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THE SANDY HOOK MORTAR BATTERIES.

There was a time, and it was not very long ago, when a hostile fleet could have silenced the forts which defend the harbor of New York and either bombard the city or exact a heavy ransom. A few years ago the upper part of the long, low peninsula called Sandy Hook was a wilderness covered with scrub pines and was used as a lighthouse station, the only defenses of this entrance to the harbor being a few smooth-bore cannon. The same conditions existed at Forts Hamilton and Wadsworth, at the Narrows, and at Fort Schuyler on Throggs Neck, and Willets Point on the Sound. The fortifications were imposing, and seemed capable of doing untold damage to an unfriendly fleet, but this appearance was deceptive, and the modern rifles of war vessels would soon have silenced them.

New York was naturally one of the first places to be considered when the question of coast defense arose, and in the last five years these conditions have all been altered, though there are few outward signs of these changes. Instead of the city being at the mercy of a small fleet of modern war vessels, it would now be practically impossible for a squadron to damage the city by trying to bombard it from outside Sandy Hook and an attempt to enter the harbor, either from the channels leading to it from the sea or through Long Island Sound, would undoubtedly prove fatal to even the most powerful vessel.

Among the sand dunes and scrub pines at the end of Sandy Hook have been constructed the strongest fortifications on the American continent. The picturesque old smooth-bores at the forts at the Narrows have given place to modern guns, and improved batteries guard the approach to New York by Long Island Sound. The work has progressed to such an extent that at present the city is almost impregnable, and this work has been done with considerable secrecy.

The subject of our first page engraving is the breech-loading mortar battery at Sandy Hook, which supplements the splendidly equipped Fort Hancock. There are two mortar batteries at Sandy Hook available for

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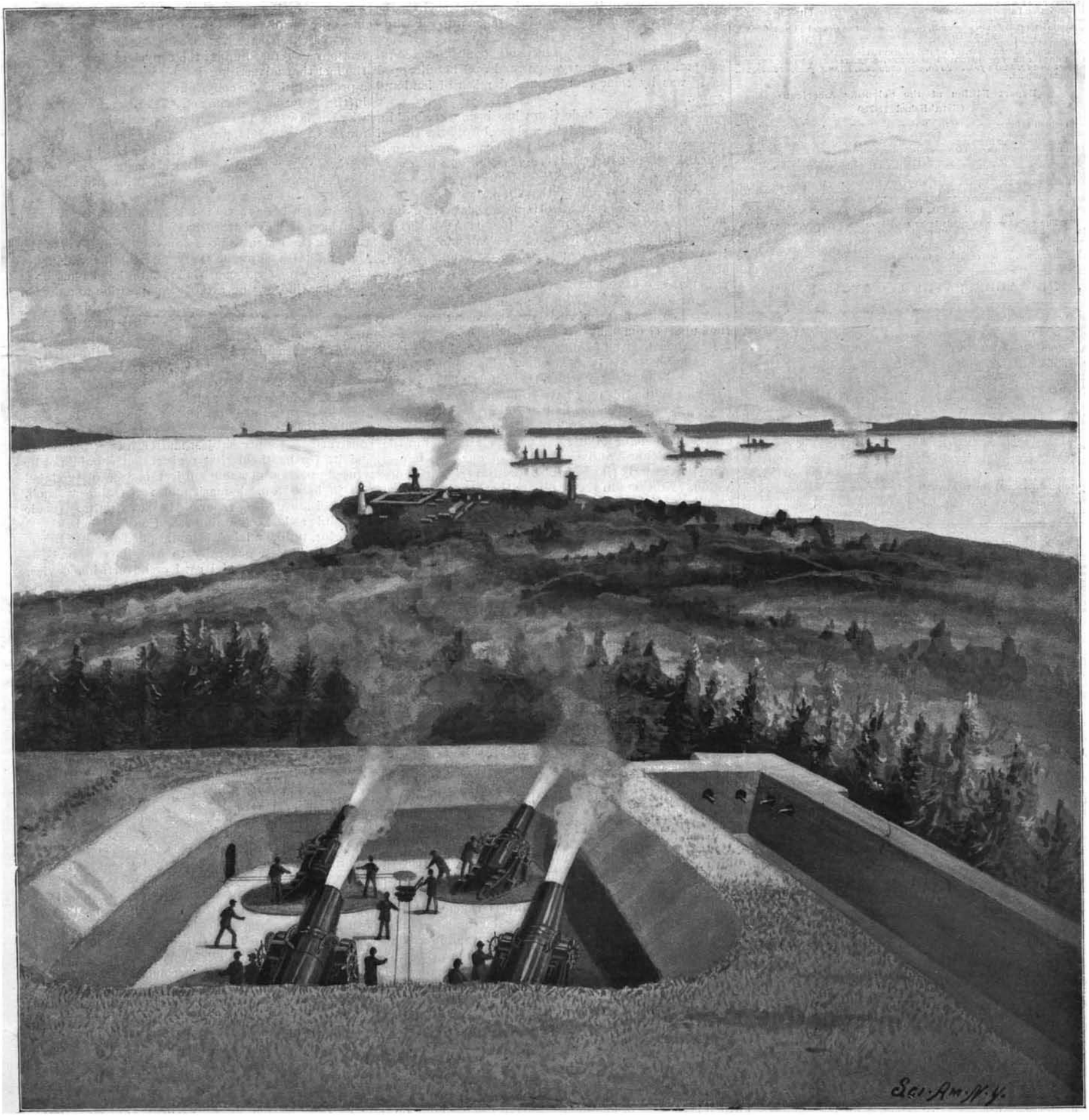

THE DEFENSE OF NEW YORK HARBOR—A QUARTER OF THE MORTAR BATTERY No. 1A IN ACTION.

THE SANDY HOOK MORTAR BATTERIES.

(Continued from first page.)

service, and more are under construction. The fortification of this important point possesses more than usual interest at the present time, when defensive preparations of all kinds are being pushed forward with haste. The original plans called for 176 mortars for New York, located at various points.

Our engraving shows a quarter of what is known as Battery No. 1 A, and it is situated on the Sandy Hook spit, so that it controls not only the entire ranges of channels leading into the lower bay, but the lower bay as well. The mortars are hidden behind and below great earthworks, so that only a shot dropping in vertically could injure them. A shot of this nature could hardly be fired from a war vessel, owing to the great elevation of the guns which would be necessary. In 1895 the stringent regulations regarding fortifications were relaxed sufficiently to allow members of the press to inspect the fortifications; but since our visit they have been closed against visitors, so that it is possible some changes have been made, but we believe the facts gathered by our representative at this time are accurate as regards the mortar batteries at present.

In the first place, the mortar battery is on a part of the Hook where it cannot well be seen except from one of the lighthouses or the other fortifications. The arrangement of the battery will be understood by reference to our plan. It consists of an earthwork with four pits, with flaring sides connected by underground bombproof passages. It is surrounded by a solid counterscarp wall twenty feet high. This wall is not intended in any way as a protection from the enemy's fire, but merely as a shield against a storming party's assault on the works. Inside of this wall and immediately at its base is a deep ditch. The space between the wall and the embankment would prove an awful place of slaughter for invaders, as at two corners of the wall are rapid-fire guns commanding all four of the trenches, and a murderous fire, which nothing could resist, could be poured out on the assailants.

From the ditch rise great earth embankments sloping gradually to a height of 35 feet. The four mortar pits are protected by a wall of concrete of great thickness and a lining of steel. The pits themselves are small, being just large enough for the four big mortars, which are set on turntables which can be moved by one man. We have already described the 12-inch mortars used for this fortification. (See the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 888, 920.) Mortars of this kind can be built in less time than rifles and at a less cost, and when supplemented, as at Sandy Hook, with forts equipped with the most modern coast defense guns, they are very effectual, as the war vessels cannot stay long enough at great range, which is necessary to give the guns sufficient elevation, to do the mortar batteries damage. Ordinary shell firing from rifled guns gives greater range or greater penetration at the same range; but, on the other hand, the sides of armored ships, at the water line at least, are protected by thick armor, while the decks are not very heavily plated; so that a shell or armor-piercing projectile would inflict serious injury on a vessel, even though she had a thick protective deck, for the shots would pass through a 6-inch steel deck. The greater accuracy, also, of horizontal shell firing is in part offset by the system of firing mortars in groups, so that if some shots may go a little short of the vessel or beyond it, there will remain others which will fall directly upon it. The full service charge for the 12-inch mortars is 80 pounds of brown prismatic powder and a shell weighing 1,000 pounds carrying 100 pounds of high explosive. An extreme range, with satisfactory accuracy, of five miles has been attained. Tests of these mortars have demonstrated that the fire can be so concentrated that the projectiles fired from a group of sixteen mortars, fired simultaneously, if desired, will fall well within the space covered by a ship's deck plan, crushing the mightiest vessel afloat like an eggshell with the tons of projectiles, not to mention the explosion of the high explosives. Our engraving shows only one pit of the mortar battery, there being four in all, but the mortars may be fired individually, in groups of four or the whole sixteen may be discharged at once. Each mortar is moved independently, and the men at the mortars can see nothing but their guns, the armored embankment and a little patch of blue sky overhead. They do not fire the mortars nor do they see the vessels in the channel. All the officers and men have to do is to train their pieces according to the directions telegraphed to them by the observers, who may be half a mile away.

The observers have range and position finders and glasses, while spread out before them is a map or chart of the harbor, marked with numbers inclosed in squares. If a hostile warship approaches, they "plot" her course on the chart until it is decided that she is within effective range. The observers find that the war vessel is going in a certain direction and at what speed. From this they calculate that she will be in a certain square at a certain time. Then they telegraph the order and designate the location of the ship to the man who does the firing. The latter is located at that point marked X in the plan. He can see nothing down in the bombproof gallery except a chart, a duplicate of the one used by the observers. The officer in the mortar battery has a table showing at what elevation his mortars will fire a shot to carry such a distance. He quickly makes his calculations and sends his orders to the pits. Up go the shining muzzles, until they point to the sky, then there is a pause and suddenly the dull brown mound of earth on the sand spit, not visible from the doomed vessel, spouts flame like a volcano and one or four, or even sixteen projectiles, each weighing half a ton, rise and descend in a graceful curve on the warship.

The magazine bisects the central bombproof gallery and it is protected in all directions by earth and steel. Running from the magazines to the mortar pits and from mortar to mortar are steel tracks for the little cars that serve the guns with ammunition. Turntables are placed at the intersection of the galleries, and the entrances to the pits and bulletproof doors are hung at the main entrance and each of the counterscarp galleries.

The huge battery, with its two 12-inch breech-loading rifles on gun lifts with a maximum range of ten miles, was completed at about the same time as the mortar batteries, and in an emergency like the present

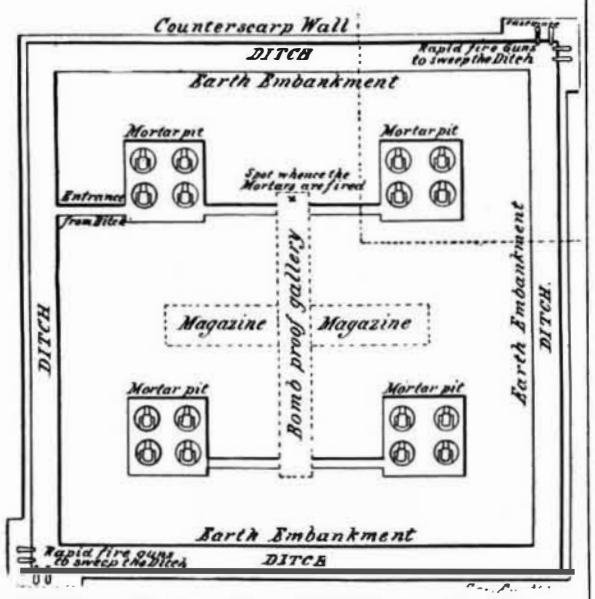

DIAGRAM OF MORTAR BATTERY No. 1A SANDY HOOK N. J.

it is gratifying to know that the most important harbor of the United States is so adequately protected against invasion by sea.

The Current Supplement.

The current SUPPLEMENT, No. 1163, contains several articles of unusual interest. An article on the "Maxim Gun" describes the very latest forms of this important machine gun. Various forms of guns are illustrated, including the tricycle, naval and the extra light rifle for cavalry and infantry use. "The Passy Railway Tunnel" describes the work on the underground railroad which will put the center, the west and the periphery of Paris in rapid communication for the coming exposition. "The Cinematograph" is an important article detailing the actual construction of the camera, the printing slide, the safety lantern, etc., with directions for developing, washing and fixing the films. This is an article which our readers have desired for a long time. "Experiments with the Glow Lamp" is an article by Hiram Maxim. "Dr. Meyer's Expedition to the Source of the Xingu" describes life in the forests of Central Brazil. "The Debt of the World to Pure Science" is the presidential address at the annual meeting of New York Academy of Sciences, by Prof. J. J. Stevenson. "Poison and Poisoners" is an interesting and popular article. "An Interesting Case of Gastrotomy" describes the removal from the stomach of twenty-five staples for barbed fence wire, fifteen screws, six horseshoes, forty-six wire nails, twenty-one cartridges, two pocket knives, bolts and pieces of chain, making 119 pieces in all. "The Red and Blue Coloring Matter of Flowers" is an interesting botanical article.

ACCORDING to a report of the Paris Journal des Arts, the director of the Rheims Museum has submitted to the French Academy of Sciences a number of small glass mirrors which have lately been found in Gallo-Romanic tombs of the Marne department. They are of the size of watch crystals, slightly convex and covered with pure lead without any admixture; they had been fixed in boxes as ornaments. In olden times the metallic mirrors are known to have been employed not only for looking glasses, but also as ornaments on tables and other furniture, even on dishes. Gradually other metals, such as tin, copper, silver and antimony, were added to the lead in producing the glass mirrors. In the thirteenth century pouring the lead over the glass was commenced, which signifies the first step toward the manufacture of the famous Venetian mirrors.

Science Notes.

Twenty-two business men, who acted as the coroner's jury in the investigation of the recent great fire in London, and served for fourteen working days, received four pence (eight cents) each as compensation.

C. B. Davenport points out the important part played by water in the growth of plants, and compares the developmental processes which go on in the tip of a twig to those which occur in the animal embryo. In both there is first a period of rapid cell division with slow growth; next a grand period of growth in which the general form of the embryo is acquired, the rudiments of the organs are established, and the organism increases rapidly in size by the imbibition of water; while finally there is a period in which the histological differentiation is carried on, while the absolute growth increments cease to increase.—Proc. Boston Sc. Nat. Hist., 1897, p. 73.

While the population of Europe, estimated at 175,000,000 in the beginning of the century, rose to 216,000,000 in 1830, 300,000,000 in 1870, and is now nearly 370,000,000, there has been a still more remarkable increase in the number of towns with over 100,000 inhabitants. There were only 21 of these in 1801 (with 4,500,000 inhabitants), 42 in 1850, 70 in 1870 (with 20,000,000 inhabitants), and 121 in 1896 (with about 37,000,000 inhabitants). In 1801 France had three towns with over 100,000 inhabitants, while England and Germany had two each, but in 1870 the figures were—England 18, Germany 10, and France 9, while in 1896 they stood—England 30, Germany 28 and France 10.

At the last convention of the American Medical Association, in Philadelphia, Dr. J. B. Learned, of Northampton, Mass., described to the fraternity his simple method for the cure of insomnia, or sleeplessness, the whole thing being accomplished without the usual resort to drugs. Briefly, muscular and mental exertion, in a systematic way, is the course involved; that is, a series of positions of the body, lying upon the back and side in the horizontal line, with the brain occupied in controlling and making changes, is the substance of the treatment proposed, the brain being occupied in devising these changes and modifying the respirations—this calls blood and vital energy away from the center of matter that keeps up the automatic motion and prevents sleep. The doctor terms this "turning off the belts." The muscular motion consists in fixing a certain group of muscles for a definite length of time, and then another and another change; fatigue soon comes to muscle and brain thus controlled, and sleep is inevitable.

Some particulars of interesting observations made with steam turbines are given in a paper read before the Albany Institute by Mr. J. F. McElroy, says Engineering Mechanics. He states that a disk varnished with shellac will throw the whole of the varnish off when run at a very high speed. The lac under these conditions flows over the surface of the wheel toward the periphery, where it is flung off, about one hour being required for the complete stripping of the surfaces. A particular turbine wheel, he states, caused little trouble up to a speed of 3,500 revolutions per minute, but on attempting to increase its speed beyond this figure, vibration was set up and the flexible shaft on which it was mounted sprung sideways ¼ inch to ½ inch. Raising its speed still further, a state of stability was again reached at which the wheel ran quietly, but on approaching a speed of 7,000 revolutions per minute vibration again appeared. The trouble arising at the critical speeds was, he found, mitigated by a gentle end pressure on the shaft at these periods. With ball bearings he had failed to get satisfactory results, as soft steel was used for the bearings. This steel flowed under the pressure of the balls, even very lightly loaded.

Scientific Ballooning.—In order to test the accuracy of the formula of Laplace for deriving the altitude of a balloon, etc., from the barometric record, Cailletet has devised a photographic camera which has been constructed by Gaumont. A prismatic box is suspended from the balloon, says The Engineer. Lenses are inserted in the lower and in the upper face. Between the two a band of sensitized celluloid is moved by a clockwork and exposed at regular intervals. The one lens produces an image of the scenery down below on the earth, the other of the needle of the barometer, whose point appears near the center of the plate, which has a size of 13 by 18 centimeters (5 inches by 7 inches). From the distance on the plate between two prominent objects on the ground the height of the balloon can be derived. Satisfactory experiments having been made with this apparatus on the Eiffel Tower, Hermite and Besançon took it up with them on October 21 in their new balloon of 1,700 cubic meters capacity, a gift of the Russian scientist Balaschof. The weather was tempestuous, and the balloon descended after a trip of four hours, having attained an altitude of 2,500 meters. The camera is said to have answered very well; twenty-six photographs were obtained. The apparatus is now to be secured against the influences of very low temperatures.