Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico..................$3 00
One copy, six months, for the U. S., Canada or Mexico................ 1 50
One copy, one year, to any foreign country belonging to Postal Union. 4 00
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for the U. S., Canada or Mexico. $6.00 a year to foreign countries belonging to the Postal Union. Single copies, 10 cents. Sold by all newsdealers throughout the country. See prospectus, last page.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to any address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries within Postal Union, *nine dollars a year.*

Building Edition.

THE ARCHITECTS AND BUILDERS EDITION OF THE SCIENTIFIC AMERICAN is a large and splendid illustrated periodical, issued monthly, containing floor plans, perspective views, and sheets of constructive details, pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To builders and all who contemplate building this work is invaluable. Has the largest circulation of any architectural publication in the world.

Single copies 25 cents. By mail, to any part of the United States, Canada or Mexico, $2.50 a year. To foreign Postal Union countries, $3.00 a year. Combined rate for BUILDING EDITION with SCIENTIFIC AMERICAN, $5.00 a year; combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN and SUPPLEMENT, $9.00 a year. To foreign countries, $11.50 a year.

Spanish Edition of the Scientific American.

LA AMERICA CIENTIFICA E INDUSTRIAL (Spanish trade edition of the SCIENTIFIC AMERICAN) is published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number of *La America* is profusely illustrated. It is the finest scientific, industrial trade paper printed in the Spanish language. It circulates throughout Cuba, the West Indies, Mexico, Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. $3.00 a year, post paid to any part of the world. Single copies 25 cents. See prospectus.

MUNN & CO., Publishers,
361 Broadway, New York.

☞ The safest way to remit is by postal order, express money order, draft or bank check. Make all remittances payable to order of MUNN & CO.

☞ Readers are specially requested to notify the publishers in case of any failure, delay, or irregularity in receipt of papers.

NEW YORK, SATURDAY, JULY 16, 1892.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 863.

For the Week Ending July 16, 1892.

Price 10 cents. For sale by all newsdealers.

PAGE

THE GENERATION OF THUNDER STORMS.

The primary cause of the constant negative charge of electricity on our earth's surface is still an open question. Did the earth obtain it at the time of its primitive evolution from chaos, and has the charge been preserved since then, partially by an atmosphere, which cannot contain, conduct, nor convey electricity, but principally by the vacuum beyond our atmosphere, such as at present we may obtain with our improved air pumps, to such a perfection that it is an absolute non-conductor of electricity, through which not a trace of the earth's electric charge can possibly pass and be lost?

Watery vapors, which frequently float in our atmosphere, are only receptacles of electric charges, and may obtain the negative charges of the earth's surface by direct contact, for instance when a mist or fog reaches the soil, in which case the earth's conducting and negatively charged surface is transferred to the upper limit of the fog; when, now, by air currents begotten by solar heat, the fog is caused to ascend and separate itself from the earth, by which it will be repelled (having the same charge), it will give origin to negatively charged clouds which then in their turn may act inductively upon other clouds. In the same way the earth acts, and causes the nearest portion of the neutral clouds to become positive and the most distant portions negative; if then such clouds while under this inductive influence become split up by air currents, they give rise to clouds charged positively and others charged negatively, and it is seen how the inductive action repeated over and over again may under proper circumstances develop and multiply the charges and give origin to the thunder storms. This happens when the clouds discharge their excess of electricity to one another or to the earth, and so tend to restore the neutral condition, which is the electric equilibrium.

This action and reaction is beautifully illustrated by an old contrivance called the electric multiplicator, in which some condensing plates, attached to a revolving axis, are caused by the revolution of the axis to act and react inductively upon one another, and in this way cause even the small spark of an electrophorus to be multiplied sufficiently to charge a Leyden jar sufficiently to administer a severe shock.

The double plate machines, which have superseded the old friction machines, are highly improved modifications of the old multiplicator.

PATERSON'S CENTENNIAL.

The city of Paterson, New Jersey, has a peculiar history, reaching back to the days of the revolution. On the 4th inst. there took place in that city the centennial celebration of its founding. It is now one of the great manufacturing cities of this country, having a population of 80,000, of which 30,000 are active workers in the mills and workshops.

During the revolutionary war, Washington and Alexander Hamilton, so the story goes, were riding down the bank of the Passaic, and Hamilton, who greatly favored manufacturing industries, said to Washington when they came in sight of the falls: "There will be a good place to begin. Those falls will furnish the power for our first manufactories." After independence became a reality, and when Washington was President, and Hamilton Secretary of the Treasury, his thoughts reverted to the beautiful Falls of the Passaic, and he immediately set about laying the foundations for the first manufacturing city in the United States.

Paterson, a plain farmer, who was Governor of New Jersey, signed the papers for a "Society for the Establishing of Useful Manufactories," which Hamilton had organized, and a hundred years ago, on July 4, the board of directors met and settled upon a site and decided upon a name. Hamilton refused to allow the city to be called after him, and suggested the name of Paterson.

The celebration being one in a double sense, was of such a nature as to give due credit to the occasion. It began with a salute of 100 guns at sunrise. It was further celebrated by church services, the ringing of bells, more firing of guns, and a great civic parade. The throng was addressed by Parke Godwin, of New York; a poem was read by Dr. Charles D. Shaw, and an oration given by George M. Robeson. Another parade was given on the following day, supplemented by a banquet and fireworks. This latter occasion was honored by the presence of Governor Abbett.

Paterson, as will be remembered, is noted for its silk mills and iron works. About thirty companies are engaged in the manufacture of silk goods, and there is a large number of iron works, including rolling mills, forges, and two or three establishments engaged in the manufacture of locomotives.

FOR more than 2,000 years, a dressed stone containing 12,922 cubic feet—being 71 by 13 feet in size—has rested on pillars in a quarry at Baalbac, in Syria. It was intended for the foundations of the temple of the sun, a mile or more distant, to which four stones nearly as large were actually transported.

GREAT GUNS AND ARMOR PLATE.

It has been said that the day of monster guns for use on shipboard is passed, and if the failures of several 110 ton guns of 16¼ inch caliber, in the British navy, are any criterion of the causes of failure being due to large ring masses shrunk on to one continuous liner, and the series of rings only holding together by shrinkage friction, there certainly is indicated a limit to the resistance of piled-up guns of such great weight and caliber to the intense explosive action expected from their size.

Splitting of the re-enforcing hoops, elongation and warping of the liners, are some of the troubles of their trials with moderate charges. Some of the guns of less caliber have split their linings and an 8 inch and a 6 inch gun have burst on target trials.

Defects have attended the fitting of the liners, so that in two instances they have turned by the enormous friction of the projectiles in following the rifling. It is now a mooted as well as a serious question as to the life of these guns, as none have been used to their full allowance of ammunition, nor can the number of shots be safely assigned as the duty of such guns, although their immense power has been tested in a single instance with a Holtzer armor-piercing projectile weighing 1,813 pounds with a charge of 960 pounds of powder, a striking velocity of 2,079 feet per second, and with the enormous striking energy of over 54,000 foot tons, at a range of 500 feet. This shot has made a world of newspaper talk, as it penetrated a target composed of a facing of 20 inches of the Brown compound iron plate backed by 8 inches of wrought iron plate, and by 20 feet of oak timber, 5 feet of granite masonry, 11 feet of concrete, and lodged in a final backing of brick, making a clean cut of 45 feet through one of the most solid targets ever built. But, alas! it was its last shot. Having been fired only sixteen rounds, not all full charges, its chase was found to droop so much and its hoops separated to an extent as to render it useless and unsafe. It was condemned.

The large-caliber guns (16½ inch) in France have shown a marked weakness, and it is intimated through French publications that all their naval guns of over 12½ inch caliber have proved far from being satisfactory.

The enormous pressure in the chamber of a gun and its control is one of the most difficult problems that the engineer has had to deal with, ranging as it may in pressure from 4,000 to 35,000 pounds to the square inch of surface in the bore, together with the uncertainty of high explosive material in its liability to change its detonating properties by handling or storage, has created much uneasiness from the fact of the bursting of several guns of moderate caliber that were supposed to be fully equal in the factor of safety for the charge used.

The tendency in gun construction now is for medium bore, greater weight, and better material.

The heaviest gun yet made is from the works of Krupp and weighs 135 tons; it is 40 feet in length, with a bore of 13¼ inches. Its range is 11 miles, with a projectile weighing 1,800 pounds, using 700 pounds powder to the charge. This is said to be the most powerful gun in the world.

It is reported that the 119 ton guns of 15¾ inch caliber, made by Krupp for the Italian navy, have been removed from the vessels and mounted on shore for coast defense; 100 ton and 105 ton guns are the largest now in use on the battle ships of the Italian navy. Even these are of doubtful reliance, as one has failed by bursting. In the German navy the largest guns are the 12 inch bore by Krupp.

The guns made in France for the Japanese navy, of 12·6 inch caliber, 40 feet in length and of 65 tons weight, breech-loading, seem to have stood the severe test required, reaching a muzzle velocity of 2,308 feet per second, with shot of about 1,000 pounds, with powder charge of over one-half the weight of the projectile and generating a chamber pressure of over 35,000 pounds per square inch. The guns were declared satisfactory, after twenty graduated rounds, and accepted.

The tendency being now for medium bore, greater weight, and better material, and since the later development of the highest resisting power to both penetration and fracture in the nickel-steel armor plates, there is a strong presumption that nickel-steel is the *Ultima Thule* in material for not only projectiles and armor plate, but for the guns; which, with the best efforts in construction, should give ordnance of medium caliber able to bear a muzzle velocity of at least 2,500 foot seconds and a chamber pressure of over 40,000 pounds per square inch.

The largest guns of the breech-loading rifle type now making in the United States are 12 inches in bore, 36½ feet in length, weighing 46 tons, designed and projectiles of 850 pounds and 425 pound charges of powder. They are intended to attain a muzzle velocity of 2,100 foot seconds, with a striking energy of nearly 26,000 foot tons at near range. With the nickel-steel and an increase in weight to 50 tons, these guns should be able to cope with any gun of foreign make in range and penetration.

The increase in the tenacity of steel by use of a 2½ per cent nickel alloy, combined with the later process of fluid compression, will result in the addition of a large percentage to the strength and resistance of guns and armor plate, as well also to the tenacity of armor-piercing shot, which are now disposed to break up under their high velocities and the great resistance shown by the new nickel-steel plates.

The increased facilities for forging and finishing are lessening the number of hoops by increasing their length, so as to stiffen the linings and prevent the sagging which has heretofore been a source of destruction in built-up guns.

Invention a Study.

To a certain extent only is genius an inheritance; so are oratory and statesmanship. The world has produced but few Edisons or Websters or Lincolns—born geniuses, orators, and statesmen. Education and study improve all of these qualities. Necessity often develops remarkable originality. Great inventors were generally of poor parentage, and industrious thinkers are seeking a competence through their own originality. In order to accomplish this, one should study one's own capabilities and inclinations. Some prefer chemistry, others mechanism; some to working wood, others prefer metals. I was brought up on a farm, but never liked that business, and the morning I was of age (21) my father asked me what I was going to follow for a livelihood. I said, "Well, I have not fully decided yet, only that I am not going to scratch the face of Mother Earth all my life for a living." Mechanism can be quite as profitably employed in farming as in a machine shop or wood working. I started as a house carpenter at work by the month.

At that time, in Maine, there was abundant timber and but few sawmills, and they the old style of up and down sash mills that all ran by water and did not saw more than two thousand feet in twelve hours. There being long, cold winters, large barns were built of heavy hewn timber; some of the smaller parts were generally sawed. This hewn timber must be all taken out of wind and counter-lined, and mortises and all other work measured from the counter lines. A boss framer could get $2.25 to $2.50 per day. I hired with a framer at $15 a month, and when the other hands were setting down resting I was going over the work, measuring lengths and the angles of braces, etc., and questioning the boss, and by the time we got up three barns I was conceited enough to believe I could lay out the work, as they then called it. So I quit and took the job to frame a forty-foot square barn. I only charged $1.75 per day on my first job, and only took on four or five helpers. I drew my plans as best I could and went at it, and my old boss—a very nice man, by the way—predicted a failure. This somewhat alarmed the man I was at work for as a boss framer, but I assured him that I would succeed. It was "root, hog, or die" then, so I worked and studied day and night, and all one Sunday. The day came for raising, and I sent for my old boss to be there, but the result was as good a job as I ever did, and I may say ever saw done. I saw that old barn two years ago and it was then more than forty years old. When the barn was up, my old boss stood on the great beams and proposed three cheers for the new framer, which was heartily responded to by the raisers, as we called them. From that time I commanded my $2.25 to $2.50 per day, and had all I could do. I mention this merely to show what persistence may do.

I finally gave up woodworking and took up the working of metals; and of metals I think that I have taken out over two hundred patents, some worthless, of course, but most of them very valuable. I do not, nor ever did, regard myself as more than an ordinary mechanic, and rather a rough workman at that, and yet I think that I possessed one rather remarkable quality, and that was never giving a thing up that I started. Persistence seemed to be my crowning quality. More than fifty years ago I worked in Lowell, Mass. Cotton factories were then being built all through the New England States, specially in Lowell and Manchester, N. H. Cards for use in mills had all been made by hand up to about that time. To punch the holes through the leather by hand and cut off the small steel wires, bend them in U shape, stick them through, and then bend them again on the opposite side, so as to pitch them forward, was indeed a tedious and slow process.

A card maker in Lowell, whose name I have forgotten, conceived the idea of doing all these operations by machinery, so he set himself at work. The leather must be stretched on a frame, and the frame feed lengthwise the leather, and two holes punched at regular distances apart until each end was reached, then the leather must rise up for another row of holes and feed back and forth, that is, right and left. The wire was on a reel and fed by machinery to exact length, and cut off, bent to U shape, and stuck through each hole as it was made. In time his machine was perfected, all except bending the wires on the opposite side to give them the proper pitch for carding.

The inventor said that he studied day and night for months and months to devise a means, and nearly gave it up. One night he was out walking the street and in a study, when all at once the method struck him, and he went home and made a pencil sketch, and went to bed and slept soundly, and next day went to work, made the attachment, and it was a perfect success. I have stood and seen one man in Lowell operating six or seven of these machines, setting card teeth. I think that I have seen quite as many intricate machines at work as any one person, and I still think that the card-setting machine is one of if not the most ingenious machines that I ever saw in successful operation. In this inventor ingenuity, perseverance, and patience were combined.

Often some grand idea will come to a person accidentally, as the turning of irregular forms did to Mr. Blanchard. Mr. Blanchard had acquired something of a reputation for ingenuity, and as he was one day at the United States armory in Springfield, Mass., he saw the workmen polishing gun barrels; they did all by hand then. All of the barrels are tapering, and it was necessary in the last polish that the lines be as near perfectly true as possible, so that in taking sight the eye would not be misled. To do this required practice and skill; so Mr. Blanchard took a contract to build and put a machine at work that would polish perfectly about six barrels at once. His machine was set at work one Saturday, and went right off. The scourers, as they were called, were made flexible, so as to yield to the irregular shapes as they ascended and descended, and the machine was accepted and did the work of more than a dozen experienced polishers. The workmen were, of course, interested, and as they were looking on and making remarks, one said, "Well, Bill, that throws you out of a job." When a workman that came from another room said to Blanchard, "Well, mister, you can't get up a machine that will throw me out of my job," said Blanchard, "What is your job?" "Making gun stocks," said the man. "Well," said Blanchard, "I don't know. I have not studied on it." Yet Mr. Blanchard rode home, a distance of about twenty miles, and said afterward, "On my way I studied up a method to turn irregular forms, built a machine, took out a patent for it, sold the right to government for $20,000, and actually did throw that man out of his job." Said Blanchard, "I was sorry for the man, but glad for myself." That invention made him a fortune, and he died quite wealthy. J. E. EMERSON.

The Utilization of Niagara Falls.

Professor George Forbes, F.R.S., has communicated to the London *Times* a letter on the extensive works for the utilization of the Niagara Falls in the production of electricity, from which the following extract has been made. Prof. Forbes, after referring to his dreams of eight years ago, when he stood on the southern edge of the American Fall, writes:

"And now eight years after I see that the preparations are almost complete for the utilization of 100,000 horse power, and part of this power will certainly be used long before the close of the year.

"Few people in England who have heard of this engineering feat are aware of how far it has been advanced. More than a mile above the falls a canal has been cut, 1,500 feet long, at right angles to the river. A vertical shaft, 140 feet deep, is being sunk, and from a lower level a tunnel, 28 feet high and 18 feet wide and 6,700 feet long has been carried at a slope of 7 per 1,000, to issue at the foot of the cliffs below the falls, just under the suspension bridge. This work is all nearly completed. The lining of the tunnel with four courses of bricks is going on at the rate of 100,000 a day, and this rate is about to be increased. The turbines are in hand. Part of the power is to be used in factories now being built directly over shafts, and we are now preparing for the electrical transmission of power. In a year's time it is probable that the city of Niagara Falls will be lighted by this power, and the street electric railways worked by it. Factories are being erected on the vast extent of land owned by the company, which has a perpetual right to use this power over five miles of river frontage, from a little above the falls upward.

"Already thirty acres of land have been reclaimed by the company from the river, and the river is about to be deepened in front of their wharves. A railway, five miles long, all passing through the company's land, is in hand to connect the three lines of railway with the principal factories on the company's property. This will eventually be worked by an electric locomotive. Streets have been laid out, and a part has been laid aside for operatives' cottages. All this I have seen, and I recognize the foundation of an important manufacturing center. Franchises have been obtained from owners of property for a second tunnel under the city of Niagara Falls. All this has been done, and at a surprising small cost, by the energy, caution, and foresight of the directors of the company, of which Mr. Adams is the president, Mr. Wickes and Mr. Stetson vice-presidents, and Mr. Rankine (a cousin of Prof. Macquorne Rankine) the secretary. In 1890 they appointed a commission of leading scientific men in Europe and America, presided over by Lord Kelvin. These commissioners considered all the proposals submitted, and since then the company's engineers have dealt with the hydraulic problems. The Board of Engineers includes the names of such men as Prof. Coleman Sellers, Mr. Herschel, and Col. Turrentini, of Geneva. The electric part of the work is now to be carried out. In 1890, when preparing plans to lay before the commission, I proposed to employ alternating currents, using as motors either the alternating dynamo or the multiphase motor, which has since attracted so much attention at Frankfort last year. This was an innovation on previous practice, and it is worthy of record that the commission were unanimous (with one exception) in desiring to pass a resolution, saying that alternating currents were not available for the purpose. Already opinion has changed, and the subsequent progress has so completely borne out the views expressed in 1890 that we are going to adopt this method.

"It may be that what I have already written may convince many of the enormous character of this undertaking. But the importance of the company's transactions has been only half told. They have lately acquired from Canada the exclusive right to use land in the Victoria Park for the same purpose for 100 years. The river above the Horseshoe Fall, on the Canadian side, has a branch going round Cedar Island. The power house can be built here. Enough water can be brought through the branch to utilize 250,000 horse power, and the tunnel from the bottom of the shaft to the very base of the fall will be only about 800 feet long. This franchise is a most valuable addition to the powers possessed by the company on the other side.

"Many visitors to the Chicago Exposition next year will stop to see the progress of this gigantic undertaking, and they will not be disappointed, and it is a matter for congratulation that, so far as the present intentions of the company go, the beauty of the falls will not be affected nor the volume of water perceptibly diminished."

Dangers of Ballooning.

The Independence Day celebration at Boston closed with a tragedy in the upper air. Prof. G. A. Rogers, the well known aeronaut, who had made one hundred and eighteen balloon ascensions, together with Thomas Fenton and De Los Goldsmith, a reporter, made a balloon ascension from Boston Common as the final feature of the observance of the day. The balloon, when released, shot up perpendicularly, and after reaching the height of about a mile was blown seaward at a rapid rate; then it began to descend. It was supposed by observers that Prof. Rogers had opened the safety valve with the intention of descending before the balloon was out at sea. While the crowd watched, the balloon suddenly collapsed and fell into the bay; the car sank and the folds of the balloon settled over the occupants. Two of these were seen to emerge from beneath the balloon, one being Prof. Rogers, the other Reporter Goldsmith. Fenton did not come to the surface. Goldsmith swam easily and was rescued, but Prof. Rogers seemed to have sustained some injury, and just before assistance reached him he threw up his hands and sank. The body of Prof. Rogers has not been recovered; Fenton's body was brought into view as the rigging of the balloon was drawn up by the rescuing party. Fenton's neck had been caught in one of the meshes of the net. His body was warm when taken from the water, but all efforts to resuscitate him failed.

Ozonine.

A new product, called ozonine, appears to be destined to render services in the bleaching industries.

In the proportion of 15 grains to a quart of water, the product acts energetically upon fibers, wood, straw, cork, and paper, as well as upon solutions of gum and upon soaps; and the effect of the bleaching is identical in acid and alkaline solutions.

The product is obtained in the following manner: 125 parts of resin are dissolved in 200 parts of oil of turpentine, and to this is added a solution of 25 parts of hydrate of potassa in 40 parts of water and 90 parts of peroxide of hydrogen. The jelly obtained, on exposure to the light, changes in two or three days into a clear fluid, to which the name of ozonine has been given. This transformation can be obtained also in the dark, but in that case it requires several weeks for its completion.—*Le Genie Civil.*

What Patents Have Done.

Disparagement of patents is common and easy, says the *Iron Industry Gazette*, but it should not be forgotten by those who sneer at inventors that, out of a total of over $8,000,000,000 of capital invested in manufacturing in the United States, patents form the basis for the investment of about $6,000,000,000. Evidently, the United States system of encouraging invention, that has resulted in the patenting of over 476,000 inventions, is a system that is exceedingly wise and valuable. The one thing that has enabled manufactures to make so wonderful progress in the United States is the patent system.