Hedge to Concrete Casemate—Evolution of Forts

(Continued from Page One)

ventive genius was put to work, consisted of natural objects, such as trees, bowlders, hills, and gullies.

First man-made fortifications, it is believed, were nothing more than thorn hedges or bundles of brushwood, similar to the *bomas* that simple African savages still plant or erect around their villages. The *chevel-de-frise* was a later and the barbed wire entanglement a still later development of the thorn hedge defense against attack.

The next step in the development of fortification was the palisade, or fence of tree trunks, stakes, or palis set on end in the earth, and in some instances sharpened at the exposed ends, a type of defense that existed on the American frontiers up to the very beginning of modern warfare. Old Fort Dearborn at Chicago, Fort Sackville at Vincennes, and many others, stout stockade defenses against the puny weapons of the Indians, were merely adaptations of the ancient palisades.

". . . the bank of earth . . . in his [Caesar's] armed camps, such as the one established at Alesia . . . A. D. 52."

Defenses Made of Earth

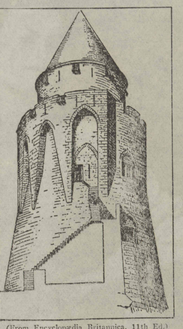
Following the stake fence in the evolution of defenses came the bank of earth, its steep exteriors frequently covered with sharpened wooden pegs or other obstructions. Early Germans employed the then old idea of the earth bank in halting Cæsar's legions, and the great Roman conqueror himself, when threatened by the warlike Gauls, was prone to employ the idea in his armed camps, such as the one established at Alesia, an ancient town taken by the Romans in A. D. 52. The influence of the earth bank type of fortification still can be seen in fortifications, both temporary and permanent and both inland and coastal.

The next development was the wall of mud, masonry, or sun-dried brick, and walls of all these types were in use when history began. So long ago as that remote and somewhat indefinite time people in some sections of the world already had abandoned nomadic habits to gather together in cities and towns. Walls were built to surround and protect those cities and towns, and, as besiegers from time to time grew more resourceful, higher, thicker, and stouter were made the walls. Sometimes they were constructed to inclose areas sufficiently large to enable people from surrounding territory to crowd in with their flocks in times of danger.

For thousands of years the walled city was the most important type of fortification. Nineveh, erected more than twenty centuries before the time of Christ, boasted a wall fifty miles in perimeter, 120 feet high, and thirty feet thick, and graced with 1,500 outjutting towers from which spearmen and archers could command the parapet of the wall and the exterior faces of the whole system of defense. Babylon likewise, and Tyre, Troy, Jerusalem, Rhodes, Carthage, Rome, and hundreds of other great cities of antiquity were surrounded by high walls, a type of defense—in fact, the principal type—that persisted for a long time after the first employment of gunpowder in warfare and down to that day when cannon at last were brought to a stage of development that found them powerful enough to shatter walls of masonry and brick.

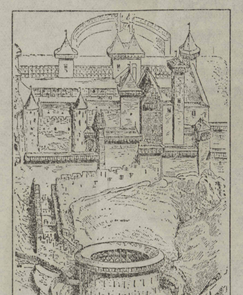
Ruins of those ancient walled cities today are explored by archeologists. So vast are some of the structures when laid bare by excavation that people wonder how it was that they could have been built before the days of mechanical cranes, steam shovels, fabricated steel, and the like. Explanation lies in the fact that in those early days the world was ruled by despots, who could order any job begun, no matter how stupendous, and see to it that the job was done; in the fact that all labor was compulsory and therefore as cheap as human life itself; and also in the fact that great projects seldom were hampered by the element of time. So millions of slaves toiled through the centuries to build hundreds of forts and fortified cities, while kings and emperors between wars plotted new conquests and wasted their lives in riotous living. Thus was built with slave labor more than two thousand years ago one of the world's greatest fortifications, the 1,800-mile-long Great Wall of China.

No article on fortifications can ignore methods of attack, so closely are the two subjects interwoven. It was the advancement in methods of besiegers that created the need of improvements in defense. Spear and arrow flashed through the thorn hedge, with death for those concealed behind it. So palisades were invented. Palisades could be surmounted, burned, or battered down. So evolved the earth bank type of fortification. The earth bank could be kept under harassing fire, enfiladed, or rushed by storming parties. So was created the wall, made of stones where stones were available, made of mud where mud only could be found, and made of sun-dried bricks where people had advanced sufficiently to know the art of their construction.



(From Encyclopaedia Britannica, 11th Ed.)
". . . Chateau Gaillard . . ." [Detail of donjon of that famous castle.]

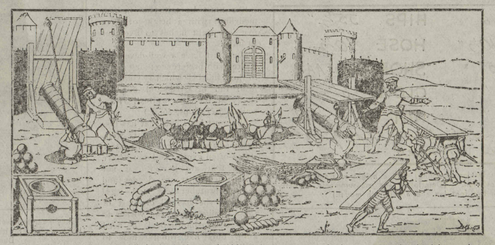
First walls were scarcely any higher than palisades, and probably only a few feet thick. Enemies took these walls by escalade, either by ladders or by construction of a ramp of fagots or other material. With the object of preventing attackers from pouring into a forte or fortified city over its walls, early engineers built the walls higher and higher. And as the walls rose in height they had to be made thicker. Evolved then the type constructed of two parallel walls, the space between filled in with rock and earth until the filling reached the top level of the walls and furnished a foundation for the parapet, upon which defenders were stationed and maneuvered in the event of a siege. The outer wall, that one facing the attackers, usually rose four or five feet above the parapet, affording a protection to the defending soldiers on the wall. More often than not it was crenellated, thus providing small open spaces through which defenders could discharge their arrows or thrust through with their spears and pikes at scaling parties. Virtually all wall fortifications were supplied with towers commanding outer walls, gates, and parapets. From the towers and from the wall itself defenders could drop heavy objects, such as stones and rocks, upon attackers, employing nothing more than gravity to give force to their missiles. Also they could pour molten metals and scalding liquids on assaulting parties to discourage them. When gravity as a force for missiles finally gave way to horizontal fire, as represented by artillery practice, the day of the high-walled fort was over.



(From Encyclopaedia Britannica, 11th Ed.)
". . . defended by a complicated approach and a huge circular barbican . . ." [Detail of Carcasonne defense.]

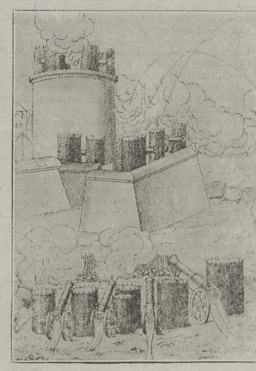
Battering Ram Ancient Weapon

When walls finally were constructed to the extreme of lofty heights they were almost perfect defenses against arrows and other missiles as well as against ordinary means of escalade. So attacking forces devised new methods. At the sieges of Jerusalem and Tyre by King Nebuchadnezzar, nearly 600 years before Christ, appeared for the first time the battering ram, a weapon destined to serve under various names through centuries of wars and sieges. The battering ram, frequently covered by a shed as a protection to its operators and capable of being moved on rollers or wheels, was nothing more than a lengthy, heavy pole, carrying at its business end a metal head. For chipping holes through solid masonry the head was pointed. For smashing through earth and softer materials there was a rounded head, or ram's head. The pole of the ram, suspended in a framework, was swung back and forth by as many men as could lay hands upon it.



"Typical of the siege of a walled town or fort in the fifteenth century were the huge cannon that fired heavy shot . . . soldiery who fought from behind or beneath shields of thick boards . . ."

Appeared also in the sieges conducted by the great Babylonian warrior the siege tower, or walking tower, a movable structure designed to overlook the object of its attack. The loftier the wall the higher was built the walking tower. In its earlier stages it was a framework, cover I usually with built hide and moved on great wheels of oak or elm. At various levels were platforms for attacking soldiery. On the top was a gangway which could be lowered to allow swordsmen to pour down upon their foes defending the top of the wall. As the walking tower was perfected it became a more substantial weapon, its sides covered with thick timbers and its wheels often as huge as twelve or fifteen feet in diameter. On page one of this section is an artist's conception of an attack on an ancient walled fort by means of a walking tower. The drawing is not intended to represent any particular event in history, but rather to convey the idea of just how the ancients assaulted a stronghold through the aid of a movable siege tower.



"By the sixteenth century . . . the fortification builder was hard pressed and in many cases unable to hold an advantage despite the fact that he, too, employed mobile guns and gabions."

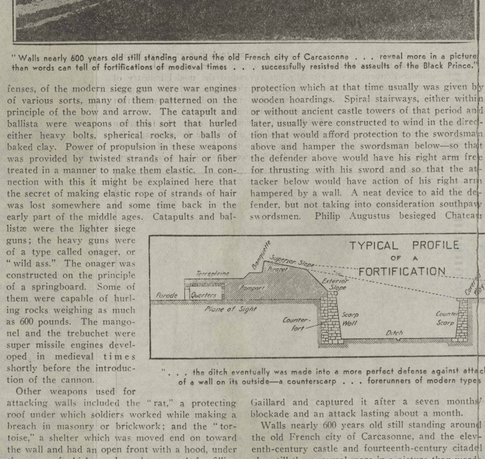
Burrowed Under the Walls

But ladders, rams, and towers were not the only weapons employed against the forts of antiquity. Mining under walls was a device as old as or older than the battering ram. A fanfare of trumpets, it has been suggested, was not what toppled the walls of Jericho in 1451 B. C., but only the din provided to drown out the noise of the mining operations conducted by Joshua's men. Mining still is resorted to in taking or attempting to take a defense. Operations of this nature as carried out by the mutineers at the siege of Lucknow, though remarkable, were amateurish as compared with those at Petersburg in 1864. And at Port Arthur in 1904 and around Verdun in the World war that business reached a height of skilful achievement undreamed of in the days of walled cities.

Forerunners, in operations against ancient defenses, of the modern siege gun were war engines of various sorts, many of them patterned on the principle of the bow and arrow. The catapult and ballista were weapons of this sort that hurled either heavy bolts, spherical rocks, or balls of baked clay. Power of propulsion in these weapons was provided by twisted strands of hair or fiber treated in a manner to make them elastic. In connection with this it might be explained here that the secret of making elastic rope of strands of hair was lost somewhere and some time back in the early part of the middle ages. Catapults and ballistæ were the lighter siege guns; the heavy guns were of a type called onager, or "wild ass." The onager was constructed on the principle of a springboard. Some of them were capable of hurling rocks weighing as much as 600 pounds. The mangonel and the trebuchet were super missile engines developed in medieval times shortly before the introduction of the cannon.

Other weapons used for attacking walls included the "rat," a protecting roof under which soldiers worked while making a breach in masonry or brickwork; and the "tortoise," a shelter which was moved end on toward the wall and had an open front with a hood, under the cover of which was brought up earth for filling the ditch or moat surrounding the wall. Many ancient and medieval fortifications were surrounded by deep ditches or wide moats.

The ditch, in fact, has played an important role throughout almost the entire history of fortifications. The ditch afforded an obstacle to the attacker and a cover for the defender. In the ditch would be gathered troops of the force defending the fortification prior to a counter-offensive. When the outer bank of the ditch was nothing more than a slope the sortie party would attack besiegers with a quick rush from the ditch. When the ditch eventually was made into a more perfect defense against attack by the construction of a wall on its outside—a counterscarp—it became necessary to provide a space in which sallying parties could be massed without being under fire. This space above and outside the counterscarp was the covered way, and a fortification ditch provided with both scarp and counterscarp was one of the developments of the immediate forerunners of modern types of fortification.



". . . the ditch eventually was made into a more perfect defense against attack by the construction of a wall on its outside—a counterscarp . . . forerunners of modern types of fortification."

That period marking the tag end of ancient times and the beginning of the medieval saw little advancement made in the science of fortification. High, thick walls still meant the best protection possible. Even today invulnerable fortifications might consist of nothing more than lofty works of masonry but for one thing—the invention of the cannon some time early in the fourteenth century.

Designed by Richard Cœur de Lion, one of the most famous warriors of his time, Chateau Gaillard, on the Seine near Les Andelys, built in 1196, was an outstanding fortification of the middle ages. It was a great castle, with walls, ditches, towers, and outer works carved out of solid rock. The waved face of the inner wall of the castle, giving a divergent fire over the front, was a then unique feature well in advance of its day. So also was the masonry protection of the machicolation at the top of the donjon, a protection which at that time usually was given by wooden hoardings. Spiral stairways, either within or without ancient castle towers of that period and later, usually were constructed to wind in the direction that would afford protection to the swordsman above and hamper the swordsman below—so that the defender above would have his right arm free for thrusting with his sword and so that the attacker below would have action of his right arm hampered by a wall. A neat device to aid the defender, but not taking into consideration southpaw swordsmen. Philip Augustus besieged Chateau Gaillard and captured it after a seven months' blockade and an attack lasting about a month.

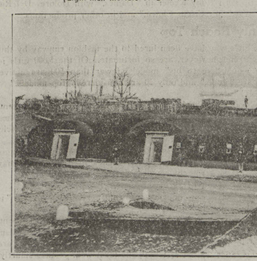
Walls nearly 600 years old still standing around the old French city of Carcasonne, and the eleventh-century castle and fourteenth-century citadel also still there, reveal more in a picture than words can tell of fortifications of medieval times. Carcasonne of the eleventh, twelfth, thirteenth, and fourteenth centuries was built on the ruins of an ancient city. In 1356 its walls and citadel successfully resisted the assaults of the Black Prince. Other cities of Europe of the middle ages—not a great many of them—were saved from surrender and pillage by their high, thick walls. Still others, in far greater number, could not be saved even by their walls, for it is the rule rather than the exception that forts and fortifications eventually fall in prolonged sieges, and particularly in cases where there is a margin in numbers of men in favor of the attackers. In other words, it is man power in the end that captures defenses. Too often the besieged, though still capable of putting up a defense, lose heart and surrender, especially when their supplies have been cut off and they see the specter of starvation in the offing.

Much of the strength of the fortifications at Carcasonne lay in the fact that for the entire works there were only two gates, the one on the east defended by two towers and a semicircular barbican; the one on the west, leading to the castle proper, defended by a complicated approach and a huge circular barbican several stories high and capable of holding 1,500 men. The castle was cut off from the fortified city within the outer walls by a wide moat.

"Walls nearly 600 years old still standing around the old French city of Carcasonne . . . reveal more in a picture than words can tell of fortifications of medieval times . . . successfully resisted the assaults of the Black Prince."

". . . the cupola type of shelter for a permanent gun." [Cupola with counterbalance weight for elevating structure.]

(International photo.)
". . . capable of delivering plunging fire . . ." [Eight-inch mortars of Civil war.]



"Earthworks of the 1861-1865 period were admirable defenses against solid shot . . ." (Potomac river fort near Washington, with casemate and exposed gun.)

"Frequently main positions followed the detached system, with connecting trenches between." (One of the temporary detached forts before Atlanta, Ga.)

High Walls Plain Targets

By the sixteenth century cast-iron shot had come into general use, and smaller and stronger guns, mounted on wheels, had taken the place of the old bombards. Though the lighter guns hurled balls of lesser diameter than did the bombards, they discharged them with greater force and greater accuracy. The fortification builder was hard pressed and in many cases unable to hold an advantage despite the fact that he, too, employed mobile guns and gabions. His tall walls were such beautiful targets for hidden guns. So long as gravity was the principal force behind projectiles, walls were made as high as possible and towers were made round. When really effective horizontal fire came in, with the development of the cannon, a revolutionary change became necessary in fortification design. It was the successes of Charles VIII. in Italy that marked the beginning of the end of the type of fortification that had existed from the time of ancient Nineveh and earlier.

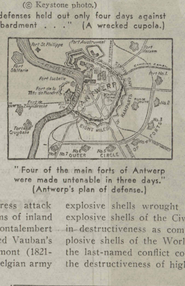
Forts Made Flat and Wide

Horizontal fire of artillery made it necessary for fortification engineers and builders to change entirely their systems of defense. A high wall no longer could resist for any length of time round shot striking it at approximations of right angles. Defenses gradually then became wide, flat surfaces of masonry or earth parallel or nearly parallel to the contours of the terrain, with guns behind them sunk slightly below their levels. The ditch, a carryover from old times, often was incorporated in the scheme. This period in the development of fortifications—a period preceding the modern era—involved scores and possibly hundreds of different ideas and modifications, the coining of hundreds of new words to describe these various ideas and results of ideas, and the eventual perfection of the completely hardened system of fortifications, the first example of which was the citadel at Antwerp, completed in the last years of the sixteenth century. Lack of space in an article of this length prevents mention of even some of the more important developments of the period, though it should be pointed out here than while fortifications, especially in Europe, underwent marked changes in the sixteenth and seventeenth centuries, in remote parts of the world old types of defenses remained well up into the nineteenth century, either because there was no necessity for stronger types or because of lack of funds. In the Indian mutiny, less than a decade before our Civil war, British forces stormed and captured the walled city of Delhi.

The Italians were the first to make revolutionary changes in their military and naval defenses. French, Germans, and Dutch quickly followed their example. Fortifications as we know them today, therefore, are not the results of one man's planning, but rather the offspring of hundreds of brilliant minds. Among defense designers, and as much or more than any others the true fathers of modern fortifications, three men stand out: Sebastian e Preste de Vauban (1633-1707), a marshal of France, who specialized in fortress building and fortress attack and who developed three distinct systems of inland defense; Marc Rene, marquis de Montalembert (1714-1800), who improved and simplified Vauban's systems; and Gen. Henri Alexis Brialmont (1821-1903), who as inspector general of the Belgian army drafted and carried out the whole scheme of defenses of Belgium, the defenses that failed when the green-gray hordes from Germany rolled into Belgium in 1914.

(Otto Kurth photo.)
"Przemysl, the great Austrian stronghold . . . boasted 1,000 guns . . . The Russians won the stronghold, however, by blockade methods rather than by disastrous bombardment."

(© Keystone photo.)
"Namur's defenses held out only four days against enemy bombardment . . ." (A wrecked cupola.)



"Four of the main forts of Antwerp were made untenable in three days." (Antwerp's plan of defense.)

It was Vauban who rebuilt the great fortress at Strasbourg in 1681 and who introduced the principle of attacking fortresses by parallels, a system still in use. Montalembert, who was an engineer and writer on military subjects, made fortifications that were described as nothing more than "immense batteries." The polygonal method of fortification was a direct outcome of Montalembert's system. Brialmont borrowed from both Vauban and Montalembert in creating his system of works in Belgium. It was he who proved that detached forts about a city or strategic center were of greater value than one great extended works, more easily defended, and offering less vulnerability to an enemy. The idea of the detached fort today is found in virtually every well planned system of defense, either for inland purposes or for coastal protection.

In that extended period which began with Vauban and ended about the time that Brialmont was born, and which was marked by the expenditure of vast fortunes in improving and rebuilding the fortifications of Europe, there was not a great amount of progress in that line in America. A majority of early American forts, fortified towns, or military outposts were mere log stockades, sometimes augmented by small cannon and sometimes not.

Virtually all military defenses of the American Civil war, either permanent or temporary, were of the low and open type, employing more often than not the simple bank of earth known as earthworks. In permanent defenses the casemate, or shell-proof chamber, was used. Frequently main positions followed the detached system, with connecting trenches between. The trench of the Civil war, a temporary fortification, was little different from the trench of the World war, the same idea being employed in each, though the World war trench, instead of being reinforced with the convenient and conspicuous stone wall, as was the case frequently with the Civil war trench, was usually made extremely difficult to take by assault by the addition of sandbags and barbed wire entanglements. Barbed wire was first used for protection of soldiers in the Spanish-American war.

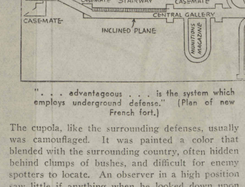
The Civil war saw no great complicated systems of trenches such as the Hindenburg line in France during the World war, incorporating a series of parallel fighting trenches, communication trenches, rapid-fire gun emplacements, observation posts, and wire entanglements.

Earthworks of the 1861-1865 period were admirable defenses against solid shot, but explosive shells wrought havoc in them, and the Civil war were almost zero in destructiveness as compared with the high-explosive shells of the World war. Fort builders of the last-named conflict counteracted in a measure the destructiveness of high-explosives by use of concrete and steel that detonated the fuses before the shells could attain great penetration in the defenses.

(Acme photo.)
"The trench of the Civil war, a temporary fortification, was little different from the trench of the World war . . ." (Civil war trench, left; World war trench, right.)

(Otto Kurth photo.)

After the middle of the nineteenth century fortification and ordnance engineers were well along in their experimentation with a new type of defense to be incorporated in the then existing systems. This was the turret, or more aptly termed the cupola, type of shelter for a permanent gun. In the nineties the cupola had reached an important stage of development and had assumed an important role in the defense system of Europe. The cupola was constructed of hard, tough steel, its top rounded like that of a mushroom and the part beneath the top cylindrical in shape. Within it was a gun, or possibly two or more guns. The whole of the cupola could be raised or lowered by mechanism, between shots, even, if necessary.



". . . advantageous . . . is the system which employs underground defense." [Plan of new French fort.]

The cupola, like the surrounding defenses, usually was camouflaged. It was painted a color that blended with the surrounding country, often hidden behind clumps of bushes, and difficult for enemy spotters to locate. An observer in a high position saw little if anything when he looked down upon the defense system which included cupolas.

Cupolas in many cases were connected with each other and with bombproof shelters and underground works by subterranean passages. So long as cannon fire was mainly horizontal there was little danger from the sky. But when artillery engineers began making siege pieces capable of delivering plunging fire that was really destructive it became advantageous for the fortification builders to put defending forces and their war engines underground. Especially advantageous now, since the perfection of the bombing plane, is the system which incorporates underground defense. Modern forts, particularly those built and being built by the French, are hundreds of feet underground. They are provided with apparatus to pump in air that fills the underground chambers and thus keeps out poison gas. But the cupola as a gun shelter today is virtually obsolete. It is used mainly for observation and is always well concealed from the enemy.

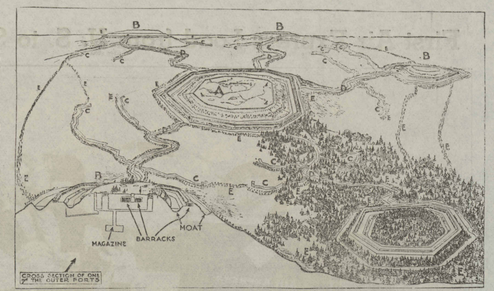
Concealment, in general, has become the main strength of a modern fortification.

Port Arthur Defenses Taken

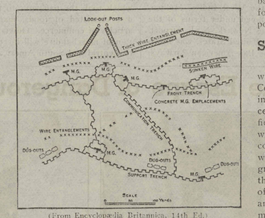
First defenses to be put to the test of war under present conditions were those surrounding Port Arthur, the Russian base which was surrendered to the Japanese in the Russo-Japanese war. Consisting of only three permanent forts of the type of 1870 and a number of temporary works, the defenses were far from completed when called upon to meet the test. Yet they held out five months. Japanese 11-inch howitzers silenced the guns of the forts, but it took one terrible assault after another and a campaign of mining with high explosives to dislodge the defending forces, so well were they protected by solid rock, underground chambers, and barbed wire.

In the World war the twelve armored forts of Liege fell in eleven days under the terrific fire of German 17-inch howitzers. Namur's defenses held out only four days against enemy bombardment. Four of the main forts of Antwerp were made untenable in three days. Steel in the cupolas of these Belgian forts was 22 millimeters thick, while that of some of the forts about Verdun, which withstood heavy shelling by the Germans, was 30 millimeters thick. The French forts, too, were protected by soundcr concrete works than were those of the Belgians. It was the field defenses at Verdun, however, more than the detached forts that held back the forces of the kaiser. Przemysl, the great Austrian stronghold in what is now the province of Lemberg, Poland, surrounded by a ring of forts nearly forty miles in circumference, twice was besieged and taken once by the Russians. Though Przemysl boasted 1,000 guns, a large part of its defenses were antiquated.

The Russians won the stronghold, however, by blockade methods rather than by disastrous bombardment. They lost it in the end to a combined force of Austrians and Germans supplied with powerful long-range guns and howitzers.



(From "With the Russian Army," by Col. Robert R. McCormick.)
". . . defenses of the Russians were examples of highest efficiency of their time . . ." [Russian fort. A—Central fort; wooded hills; about 600 acres. B—Ring forts. C—Trenches. D—Sunken roads. E—Wire entanglements.]

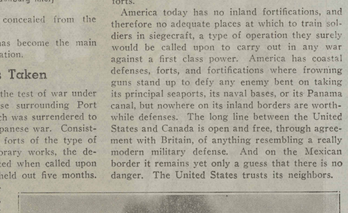


(From Encyclopaedia Britannica, 11th Ed.)
". . . incorporating a series of parallel trenches . . ." [Typical sector of Hindenburg line.]

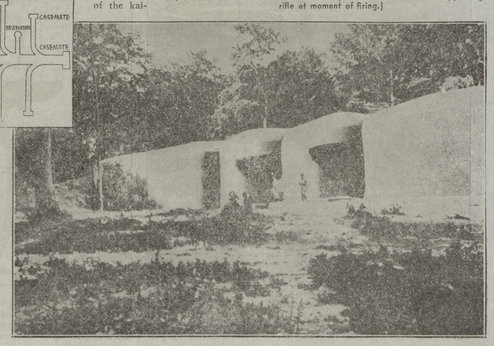
Strength in Concealment

Some of the World war defenses of the Russians were examples of highest efficiency for their time. Constructed on the detached fort principle, covering many hundreds of acres, and employing concealment almost as effectively as an army in the field with unlimited space in which to operate, they were everything that military knowledge of 1914 could devise. Terrain within the forts was planted with trees of the conifer varieties, which remained green throughout cold weather. Hidden among the trees were guns in great numbers, from those of 6-inch bore to the largest afforded at the time, and four or five times as many concrete emplacements as there were guns, so that the guns could be shifted about on the roads within the forts.

America today has no inland fortifications, and therefore no adequate places at which to train soldiers in siegecraft, a type of operation they surely would be called upon to carry out in any war against a first class power. America has coastal defenses, forts, and fortifications where frowning guns stand up to defy any enemy bent on taking its principal seaports, its naval bases, or its Panama canal, but nowhere on its inland borders are worthwhile defenses. The long line between the United States and Canada is open and free, through agreement with Britain, of anything resembling a really modern military defense. And on the Mexican border it remains yet only a guess that there is no danger. The United States trusts its neighbors.



(Associated Press photo.)
". . . guns stand up to defy any enemy bent on taking its . . . seaports . . . naval bases . . . canal . . ." [An American 12-inch disappearing rifle at moment of firing.]



"Modern French forts . . . are hundreds of feet underground . . . provided with apparatus to pump in air . . . keeps out poison gas." [Steel and concrete casemates of new French fortress.]