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AN ELECTRIC GUN.

Since the perfection of the breech-loading gun the aim of the mechanician has been to insure rapidity of fire, and magazines of various sizes and forms have been devised with a view of obtaining it. Experience in the field, however, has shown that these have a serious if not fatal defect. The cartridges, pressing, as they do, the one upon the primer of the other, are likely to explode prematurely, this rendering the device especially impracticable as a military arm. A writer on this subject says:

"A French army cartridge, which is about the average weight of military cartridges in use, weighs more than 1⅖ ounces. The weight of a column of five such cartridges would be 7 ounces, four-fifths of which weight would, in a tubular magazine, rest upon the point of the bullet of the last cartridge, and which bullet comes directly in contact with the primer of the cartridge in advance of it. All ordnance officers and ammunition manufacturers realize the difficulty experienced in preparing fulminate of mercury—used for primers—that will, in practical use, always have a uniform degree of sensitiveness. It can be made so sensitive that the slightest scratch will ignite it, and many fulminate mixers have lost their lives by a moment's inattention or relaxation of caution while compounding it. While it is generally possible to produce fulminate of nearly equal quality, still different batches do vary; and whether it be from difference in the quality or from the different position or placement of the fulminate in the primer as regards the cartridge anvil, or otherwise, still it is certainly true that cartridges are to be found in use that will explode with one-half the concussion ordinarily required. It is a fact that cartridges have exploded by dropping a few inches from the machine in which they are loaded into the receptacle below."

In order to prevent the cartridges from resting upon one another, a system has been devised of placing them side by side in a metallic case, which can be attached under the breech, and when emptied replaced by another, and so on. But the mechanism is intricate, and the parts awkward to handle.

Several attempts have been made to use electricity for firing the cartridges, and thus do away with fulminate of mercury altogether.

About two years ago Colonel Fosbery, Royal Engineers, exhibited to the Royal United Service Institution an electric gun which he had brought with him from Liege. The cartridges were of the ordinary kind, but contained no fulminate of mercury. Col. Fosbery carried in his pocket a small primary battery of about the size of a two ounce vial, which was connected with the gun by a fine wire. This fired the cartridges as fast as they could be placed in the breech. For obvious reasons this could be of little use outside of a laboratory or lecture room.

Several months ago an electric gun was sent by an arms company to Captain S. A. Day, Fifth Artillery, at Fort Hamilton, for trial in the field. Captain Day, an expert in small arms, has tested this gun under all conditions and found it admirably contrived to answer the purpose, not only of a sporting gun, but also of a military arm. The mechanism is simple, the parts few, and the electrical firing contact sure. The principle is applicable to any arm. A primary battery, of cylindrical form, about 8 inches long by 1 in width, is set in the stock of the gun and connected with the primer of the cartridge; contact being made and broken by pressing on and releasing a trigger of the usual form. When this system is used, there is no need of tumbler, hammer, mainspring, or any of the ordinary safety levers used in firing percussion.

There is an electric igniter or primer inserted in an ordinary metallic base shell, and this primer can be tested before loading the shell, whereas with percussion primers, to test is to explode. The change from the percussion fire to the electric is so easy that any intelligent person can make it.

The electric primers for the shells are easily made too, and not easily destroyed by repeated firing. Captain Day says that the power of igniting charges of long proportions at any desired point along the central line, instead of at the base, as with percussion primers, or even at the wad as in the needle gun, gives the facility to burn the entire charge and under better conditions of using the expansive force. The exact point of ignition for best results should vary with dimensions and form of charge, but the power to determine at will the point at which ignition shall take place, and vary it, is given by this method. With the uniform precision of an electric point, an exactitude of performance and an economy of producing given results are secured not heretofore possible with any percussion fire.

In the recent and final trial of this electric gun, the cartridges were loaded in the field in order to show how many shots could be fired from a single shell, or rather how many could be fired without renewing the primer. In testing this, Captain Day and the writer fired alternately and repeatedly; the latter firing as many as ten rounds from one shell before it became necessary to renew the igniter. The battery is said to be good for more than fourteen thousand rounds before becoming exhausted and requiring recharging and renewal of elements. At an absolute trial in the gun works, where men fired notch by notch for weeks, we have Captain Day's authority for saying that within a few hundred rounds of 15,000 were fired from the same gun and with the same battery.

Probably the most convenient form of gun that this electro firing apparatus can be attached to is that type which has a tubular magazine, because, where no percussion is used, this seems by long odds to be the easiest handled, the weight being equally distributed, and because only the simplest mechanism is required to throw out the empty shell and send home the loaded one.

As a military arm the electric gun has great advantages. No magazine of cartridges primed with fulminate of mercury can withstand the ordeal of the manual of arms without imminent danger of premature explosion, and, as is well known, percussion cartridges rapidly deteriorate and become uncertain of fire when kept long in the field.

SHALL WATER PIPES AND GAS PIPES BE CONNECTED WITH LIGHTNING RODS?

Every man who builds a house becomes interested in the subject of lightning rods, even if the subject of electricity had failed hitherto to attract him. In placing lightning rods upon a building, the question immediately arises, "Shall the water pipes and the gas pipes be connected with the exterior lightning rod?"

Theoretically, there is no doubt that this connection should be made. Great care, however, should be taken that the connections should be large enough not to be melted by a discharge of lightning, and that there should not be any break of metallic continuity caused by paint, varnish, or cement.

In the fifth annual report of the Water Commissioners of the city of Fitchburg, Mass., this paragraph occurs:

"During a violent thunder storm on the sixth day of June, two houses were struck by lightning, one on Burnap Street and one on Milk Street. The electric fluid in both cases followed the service pipes from the buildings to the 4 and 6 inch wrought iron cement lined main pipes, and when it reached these mains its path of ruin was fearful. In some cases a length of pipe would be split from end to end, others would be perforated with holes, which in almost every case indicate that the fluid passed from the outside to the inside of the pipe. Nearly every joint on the two thousand feet of its course was opened, and one gate and two hydrants were so badly damaged as to be useless. The pipe was replaced by cast iron pipe, and the gate and hydrants by new gate and hydrants, the total cost of which was nearly $1,700. This loss is added to the maintenance account of the current year. Three times our main pipes have been struck by lightning, and each time is more alarmingly suggestive of what accidents may happen from the same cause. Cannot some electrician give us a plan of protection?"

On investigation it was found that the cement lined pipe was made as follows: The wrought iron shells were 8 feet long, made of about 18 gauge iron, lined on the inside with cement one-half inch thick, and covered on the outside with cement from one-half inch to one inch in thickness. In laying, the ends were butted together, over which is a sleeve filled with cement, about 6 inches in length, to make a water tight joint. In laying, the iron of one length does not usually come in contact with the iron of the next length, being separated by from one-eighth inch to one-fourth inch of cement.

In taking up the damaged pipe it was generally found burst from end to end; then for three or four lengths no trace of lightning could be discovered on the outside of the cement covering; but at each joint one to ten holes could be found punched from the outside of the pipe into it, from one-tenth of an inch to three-fourths of an inch in diameter; then a sleeve would be cut as smooth as could be done with a pair of snips; then a length burst; and then the lightning disappeared at a hydrant or gate.

The water mains of Fitchburg have been damaged seriously by lightning five times. In every case buildings have been struck, and the discharge has followed the supply pipes to the main; there it has divided and followed the main each way until it has reached a valve. In 1877 about 2,000 feet of mains were destroyed in one shower. In every case the damage has been confined to the old cement lined pipes.

It will be seen that the cement lined pipe when filled with water constitutes a Leyden jar, which is quickly ruptured by being heavily charged. It is manifestly unsafe to cover the iron mains with any insulating varnish unless metallic connection is made with each section of the main at the joints, and these joints are connected to the water by a unvarnished piece of iron or other metal. If cement lined water pipes are connected with the lightning rods, it is necessary to remove the cement at regular intervals to allow contact between the water and the iron of the pipes. It would be sufficient to insert pieces of iron here and there in the cement, one end of such pieces being soldered to the iron of the pipe and the other end being in free contact with the water.

If the gas pipes are not insulated from each other at the joints, there can be no danger in connecting the lightning rods with them. The electrical continuity, however, of the gas pipes should be carefully ascertained. The practice of connecting telephone wires with gas pipes shows that in most cases this electrical continuity is insured by the present method of laying the pipes.

ASPECTS OF THE PLANETS FOR JULY.

VENUS

is evening star. She wins her old place at the head of the roll, if the interest attached to her movements and the lovely aspect she presents are made the standard of classification. She is now far enough advanced on her eastward course to be plainly seen by observers who carefully study her position in the heavens before attempting to find her.

Venus moves at a rapid pace during the month, being, at its commencement, southeast of Castor and Pollux in Gemini, and, at its close, southeast of Regulus in Leo. She must be looked for a little south of the sunset point on the 1st, and about 6° south of it on the 31st.

No lover of the stars can look unmoved on this charming planet, when, after an absence of nearly a year, she is first seen in the evening twilight as, tremulous with brightness, she floats on the golden waves that succeed the sunset.

Venus has won tributes of admiration since men first began to study the stars. The shepherds of olden times paid such homage to her surpassing beauty that she was called the Shepherd's Star. She was equally well known as Hesperus and Vesper. The whole world agreed in naming her for the goddess of love and beauty, and she richly deserves the proud titles of queen of the stars and fairest of the stars. Even grim Galileo had a touch of poetic sentiment when, suspecting her phases, and fearing that some one else might anticipate him, he concealed the discovery in an ingenious Latin transposition, that truly interpreted meant, "The mother of the loves imitates the phases of Cynthia."

No better time can be chosen for following the movements of the earth's twin sister than that when, emerging from the sun's eclipsing rays, she first appears in the western sky. Such is her present position. Once detected, she is sure of being found on each successive favorable night, oscillating eastward, slowly increasing in radiance and in the length of time she remains above the horizon. As the months roll on, she becomes the fairest object in the starlit sky for hours after the sun has sunk behind the western hills, reflecting his glorious radiance, and shining far more brightly than any of the myriad stars whose inherent light pierces the star depths from distances of which infinity is the measuring unit.

On the 17th, at 9 o'clock in the morning, Venus is in conjunction with Mercury, being at that time 11′ north. The conjunction is invisible, but a telescope will give a fine view of the two planets on the evening of the 17th. This conjunction of the two inner planets affords a good illustration of the velocity with which Mercury moves. Both planets are traveling from superior conjunction to eastern elongation. Venus passed the former goal on the 4th of May, and Mercury on the 26th of June, and yet the latter now overtakes and passes the former.

On the 27th, at 18 minutes past 7 o'clock in the evening, Venus pays her respects to Regulus, or Alpha Leonis, the bright star that lies in wait for the planets. At the time of conjunction, Venus is 1° 10′ north of Regulus. The event occurs too soon after sunset to be visible to the naked eye, but a telescope will reveal the actors in the scene. Venus will not linger in the vicinity of the star, for nothing can stay her course as she hastens to overtake the princely planet who is then not far in advance.

The right ascension of Venus on the 1st is 7 h. 51 m.; her declination is 22° 19′ north; her diameter is 10·4″; and she is in the constellation Gemini.

Venus sets on the 1st at 18 minutes after 8 o'clock in the evening; on the 31st she sets at 7 minutes after 8 o'clock.

MERCURY

is evening star, his course lying near that of Venus. We have already referred to his conjunction with Venus on the 17th.

On the 26th, at 2 o'clock in the morning, Mercury is in conjunction with Regulus, being at the time 11′ south. Thus this star is in conjunction with two planets on two successive days. Though the conjunction is invisible, star and planet will be near together on the evening of the 26th. Sharp sighted observers may pick up the planet on the east of the star, if the sky be cloudless and the atmosphere be exceptionally clear, as Mercury is within a few days of eastern elongation.

The right ascension of Mercury on the 1st is 7 h. 5 m.; his declination is 24° 14′ north; his diameter is 5″; and he is in the constellation Gemini.

Mercury sets on the 1st soon after half past 7 o'clock in the evening; on the 31st he sets a few minutes after 8 o'clock.

JUPITER

is evening star, and shares with Venus the place of honor on the midsummer annals. His luster is, however, diminishing, while that of his fair rival is increasing. As their paths lead in opposite directions, the former moving westward toward the sun, and the latter moving eastward from the sun, they must approach each other. The most interesting planetary event of the month will be to observe this gradual lessening of the space that separates the beautiful evening stars, and to note their close proximity at its close.

The right ascension of Jupiter on the 1st is 10 h. 19 m.; his declination is 11° 34′ north; his diameter is 31·6″; and he is in the constellation Leo.

Jupiter sets on the 1st soon after 10 o'clock in the evening; on the 31st he sets at 21 minutes after 8 o'clock.

URANUS

is evening star. He has completed his passage of 7 years through the constellation Leo, and has entered the constellation Virgo, where he will be found for 7 years to come. He is almost stationary during the month, changing his place slightly to the southeast.

The right ascension of Uranus on the 1st is 11 h. 57 m.; his declination is 1° 2′ north; his diameter is 3·6″; and he is in the constellation Virgo.

Uranus sets on the 1st a few minutes after 11 o'clock in the evening; on the 31st he sets soon after 9 o'clock.

NEPTUNE

is morning star, and leads the trio of planets that precede the sun.

The right ascension of Neptune on the 1st is 3 h. 30 m.; his declination is 17° 18′ north; his diameter is 2·5″; and he is in the constellation Taurus.

Neptune rises on the 1st at half past 1 o'clock in the morning; on the 31st he rises about half past 11 o'clock in the evening.

SATURN

is morning star. Before the month closes he will be a conspicuous object, rising a few minutes before 2 o'clock. He is brilliant enough to be recognized on his own merits, needing no aid from stars in his immediate vicinity. Indeed, he reigns alone at present, being surrounded by no rivals to lessen the brightness of his shining. He has passed beyond the boundary line of Taurus, and commenced his passage through Gemini. He will remain here for the coming 2½ years, moving, as is his wont, now forward, now backward, and now standing still. At present, his motion is direct, or eastward.

On the 20th, at 1 o'clock in the afternoon, Saturn is in conjunction with Eta Geminorum, a star of the 3·3 magnitude. The conjunction is almost an occultation, for star and planet are only 1′ apart, and 1′ is a very small space in celestial measurement when the distance between visible objects is to be measured. These close conjunctions are called appulses. It is a rare event when a planet approaches so closely a star of the 3 magnitude.

The right ascension of Saturn on the 1st is 5 h. 57 m.; his declination is 22° 31′ north; his diameter is 15·6″; and he is in the constellation Gemini.

Saturn rises on the 1st soon after half-past 3 o'clock in the morning; on the 31st he rises a few minutes before 2 o'clock.

MARS

is morning star. There are no changes during the month in the position of the planets on the east and west sides of the sun. At its close, Venus, Mercury, Jupiter, and Uranus are evening stars; Saturn, Mars, and Neptune are morning stars.

The right ascension of Mars on the 1st is 4 h. 29 m.; his declination is 21° 48′ north; his diameter is 4·4″; and he is in the constellation Taurus.

Mars rises on the 1st about a quarter after 2 o'clock in the morning; on the 30th he rises at half past 1 o'clock.

THE MOON.

The July moon fulls on the 26th at 33 minutes past 6 o'clock in the afternoon. The moon in her last quarter is in conjunction with Neptune on the 8th at 6 h. 59 m. A.M., being at the time 2° 33′ south. She is at her nearest point to Mars on the 9th at 3 h. 44 m. P.M., being 5° 1′ south. She is in conjunction with Saturn on the 10th at 5 h. 48 m. P.M., being 4° 7′ south. She next draws near the evening stars. She is in conjunction with Mercury on the 13th at 6 h. 57 m. A.M., being 5° 39′ south, and with Venus four hours later, at 10 h. 21 m. A.M., being 5° 22′ south. She is in conjunction with Jupiter on the 15th, at 2 h. 2 m. A.M., being 3° 7′ south, and ends the circuit with a conjunction with Uranus on the 16th, at 6 h. 37 m. P.M., being at the time 34′ south.

OCCULTATION OF ALDEBARAN.

On the 8th the moon occults Aldebaran, or Alpha Tauri, for the 7th time this year. The phenomenon will be visible in this vicinity. The immersion of the star takes place at 4 h. 25 m. A.M., Washington mean time. The immersion takes place at 5 h. 18 m. A.M., the occultation continuing 53 m. A telescope will be required for observation, as the presence of the sun will hide the actors in the scene from the naked eye.

OCCULTATION OF URANUS.

The moon occults Uranus on the 16th, for the sixth time in the year. The phenomenon is visible to observers favorably situated according to time and place between the limiting parallels 2° north and 75° south. This means that their position must correspond to the position of the planet as seen from the earth's center, and they must be at the time on the dark side of the globe.

JULY

is not unfruitful in planetary events. Jupiter and Venus, the most brilliant members of the sun's family, are visible in the west. They are approaching each other so rapidly that, though at the beginning of the month there is a difference of two hours in the time of their setting, they are only 15 minutes apart at its close. Mercury, though invisible, follows swiftly on the track of his more distinguished fellow planets passing Venus, and hastening to overtake Jupiter. Regulus comes in for its share of attention, both Mercury and Venus passing near its domain. Saturn treats us almost to an occultation, making an appulse to Eta Geminorum. Our fair neighbor, the moon, besides following her usual round, kindly occults Aldebaran for our observation, and hides Uranus from sight for the pleasure of observers farther south.

Midsummer nights are most favorable for the study of the stars. There is a delightful companionship in the society of the myriad twinkling mysteries that stud the canopy of night, a feeling of satisfaction in learning to know by name not only the planets, but the brilliant stars among which these wanderers tread their shining course with tireless feet.

An intelligent observer with the aid of a star map can easily trace the most brilliant of the July stars. The Great Bear is descending toward the northwest; Arcturus is lovely to behold as bathed in rosy light he nears the horizon. The brilliant Vega is approaching the zenith; below it the Northern Cross rests on the Milky Way; Altair beams brightly with its less brilliant companions on either side; the lone Spica shines in the southwest; and the constellation Scorpio, with its leading brilliant, Antares, is a charming object in the south. We give the outline for the sky about 9 o'clock, at the beginning of the month. The same outline will answer for its close, but the observation must be made two hours earlier.

Economical Results of Natural Gas.

It is stated that with one exception every iron mill in Pittsburg will be using natural gas instead of coal by July 1. Those firms which have not already made the necessary arrangements to use it are taking advantage of the present stoppage to do so.

Forty iron firms within a radius of thirty miles are using it. Beside these, glass factories, breweries, distilleries, and other establishments are using it.

The finished output of iron and steel in the Pittsburg district is 750,000 tons a year. Assuming as a moderate estimate that it takes fifty bushels of coal to finish a ton, the general introduction of natural gas into the iron and steel mills supplants 38,250,000 bushels of coal a year, or about one-seventh of the annual output of the region tributary to Pittsburg. Thousands of men in addition to those who have already been affected by it will be thrown out of employment. In every mill it will do away with firemen, ashmen, and deliverers, and many a coal miner will have to seek new fields and the operators new markets for their product.

A Profitable Dog.

An exchange tells of a man residing on the line of a railroad who has taught his dog to bark vociferously at every passing train. The impulse of the firemen is to watch for the barking dog, and hurl pieces of coal at him in passing. The result to the owner is that he has delivered at his door all the coal he requires for his own use free of cost, and is now contemplating the opening of a coal yard for the supply of his neighbors. He thinks he can compete in price with the oldest coal dealers in the vicinity.

An Optical Experiment.

A contributor to *Cosmos* suggests a curious optical experiment which may serve to show the principle of the stereoscope. If we cut out of black paper two similar figures—two crosses, for example—and place them, their extremities almost touching, at about three inches from the eyes, before a sheet of white paper, we shall see three crosses, the middle one being dark and completely separate. This phenomenon is explained by the simultaneous vision of the two eyes, and it is easy to show this by looking at the objects successively with one eye. The experiment becomes still more interesting when, instead of black figures, we employ complementary colors—red and green, for example. In this case we must use a dark background, and there will appear a white cross in the middle.