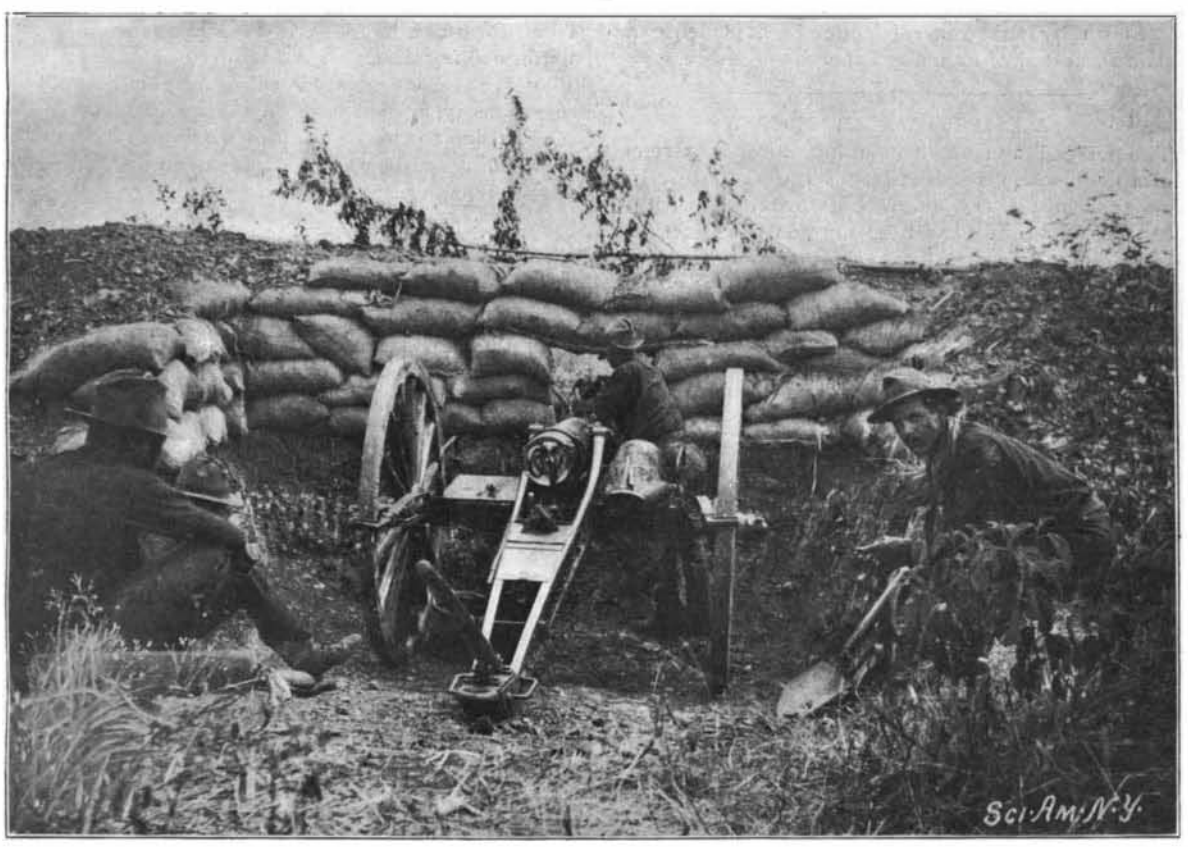
GUNS, ANCIENT AND MODERN, AT SANTIAGO.

Peculiar interest attaches to the accompanying illustrations of two guns which did duty, one in the attack and the other in the defense of Santiago. The photograph of the American gun, a 3·2-inch field-piece, was taken when it had been moved up to its last position before Santiago, and made ready to take part in the bombardment of the city. It formed part of Captain Capron's battery to the right of the Santiago-Caney road and on the right wing of General Lawton's division. It was Capron's battery, it will be remembered, that opened the memorable fight which ended in the capture of El Caney and the storming of San Juan hill.



A 3·2-INCH FIELD-PIECE FORMING PART OF CAPTAIN CAPRON'S BATTERY BEFORE SANTIAGO.
(From photograph on the field of battle.)

The 3·2-inch field-gun is a comparatively light weapon and is not designed specifically for bombardment, the 5-inch gun, the 7-inch howitzer, and the 7-inch mortar being intended for this work. The confusion which prevailed at the unloading of the transports and the difficulties of transportation were answerable, we believe, for the failure to get any siege guns into position before Santiago, and, had the bombardment taken place, it would have been carried on with the smaller weapons. The 3·2-inch gun fires a 13·5-pound shell with a velocity of 1,685 feet per second. It can penetrate 3·8 inches of steel at the muzzle and it is an effective piece when firing shrapnel against bodies of troops—though it does not possess sufficient battering power to be very effective for bombarding. The siege gun of 5 inches caliber has a muzzle energy of 1,045 foot-tons, as against 266 foot-tons for the 3·2-inch gun.

The photograph shows very clearly the method adopted for emplacing these guns. This trench and embrasure form only part of the excavations necessary for the gun and its ammunition. A long pit, six feet deep, is dug, at one end of which is the gun and at the other end the main store of ammunition. At a little distance from the gun two cross-pits are dug, in which is kept a smaller supply of ammunition for the immediate use of the gun. A breastwork of sandbags is built up around the piece for the protection of the gun and its gunners.

The other photograph was taken by the same photographer, William Dunwoodie, after the surrender. It represents an obsolete, rifled, muzzle-loading mountain howitzer which was used in the Spanish defense. It formed part of the Ursula battery on the right of the Spanish lines. It is a very old weapon, dating from the time when rifling was beginning to be introduced into muzzle-loading guns. The grooves, as will be seen from the muzzle of the gun, were deep and very few in number. They were engaged by metal studs projecting from the body of the shells—a device which preceded the use of the modern, copper rifling band.

The Spanish method of emplacement was to dig a trench and project the embrasures for the gun forward beyond the line of the trench. In the wings of the trench, to right and left of the gun, were the secondary ammunition pits for immediate supply, and at some distance was the main magazine, which consisted of a bombproof, composed of a circular wall of barrels filled with broken stone. The barrels were three or four deep, and the whole was roofed with timber and covered with earth. The Spaniards had only two modern field guns, but their shrapnel was excellent and exploded with remarkable precision. The stem of the fuse was graduated and could be adjusted with great facility. They used both time and percussion shells and solid shot. The Spaniards used smokeless powder, thereby rendering it difficult for our batteries to locate their position. Both sides made considerable use of brushwood for masking their batteries.

Although, from a comparison of the two guns illustrated, it seems that the Spanish artillery was considerably handicapped, we must remember that matters were largely equalized by the fact that, being entirely on the defensive, they had the choice of position, and abundance of time to strengthen their positions before our hastily improvised emplacements could be constructed.

SPANISH MUZZLE-LOADING HOWITZER USED IN THE DEFENSE OF SANTIAGO.
(From photograph taken after the surrender.)

Electric Protection for Banks.

BY JAMES H. HOWARD.

There are several electric burglar alarm systems in use, of which perhaps the most valuable is that using a mesh of conducting wires interwoven and covered with cloth, forming a curtain with which the safe may be covered or the interior of the vault lined. The cutting of any such curtain breaks the circuit and gives the alarm. The curtain may also be constructed with two solid tinfoil sheets and an insulating medium between them, or a single tinfoil sheet and a mesh of insulated conducting wires spread over it. Any cutting of such a curtain either opens the circuit or short circuits the two sides of the system, between which a resistance should be inserted, so that either effect will make such a change in the circuit resistance that it will sound the alarm. The doors of the safe may be lined with wooden shutters carrying suitable conducting wires attached to metal points of contact, which suitably close the circuit when closed and open it when disturbed. Some curtains of this kind have been made with a tinfoil sheet and wires run in one direction across the other side of the curtain. Such a curtain can with care be cut parallel with the wires and opened out without disturbing the circuit. A more suitable arrangement is that with wires run back and forth vertically on one side and horizontally on the other side, thus crossing each other, making a mesh which cannot be cut in any direction without disturbing the circuit. These wire sheets should be mounted on the two sides of a cloth curtain, the whole covered again with cloth on both sides, painted, and again covered with thin strips of wood grooved and wired together at top and bottom to give suitable mechanical protection. The several breadths of the curtain should also be sewed together with fine insulated wires which may be put into the circuit.

The circuits should preferably be completed by leading the two terminal wires by different routes to the alarm station. The system may be further complicated, so that burglars with a knowledge of electricity cannot tamper with it, by inserting false wires in the conduit. At the station where the alarm is to be given there should be inserted in the circuit a relay or relays to respond to either a marked increase or decrease of the current, with suitable local circuits, annunciator drops, etc., in case several points are under protection. To prevent the insertion of a resistance across the circuit equal to that between the two sides of the protecting curtain and the cutting out of the latter, which could be done gradually without giving an alarm, there may be placed in the vault a variable resistance, changed preferably by clockwork. To prevent this variation acting upon the relay, there may be placed in the same circuit at the central station another variable resistance, also acted upon by clockwork, the two being so arranged that the total resistance of the circuit remains constant. It is useless, of course, to rely on a variable resistance device at the alarm station only, as the resistance in the safe would always remain the same and there would be nothing gained.

Too much confidence is often placed in electrical devices by those who do not understand them, but think that because they are electric they must be very difficult to overcome.—Electrical World.

Efficient Signal Service in Porto Rico.

The Signal Corps of the army has already constructed about 250 miles of telegraph and telephone lines in Porto Rico, and more than half of the island is equipped with means of prompt communication.

Information received on August 11 by Gen. Greely, the Chief Signal Officer, from Lieut.-Col. James Allen is that four distinct lines radiating from Ponce have been completed, and are now in good working order. The central office is, of course, at Ponce. The first line leads from Ponce to the east, through Guayama to Arroyo to Gen. Brooke's headquarters; the second from Ponce to Coamo to Gen. Wilson's headquarters; the third from Ponce through Adjuntas and Utuado to the advance lines of Gen. Stone; and the fourth from Ponce to Guayabila and Yauco. The lines are being extended as the army advances.

Dr. James Hall.

Dr. James Hall, the geologist and paleontologist, who has also been State Geologist of New York since 1837, died at Echo Hill, Bethlehem, N. H., on August 8. He was born at Hingham, Mass., September, 1811, and was graduated at the Rensselaer School, now the Troy Polytechnic Institute, in 1832, and remained there as Assistant Professor of Chemistry and Natural Science until 1836, when he was made Professor of Geology. On the organization of the Geological Survey of New York, in 1836, he was appointed Assistant Geologist in the second district, and he continued his connection with this scientific bureau of the State until his death.

He began his explorations in the western part of the State in 1837, and from 1838 to 1841 he published annual reports of progress. In 1843 he made his final report on the Survey of the Fourth Geological District, which was published as "Geology of New York, Part IV.," Albany, 1843. Retaining the title of the State Geologist, he was placed in charge of the paleontological work, the results of which have been embodied in "Paleontology of New York." Prof. Hall also extended his investigations west to the Rocky Mountains and his explorations served as the basis of all our knowledge of the geology of the Mississippi basin. In 1855 he was offered a position as paleontologist of the geological survey of Canada, with the promise of directorship of the survey, but he declined the offer. Prof. Hall also held the appointment of State Geologist in Iowa in 1855, and of Wisconsin in 1857. He was one of the original members of the National Academy of Sciences. In 1876 he was one of the founders of the International Congress of Geology, and opened the session at Paris in 1878, and Bologna in 1881, and Berlin in 1885. He was a member of many learned societies and received many degrees and honors. In addition to a number of important works, he published some 250 shorter papers.

Georg Ebers.

Georg Moritz Ebers, the great Egyptologist, died at Tutzing, near Munich, Germany, on August 7. He was born in Berlin, in 1837, in the same house in which lived the brothers Grimm, the great grammarians and treasurers of the wealth of Teutonic folk lore, and it is probable that to their influence the scholarly bent of young Ebers' mind is due.

After the usual course at the gymnasium, Ebers read law at the University of Göttingen. While studying, he had a dangerous illness, which unfitted him for active life, so he decided to devote himself to academic studies in the science which always attracted him, namely, Egyptology. Jacob Grimm introduced him to Lepsius. The first fruits of his study was "A Princess of Egypt," which to the general reader opened up a new world. The scholarship which Ebers displayed in his treatise on "Egypt and the Books of Moses" won the recognition of the learned, and in 1864 he was appointed to a professorship in the university. He made a short journey to Egypt, and then filled the chair of Egyptology at the University of Leipsic. He revisited Egypt in 1872. During his excavations at Thebes, he discovered a papyrus dating from the second century B. C., which is still known by the name of its discoverer. On his return to Leipsic he resumed his round of lectures, which helped to train many Egyptologists of the present day. In 1876, twelve years after the appearance of his first romance, came "Uarda;" "Homo Sum," "The Sisters," and "The Emperor" followed in quick succession. In all, sixteen historical novels have come from his pen, in addition to many treatises, fairy tales, biographies, and two great works of reference on Egpyt and Palestine. Prof. Ebers will also be gratefully remembered for his historical romances, which have done a great deal, not only to popularize Egyptian archæology, but which also interested a vast audience in the history of this strange land. Not often has the scientist and the novelist been combined in the same person in such a remarkable degree.

New Method of Preserving Meat.

A new method of preserving freshly killed meats has been discovered by the Danish zoologist August Fjelstrup, already well known through his method of condensing milk without the use of sugar. The system (according to the printed reports) has stood a remarkably hard three months' test at the Odense (Danish) Company's slaughter houses, in a very satisfactory manner.

The method in itself is extremely simple and might be of great service for the troops in the tropics (the writer having had considerable experience in trying to keep meat fresh in Cuba).

The animal to be used is first shot or stunned by a shot from a revolver (loaded with small slugs) in the forehead, in such a way as not to injure the brain proper. As the animal drops senseless, an assistant cuts down over the heart, opens a ventricle, and allows all the blood to flow out, the theory of this being that the decomposing of the blood is almost entirely responsible for the quick putrefaction of fresh meats. Immediately thereafter a briny solution (made of coarse or fine salt, more or less strong, according to length of time meat is to be kept) is injected by means of a powerful syringe through the other ventricle into the veins of the body.

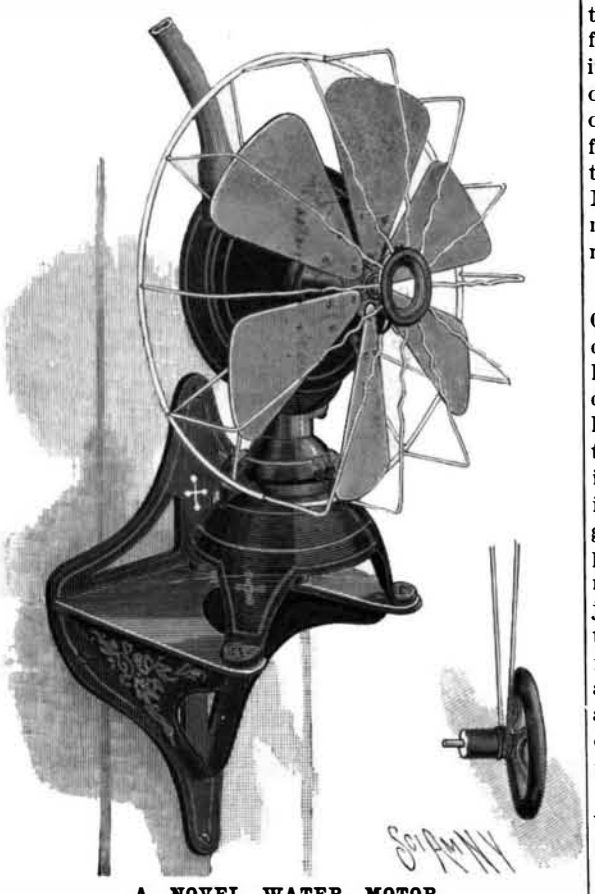
The whole process takes only a few minutes, and the beef is ready for use and can be cut up at once. This method has been examined and very favorably reported on by the general councils at Odense and Aarhaus, and also by many experts.

A NOVEL WATER MOTOR.

The possession of an electric fan-motor is extremely desirable in warm weather, but it unfortunately happens that not every building is provided with the means for obtaining the necessary current. A fan is, however, manufactured by the A. Rosenberg Company, of Baltimore, Md., which requires no electric current, but depends for its motive power wholly upon the water coming from the faucets in every house.

In its construction the motor is exceedingly simple, consisting as it does of a casing in which an impact water-wheel is located and of a spindle rigidly attached to the water-wheel and projecting from the casing. A ball and socket joint at the bottom of the casing enables the motor to be inclined in any direction, even when in motion.

The water enters at the top of the casing by means of a rubber tube having an opening in its lower end varying between $\frac{3}{32}$ inch and $\frac{5}{64}$ inch in diameter. The



A NOVEL WATER MOTOR.

resulting jet strikes the water-wheel at a tangent to the periphery, and after expending its force passes down through an opening in the ball and socket joint, after which it is led away.

By attaching a balance-wheel and pulley, the motor can be made to drive a ceiling or post fan, or a sewing machine, with water working at a pressure of 40 pounds to the square inch. With a pressure of 50 to 60 pounds, a telephone exchange generator can be driven. By attaching a guard to the casing and blades to the spindle the motor can be directly used as a fan, as shown in our illustration. The motor consumes about seven pints of water per minute.

Crystallized Calcium Metal.

Since the memorable researches of Humphry Davy on the decomposition of the alkaline earths, many methods have been suggested for preparing the metal calcium in the pure state. M. Moissan, in the current number of the Comptes Rendus, after showing that none of these yields a pure metal, describes two ways of preparing crystallized calcium containing less than one per cent of impurities. The first of the methods depends upon the property possessed by calcium of dissolving in liquid sodium at a dull red heat, and separating out in crystals on cooling. By treating the mass cautiously with absolute alcohol the sodium is removed, and the calcium is obtained in the form of brilliant white hexagonal crystals. Similar white crystals of calcium can be obtained by the electrolysis of fused calcium iodide. It is noteworthy that calcium has usually been described by previous workers as a yellow metal; doubtless owing to the presence of impurities.—Nature.

Science Notes.

A clever imitation of ivory is extensively manufactured from the fruit of a palm-like shrub called Phytelephas macrocarpa, says The Engineer (London). This fruit grows to about the size of an apple, and has a very hard, white kernel. Worked in the lathe, this ivory can be passed off as the genuine article, the resemblance being so great that it is sold at the same price. It can also be covered just like genuine ivory. To M. Pasquier, of Liége, is due a practical method of distinguishing the two varieties of ivory. It is the following: Concentrated sulphuric acid applied to vegetable ivory will cause a pink coloring to appear in about ten to twelve minutes which can be removed by washing with water. Applied on genuine ivory, this acid does not affect it in any manner.

At Nedunkeni, in the Northern Province of Ceylon, the abnormal rainfall of 31·72 inches in twenty-four hours was experienced. Nedunkeni, 11 miles down the southern road to Mullaittivu, and 122 feet above sea-level, is a small village a little to the east of the dividing ridge of North-Central Ceylon, and though itself in the catchment area of the eastern Per Aru, which flows through Tannir Murippu Tank, it is only a little to the southwest of the point where three separate drainages meet. Forest, containing a thick growth of high trees, extends over the neighborhood, and more especially for many miles from the south to the east. For about three years a rain gage has been established in the grounds of the dispensary in the village, and its records are regularly transmitted to the Public Works Office, and are published among the rainfall returns. Although the mean annual rainfall at Nedunkeni is probably little more than 50 inches, the fall for last December was 67·07 inches, and of this amount 31·72 inches were measured at 9:30 A. M. on December 16 as the rainfall of the preceding twenty-four hours. From an examination of the position of the rain gage, and the testimonies of the observers, Mr. Parker, in The Ceylon Observer, concludes that most probably the actual rainfall was in excess of the recorded amount.

H. N. Toply, of the Department of the Interior, in Ottawa, Canada, who discovered recently a method of developing negatives without the use of a dark room, has discovered that the printing of photographs is not dependent on nitrate of silver. Heretofore the nitrate has had to be used in all prints, but Mr. Toply says that the juices of certain fruits are equally as good, if not better than the nitrate, for photographic printing purposes. By means of this discovery a photograph can be printed upon anything—wood, pulp, and paper—which can absorb these juices. The juice is not used just as it comes from the fruit, but it is subjected to a process which Mr. Toply, of course, desires to keep to himself at present. He has been engaged in the development of the process for five years. His attention was first directed to the possibility of "herbaceous photography," as he calls it, by the withering of the white pine, which becomes a very dark gray under sunlight. A piece of planed pine was placed under the negative and exposed to sunlight without treatment and a permanent print on wood was obtained. Mr. Toply followed up this discovery by a series of experiments with the juices of fruits, which he found could not only turn dark gray, but would become jet black in sunlight. The process is so simple that, were it brought into general use, the price of photographs would be reduced to a minimum.

Walking along the beach on Mobile Bay, a young woman, a relative of the writer, picked up a handful of little shells, left by the tide, and among them several shells of a small marine "snail," the largest of which was probably a half-inch in diameter and the smallest some three-eighths of an inch. She dropped them into her pocket and forgot all about them until several days afterward, when an unpleasant odor in her wardrobe attracted her attention to them. On taking them out of the pocket some fell on the floor, and in recovering them she placed her foot on one. The act was followed by an explosion, quite sharp, and loud enough to be heard all over the floor on which her room is. Astonished, she concluded to try another, and the same result followed. The shells were then brought to the writer, who, on examination, found the mouth of each firmly closed by a membrane of greater or less thickness, formed by the drying of the animal slime. This had probably occurred soon after removal from the moisture of the beach, and, the little inhabitant of the shell dying, the gases of decomposition had quite filled its internal space. On exerting a little pressure by squeezing the shell between two blocks of wood quite a loud explosion was produced, the fragments of the shell being thrown several feet. Subsequently, on trying the experiment, out of a dozen shells, only two failed to explode. The conditions most favorable to success in making the experiment seem to be removal from the beach in very hot, dry weather, which causes the slime to be exuded in greater quantity than usual and dries it up rapidly as it exudes.—National Druggist.