



Henry L. Abbot  
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**Henry Larcom Abbot** (1831-1927) was graduated second in his class from the United States Military Academy in 1854 and assigned to the Topographical Engineers. Before the Civil War he surveyed railroads on the West Coast and aided A. A. Humphreys in his study of Mississippi River hydraulics. With the outbreak of war, Abbot served on the staff of

Irvin McDowell as topographer and was wounded at First Bull Run. Returning to duty, he served as aide to Chief Engineer John G. Barnard in construction of the defenses of Washington and continued on Barnard's staff during the Peninsula Campaign. Abbot was commissioned Colonel, 1st Connecticut Heavy Artillery, and placed in charge of organizing the army's siege train for the 1864 Virginia Campaign. In June 1864, he transported the siege train to Petersburg and directed its activities until Appomattox.

Abbot wrote a full report on the siege artillery at Petersburg, published in 1868 by the Corps of Engineers. Abbot devotes one chapter to earthworks, which is reproduced here in full. He was one of the few engineers who attempted to describe the "system" of forts that grew up around Petersburg and at Bermuda Hundred, how the Federal system diverged from Confederate efforts, and how the fortifications contributed ultimately to victory. He refers to this chapter as a "few remarks" — his primary subject being ordnance and artillery — but he offers some insights that leave one wishing he had expanded the chapter into a treatise. —*D. Lowe*

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## SIEGE ARTILLERY

IN THE

## CAMPAIGNS AGAINST RICHMOND,

with

## NOTES ON THE 15-INCH GUN,

AN ALGEBRAIC ANALYSIS OF THE TRAJECTORY OF A SHOT IN ITS  
RICOCHETS UPON SMOOTH WATER.

ILLUSTRATED BY ACCURATE DRAWINGS OF A LARGE COLLECTION OF THE  
RIFLE PROJECTILES AND FUZES USED BY EACH ARMY IN VIRGINIA.

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#### CHAPTER IV.—EARTHWORKS.

Defensive lines. Redoubts with closed gorges superior to open redoubts in the battles before Petersburg. Obstacles. Shelter from projectiles, including parapets, looped shields, mantelets, bomb-proofs, &c. Data for estimating soldiers' labor. Magazines. Boyaux.

Earthworks are so closely allied to siege artillery that this paper would hardly be complete without a few remarks upon them.

Our system of intrenchments at Petersburg consisted, in general terms, of a series of field-works, each capable of containing a battery of artillery and a strong infantry garrison. These works were closed at the gorge, were protected with abatis and palisading, were often supplied with bomb-proofs, and were located, at intervals of about 600 yards, on such ground as to well sweep the line in front with artillery fire. They were connected by strong, continuous infantry parapets, with obstacles in front. The main Bermuda Hundreds line and that north of James river were similarly constructed, as were also the defences of Washington.

The confederate system differed from this, chiefly, in having its redoubts open at the gorge, and not arranged for independent defence.

The merits of these different systems of lines have been much discussed by military writers. The Petersburg battles of March 25th and April 2d, 1865, illustrate the superiority of the arrangement adopted by our own engineers. The circumstances attending the first named battle were the following:

Hare Hill was situated near the right of our Petersburg line, about a mile from the Appomattox river. It was protected by Fort Steadman, with battery No. 10 on its right and batteries 11 and 12 on its left. The next work closed at the gorge, on the side of the Appomattox river, was battery No. 9, situated near the foot of the hill. The next work on the left of Hare Hill and its collection of batteries

was Fort Haskell, situation on another hill, with a small creek between.

Fort Steadman was one of the weakest and most ill-conditioned works of the line, being unprotected by abatis in rear, being masked on its right (just in rear of battery No. 10) by numerous bomb-proofs rendered necessary by the terrible fire which habitually prevailed in this vicinity, and, being only about 200 yards distant from the enemy's main line. The parapet had settled during the winter, and, in fine, the work was not well prepared to resist sudden assault

At about 4 o'clock a. m. of March 25, three divisions of the enemy, under General Gordon, made a sudden and well arranged attack upon the defences of Hare Hill. It was a complete surprise, and was successful. Their column simultaneously swept over the parapet between Steadman and battery 9, over battery 10 and over battery 11, joined in rear of the fort, and carried it almost without opposition. From that time to daylight a scattering hand-to-hand fight raged among the bomb-proofs and on the flanks of the enemy's position. He assaulted Fort Haskell again and again, but failed to carry it, or battery No. 9. As soon as the light would admit, all the siege artillery from batteries 4, 5, 8, 9, and Fort Haskell, and all the light artillery which General Tidball, chief of artillery 9th Corps, could concentrate upon the position, opened and maintained a heavy fire upon the enemy. No re-enforcements could join him from his own line, owing to this fire which swept his communications; his captured position was entailing deadly loss; our reserves were rapidly assembling, and finally, about 1 a. m., they made a charge, which resulted in the recovery of our works, of all our artillery, (even including the Coehorn mortars,) and in the capture of over 1,800 prisoners. The following extracts from the confederate papers show the effects of our artillery fire:

“It was found that the enclosed works in the rear, commanding the enemy's main line, could only be taken at a great sacrifice.” “The enemy massed his artillery so heavily in the neighboring forts, and was enabled to form such a terrible enfilading fire upon our ranks, that it was deemed best to withdraw.”

"The enemy enfiladed us from right and left in the captured works to such an extent that we could no longer hold them without the loss of many men," &c., &c.

If the enclosed works on the right and left had not fixed a limit beyond which the enemy found it impossible to extend his lines, his great local superiority in numbers might have given us trouble.

On April 2 we, in turn, were the assaulting party. As in the battle of March 25, the sudden unexpected attack at early dawn was successful, near Fort Mahone; and the confederate redoubts being all open at the gorge and hence untenable against a flank and rear attack in force, were soon occupied along such an extent of their line as to prevent that terrible concentration of artillery fire which would have been made upon a contracted position. We succeeded all day in holding our own against a series of counter assaults, which clearly showed that the ruin then impending over the confederacy did not impair the personal courage of its defenders.

The great practical difficulty in defending lines in close proximity to the enemy lies in *keeping the troops always ready to receive assault*. The engineering system adopted on the Bermuda Hundreds lines, with this object in view, proved excellent; viz., to place from 300 to 400 yards in advance of the main line a series of small redoubts, well protected by obstructions, provided with three or four smooth-bore field guns, and garrisoned by a full artillery company armed with muskets and supported by a small force of infantry. These works could not be neglected by an assaulting column, and their vigorous defence, even if unsuccessful, would give the necessary time for manning the main lines; which the pickets, unsupported, could not in such circumstances be trusted to secure. The confederate assault of June 2 was repulsed by one of these advanced redoubts, laid out, it should be added, entirely without local flanking arrangements.

When a large isolated earthwork, with a small garrison, is to endure a siege, as at Fort Wagner for instance, it is

doubtless necessary to provide flanking arrangements for the ditches; but the experience in Virginia showed that with small earthworks on the lines of a great army, the interior space thus necessarily sacrificed is of far more importance to the defence. If the line offered strong salients which crossed fire in front of each other, the close flanking of the ditches proved to be of little importance.

Regular siege approaches upon a long line of well-manned earthworks, which cannot be enveloped, and which are vigorously defended by forces nearly equal to our own, provided with smooth-bore field artillery, numerous mortal and modern rifle muskets, we found to be so difficult as warrant little anticipation of victory.

#### OBSTACLES

Efficient exterior obstacles are of the greatest importance but our experience showed that they should not be placed close to the ditch. The nearest line should be about fifty yards in front; and, if possible, a second at one hundred yards distance should be added. Abatis at these distances properly pinned down, with a few telegraph wires twisted around stumps or stakes about a foot above the ground, is almost impassable, and cannot be destroyed with artillery fire, unless by enfilade. A "slashing" in forest land is very effective, but in dry weather it soon becomes liable to be burned by shells; a fate which often befell our defences of this character. Chevaux-de-frise were not used by us, but were much depended upon by the confederates, who connected them by chains at the ends. In the assault upon the works at Petersburg, on April 2, 1865, this species of obstruction but very little retarded our troops.

The following statement of the obstructions on the posed portions of the lines in front of Bermuda shows importance attached to this means of defence by the confederate engineers: 1st, a fraised ditch to the main line; 2d, an abatis at about 25 yards; 3d, a palisading at about 50

yards; 4th, a chevaux-de-frise at about 75 yards; 5th, an abatis at about 150 yards; 6th, an intrenched skirmish line at about 500 yards; 7th, an abatis just in front of the latter. We never defended our lines so strongly, usually depending upon a slashing, or upon one or two lines of abatis or palisading, interlaced when practicable with telegraph wire. Such indeed, was the usual confederate system.

The confederates also paid considerable attention to land torpedoes as obstacles against assault, while we neglected them. At Fort Fisher, North Carolina, the elaborate system of electrical torpedoes is well known. Along and in front of the abatis of the works north of James river, near Fort Harrison, immense numbers of loaded shell, with a very sensitive fuze so arranged as to ignite when trodden on, were buried. Earlier in the war, at the siege of Yorktown, these loaded shells were also used in great numbers, and not always according to the rules of civilized warfare. At Charleston and Mobile, also, they were planted in large numbers.

#### SHELTER FROM PROJECTILES.

In ordinary soils, parapets likely to receive a heavy fire from field artillery should be not less than 12 feet thick, of well-rammed earth; to resist the fire of modern siege guns this must be increased to 16 feet; to resist the 7-inch and 8-inch 11 rifled sea-coast guns, not less than 20 feet will suffice. All these dimensions must be increased when, as is generally the case in the field, ramming is not attempted, and the fire is expected to begin before the earth has had time to settle. In quartz sand a less thickness will suffice.

In sandy clay, like the soil in Virginia, the width of the berme should be at least half the depth of the ditch, to resist the crumbling action of frost. The ultimate practice in the defences of Washington was to prolong the exterior slope to the bottom of the ditch.

Revetment for interior slopes in Virginia was usually

made of logs or poles; rarely of gabions, fascines, hurdles, or sand bags.

The parapet of field-works on the lines of an army should not be made more than eight feet high. The curvature of the trajectory, both for artillery and musketry, is so great that almost the only utility of defiladement is to conceal the interior of the work from the view of the enemy. This object is more readily attained by a few sand bags, or by a hurdle screen looped for musketry, than by attempting the construction of enormous parapets with soldiers' labor,\* which, unless an immediate attack is apprehended, is far less than that of paid workmen.

The great accuracy of the rifled musket rendered it necessary at several points of the lines to construct covers for

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\* To determine what would be a safe estimate for the labor of good troops, some careful notes were taken when fortifying the siege-train depot at Broadway Landing. The soil was sandy clay; the weather excellent; the troops, a detachment from the 15th New York volunteer engineers, company M, 3d Pennsylvania artillery, and a few men of the 1st Connecticut artillery. Three thousand days' work, of ten hours each, were required; of which twenty-five hundred were spent in digging, and five hundred in cutting and placing 420 yards of pole revetment well anchored with wire, in cutting and planting 600 yards of good abatis, and in slashing several acres of timber in the surrounding ravines. The men were placed half in the ditch, (picks and shovels equally distributed,) and half on the parapet, which was seven feet high; the ditch was twelve feet wide and six feet deep. The men averaged 6.4 cubic yards of dirt moved to the day's work. Hence, with moderate profiles, in ordinary soil where the pick is needed, and the abatis, &c., easy of access, the daily amount of excavation by the detail, less one-sixth for the party placing the corresponding revetment, abatis, &c., may be estimated by allowing 1.6 cubic yards per man;—where the pick is not needed one-fourth more will be done;—that is, a detail of six hundred men will excavate and place in the parapet  $500 \times 1.6 = 800$  cubic yards in the former, and  $500 \times 2 = 1,000$  cubic yards the latter case per day. My experience as an engineer in the earlier campaigns of the war accords with this rule when our best class of troops are engaged and *not expecting immediate battle*. In the latter case, their exertions are nearly doubled. In De Rouvre's "Aide Memoire d'Etat Major" the day's work is laid down at 2.6, 5.2, and 6.5 cubic yards in hard, medium, and light soil respectively. Professor Mahan, in his "Field Fortifications," gives 6 cubic yards for ordinary, and 8 to 10 cubic yards for task work with soldiers. In Laisné's "Aide Memoire du Genie" these classes of work are estimated at 10.5 and 15.4 cubic yards respectively, when laborers are employed. The latter estimate accords well with that of experienced contractors upon the levees of the Mississippi river.

the head in firing, reconnoitring the enemy's line, &c. We usually made them of sand bags, and the confederates of logs roughly looped at three feet intervals, but both devices were occasionally employed by each party. To protect the sharpshooters something more was necessary, and a log having a square loophole of minimum size, strengthened by a small musket-proof iron plate on its exterior was adopted. These plates often bore the marks of having been repeatedly struck, so deadly was the precision of this description of fire.

To protect our artillery, mantelets were often required. They were furnished by the Engineer Department—two patterns of combined wood and iron, and one of rope. Both the former met with little favor, owing to the impossibility of modifying the openings when used in oblique embrasures; owing to the shattering caused by the blast of short guns; and owing to the dangerous splinters thrown off when struck by artillery. The latter—dimensions 5 by 4.5 by 0.5 feet, with opening 1.6 by 1.3 feet—was too heavy for convenience, weighing over five hundred pounds. The penetration into it of a rifled musket ball fired at twenty yards was 2.5 inches. A later pattern, only four inches thick, served every purpose, although occasionally balls striking between the ropes would pass through. It was made of four thicknesses of three-inch rope, each of the two outer layers being in one piece bent vertically, and the two inner of short pieces laid horizontally, the whole well tied together.

The chief object of the mantelet is to conceal the cannoniers from the enemy's sharpshooters by a screen *supposed* to be bullet proof. When this is done but few shots are directed at it, and if they occasionally penetrate, the risk must be incurred rather than allow excessive weight.

Our mantelets were hung on horizontal poles supported upon forked uprights, the elasticity of which greatly increased the resistance; thus, on one occasion when one of the later (four-inch) pattern in battery No. 9 on the

Petersburg lines was struck by a ten-pounder rifled shot, fired at six hundred yards, the shot was deflected after breaking the lashings and throwing down the pole supports, and was so much checked in velocity as to then knock a man down without killing him. The confederates made some use of small ring mantelets placed upon the gun itself and pierced with a slit to admit of pointing. We tried this plan ourselves at the siege of Yorktown; the gun, of course was run back and loaded under cover of the parapet; the device seemed a good one.

The confederate batteries on Chesterfield Heights were interesting studies, from the ingenuity displayed in obtaining shelter. They had long annoyed the right of our line before Petersburg with an enfilading fire, and had received much attention from our batteries in consequence. The range was about one thousand six hundred yards, and to avoid the effects of our shells, which often exploded in the embrasures, an extraordinarily long and narrow shape was given them. The most troublesome battery (4.2 inch siege rifles) was half sunken, and had a parapet thirty-three feet thick, with embrasures which were hurdle-revetted two feet wide at the throat, and only four feet wide at the exterior crest! Substantial traverses with good splinter proofs were made on each side of the guns in this battery, and solid bomb-proof quarters were near by. In locating one of these batteries for Whitworth guns, much skill had been displayed in lessening the effect of our fire by stratagem. The bluff of the Appomattox is here level at top; the battery was placed about four hundred yards from the edge, with a ploughed field in front and a skirt of bushes on either side, so that from our lower bank we could obtain no flank view. An error had clearly been made in under-estimating the distance of the battery from the edge, and our shells throwing up dust from the field in front had been supposed to be striking the parapet. With horizontal fire this was not a perfect protection, as the ricochets would annoy the gunners, but for effective mortar fire it was fatal.

Many plans were tested by both armies for obtaining protection against mortar fire. Bomb-proofs of every conceivable shape, generally made in half excavation of log framework covered by earth, answered this purpose for men off duty. Each soldier generally made his own shelter. They were placed near—sometimes under—the parapet, and often encroached upon the space required for using the musket. In fact, the lines in some places became involved labyrinths, nearly impassable at night to one not very familiar with the locality. At the approach of winter, chimneys of sticks, or, better still, of gabions plastered with mud, were added; and the edifices assumed an appearance only to be represented by the photograph.

For the protection of men on duty, the usual plan was to place at intervals of about fifty yards cross-pieces of timber or railroad iron from the parapet to some bomb-proof or magazine just in rear, and to cover the top with earth, (one layer of railroad iron and three feet of earth sufficed.) These covers were about six feet wide at the crest line; and the sentinels could step for a moment under them to avoid descending fragments without relaxing their vigilance.

Mortar battery number 12 on the Petersburg lines, which frequently received a heavy return fire, was constructed upon an excellent plan by Captain Pride, 1st Connecticut artillery, commanding it. He placed his mortars by twos, separated by substantial traverses; at each side of which a good shelter like those just described was placed. The cannoniers could readily pass in and out to avoid fragments, and could keep all their ammunition under cover until required for use. In the end of one traverse he arranged a covered lookout, where the effect of the shots could be safely observed. Although this battery was subjected to a very heavy fire, which tore up the platforms and marked the mortars with fragments, it could not be silenced and very few casualties in it occurred.

For protection against heavy horizontal fire, the confederates adopted the following plan on the Bermuda Hundreds

lines: a continuous splinter-proof was made under the parapet behind the breast-height revetment, top two feet above and bottom one foot below the banquette tread, width four feet; this was made of a heavy framework of logs which consisted of two parallel rows of uprights (uprights in each row three feet apart) supporting cap sills and roofed by logs sloped to the front and projecting over the scarp, thus forming a fraise. The shelter was well drained, and furnished cover for one man to every six feet of parapet.

#### MAGAZINES.

Our experience indicated that for siege guns a very simple plan, involving nothing but what could be obtained upon the spot, answered all necessary purposes for magazines in upland soil like that of Virginia. We took great care to shelter them as much as possible by the parapet, and made the chamber entirely below ground, roofed by heavy logs, (sometimes resting on plates supported by uprights, and sometimes on horizontal logs notched into each other like the sides of a log house,) and covered by earth about six feet thick. The entrance was straight and from the rear. Boards were seldom used either for the sides or the floor, which was made to drain into a hole (a barrel if practicable,) sunk near the entrance. The usual dimensions in the clear were six feet wide by five or six feet deep, length to vary according to capacity required. In no instance was one of them blown up, although often hit by shells; and very little loss of ammunition occurred from dampness even in heavy rains, such as that of August fifteenth at Petersburg when several soldiers in the low bottom were washed away and drowned.

Where so much magazine room as is required by modern rifled siege and field artillery is needed, it is not often practicable to construct magazines upon the elaborate plans laid down in the text-books. For the heavy James river water batteries, however; this was deemed necessary by both armies; especially by the confederates, whose maga-

zines and bomb-proofs for this purpose were extremely substantial and well made.

#### BOYAUX.

Our experience with covered approaches indicated that absolute protection must be sacrificed to facility in turning the corners with wagons, and especially with siege guns; the latter were several times overturned in passing the angles of the boyaux leading to Fort Sedgwick, on one occasion crushing an officer to death.