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SCIENTIFIC AMERICAN SUPPLEMENT

No. 863.

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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.