SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) .... $3.00 a year
Scientific American Supplement (Established 1876) .... 5.00 "
Scientific American Building Monthly (Established 1885) .... 2.50 "
Scientific American Export Edition (Established 1878) .... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MAY 7, 1904.

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.

COMMEMORATION OF THE LOUISIANA PURCHASE.

The huge industrial exposition on the banks of the Mississippi, which has now opened its gates to the world, is a worthy commemoration of one of the most important steps in the development of the United States. In view of the vast extent of the country—over one million square miles—which was acquired from the French government; the splendid field which it opened for the restless energy of the young republic; and the unparalleled growth in prestige, population, and wealth that has followed, it was necessary that any national commemoration of the anniversary of the Louisiana purchase should be carried out upon a scale that was commensurate with its intrinsic importance, and with the splendid results to which we, the posterity of a hundred years later, are the fortunate heirs.

That the St. Louis Exposition will be worthy of the event which it commemorates is shown by the vast scale upon which it is laid out, the architectural magnificence of the individual buildings, and the well-considered and harmonious plan upon which they are grouped. If mere size is to be taken as a standard of merit, the St. Louis Exposition will surely justify its existence. In point of area it covers no less than 1,240 acres, which invites comparison with the 733 acres of the Chicago Exposition, the 336 acres required for the Paris Exposition, and the 300 acres of the Pan-American Exposition at Buffalo, all three of which do not much more than equal the area of the present Exposition grounds at St. Louis. So again, if we compare the total area that is actually roofed over by the various buildings, great and small, we find that while Chicago had 82 acres, Buffalo 15, and Omaha 9 acres under roof, the main exhibit buildings at St. Louis cover 128 acres. The total cost will reach the huge sum of $50,000,000, of which $15,000,000 has been contributed in equal parts by the United States government, by the city of St. Louis, and by private stockholders. This sum has been swelled by the appropriations of States and Territories, and of the various foreign governments, and by the expenditures by the various exhibitors and concessionaires. The response of foreign governments has been most liberal, Germany and France spending over $1,000,000 each, Brazil $600,000, while Great Britain, Mexico, China, and Japan each are spending over half a million dollars. The individual buildings themselves are on a scale commensurate with the exhibition itself. The Liberal Arts and the Mining and Metallurgy buildings each cover a space of 750 by 525 feet. The Government Building, conspicuous by its splendid burnished dome, covers 800 by 260 feet. The Palace of Manufactures and the Palace of Varied Industries each extend 525 feet in breadth by 1,200 feet in length. The Transportation Building, 559 feet in width, is over 1,300 feet in length; while to crown all in point of size, as is fitting, considering that the agricultural interests are the greatest of all interests in the United States, is the building devoted to agriculture, 500 feet in width and 1,600 feet in length.

The men who negotiated for the United States the purchase of the Louisiana territory have left abundant evidence of their farsightedness. They believed in the future growth of the young republic; though whether, in their most sanguine moments, they dreamed of such a growth in population and wealth as we witness to-day, is much to be doubted. In 1803, when the transfer was made, the population of the United States was about 5,500,000 souls, our western boundary was marked by the Mississippi River, and the center of population was about thirty miles northwest of Washington, D. C. In 1820 the population had grown to 9,638,453, and its center was at a point about 16 miles north of Woodstock, Va. The westward migration was so greatly stimulated by the opening of the Louisiana territory, that the center of population moved steadily westward, and by 1840 the 17,000,000 souls in the United States found their center at a point 16 miles south of Clarksburg in the present State of West Virginia. Twenty years later, in 1860, the population had almost doubled, having reached a total of 31,443,321, and its center was to be found at a point 20 miles south of Chillicothe, Ohio, at about the center of the southern boundary of that State. By 1880, the center had moved westward along the southern boundary of Ohio until it lay at the point where the States of Ohio, Indiana, and Kentucky meet, and the total population had grown to a little over 50,000,000 people. Twenty years later the Census of 1900 showed that our population had reached 75,568,686, with its center in the southern suburbs of the city of Columbus, Ohio, or about 240 miles from the city of St. Louis. Judging from the fact that in the last ten years, from 1890 to 1900, the westward progression of the center of population was only about half as much as in the ten years 1880-90, it is questionable whether the center will have moved to St. Louis or to any point on the Mississippi River, before the second centennial of the Louisiana purchase has been celebrated.

BATTLESHIP OR TORPEDO BOAT.

It was inevitable that the unbroken series of disasters to the Russian battleships should stimulate into renewed activity those people who believe that the battleship is a cumbersome and costly type of war vessel, that has outlived its usefulness. This was proved in a recent discussion in Congress, when several prominent members, one of whom at least is closely connected with naval affairs, seriously advocated the abandonment of all battleship construction. The argument adduced was the familiar fallacy that because a ship costing six or seven million dollars can be destroyed in a few minutes by the attack of an insignificant torpedo boat, or sunk by a mine, it would be better to build smaller ships and more of them. "Let us have done with 12-inch guns and foot-thick armor," said one; "give me the fast cruiser and the 8-inch gun, which is big enough to sink any ship afloat."

We are not going to reiterate the well-known arguments in favor of the big battleship. They are as well known to our readers, doubtless, as they are to the gentlemen in Congress, who just now seem to be seized with something of a panic because of the Russian disasters. What we do wish to state, is that while the torpedo boat and the submarine mine have given fresh demonstration of their deadly powers, nothing whatever has occurred to prove that the battleship has outlived its usefulness. The loss of these vessels must be viewed carefully in the full light of the circumstances under which it happened. On the night of the attack at Port Arthur, there is no question that the Russians were totally unprepared. An article published recently in one of our leading dailies, by a correspondent who was on board a passenger steamer that lay with the Russian fleet in the outer roadstead, makes it perfectly clear that an attack by the Japanese on that particular night was not even dreamed of.

The task of sinking these ships, judging from the description, was almost as simple as if the torpedo boats had steamed in among a fleet of anchored merchant vessels in time of peace. In saying this we do not detract one iota from the praise due to the Japanese for their alertness, dash, and skill. We simply wish to emphasize the fact that the torpedoing of the battleships "Czarevitch" and "Retvizan" and the cruiser "Pallada" proves nothing more, as regards the vulnerability of battleships, than that an 18-inch Whitehead torpedo with 200 pounds of guncotton in its nose will, if fired from close ranges of a few hundred yards, most surely disable, if not send to the bottom, any battleship afloat. This has been known for years, and the practical demonstration of the fact on that eventful night in Port Arthur has introduced into the problem of battleship construction not a single factor that was not well known before.

As to the sinking of the "Petropavlovsk," it is not denied that she was sunk by a submarine mine of some kind, and the probabilities are that it was one of several that were laid by the Japanese on the night previous to the disaster. A submarine mine may contain anywhere from 250 to 500 pounds of the most powerful high explosive. It was perfectly well known that contact with such a mine by anything that floats, battleship or what-not, meant almost certain destruction. The "Petropavlovsk" did not turn turtle because of any faults in her design, or any want of a proper margin of stability; she turned turtle because when a huge section of her bottom was blown in, the work of cutting her in two was completed by the blowing up of the magazines. It is little wonder that she went down; and it matters little whether she went down on an even keel, by the head, by the stern, or keel uppermost. It was not that the battleship was weak; but that the mine was strong. The true lesson of the loss of the Russian battleships is that these costly and most formidable engines of war are to be handled with a becoming sense of their inestimable value, and of the terrible gap that is left in the naval fighting strength of a nation if so much as one of them be lost. They are not designed for running in and out of harbors over fields that are mined both by friend and foe. They were never built as floating fortresses for harbor defense. Their place is in the open; they are pre-eminently deep-sea craft; they are designed to fight where sea room can be had, the perils of the mine do not exist, and the deadly torpedo boat can be fought under conditions that limit its powers. Had the splendid Russian fleet on the night of February 9 been concentrated, as it should have been, in the inner harbor of Port Arthur, it would not have had its wings clipped at the very opening of the war. It would have probably met and fought the Japanese fleet on the open sea, on thoroughly even terms, if not with a slight advantage in weight and numbers, and we have not a doubt that after the hard hammering of a bitterly-fought engagement in the open, the survivors would have proved to be the ships that carried the heaviest guns and the heaviest armor.

The torpedo and the mine, however, have undoubtedly added in this war to their prestige, even among those naval experts who are able to estimate the dramatic incidents of the war at their full value. The most astonishing thing is the comparative immunity with which the torpedo boats seem to have run in under the fire of the forts, whether to attack with the torpedo, or to escort loaded merchant ships for blocking the harbor. What naval men are hoping for is that there may yet be a fleet engagement in which the battleship will be given an opportunity to demonstrate its powers of attack and defense.

SOME INTERESTING FACTS ABOUT THE DEVELOPMENT OF THE EDISON STORAGE BATTERY.

In a lecture delivered before the New York Electrical Society on April 27, Mr. R. A. Fliess, the superintendent of the testing department of the Edison Storage Battery Company, traced the development of the new nickel-iron storage cell from its beginnings up to its present form, in which it is being manufactured. A number of interesting lantern slides were exhibited, showing the cell and the way it was tested in the Edison laboratory, as well as numerous discharge curves taken from the different cells under widely varying conditions. Some half dozen cells on the lecture room table showed the different steps in the development of the present type.

Mr. Edison's first experiments were made with small single briquettes of active material suspended in caustic potash electrolyte in round glass jars. By surrounding a briquette of nickel with a number of briquettes of iron and discharging it, Mr. Edison found he could obtain 1-5 of an ampere hour of current per gramme of nickel, and by reversing the process, 0.23 ampere hour per gramme of iron. These results were arrived at early in 1901 after much experimenting; and the best part of a year, during which some 10,000 tests were made, was spent in refining and improving these active materials in order to increase their capacity. Finally, in the fall of 1901, ½ an ampere hour per gramme of nickel and 0.57 ampere hour per gramme of iron were obtained, whereupon Mr. Edison set to work to build a commercial cell.

The active materials were prepared in sufficient quantity to make up a set of automobile cells, but when the first one was completed and tested, it was found that mixing the active material in bulk and in commercial quantities was quite a different matter from making a little for laboratory purposes, and that consequently the capacity of the first lot of cells was somewhat reduced.

The first machine-made cell was completed in January, 1902. This cell had 9 iron and 9 nickel plates, although the first hand-made cell had twice as many iron as nickel. Twenty of these cells were made and were tested on the road in a Baker runabout, which was first sent out equipped with the new battery on April 3, 1902. These cells, which were of the "C" type, were tested thoroughly after they had driven the runabout 2,488 miles, and, on the test discharge, they gave about 18 per cent in increased capacity. This increase, however, was due to numerous overchargings which they had received when in service, and, on receiving a normal charge afterward, they resumed their normal capacity. This appears to be a good feature of the Edison cell, viz., that if extra capacity is needed, about one-third more can be got out of it if it is given an extra long charge first. Yet this heavy overcharging does not appear to hurt the plates. The "C" type cell was, however, affected by the rates of discharge to a considerable extent. It lost 37 per cent in watt-hour capacity when discharged at five times the normal rate, as against 50 per cent loss by the lead cell at the same rate. This defect Mr. Edison set out to remedy. Another difficulty which was met with at the start was that if hard rubber was used in the cell for separation and insulation purposes, it caused the caustic potash to foam. Rubber had to be abandoned, therefore, for a time, and glass used instead. Flat, enameled, iron clamps were devised for holding the plates together and against the glass rods which were placed between them, while different arrangements of glass tubes on steel plates had to be devised and tested for insulating the plates from the bottom of the jar. All this took a great deal of time, as Mr. Edison was very thorough. Later, after he had solved the problem of capacity at varying rates of discharge, he took up again the question of rubber for insulating purposes, and finally succeeded in treating it so as to overcome the difficulties and so that it can now be used without any damage to the cell.

The "D" type cell showed a considerable advance over the "C" type. There was 35 per cent more surface area of active material in this type cell, which contained 18 positive plates of nickel and 18 negative plates of iron. When discharged at a 150-ampere rate, this cell gave only 4 ampere hours, or 2 per cent, less capacity than when discharged at a 10-ampere rate, and there was no difference in ampere hour capacity between a 30- and a 120-ampere discharge rate.

The present, or "E" type, cell is perfect as regards falling off in capacity at a high rate of discharge. This cell can be discharged at five times the norma' rate without any loss whatever in ampere-hour ca icity. This type of cell having 18 plates (6 iron and 12 nickel), weighs 47¾ and 54¼ pounds per horse-power-hour at a 30- and 120-ampere discharge rate respectively. At the former rate of discharge, the "E" cell gives 15.56 watt-hours per pound as against 14.7 watt-hours per pound—the figure given by Dr. Kennelly in his paper read in May, 1901. The comparison between the lead cell and the nickel-iron cell was neatly made by a photograph showing two of the latter cells in one pan of a balance, which was elevated by a single lead cell in the other pan. The lead cell weighed 27½ pounds against 25 pounds for the two Edison cells (which is equal to a net gain of 9 per cent in weight), and the latter had 34 per cent more energy, their watt-hour capacity being 375. The space they occupied, however, was only slightly greater than that taken up by the lead cell. The three sizes of cells that are now being manufactured are a 12½-pound, 18-plate, 110-ampere-hour cell; a 17¼-pound, 27-plate, 165-ampere-hour cell; and a 28-pound, 45-plate, 275-ampere-hour cell. These cells, by a considerable overcharging, can be made to give 140, 220, and 350 ampere-hours respectively. The first cost of an Edison battery is nearly double that of a lead battery of equal capacity, a fact mentioned not by Mr. Fliess, but by one of the audience who took part in the discussion. At a four-hour rate of charge, Mr. Fliess claimed for the Edison battery 55 to 60 per cent watt hour efficiency, while the watt hour efficiency of a good lead battery is about 75 per cent. Discharging the Edison cell at high rates for short periods decreases the energy output but slightly. Between the normal and five times the normal rate of discharge, the efficiency of an Edison cell varies between 55 and 44 per cent only, while the efficiency of a lead cell under the same conditions varies from 75 per cent to 38 per cent.

If the battery is charged in two hours at 75 amperes instead of in 3¾ hours at 40, the total loss in efficiency due to the use of this high rate is only 6.6 per cent, whereas the saving in time amounts to 46 2-3 per cent. At still higher rates of charge, such as 120 amperes for 2¼ hours instead of 30 amperes for 9 hours, the loss of efficiency in output increases in a slightly greater ratio than that of the saving in time. For instance, in the case just cited, there is a saving of 75 per cent in time, with a loss of 12 per cent in efficiency. The voltage on charge reaches 1.85 volts when the cell is about two-thirds charged. From that point on, the charge curve is a straight line, no matter how much longer the cell is charged. On this account there is no way of telling when the cell is charged, except by keeping account of the amount of current that has been put in. A recording ammeter for the discharge and charge will of course overcome this difficulty.

With regard to the durability of the cell, Mr. Fliess stated that a three month's test in a specially devised bumping apparatus, during all of which time the cell was being constantly charged and discharged, failed to show a loss of active material or capacity. Tests on the road covering over 5,000 miles under the most severe conditions failed to cause any deterioration. This would go to show that the life of the Edison cell is extremely long.

THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

Though the evening skies are not very brilliant at present, there is yet much worth seeing in them. In identifying the principal constellations, let us begin with Ursa Major, which, at our usual hour of 9 P. M. on the 15th, lies just north and west of the zenith, the Dipper being most nearly overhead. The star at the bend of the handle—Mizar—is a fine naked-eye double, having a companion of the 5th magnitude, at a distance of some 12 minutes of arc.

Following the curve of the dipper-handle to the southward, we pass several fainter stars in Boötes, and reach Arcturus, the brightest star in this part of the sky. Half way down from this to the horizon, and rather to the right, is the fainter Spica, the principal star of Virgo. Below it and to the right is the little group of Corvus.

Leo lies southwest of the zenith, and Hydra occupies the dull region below him and Virgo.

A series of brighter constellations lies along the course of the Milky Way, which skirts the horizon pretty closely from west through north to east.

Canis Minor is almost due west, Procyon being still an hour high. North of it is Gemini, and then Auriga. Perseus has almost set in the northwest, but Cassiopeia is still visible, right under the Pole. Cepheus comes next on the right, and then Cygnus, which is just rising. Lyra is higher up, so that Vega is the most conspicuous star in the northeastern sky.

Ophiuchus and Serpens are rising in the east, and Scorpio in the southeast. Hercules and Corona Borealis, which lie between Vega and Arcturus, and Draco, which is between them and the Pole, are the only other prominent constellations.

Observers south of latitude 30 deg., that is, in southern Florida and Texas and farther south, can see the Southern Cross at this season, low on the horizon, and, a little later, the two bright stars of Centaurus, which lie some 15 deg. east of the Cross, and point to it.

Certain recent observations relating to some of the asteroids are of sufficient interest to deserve mention here. It will be remembered that these small planets are, for the most part, too small to be seen as disks even in the most powerful telescopes. Only the four brightest ones have measurable diameters, and Prof. Barnard has found that these are from 200 to 500 miles in diameter. Many of the fainter ones must be less than 50 miles in diameter—probably less than 20; and telescopes several times more powerful than any now existing would only show them as star-like points.

There would seem to be no hope of finding out the time of rotation of such small bodies; but in some cases this can be done, as we shall soon see. The first asteroid to lend itself to such an investigation was Eros, already remarkable enough for its singular orbit and close approach to the earth. Early in 1901 it was discovered that the planet showed rapid variations in brightness, to the extent of more than a magnitude, so that at some times it was three or four times as bright as at others. Further observation showed that the changes repeated themselves in a period of 5¼ hours, during which there were two maxima of brightness, and two minima, which some observers found to be unequal in light.

As the planet changed its direction from the earth, the amount of the variation decreased, and in a few months it had become insensible.

Early in the present year it was announced from the Harvard Observatory that Iris, one of the brighter asteroids, showed similar fluctuations in light, but of much smaller range—only 3-10 of a magnitude, or about 25 per cent of the total light. In this case the period is 6¼ hours, with two maxima and two minima, as before.

Certain other asteroids have been observed to vary in brightness, but the extent and period of their variation is not yet determined.

The only available explanation of such changes in a planet's light seems to be to assume that the planet is rotating about an axis, and either that it is not spherical in form, or that some parts of its surface are much darker than others, or that both of these things happen together.

If the planet is of irregular form, and we are looking at it from the direction of its equator, we will evidently see it "end on" twice in each revolution, and broadside on twice.

The first position will give us a minimum of light, and the second a maximum. If we accept this explanation for the cause of the light-changes, the period of rotation of the planet must be twice the interval between consecutive maxima, that is, 5¼ hours for Eros, and 6¼ for Iris.

But if we assume that the variation is due to the presence of dark and light spots on a nearly spherical planet, the phases will in general occur only once in each revolution, so that we will be led to find values for this period just half as large as those quoted above. However, it is easily possible to imagine arrangements of spots which give rise to two maxima and two minima in each revolution, so that the time period remains uncertain. If we allow ourselves to assume that the planet is irregular both in shape and in the brightness of its surface, it would be possible to represent almost any observed light curve by a variety of different assumptions. Consequently, we cannot be sure of any details about the planet's surface (at least at present), though we can be certain that it rotates rapidly, and that the period is either that mentioned above for each planet, or else one-half of it. The longer periods appear on the whole to be more probable.

The rotation hypothesis affords also an explanation of the observed change in the range of the variation of Eros. If we looked at one of our hypothetical planets from the direction of its axis of rotation, the total amount of light it sent us would be constant, no matter how it was spotted, for we would always see the same side of it.

Consequently, if we assume that the planet's axis of rotation is so situated that at first the earth was nearly in the plane of its equator, but later got nearer and nearer to its pole, we can account for the decrease and final disappearance of its variations in brightness.

The idea that the asteroids may be irregular in shape recalls, and apparently confirms, the old "explosion hypothesis," which regarded them as the fragments of a disrupted planet. This theory has however been discredited by the proof that it would have required, not one, but many successive explosions to produce the present system of asteroid orbits, so that the wisest attitude appears to be to suspend judgment on the question.

THE PLANETS.

Mercury is evening star until the 13th, when he passes between us and the sun and becomes a morning star. He is usually nearly in line between us and the sun, and if he had been in conjunction a day earlier, he would have transited across the sun's disk. We need not regret this seriously, however, as there will be a transit in 1907. He is practically invisible to the naked eye throughout the month.

Venus is morning star, but is inconspicuous, as she is getting near the sun. On the 1st she rises about an hour before him, but the interval decreases to about half an hour at the end of the month, when she will be hardly visible.

Mars is evening star until the 30th, when he is in conjunction with the sun and becomes a morning star. He is entirely invisible throughout the month.

Jupiter is morning star in Pisces, rising at about 3 P. M. on the 15th, and is fairly conspicuous.

Saturn is morning star in Capricornus. On the 11th he is in quadrature with the sun, rises at 1 A. M., and comes to the meridian at 6 A. M.

Uranus is in Sagittarius, and comes to the meridian at 2:20 A. M. on the 15th.

Neptune is in Gemini, and sets about three hours after the sun.

THE MOON.

Last quarter occurs at 7 A. M. on the 7th, new moon at 6 A. M. on the 15th, first quarter at 5 A. M. on the 22d, and full moon at 4 A. M. on the 29th. The moon is nearest us on the 22d, and farthest away on the 8th. She is in conjunction with Uranus on the 3d, Saturn on the 7th, Jupiter on the 12th, Venus on the 13th, Mercury on the 14th, Mars on the 15th, Neptune on the 18th, and Uranus again on the 30th.

Cambridge, England.

ACTION OF RADIUM ON METALS.

Mr. N. Orloff, as stated in a recent communication to the Russian Phys. Chemical Society, covered in April, 1903, an ebonite capsule containing 0.03 gramme of radium bromide with an aluminium plate, 0.01 millimeter in thickness, instead of the mica generally used. In the course of July, the author, having opened the capsule, noted on the surface of the aluminium turned toward the radium some protuberances of the same aspect as the surrounding surface of the aluminium and resembling small drops of melted metal. These protuberances proved to be radio-active, producing a photographic image on acting for some minutes through black paper, and even after six months they were found to emit invisible radiations without any appreciable weakening. The author thinks that a stable alloy is formed by the accumulation of material particles given off from the atomic systems of radium, around small aluminium nuclei.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1479, opens with an illustrated article on the "Old and New Railway Bridges Over the Susquehanna River at Rockville." The English correspondent of the SCIENTIFIC AMERICAN describes at length an engineering novelty in the form of a powerful gasoline locomotive. Pictures accompany his article. Dr. Erlwein's interesting discussion of the purification of potable water by means of ozone is concluded. Prof. C. F. Burgess and Mr. Carl Hambuechen recently read a paper at the Washington meeting of the Electro-Chemical Society on electrolytic iron, to which subject much attention has been devoted of late. The paper describes original work in an investigation, the primary object of which was to produce, if possible, pure iron in such quantities and at such cost as to make it an available material for further inquiry into its properties. The work shows that it is possible to obtain electrolytic iron in large quantities and at a reasonable cost. Mr. William A. Robertson writes interestingly on Pennsylvania's first mountain railroad. "Sofka and Blue Dumplings, a National Indian Dish," is the title of an instructive article by William R. Draper. Charles H. Coe discusses the subject of ginseng, its character, history, commerce, and medicinal value, with great thoroughness. In a *résume* of recent studies of radio-activity, new information about radium is given.