near the sun to be visible to the naked eye.

Mars is morning star in Gemini and rises about two hours before the sun. On the 12th he is nearly in line with the two bright stars, Castor and Pollux, which may aid in finding him.

Jupiter is in Pisces and will soon be conspicuous in the evening sky. He rises before 10 P. M. on the 15th, and is well observable after midnight. Transits of his satellites may be seen on the nights of the 2d, 7th, 9th, 14th, 16th, 18th, 23d, 25th, and 30th.

Saturn is in opposition on the 10th, and is visible all night long. He is better placed for observation than he has been for several years, though he is still a good way south of the equator. He is in Capricornus, a long distance from any bright star, so that he can hardly be mistaken for anything else.

His rings are seen more nearly edgewise than in the last few years, and consequently appear narrower, so that the ball of the planet projects conspicuously beyond them at each side. The apparent orbits of his satellites are also becoming narrower, for the same reason. The fainter of these interesting bodies can only be seen with large telescopes, but the brightest one, Titan, is easily visible with a small instrument. It may aid in identifying him to know that he is north of the planet on the 3d, east on the 7th, south on the 11th, and west on the 15th, the positions repeating themselves regularly in the satellite's period of 16 days.

When north or south of Saturn his apparent distance from the planet is about equal to the greatest diameter of the rings, but when east or west of him it is about four times as great.

Uranus is evening star in Sagittarius. His position on the 15th is R. A. 17 h. 43 m., dec. 23 deg. 36 min. south. He is not near any conspicuous star, but if his place is plotted on a star-map, he can easily be found.

Neptune is morning star in Gemini, and rises at about 2 A. M. in the middle of the month.

THE MOON.

Last quarter occurs at 9 A. M. on the 4th, new moon at 8 A. M. on the 11th, first quarter at 11 P. M. on the 17th, and full moon at 8 P. M. on the 25th. The moon is nearest us on the 12th and farthest away on the 26th. She is in conjunction with Jupiter on the 3d, Neptune on the 8th, Mars on the 9th, Venus on the 12th, Mercury on the 13th, Uranus on the 20th, Saturn on the 24th, and Jupiter again on the 30th. None of the visible conjunctions is close.

An occultation of the fourth-magnitude star Gamma Tauri, which takes place early on the morning of the 6th, is visible in the eastern part of the United States. As seen from Washington, the star disappears behind the moon's bright limb at 1.56 A. M. and reappears from behind the dark limb at 2.55.

The times of the phenomena will vary for different places, being in general earlier for places farther west.

Cambridge, England.

The Michigan Central Railroad officials have for some time been considering the proposition of bridging the Detroit River at Detroit, Mich., but it is said that there is a strong possibility that these plans will be entirely abandoned, and the crossing effected by tunnel. Representatives of the company have been investigating the tunnel work around New York, and a careful examination of the Detroit River bed is now being made; and if the reports are as favorable as anticipated, the work will probably be commenced at an early date. The work is authorized by charters which have already been secured from the United States and Canadian governments. It is said that the tunnel route has many excellent features to recommend it.