

For continuing the construction of the batteries of heavy modern guns in accordance with the existing project, designed by the Board of Engineers for the Pacific Coast, an appropriation is recommended.

No appropriation was made for the fiscal year ending June 30, 1880.

Appropriation asked for next fiscal year..... \$50,000 00

*Batteries at Point San Jose, San Francisco Harbor, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.*—These temporary batteries, constructed during the late war, are unserviceable. The timber platforms and the wood-work of the magazines are decayed and falling to pieces. No work was done during the past year, and none is contemplated during the present year, unless for repairs necessary for practice firing.

Projects for new batteries of heavy guns and mortars for the occupation of this important point in the second line of defense for the bay and harbor of San Francisco have been prepared by the Board of Engineers for the Pacific Coast.

No appropriation was made for the fiscal year ending June 30, 1880.

No appropriation asked for next fiscal year.

*Batteries on Angel Island, San Francisco Harbor, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.*—These three temporary earthworks, constructed during the late war, are essentially unserviceable. The platforms are decayed, and most of the carriages have been condemned. No expenditures have been made, and none are at present contemplated.

Projects for open batteries for heavy guns and mortars to occupy points bearing upon the channels leading to the upper portion of the bay and the navy-yard at Mare Island have been made by the Board of Engineers for the Pacific Coast.

No appropriation was made for the fiscal year ending June 30, 1880.

No appropriation asked for next fiscal year.

*Fort at San Diego, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.*—This work, situated in rear of Ballast Point, commands the channel at the entrance to the bay and harbor of San Diego.

The first and only appropriation for this work was an appropriation for the fiscal year 1873-'74; under it considerable progress was made, but in its present unfinished state this battery is utterly worthless. Its position wholly controls the entrance to the harbor and bay of San Diego; every vessel going in must pass close to the work.

To complete it for its armament of heavy guns and mortars according to existing plans, prepared by the Board of Engineers for the Pacific Coast, so that it may be a defense to this important harbor, will require about \$135,000. An appropriation for the fiscal ending June 30, 1881, of \$70,000, is asked for this work.

It has been in care of a watchman during the year. The public property is in fair condition.

No appropriation was made for the fiscal year ending June 30, 1880.

Appropriation asked for next fiscal year..... \$70,000 00

*Defenses at the mouth of the Columbia River, Oregon and Washington Territory, in charge of Maj. G. L. Gillespie, Corps of Engineers.*—The defenses consist of Fort Stevens, Point Adams, Oregon, on the south side, and Fort Canby, Cape Disappointment, Washington Territory, on the north side of the entrance to the river. These works are temporary earthen barbette batteries, constructed during the late war, and constitute the only defense of the mouth of the Columbia River.

*Fort Canby.*—The three batteries require extensive repairs, the maga-

zines of the left and center batteries are in ruins and should be rebuilt, that of the right battery can be made serviceable by slight repairs to the lining of the passage. The main powder magazine on the lower slope near the light-keeper's dwelling needs a few repairs. The wooden revetments and platforms of all the batteries are rapidly decaying; noticeably those of the center battery. The road leading to the right battery has been greatly impaired by a land-slide near the entrance gate.

No work has been done during the past fiscal year for want of funds.

*Fort Stevens.*—All of the platforms except that of the 15-inch gun are badly decayed and should be renewed.

During the year the drain to the moat has been put in order, the old lining of the passage leading to the magazine chamber has been strengthened, and a substantial interior lining added which is thoroughly watertight. The revetment of the sally-port has also been strengthened. The parapet has settled a little on the north side, and has been partially injured by the burrowings of water vermin, otherwise the work is in good condition. The high-tide line on the beach in front of the work has slightly advanced seaward during the year, and there seems to be no occasion for fearing any early injury to the fort by high seas.

The usual annual comparative surveys have been made of Sand Island, Point Adams, Clatsop Spit, and the Swash Channel, and charts prepared.

No appropriation was made for the fiscal year ending June 30, 1880.

Appropriation asked for next fiscal year..... \$30,000 00

#### BOARDS OF ENGINEERS.

*The Board of Engineers for Fortifications*, stationed at New York City, consisting of Col. J. G. Barnard, Col. Z. B. Tower, Col. H. G. Wright, and, for the time being, the officer in charge of the defenses under consideration, has been engaged upon the duties, and has submitted the reports mentioned in the following summary:

In September, 1878, the board presented memoranda upon our system of coast defense, setting forth briefly the action of this board in reference thereto, the present weak condition of the works, and the immediate necessity of appropriations for resumption of work upon them, in accordance with plans adopted for their modification to prepare them for the reception of guns that will be available against iron-clad fleets.

*January 30, 1879.*—The board reported upon the government reservation at Sandy Hook, N. J., its necessity for defensive purposes, and the propriety of permitting the temporary occupation of some portion thereof by a private company.

*September 4 and October 28, 1878.*—Upon the use of 8-inch converted rifles in casemates, and the distribution of those ready to be mounted.

*November 9, 1878.*—Upon system to be adopted for the delivery, storage, and preservation of torpedoes and their accessories in forts, for the defense of which they will be needed.

*February 8, 1879.*—The board, with Col. J. N. Macomb, Corps of Engineers, as member thereof for that purpose, to whom had been previously referred the subject of the growing obstructions in the harbor of the Delaware Breakwater, submitted its recommendations for remedying the same, together with its views upon Captain Ludlow's project for improving this artificial roadstead.

*March 22, 1879.*—Project submitted for the expenditure of the appropriation for torpedoes for harbor defense for fiscal year ending June 30, 1880.

April 28, 1879.—Defenses of Fernandina Harbor, Florida. The board during the year 1878 had prepared plans for modifying Fort Clinch, but reserved them for further study. Reconsidering the question, quite different plans have been prepared during the past year, which, while much less expensive, are thought to be quite commensurate to the present requirements of the position. These plans, with report thereon, were submitted April 28, 1879.

May 22, 1879.—Report submitted upon application of Col. G. W. Getty, requesting permission to construct models of certain of the fortifications of the United States to be used for purposes of instruction at the artillery school.

Fort Wool, Hampton Roads, Virginia.—This fort has been a subject of much study on the part of the board. A plan for its completion by the addition of a barbette tier for 12-inch rifle guns, reserving its casemates (embrasures strengthened as far as possible) for 9-inch rifles, was prepared as early as 1870. With the improvement of guns from year to year, up to their great increase of caliber as developed very recently, a reconsideration of this work has been necessary. The first study of the past year, aiming at the greatest development of offensive power attainable, gave plans for modifying Fort Wool for the reception of twenty-one 81-ton guns and five 12-inch rifles. The ultimate opinion of the board, however, favored a less expensive work, and a revision of the plans to meet this view was made, with a report thereon submitted June 14, 1879. In connection with the works devised already and that will be required in the future on the Fort Monroe side of the entrance to Hampton Roads, the less costly plans are deemed sufficient.

Sandy Hook, New Jersey.—The modification of the fort devised for the northern point of Sandy Hook has occupied the attention of the board for the past six months. Almost every possible combination has been studied and drawn to exhibit the power and capacity of the fort if finished on its present lines. The various phases of the question thus presented gave, by comparison and arrangement, the final plans adopted, which, though not the strongest possible combination, seemed quite proportionate to the development elsewhere, as well as to the needs of the position.

The board has also under study the subject of the modification of the casemated fort at Willet's Point, eastern entrance to New York Harbor. Plans exhibiting the proposed modifications are well advanced towards completion.

#### PROJECT FOR THE YEAR 1879-'80.

Two years since, this board in its annual report set forth fully the work it had done in planning defenses for the Atlantic, the Gulf, and the Pacific coasts, in accordance with conclusions reached in 1869—and reported upon—as a system not too costly and quite practicable in an engineering point of view, though but a partial solution of the question of national defense. The work of the board involved the consideration of every harbor upon our extended sea and lake coasts that demanded protection. Besides modifying nearly all of the barbette batteries of existing works, and those exterior thereto, many new batteries were planned. The system, however, was one of defense by barbette guns with the maximum caliber of the 12-inch rifle. Though with slight alterations and the substitution of suitable platforms, the barbette batteries projected and partly built can be made to accommodate the very large guns recently manufactured at the Essen, Woolwich, and Elswick factories, yet this board has been and is still of the opinion that such guns should

be put under cover, either in casemates or in turrets. For the past two years the question before it has been mainly the conversion of some of the more important forts to the reception of such guns. Thus far it has dealt with works which, from the width of their casemates or from their state of progress, permitted the conversion or the finishing in accordance with the general method adopted for the new work planned for the site of old Fort Lafayette. Designs have thus been presented for both the eastern and southern entrances to New York Harbor, viz., for Fort Schuyler, Fort Lafayette, and Sandy Hook; also, for Fort Carroll, entrance to Baltimore Harbor; and for Fort Wool, Hampton Roads.

There are many important forts which were finished according to the system that prevailed prior to 1860, and which will not permit modification of their casemates for the reception of the large guns now required for sea-coast defense. Of these works may be mentioned Forts Warren, Adams, Trumbull, Wadsworth, Delaware, Taylor, Jefferson, and fort at Fort Point, San Francisco Harbor, Cal. How to utilize these works, and by what means prepare them for guns absolutely necessary for defending the positions they occupy, are questions now before this board, and which it proposes taking up during the present year. Their discussion will involve the question of turrets, of machinery, &c., and will require the aid of good draughtsmen, themselves capable mechanical engineers.

Naval power has made rapid advances within the past ten years. Shore defense seems to have gained but little beyond its torpedo lines, except that incidental to the increase of the caliber and power of guns. There has been but little accomplished in the way of making provision for utilizing such guns for shore defense. The present problem is to provide protected emplacements for these large guns in or on our sea-coast works, and with such mechanical appliances that they can be maneuvered with facility like those on ship-board. Until that end is accomplished, the shore defense will be by all odds inferior to the naval attack, and the safety of our harbors will depend entirely upon our ability to maintain our torpedo lines in the face of a fleet of iron-clads.

#### TORPEDO DEFENSE.

The work of the board in this connection, for which special duty Major H. L. Abbot, Corps of Engineers, in charge of the torpedo school at Willets Point, is a member, is exhibited as follows:

During the past year Major Abbot has devoted much time and labor to the final reduction of the data accumulated since the beginning of the trials, in 1869, for developing a system of torpedo defense for our harbors and navigable channels.

The subjects of subaqueous explosions and of electrical fuzes have been thoroughly discussed, and 116 pages treating of the former have been printed by soldiers of the Engineer Battalion, and are now in the hands of the board.

The results of this analysis are highly satisfactory. Major Abbot has been able to revise the constants of his formulæ so that it is evidently applicable to all varieties of modern explosives. The important subject of the destructive range of torpedoes can thus be treated in the manner usually adopted for engineering problems.

The subjects covered by this investigation are much too extensive to be even mentioned here; but the following table, exhibiting the relative

intensity of action of several of the modern explosives, when exploded under water in torpedo cases, is given as a sample of the work:

Dynamite, No. 1 .....	100
Gun cotton .....	87
Dualin .....	111
Rendrock .....	94
Dynamite, No. 2 .....	83
Vulcan powder .....	82
Mica powder .....	83
Nitro-glycerine .....	81
Hereules powder, No. 1 .....	106
Hereules powder, No. 2 .....	83

It should be added that, for various reasons not necessary to discuss, the board is agreed that dynamite No. 1 should be adopted for our service.

To illustrate the precision of analysis rendered possible by the formula deduced from the data collected, the following example is given:

The problem is to determine the crater radius ( $r$ ) which will be produced in ice from 8 to 10 inches thick, by the explosion of ( $e$ ) pounds of a modern explosive, of which the constant is ( $E$ ) submerged ( $S$ ) feet below the surface, the angle from the nadir to the line of fracture being ( $\delta$ ). For dynamite No. 1 the numerical value of  $E$  is 186. The formulæ are:

$$r = \frac{S}{\cos(180 - \delta)}$$

$$(\delta + E) \cos^2(180 - \delta) = \frac{10.49S^2}{e}$$

Twenty-one trials were made with dynamite No. 1, dualin, and gun-cotton, with charges varying from 1 to 10 pounds, and submergences varying from 2 to 13.5 feet, and crater radii varying from 0 to 14.1 feet. The maximum discrepancy between observation and the indication of the formulæ was 1.2 feet in the crater radius, the mean discrepancy being 4.5 inches.

Thirty-five shots have been fired in the submerged ring, chiefly to test new explosives; and this work will be continued during the coming season.

Many experiments have been made with electrical fuzes, employing original methods and apparatus. The object has chiefly been to detect any deterioration due to long storage. The result has shown that our adopted patterns exhibit none, and some of the samples have been on hand eight years.

One of our buoyant mines, after being submerged in the channel off Willets Point for four years and five months, has been found to be in a perfectly serviceable condition, thus sufficiently proving its trustworthy character.

Attention should be invited to a very compact and simple dynamo-electric machine made by the Laffin and Rand Powder Company. The cost is only twenty-five dollars, and the instrument is admirably adapted for use as a portable igniting apparatus for torpedoes and heavy ordnance. It has been carefully tested by practical use at Willets Point during the past two years.

A supply of torpedo cable insulated with kerite and made in this country has been purchased for trial during the past year. The insulation is low, varying from fifty to one hundred megohms per mile, but the material promises well in respect to permanence. Time alone can

properly test its value, and measures have been taken to determine this important point.

Experiments have been continued with the electric light to test its value as a means of protecting our mines against operations of the enemy. The results upon the whole are satisfactory.

To determine the destructive range of countermines which may be employed by an enemy against our mines, a charge of 500 pounds of dynamite No. 1 was exploded last autumn. This charge was contained in an iron torpedo resting just above the bottom in water 20 feet deep. It was surrounded by our service mines at various distances, and the result proved that its power of injuring them was far less than the estimates given in foreign journals. A charge of eight pounds of dynamite No. 1, contained in a cast-iron shell, was placed at a horizontal distance of 40 feet from the exploded charge, and was not detonated by sympathy. It was subsequently cracked open by a charge of half a pound of dynamite laid upon it when supported upon a rock in the air, and the charge (8 lbs.) was thus recovered quite uninjured. This experiment has been repeated several times, and in no case has the charge been fired. Charges of one pound of dynamite contained in tin cases were suspended at various distances from the great mine, and even when crushed at 80 feet, were not fired by sympathy. These experiments seem to prove that the danger of sympathetic explosion of mines charged with dynamite has been greatly exaggerated in Europe.

To obtain some precise data upon the manner in which the forces developed by a subaqueous explosion act upon a vessel, an old schooner was blown up last autumn at Willets Point. Her name was "Olive Branch"; length, 71 feet; tonnage, 60 tons. She was anchored in water 15 feet deep. Two torpedoes, each a beer-keg containing 50 pounds of mortar powder, were suspended 10 feet apart and 3 feet below her bottom amidships. They were submerged 7 feet. Six cameras were placed at a distance of about 500 feet, so arranged that by the aid of electricity instantaneous views could be taken at the pleasure of the operator. The time of explosion and of dropping each camera slide was electrically recorded on a field chronograph. The torpedoes were exploded simultaneously. A picture taken one-tenth of a second thereafter showed the bow and stern plunged in the water, and the middle of the vessel raised about 16 feet in the air. The masts were still vertical, and the jet of water had reached a height of about 70 feet. The second picture, taken 1.5 seconds after the explosion, showed a column of water 160 feet high, containing many fragments of the wreck. The third picture, taken 2.3 seconds after the explosion, showed the jet at its maximum, 180 feet high. The air was full of fragments, but apparently none had yet begun to fall back to the water. The fourth picture, about 3.3 seconds after the explosion, exhibited a descending mist; the water agitated by heavy splashes of fragments, and the site of the wreck shrouded by a cloud of smoke. The fifth picture, taken a second later, showed only a thin cloud of mist and smoke, with no evidences of violent action remaining.

Thus the total destruction of the schooner had only consumed about 0.1 of a second, and the whole exhibition of power only about 4.5 seconds. The exceedingly short duration of the destructive action leaves no doubt that upon the mean and not upon the maximum intensity of action (pressure), will the useful effect probably depend.

The purchase and storage at our forts of the material approved for the torpedo defense of our harbors has continued during the past year so far as permitted by the limited appropriations granted by Congress.

It should be understood that large sums can now be judiciously expended, and that, in the present unsatisfactory condition of our heavy ordnance, as presented in the reports of that department, the safety of our coast may depend largely upon having a suitable supply available for immediate use.

#### RECOMMENDATIONS BY THE BOARD.

It is the duty of the board to again invite attention to the urgent necessity of increasing the number of enlisted men of the Battalion of Engineers sufficiently to enable them to properly perform the new duty assigned them by Congress of acting as a Torpedo Corps for the defense of our extended coast. The minimum force consistent with reasonable efficiency has been carefully estimated at 520 men, and the number now available is only about one-fourth of that figure. No increase in the legal organization nor in the number of officers is required. A provision, authorizing the President to recruit the companies to the standard now authorized by law, will supply the needful number. The duty is perhaps more technical than any other in the Army, and requires special qualifications and special training; and the men are equally as available for other duties in an emergency as those enlisted in the other three combatant arms of the service.

The board would renew its recommendation that a special appropriation be requested for preparing our forts for operating torpedoes. At the outbreak of hostilities it will be too late for this work to be properly done; the cost is small; the necessity is evident. An appropriation of \$100,000 would suffice to place many of the more important works in an efficient condition for this service.

For the purchase of torpedo materials, and for instructing the engineer troops in the use of the same, and for continuing the trials designed to perfect the system, an appropriation of \$100,000 is recommended.

#### SPECIAL DUTIES OF INDIVIDUAL MEMBERS.

In addition to their duties in connection with the Board of Engineers for Fortifications, the individual members composing the board have, as usual, been much engaged as members of other permanent and special boards.

As in previous years, Colonel Barnard has continued to serve as a member of the Light-House Board, and throughout the past year has presided over the Board of Engineers constituted by S. O. 71, H. Q. C. E., July 8, 1878, to take into consideration the improvement of the low-water navigation of the Mississippi and Missouri Rivers, and to submit a plan therefor. By direction of the President of the United States, and in accordance with section 4 of the act of Congress approved June 19, 1878, he served as senior member of a board of engineers required to examine the works in process of construction at the South Pass of the Mississippi River, and report upon progress made, probable cost of completion, results produced, and that may probably be produced, probable permanency of the works, and advisability of any modification of the terms of the act under which the works are being constructed; and, by further direction of the President, served as a member of the commission appointed under act of Congress approved June 20, 1878, to select a site for the Naval Observatory, &c.

Colonel Tower has served throughout the year as a member of the Board of Engineers for the permanent improvement of the channel of

entrance to Charleston Harbor, South Carolina, and of the Board of Engineers to take into consideration the improvement of the low-water navigation of the Mississippi and Missouri Rivers, and to submit a plan therefor. He has also served upon the board appointed under act of Congress, approved June 19, 1878, to examine the works in process of construction at the South Pass of the Mississippi River, &c.; as member of board to consider and report upon plan and location for a harbor of refuge at or near Cincinnati, Ohio; of board to consider and report upon project for improvement of the Shrewsbury River, New Jersey; of board for the further improvement of Savannah River and Harbor, Georgia; and of board to consider and report upon the improvement of Pass Cavallo Inlet into Matagorda Bay, and of Aransas Pass and Bay up to Rockport and Corpus Christi, Texas, and also the continuation of the improvement of the entrance to Galveston Harbor, Texas.

Colonel Wright has, under act of Congress approved July 19, 1876, continued to serve upon the commission for the repavement of Pennsylvania avenue, Washington, D. C.; and has served throughout the year as member of the board for improvement of the channel of entrance to Charleston Harbor, South Carolina; and of the board for the improvement of the low-water navigation of the Mississippi and Missouri Rivers. He has also served as member of the Board of Engineers appointed under act of Congress, approved June 19, 1878, to examine the works in process of construction at the South Pass of the Mississippi River, &c.; also, during the temporary absences of the Chief of Engineers during the past year, performing the duties of that officer as acting chief, and other duties assigned to him in that connection.

The Board of Engineers for the Pacific Coast during the past fiscal year has consisted of Lieut. Col. B. S. Alexander, Lieut. Col. C. S. Stewart, Lieut. Col. R. S. Williamson, and Maj. G. H. Mendell, with First Lieut. A. H. Payson recorder, until the death, on the 15th December, 1878, of Lieut. Col. B. S. Alexander, since which it has been formed of the other officers above named, with whom Maj. G. L. Gillespie, Corps of Engineers, has, for part of the fiscal year, been associated.

During the year the board has had under consideration the locating of a breakwater and harbor of refuge on the Pacific Coast between the Straits of Fuca and San Francisco, California; also the improvement of Coos Bay, Oregon.

In addition to the above, the members of the board have been in charge of the works of fortification and of harbor and river improvement mentioned elsewhere in this report.

#### BATTALION OF ENGINEERS AND ENGINEER DEPOT.

*Battalion of Engineers, commanded by Maj. H. L. Abbot, Corps of Engineers, headquarters Willets Point, eastern entrance to New York Harbor.*

The strength of the Battalion of Engineers on June 30, 1879, was 11 commissioned officers and 192 enlisted men.

It was commanded by Maj. Henry L. Abbot, and was stationed as follows: The headquarters and Companies A, B, and C at Willets Point, New York Harbor; Company E, at West Point, N. Y. Company D is a skeleton organization, at present commanded by the battalion adjutant, and serving on detached duty with troops in the West.

No regular system of recruiting has been carried out during the past year, the vacancies being filled by enlistment and re-enlistments in the

companies and by special assignment from the general depot of the recruiting service, in New York Harbor.

The changes during the year have consisted of 1 death, 50 discharges, 3 desertions, 17 re-enlistments, 30 recruits received, and 3 deserters apprehended, and 2 transfers.

The company at West Point, besides performing ordinary post duties, has aided in the instruction of cadets in field engineering, pontoniering, and military signaling and telegraphy.

The companies at Willets Point have, as heretofore, performed the ordinary garrison duties of the post; cared for, repaired, and issued the property and instruments pertaining to the engineer depot; remodeled a part of the bridge-train to make it conform to the new patterns, and performed needful labor upon the post and public buildings of Willets Point.

The post now constitutes a regular school of application for the engineer service.

The officers are assigned for limited periods to duty with the troops, and thus the whole corps of officers below the grade of field officer, and especially the recent graduates joining from the Military Academy, acquire that experience with enlisted men and that familiarity with company duty which is so essential to a combatant arm of the service.

In addition to these routine duties the younger officers are afforded every facility for acquiring practical experience in the use of instruments and ordinary methods of operation upon the civil works of the country intrusted to the Corps of Engineers.

The tour of duty at Willets Point, which usually follows immediately after the theoretical course at West Point, and covers from two to three years, thus serves the important objects of practical military training of the new officers and of practical instruction in the civil duties to which they are to be transferred as assistants.

In addition to the former military duties of engineer troops in campaign, such as field fortification, pontoniering, sapping and mining, reconnaissance, military map making and printing, and other kindred matters, Congress, since the war, has constituted these troops the Torpedo Corps, for the defense of our coasts against the inroads of hostile fleets.

These new duties are not only of the highest importance, but they also involve much special training, notwithstanding the fact that the familiarity with boats acquired in pontoniering, and with explosives and modes of electrical ignition in land mining, specially prepares engineer troops for the service.

At Willets Point the most systematic attention is devoted to this new branch of warfare, a regular individual training being given to every soldier and full records of his proficiency being preserved.

Officers pass through a complete course of laboratory instructions, designed to render them familiar with all branches of the subject, so far as defensive mines which can be operated from the shore are involved.

A fine laboratory, provided with all the needful electrical and other apparatus, has been provided. In fine, everything possible has been done to prepare in peace for the vitally important duty which will certainly have to be performed upon the first breaking out of hostilities with any maritime power, the placing of our principal harbors in a defensive state by submarine mines.

Notwithstanding these efforts, it is my duty to invite the attention of the department to the fact that the service is in an unsatisfactory state,

and that disastrous failures are probable by reason of the present excessive reduction in the number of enlisted men of engineers. The law provides for a total of 752 of these soldiers; but the force authorized to be enlisted is only 200, including 50 men at West Point, where no facilities exist for the needful instruction in torpedo warfare. A very careful estimate of the number of trained men which will certainly be required in addition to the ordinary laborers, sailors, &c., who can be raised in an emergency, fixes the minimum at 520 men. I would therefore respectfully urge that the companies at Willets Point be allowed to be recruited to that number.

It should be remembered that these men are thoroughly instructed in the duties of infantry soldiers, and are equally as available as any other troops for special service in any special emergency, such for example as the labor riots of 1877, when they served with the rest of the troops in a manner to win the high commendation of General Hancock. Indeed it may safely be asserted that in discipline, marksmanship, and drill they are second to none in the service.

*Engineer Post and Depot at Willets Point, New York Harbor, commanded by Maj. H. L. Abbot, Corps of Engineers.*—This post, situated on Long Island near where East River widens into the sound, constitutes the principal engineer depot of the Army, where are stored the bridge equipage, the tools for field service, the torpedo material collected for the defense of the coast, and the astronomical and surveying instruments used by the Corps of Engineers upon the various military and civil works of the country. This material is cared for, guarded, received, and issued exclusively by the soldiers of the Engineer Battalion.

Willets Point is also a useful school of application for the Engineer Service. The enlisted men are thoroughly instructed in these duties, as sappers, miners, and pontoniers; in field reconnaissance and photographing maps for use of armies in campaigns; in the new system of submarine torpedo defense for our harbors and navigable channels; and also in the usual duties of infantry soldiers. The officers, in addition to their strictly military duties, are furnished with all needful facilities for becoming practically familiar with the instruments and methods in use upon the various civil works of the corps. Newly assigned officers, upon leaving Military Academy at West Point, are usually stationed at Willets Point for about two years before being sent as assistants upon the public works; and the need of more practical familiarity with instruments, etc., which before the establishment of this system was often experienced by young officers, should no longer be felt.

Appropriations of \$1,500, for the purchase of engineer materials, to be used in the instruction of the Engineer Battalion, including the company at West Point, and of \$4,000 for the contingent expenses of the depot, are requested. The first of these appropriations has heretofore been \$1,000, but that amount has proved insufficient for the battalion, including the company at West Point. There is also requested an appropriation of \$1,500 for the purchase of a small (5-inch) astronomical telescope for the use of the field observatory, which is now provided with no instrument suitable for this class of observations. The next transit of Venus will be visible at Willets Point, and it is desirable that the means of properly observing it should be prepared in season to be certainly ready. These observations could be made with such a telescope, besides many others occasionally required of the Corps of Engineers.