MAXIMUM LOAD DUE TO A CROWD OF PEOPLE.

The accompanying illustration does not represent the descent of a crowd of people down the shaft of a mine, nor an overloaded elevator. It is a photograph of a careful attempt to determine exactly how great a load of people may be crowded within any given space—a subject of the most vital importance which ought to have been investigated in this careful manner long ago. The experiments were carried out at Harvard University by Mr. L. J. Johnson, professor of engineering, who recently published the results at a meeting of the American Society of Civil Engineers.

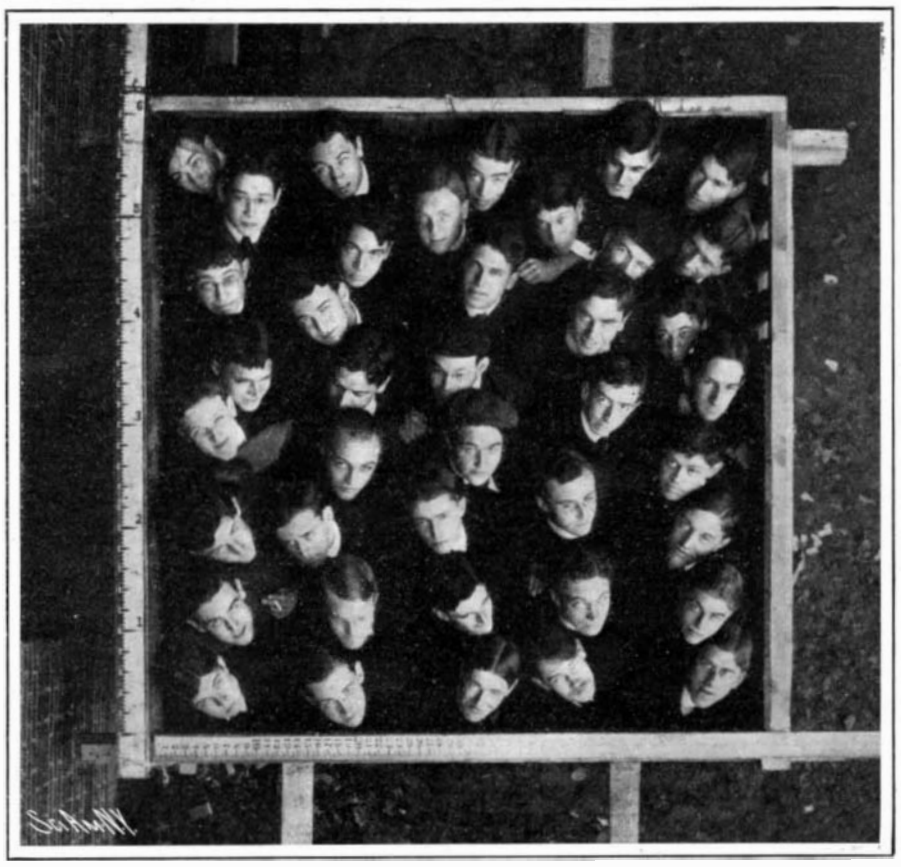
In obtaining this data, a box 6 feet square, provided with a gate at one side, was built, and a certain number of men, whose separate weights had been carefully taken, was placed within it. By dividing the aggregate weight of the men by the number of square feet within the box, the load per square foot was determined. In the first case eleven men were placed inside the box whose average weight was 154.6 pounds. This gave a load per square foot of 47.2 pounds, which is 2.2 pounds more than the loading that has been assumed in the designing of some floors, platforms, and bridges. That this loading does not represent the weight of an average crowd is proved by the fact that, when the men were lined up side by side around the walls of the box, they only covered three sides of it. Twenty-eight men of an average weight of 167.7 pounds were found to be equivalent to a load of 130.4 pounds per square foot.

In the early experiments, when the men were allowed to stand facing in various directions, a maximum result of 156 pounds per square foot was obtained; but since, in crossing a bridge, or in a packed assembly hall, all the people face one way, the experiments were continued in order to determine how much a crowd of this kind would weigh, and a result of 176.4 pounds per square foot was obtained. On studying the photograph it was evident that the maximum had not been reached, and ultimately forty men, averaging 163.2 pounds, were placed in the box, with the result that a maximum load of 181.3 pounds per square foot was obtained. The men, all of them undergraduate students of engineering, ranged in weight from 119.6 to 203.1 pounds, twelve of them weighing less than 150 and ten more than 175 pounds.

A competent and careful observer of the test which resulted in a load of 176.4 pounds per square foot, declared that, in his opinion, the congestion did not differ much from that of the crowd on the local drawbridge after football games; and this statement was borne out by the testimony of the men themselves.

In the discussion before the American Society of Civil Engineers, Mr. Theodore Cooper had given 45 pounds per square foot as the weight of the most densely packed crowds on the New York elevated trains. Those of us in New York who have experienced the crowding on these trains during rush hours will agree that the loading on the platforms and the cars must be nearer the 181.3 figure than the 45 pounds of Mr. Cooper's estimate.

We entirely agree with Mr. Johnson in his conviction that crowds of 167 pounds per square foot are entirely likely, and that from 130 to 140 pounds must be commonly reached in all places where people congregate standing.



These 40 men, averaging 163.2 pounds in weight, gave an average loading of 181.3 pounds per square foot.

MAXIMUM POSSIBLE LOAD ON BRIDGES AND PLATFORMS.

DISAPPEARING COAST-DEFENSE GUNS.

One of the lessons that the present war has served to emphasize very strongly, is the necessity for giving the greatest protection possible to the gun detachments. On land the question of the efficiency of artillery fire has resolved itself very largely into the question of invisibility. Such is the accuracy of the modern gun, so reliable are the means for finding the range, that when once a battery has been located, unless the cover is particularly complete, the silencing of the guns follows almost as a matter of course; and in the majority of cases it is the gunners, rather than the guns, that have been destroyed.

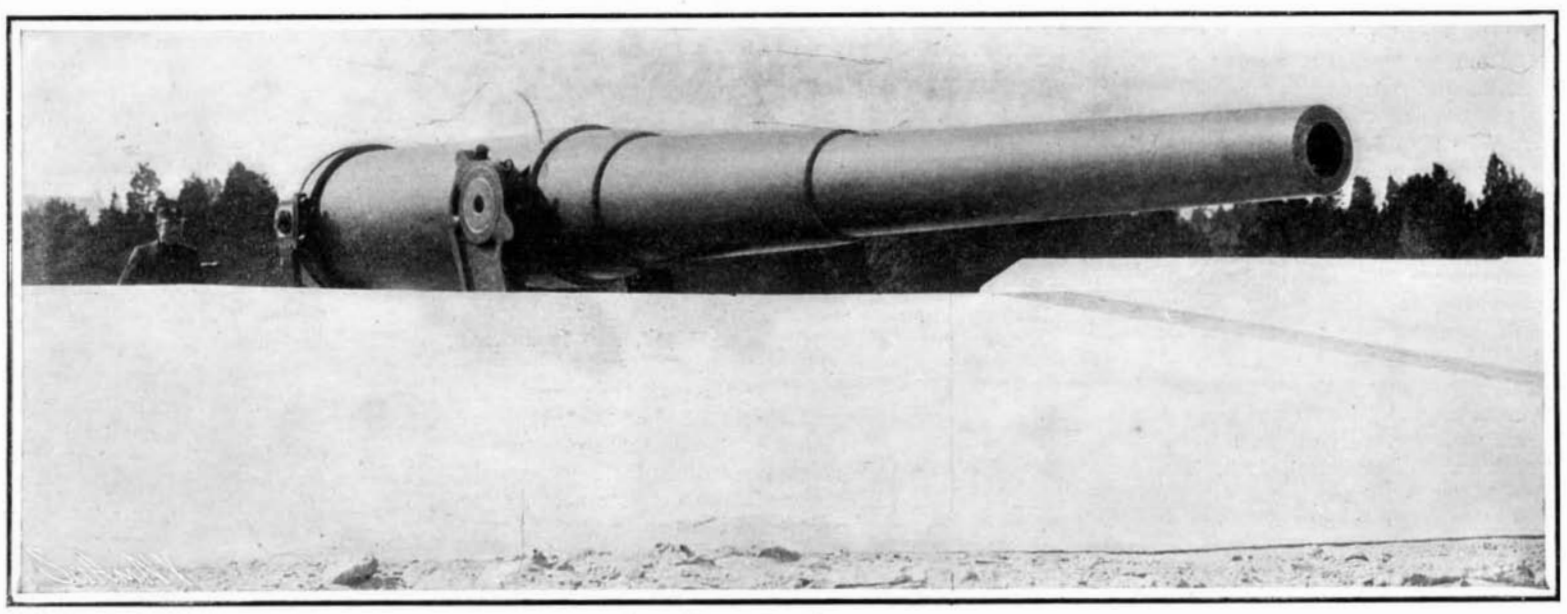
This question of invisibility is particularly important in the construction of fortifications and the emplacement of their guns. When the important scheme of defense drawn up by the Endicott board was determined upon, it was decided to make extensive use of the Buffington-Crozier system of disappearing guns, which is called after its inventors. The idea had received considerable attention in Europe previous to its adoption here, and was not, therefore, by any means in the nature of an experiment. The design which was then adopted, and has since been followed with only minor modifications, is probably the most satisfactory type of disappearing gun carriage in use at the present time.

The principal methods of mounting seacoast guns are the casemate, the barbette, and the disappearing mount. In the casemate system the gun fires through an opening in the masonry or metal wall of the fort, and may, or may not, be protected by a shield. This is a very complete system of protection; but it has the disadvantage that the arc of fire is generally somewhat limited. A gun mounted *en barbette* is so placed that though part of its mount is below the parapet of the fort, the gun and upper part of the carriage are constantly exposed to the direct observation and fire of the enemy. In this form of mounting the greater part of the gun detachment is exposed to direct fire. In the disappearing system, on the other hand, the mount is entirely below the parapet and fully screened from observation. The gun itself lies also below the parapet during the operations of loading and training, and the whole of the gun detachment is also similarly sheltered.

The carriage is of what is known as the front-pintle form, and its general construction is as follows: The gun is carried, by means of its trunnions, upon the upper ends of a pair of massive rocking levers, one on each side of the gun, which are themselves pivoted at their mid-length to the top sliding gun carriage. At the opposite end of these levers is suspended by means of a pair of rods a massive lead counterweight, which is sufficient, when released, to depress the outer ends of the two levers, which, pivoting at their center on the top carriage, serve to raise the gun to the firing position. Near the breach of the gun are pivotally-connected a pair of elevating rods, which coact with the trunnion levers in steadying the gun and keeping it in its proper relation to the carriage, as it is raised or lowered. The top carriage is formed with two hydraulic cylinders, one on each side, in one piece of gun iron. In each cylinder are two throttling bars of steel, which pass through notches in the piston, and serve to regulate the size of the orifices for the flow of the liquid past the piston, and present an increasing resistance to the recoil of the gun. The action of the system in recoiling is such that no matter at what elevation the gun may have been fired, it will have practically the same inclination to the horizontal, about seven degrees, when in the loading position.

The racer is of cast steel, and the base ring of gun iron. The base ring is fastened to the platform with a large number of heavy holding-down bolts. The traversing of the gun is accomplished by means of cranks operated by hand, and the elevation by means of elevating hand-wheels, mounted on a shaft passing through the mount, upon which are pinions of bronze, gearing into spur-wheels of cast steel. On the shaft with these are pinions of bronze, which gear into elevating racks attached to the lower end of the elevating rods.

When the gun is in the lowered position, it will be evident that all the operations of sponging, loading, traversing, and elevating may be carried through without exposing any of the gun detachment, except the man at the telescopic sight, whose head will be exposed above the line of the parapet. The breech of the gun in the lowered position is always at a predetermined height above the platform, so that when the ammunition is brought forward on its truck, it is at just the right height to be thrust from its tray into



This view shows how little of the mount is exposed.

DISAPPEARING 10-INCH BREECH-LOADING RIFLE, IN THE FIRING POSITION.

(*Continued on page 322.*)

point the sulphur is placed on mules to be transported to the railway station about nine miles distant.

Various estimates have been made of the quantity of sulphur which at present exists in the crater, some figures placing it at fully 100,000,000 tons. Von Humboldt, who made an exhaustive study of the interior of the volcano, gave the opinion that the bed is the largest in the world. A commission of experts appointed by the Mexican government, however, made a careful study of the crater and confirm the statements that the quantity of sulphur is undoubtedly enormous. These reports have led to such an interest being taken in Popocatepetl that it has actually become American property and the flag of the United States is probably ere this floating above its summit, for a company of capitalists from the States have actually purchased this great factory of nature and intend mining the sulphur on an extensive scale.

Consequently the famous mountain has become a subject of more than usual interest. As is well known, it is one of the highest peaks on the American continent, reaching to a point 17,520 feet above sea level. The crater itself is somewhat unique, since its present form resembles a bell rather than a cone, to which most craters bear a similarity. The opening is 2,700 feet at its greatest diameter, which is from east to west, while the greatest diameter at right angles to this line is 1,200 feet. The rim of the crater is considerably lower on the side toward the city of Puebla, which is situated within sight of it. At this point the hoisting windlass has been erected. From the hoisting platform to the floor of the interior, as already stated, is no less than 550 feet, of which 225 feet comprises a wall, which is practically vertical. Fortunately the walls are formed of the trachytic and porphyritic rock, covered at the summit by a lava which has been thrown out in past eruptions. The lava rock has assumed such a curious shape that the rim near the hoisting side is popularly known as the "Devil's Spine"—a very proper term. That the sulphur is continually being formed is shown by an examination of the bottom of the crater near the fissures. Here the rocks have been found covered with a layer of powdered sulphur recently deposited. From time to time openings have been made in the mass of debris which has accumulated in the crater as the result of eruptions. These pits have revealed masses of sulphur ranging from 6 to 10 feet in depth. The commission of Mexican experts has traced the deposits, covering spaces which represent nearly half a mile in area, while borings indicate a depth ranging over a thousand feet. The quantity of sulphur secured during the last thirty years, however, gives possibly the best conception of the extent of this curious industry, for it amounts to 10,000 tons, although every pound was taken from the deposits and carried away from the mountain by men and animals.

When the plans of the new owners are carried into execution, the crater will become the site of a most interesting series of operations. Arrangements have been made to install pneumatic machinery which will cut away all of the rock formation which can be reached. It is then believed that the sulphur can be obtained merely by the use of the pick and shovel, since it exists in such a loose formation. A tramway will be built along the floor of the crater with tracks reaching the principal workings. As the sulphur is mined it will be loaded into cars and hauled to the foot of a cableway consisting of a series of huge buckets, traveling along an endless wire rope. As fast as the buckets are filled with sulphur, they will be hoisted to the edge of the crater, thence carried down the mountain to a refinery which is to be built at the foot. Here the impurities will be separated from the sulphur and it will be transported by another cable system to the Interoceanic Railway, whence it will be shipped to the city of Vera Cruz, the nearest seaport.

DISAPPEARING COAST-DEFENSE GUNS.

(*Continued from page 320.*)

the breech. The action of the carriage is as follows: Upon firing the piece the central pivot of the levers moves horizontally to the rear, carrying the top carriage with it. The lower end moves vertically upward, being constrained by the crosshead guides. The gun moves downward and to the rear in the arc of an ellipse. The energy of recoil is absorbed partly by raising the counterweight and partly by the resistance of the hydraulic cylinders. After loading, the pawls are tripped, and the greater moment of the counterweight enables it to raise the piece into battery. The return to battery is softened by the hydraulic counter-recoil buffers in the cylinders, forming a sort of dash-pot.

An attacking fleet would be practically at the mercy of such a battery of disappearing guns. At the outset it would be ignorant of the location of the fort; and the use of smokeless powder would render the detection of the guns, during the few seconds that they showed above the parapet, a difficult matter. The only possible chance to place a shell inside the fort would be by making use of high angle fire; and this is impracticable in the modern warship as at present constructed, for two reasons: first, that the existing gun carriages will not allow the breech to be sufficiently depressed to admit of such fire; and, secondly, that the existing decks are not strong enough to withstand the heavy vertical strain of the recoil. The aiming of the gun is all done under shelter. By means of a "range finder" and the "converter board" the gunner can lay the piece with perfect accuracy while it is yet below the level of the parapet. Gun for gun, such a battery has an enormous advantage over the floating fortress, for it would have in its favor: 1. Invisibility. 2. Absolute protection from gun fire. 3. Absolutely steady platform. 4. Absolute determination of the range and bearing of the enemy. To this must be added the moral effect upon the courage and endurance of the gun crews, resulting from their superior protection.

The Current Supplement.

The events which are now occurring in the Far East lend a peculiar interest to the launching of the new first-class battleship "Kashima." Harold J. Shepstone describes the ship in the opening article of the current Supplement, No. 1529. A demand exists for posts that are strong, convenient, durable, and cheap, particularly in those parts of the country where timber is difficult to obtain. C. L. Catherman believes that cement posts admirably answer all requirements, and presents convincing arguments to uphold his view in an instructive article. Dr. O. N. Witt presents another one of his instructive papers on Patina, giving explanations that are wonderfully simple. "Friction Clutches" is the title of a most exhaustive discussion by George A. F. Pover. The so-called main spring of a watch finds manifold application as the cheapest and simplest means for mechanically driving simple apparatus. Emil Riedel tells how the motor spring is to be calculated. A highly suggestive lecture was recently delivered before the Royal Institution by Prof. J. J. Thomson on the Structure of the Atom. An abstract of the lecture is published in the current Supplement. For several years American engineers have bent their energies to the designing of a simple and safe single-phase alternating-current railway. Mr. A. Frederick Collins describes the first successful American road of this type. Jeanette Macdonald presents a vivid picture of a California Hop Garden. Prof. Charles Fisher publishes a description of the objects belonging to the later Greek period, showing their marked differences from the Babylonian type, and contrasting them with the objects of the first Greek or Mycenaean period. The first of three papers by the late Alfred J. Hipkins is presented, the installment describing stringed or musical instruments without keyboards.

Population of the Philippines.

The total population of the Philippine archipelago as returned from 342 independent islands is 7,635,426. Of this number almost seven million are more or less civilized. The wild tribes form about 9 per cent of the entire population. The civilized tribes are practically all adherents of the Catholic Church. The Moros are Mohammedans, and the other wild peoples have no recognized religious beliefs.

The total population, according to the most reliable authorities, is a little more than four times as great as it was one hundred years ago. During the same period that of the United States multiplied almost fifteen times. The excess of birth rate over death rate in the Philippines has been large, in spite of sudden and great losses as a result of epidemics of various diseases.

While it is true that the enumeration of the wild tribes, according to the methods employed among civilized peoples, was not practicable, very careful and painstaking estimates were made, and the returns are probably within 10 per cent of the true number. The total number of non-Christian peoples is stated to be 647,740.

A "Bureau of Authenticity."

Owing to the prevalence of spurious but often deceptive imitations of old and of contemporary masters, the Society of Friends of the Luxembourg Museum, under the patronage of M. Dujardin-Beaumetz, Under-Secretary of State for Fine Arts, is about to organize a "bureau of authenticity" for works of art. A number of experts are to be attached to the bureau, duly provided by the Prefect of Police with the full authority of police magistrates. There is to be a thorough search, high and low, for falsified pictures and statuary. The idea is new in France, and its application will meet with almost insurmountable difficulties, but M. Dujardin-Beaumetz is confident that with patience and indefatigable perseverance these will in due time be surmounted. —New York Tribune.

Correspondence.

About the Moving Stone Ball.

To the Editor of the Scientific American:

Noticing the article in your paper this week regarding the stone ball on the monument moving spontaneously, I make free to express an opinion on it.

I think the theory that the ball becomes more heated than the base is wrong, as the ball is polished, whereas the base is finished with a rough surface; it would therefore look to me that the base becomes more heated, and expanding somewhat, "bites" the ball slightly on the south side, and in contracting when cooling again, draws the ball down a little to the south. John Goodsmith.

Washington, D. C., April 13, 1905.

The Projections on the Old Chinese Temple Bells.

To the Editor of the Scientific American:

In the issue of April 8, article "Some Remarkable Old Chinese Bronzes," the writer speaks of the thumb-like projections on the temple bells as being for the purpose of adjusting the sound. Many Chinese and Japanese bells have similar projections, but in every one of them these are above the sound bow of the bell. This would not be the case if the above theory were correct. An educated Japanese gave me another reason, to wit: Once upon a time Buddha was so engrossed in his meditations that he did not observe the sun's beating down on his bare head. The snails, seeing his plight, covered his scalp with their slimy bodies and prevented his having a sunstroke. Since then Buddhist bells that were cast had these twisted protuberances, while those of beaten metal have been covered with small convex bosses.

Washington, April 10, 1905. E. H. Hawley.

Death of Col. Nicolas Pike.

Col. Nicolas Pike, soldier, author, and naturalist, descendant of a line of scientific men, and a relative of Capt. Zebulon R. Pike, for whom Pike's Peak is named, died on April 11.

The Pike family were Puritans, landing in New England in 1635. Col. Pike was born in Newburyport, Mass., eighty-seven years ago. In early manhood he settled in Brooklyn, where he first identified mastodon bones and teeth exhumed near Jamaica. Through Daniel Webster he obtained the appointment as United States consul in the island of Mauritius, in the Indian Ocean, where he made a great collection of birds, fishes, algæ, and shells. He presented to Cambridge University more than 800 drawings of the fish of the Indian Ocean, and received letters of thanks from Prof. Agassiz. His work, "Sub-Tropical Rambles in the Land of the Aphanapteryx," dealt with Mauritius. Upon returning to this country, his home in Clinton Street, Brooklyn, became a Mecca for students of natural history.

In the civil war he organized an engineer regiment and did notable work in adapting photography to the needs of the army. Among the curiosities he leaves is a three-sheet autograph letter from Washington to his uncle, Nicholas Pike, commending him as the author of the first arithmetic published in the United States. He also possessed the camp chest presented to Dr. David Livingstone by Sir Moses Montefiore.

Col. Pike was a very well-known figure in the office of the Scientific American. For years he contributed articles on various subjects of natural history to its columns. It was always a pleasure to see this rugged old gentleman enter the editorial sanctum, bringing with him a light heart, a sparkling eye, and the vivacity of youth.

He was a magnificent specimen of humanity, with his deep chest and active physique. Even after the age of eighty he would frequently appear at the office after having had a six or eight-mile walk, but with his cheeks flushed with the glow of health.

Those who were accustomed to his visits will for a long time miss the influence of his buoyant nature and always cheering presence.

Opening of the Simplon Tunnel.

The Simplon tunnel was opened on April 2, when from the Swiss and Italian sides the first trains passed through, meeting at the center. Herr Brandau, the engineer who had directed the work on the tunnel, conducted the Italian train, which was lighted part of the way by miners with lanterns. The train from the Italian end was the first to reach the iron door at the center, but a little later the train from the Swiss end was heard on the other side. There was a brief time spent in communicating by means of hammering, and then the door was knocked down amid frantic applause and cries of "Long live Switzerland" and "Long live Italy." Bands played the Italian royal march and the Swiss anthem, and the two parties embraced and kissed each other. Herr Brandau shook hands with Herr Rosemund, the director of the work on the Swiss side, and Italian Bishop Novara embraced the Swiss Bishop Sion. The latter bishop preached a short sermon, and blessed the tunnel.

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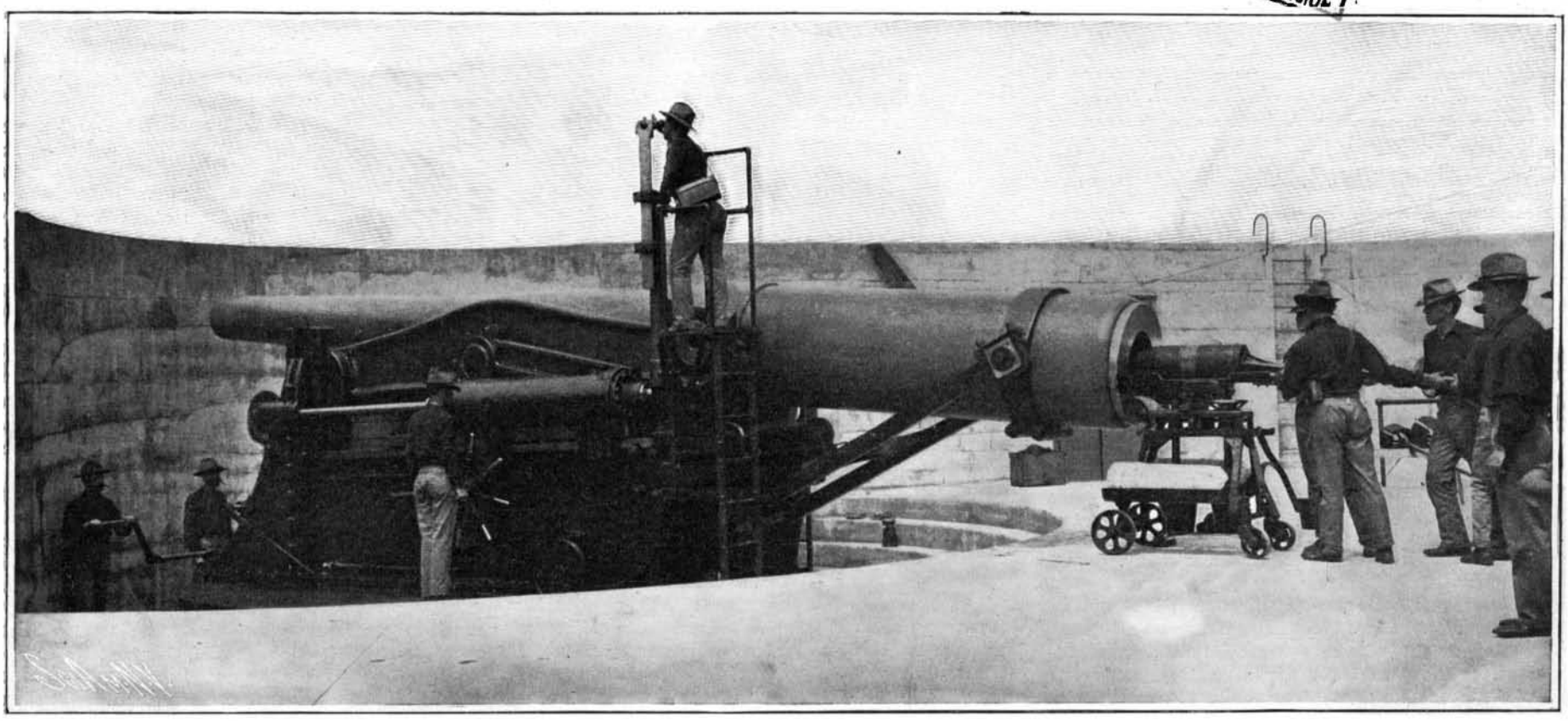
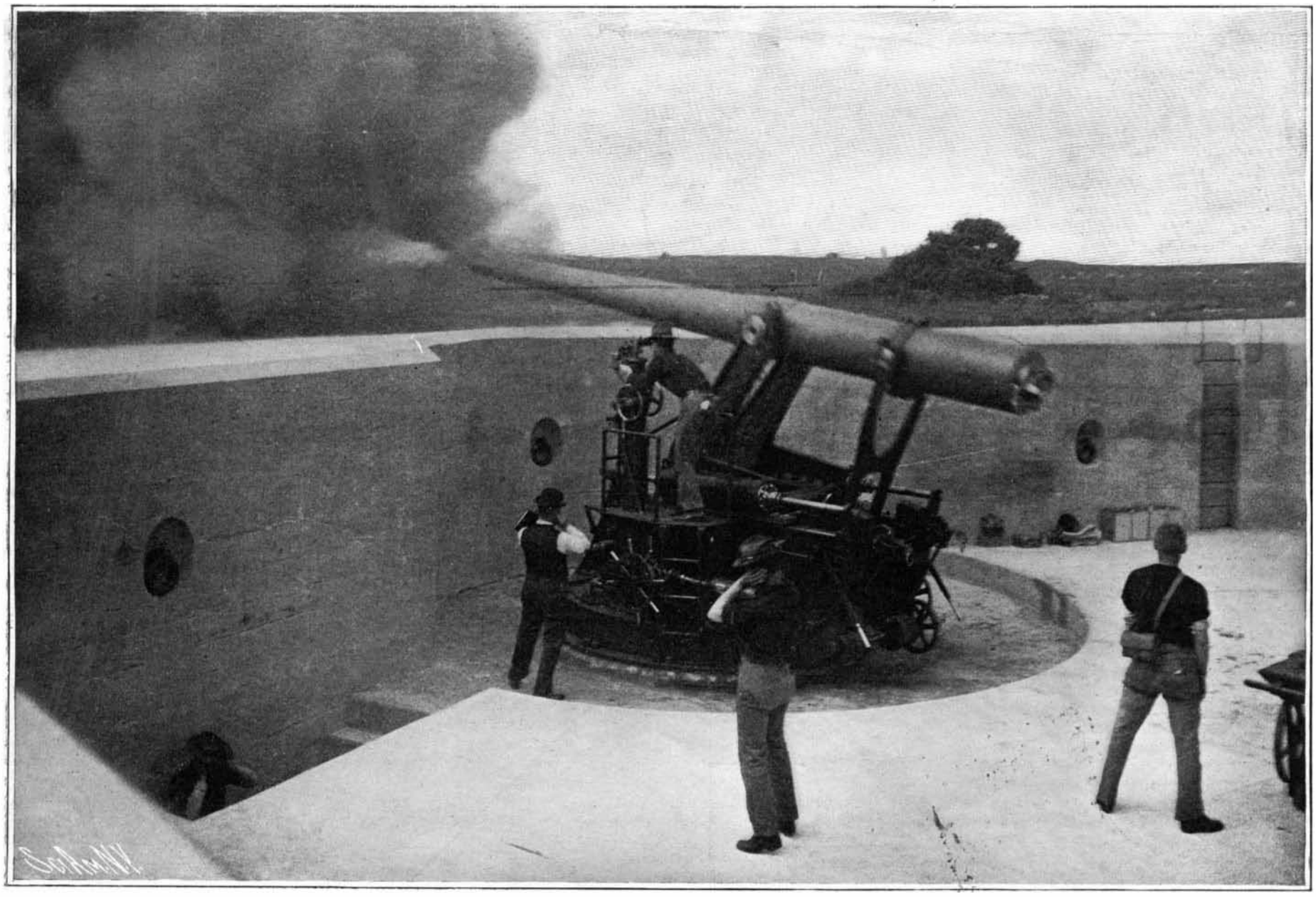


View inside the fortification, showing complete concealment of the piece and the gun detachment during loading.

Disappearing 10-Inch Breech-Loading Gun in the Loading Position.



The gun is swinging back and down to the loading position.

Discharge of a 6-Inch Disappearing Gun.

THE DISAPPEARING COAST-DEFENSE GUN.—[See page 320.]