

tions of distant earthquakes. By the disturbance of magnetographs, levels, or lakes, the propagation of surface undulations to immense distances had been known for more than a century. For the fuller knowledge gained during the last twelve years, we are indebted to the late von Reuber-Paschwitz and those upon whom his mantle has fallen—Prof. Milne, Dr. Agamennone, Mr. Oldham and others. Much still remains to be learnt in this fascinating field of inquiry, but it is no slight feat to have proved that, in an earthquake, two series of elastic waves traverse the body of the earth with velocities of not less than 9 and 5.13 kilometers per second respectively; while the slow-period undulations spread over the surface at the rate of 3 kilometers per second, the latter having been traced to distances of more than four-fifths of the earth's circumference. It is an achievement worthy of the last years of the century. While the more obvious earthquake phenomena were well known fifty years ago, closer study has revealed others of equal importance. Statistical inquiries have proved that earthquakes are far more numerous than was formerly supposed, the most modern estimate being that one takes place on an average every half-hour."

GATHMANN 18-INCH TORPEDO GUN.

BY EMIL GATHMANN.

The Gathmann 18-inch gun which was recently completed at the Bethlehem Iron Works is essentially a torpedo or high-explosive, shell-throwing weapon. This is the reason for making the gun of so large a bore, as shells containing enormous explosive charges are to be thrown therefrom. The following are particulars of construction and ballistic data, as obtained at recent proof firing at the Bethlehem Proving Grounds, Reading, Pennsylvania.

Total weight.....	50.6 tons
Total length	44 feet
Diameter over chamber	45 inches
Thickness over powder chamber.....	13 1/4 inches
Max. tang. resistance, square inch.....	40,300 pounds
Max. rad. resistance, square inch.....	38,500 pounds
Rifling, Gathmann type.	
Twist	Zero to 1 in 26
Powder charge.....	310 pounds
Gathmann type of rod.	
Projectile.....	1,800 pounds
Explosive charge of projectile.....	630 pounds
Pressure in powder chamber.....	20,000 pounds
Muzzle velocity, expected.....	2,100 foot seconds

The mean of eight proof rounds fired is as follows: Projectile, 2,000 pounds; powder, 300 pounds; muzzle velocity, 1,900 feet; pressure, 19,000 pounds. From these data it will be seen that with the Gathmann regular 18-inch torpedo shell carrying 600 pounds of desensitized guncotton, total weight only 1,800 pounds, a velocity of about 2,100 foot seconds can be expected with about 20,000 pounds maximum chamber pressure



THE 18-INCH GATHMANN GUN, MOUNTED ON PROOF CARRIAGE.

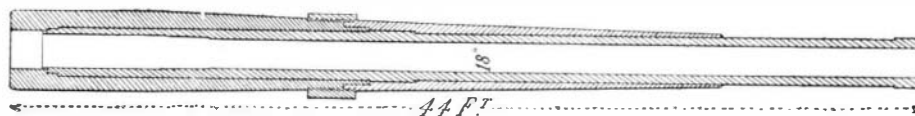
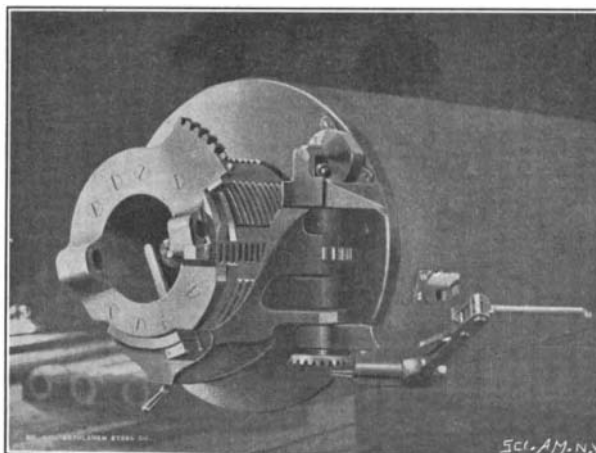


DIAGRAM SHOWING CONSTRUCTIVE FEATURES.

when Gathmann form of powder is used. This will give quite a flat trajectory to any range at which modern ordnance is likely to be employed, and an extreme range equal to that of any service gun. The total energy of impact of an 1,800-pound solid shot at this velocity will be some 55,000 foot tons, which



THE BREECH OPENED.



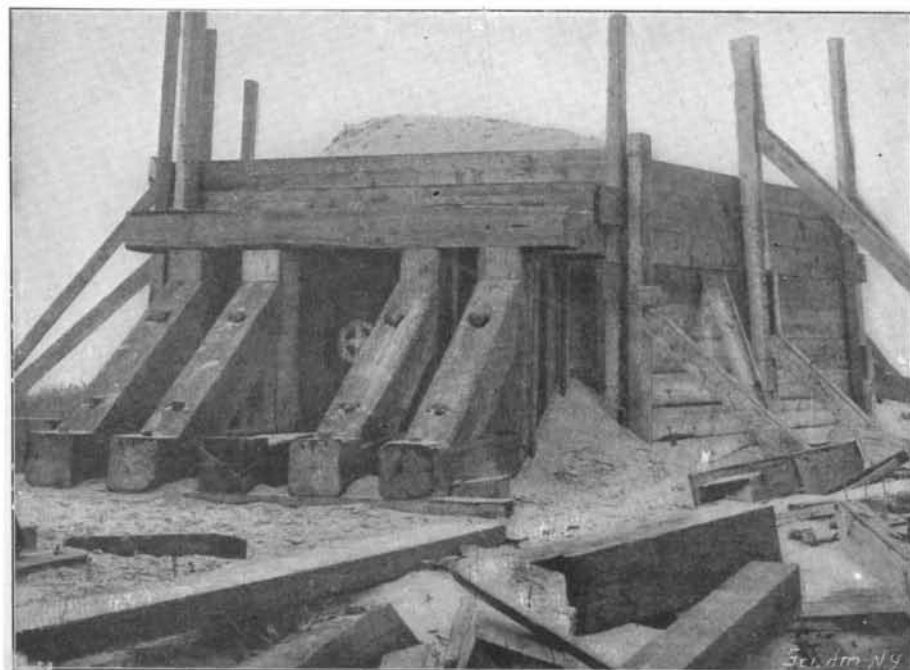
BREECH-BLOCK WITHDRAWN.

is much greater than can be obtained from the navy's new 12-inch 40-caliber rifle with its 850-pound projectile at 3,000 feet muzzle velocity. The smashing effect of the 1,800-pound shot would certainly be very great. When a Gathmann 18-inch aerial torpedo, carrying over 600 pounds of high explosive, impacts against the target, the striking energy will be truly enormous. The writer has calculated, and Lieut. Meigs, Ordnance Engineer of the Bethlehem Steel Company, agrees thereto, that some half million of foot tons energy will result therefrom.

In reply to the experts who tell us that the effects on heavy armor plates of the torpedo shell will be nil, it may be said that from tests already made with 12-inch torpedo shells fired from army 12-inch rifles at high velocity (2,000 foot seconds and over) carrying a charge of from 140 to 200 pounds of wet guncotton, it has been determined that a forward direction is always given to the explosive wave when the torpedo is detonated by a base fuse. Armor plates of 10 and 12 inches in thickness, together with their entire backing, were repeatedly destroyed, or in fitter language entirely obliterated, as can be seen by the official photographs. To determine the effect of very large charges of high explosives against the heaviest of armor plates, a wooden box containing 500 pounds of guncotton compressed in cakes was suspended and placed in contact with the vertical and convex face of a large Harveyized armor plate, 17 inches thick and 8 by 10 feet section. Upon detonation of charge the plate was smashed to fragments and the supporting structure entirely demolished. To obtain full force of any high explosive upon armor plate or other strong structures (that is, to utilize energy in doing disruptive work) it is necessary that explosives be in a very close contact with objects attacked. With the torpedo shell invented by Mr. Louis Gathmann, this condition of close contact of explosive charge with target against which it is impacted is realized. The safety detonator and base fuse devices, the joint inventions of Mr. Louis Gathmann and of the writer, insure with certainty the safe delivery of torpedo from bore of gun, and the detonation of the explosive charge upon impact of torpedo with any resisting target.

The problems connected with the building of the large caliber guns which are needed in this system of ordnance (18 inches in this instance) are principally those well known in the practice of modern ordnance construction and design. Nevertheless numerous new features have been incorporated in the 18-inch Gathmann gun which have proven of great value in actual trial.

A few words more to explain just what is meant by the Gathmann system. The problem has not been one of devising ways and means to get the high explosive out of the gun gently, for desensitized gun-



REAR VIEW OF TARGET CONSISTING OF 10-INCH PLATE BACKED BY 180 TONS OF EARTH.



THE TARGET AFTER BEING STRUCK BY GATHMANN 12-INCH SHELL, CONTAINING 300 POUNDS OF WET GUNCOTTON.

cotton and numerous other high explosives (though we always prefer guncotton) will stand all manner of rough treatment without the least danger. The problems—for there were more than one—have been, in order of their importance, first, an insensitive high explosive incapable of detonation or explosion either from shock in a gun or heat of powder gases, even though exposed directly thereto, and which requires the close contact of strong initial detonation to insure of its own detonation. Second, a detonator or fuse which would insure with certainty the non-detonation or explosion of main shell or torpedo charge of high explosive, until said torpedo had been discharged from gun and had struck a resisting target. Third, a shell or explosive carrier which would give a maximum carrying capacity of explosives for a given total weight, and deliver said explosive in intimate contact with target. Fourth, a form of grain of progressive-burning, propelling powder, which insures a uniform distribution of said propelling charge in chamber of gun, and consequently gives uniform and reliable low chamber pressure, obviating wave action of gases.

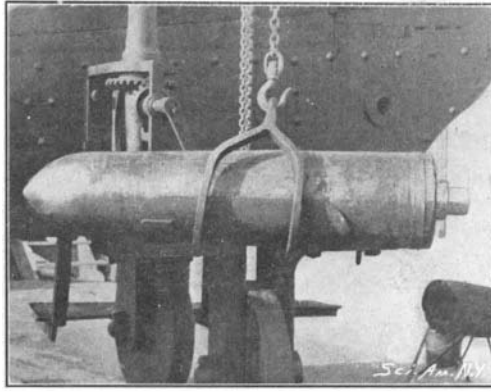
That all of the above-named problems have been solved by the Gathmann invention has been proven by the numerous tests already made under government supervision during the last three years, with 6, 8 and 12-inch weapons. The method by which these problems have been solved is termed the Gathmann system. The coming tests of comparative efficiency of the service 12-inch rifle and the Gathmann Aerial Torpedo Gun against two similar target structures of 12-inch Kruppized plates, 8 by 16 feet dimension, will determine the final and really most important problem of all: that of relative efficiency. The torpedo gun and the 12-inch service army rifle are of about equal weight and cost, and the advocates of the new weapon claim that ten hits from the latter will in nowise equal the destruction of one hit from the torpedo shell. In an early issue we shall give the results achieved by the 12-inch gun in firing service shells filled with a high explosive.

MALARIA AND ITS PREVENTION.

Since the work of Laveran (1880) proved malaria to be a fever caused by the invasion of the blood by minute animal organisms, steady progress has been made in the work of probing and elucidating the etiology and pathology of this dreadful scourge. English, Italian and German workers have competed with each other in their attempts to limit this dread disease, if not exterminate it, and of their work an immense bibliography remains as a monument to-day.

We have already published a considerable number of papers upon malaria and its prevention, and upon the Anopheles, but a few brief notes relative to some investigations which have recently been carried on may prove of interest. The prime cause of malaria being known, its method of invasion having been satisfactorily demonstrated, and the official seal of scientific approval of these facts having been obtained in Lord Lister's recent address to the Royal Society, it remains now to apply our knowledge in a practical way so as to evolve some method or methods of prophylaxis and thereby crown a piece of scientific work as far-reaching in its power to benefit the whole human race as any of those brilliant discoveries which have made the Victorian age conspicuous above all others. Some of the members of the various expeditions have advocated the wholesale destruction of mosquitoes by surface drainage and by the treatment of their breeding puddles with substances fatal to their development. Others have suggested a careful and more extensive use of mosquito-proof curtains and blinds, while one distinguished authority holds that the continuous administration of quinine is likely to give the best results. The efficiency of surface drainage appears to have been known as far back as 500 B. C., and it is doubtless one of the surest methods of exterminating the mosquito, but in districts unsuitable for any cause, the application of larvicidal substances (petroleum, tar, lime, etc.) has been suggested; but so far as experiments go the effect of such application has proved too transient to be of much value. The general point is to avoid being bitten by infected mosquitoes by night, and also by day, for, notwithstanding statements to the contrary, Mr. R. Fielding-Ould says in Nature that he has repeatedly noticed Anopheles gorging themselves in full daylight, though no doubt their habits are chiefly nocturnal. For this purpose the constant use of mosquito curtains of a prepared kind is essential, but only too frequently one finds in the tropics curtains of an utterly useless kind. Either they are torn or the mesh is too large, or by their arrangement the free ingress of mosquitoes is possible. They are best fixed on four posts on the four corners of the bed, and as the netting descends around the bed, it should be tucked in under the

mattress. The inclosed space should be of sufficient size to allow a certain freedom of movement during sleep so that the danger of coming in contact with the netting is impossible. Celli recommends that windows should be protected by wire netting and meshes which measure only from one to one and a half millimeters square and that all doors opening



TORPEDO SHELL.



POWDER CHARGE FOR 12-INCH TORPEDO GUN.

exteriorly should be protected by a cage of similar netting so as to oppose two screens to the ingress of the mosquitoes, as shown in our engraving. He further suggests that to facilitate the capture of any stray mosquitoes, all walls should be bare and painted white, and trees should not be allowed to grow near dwellings, as they afford a retreat in which mosquitoes may hide. Experiments carried out on the Roman Cam-



HUT WITH MOSQUITO CAGE AROUND DOOR, WHICH IS ITSELF MOSQUITO PROOF (AS SUGGESTED BY CELLI).

pagna have proved that these and similar devices have been sufficient to protect inhabitants from fever for considerable periods, but it is to be feared that unless unceasing vigilance be exercised all such precautions may prove ineffective, and one mistake may render them entirely abortive.

Liquid air has been tested for blasting purposes in the Simplon tunnel. The cartridges used consisted of a wrapper filled with a carbonaceous material such as equal parts of paraffin and charcoal, and were

dipped bodily into liquid air until completely soaked. The cartridges were kept in liquid air at the working face of the rock until required for use, when they were put quickly in the shot holes and detonated with a small guncotton primer. The life of such a cartridge is very short after it has been removed from the liquid air.

London's Electric Tramway.

The first electric tramway in London is now in full operation. The road has been in readiness for some months past, but it was impossible to commence the service, owing to the objections raised by the observers of the Kew Observatory, who stated that their magnetic observations were deranged by the stray currents from the tramway. The Board of Trade instituted an inquiry into the subject, and the result of their investigations has been in favor of the observatory. In view of the urgent necessity of such a rapid means of transit in this part of the metropolis, however, it has been decided to remove the observatory to a more secluded spot, the tramway company to defray about half the expenses of removal. The complete system, comprising about 42 miles, is not yet in full working order, but the complement of passengers carried over the opened section averages between 150,000 and 200,000 per day.

The tramway was originally a horse car system, and its finances were at a low ebb when it was purchased by a small syndicate, headed by Mr. Clifton Robinson, who had previously assisted Mr. Yerkes in the development of his tramways in the West. They decided to convert it to electric traction, and the necessary Parliamentary powers were immediately sought to enable the conversion to be carried out. At first the project encountered violent opposition, but Parliament granted the franchise, subject to certain minor conditions. The overhead trolley system has been employed, since it is considered more economical and easier to repair. In accordance with the requirements of the Kew Observatory, the rails were not employed as the earth return, but the overhead trolley wires are connected up on the three-wire system, the two center wires forming the neutral and the outside wires the positive and negative side. The neutral wire is only grounded at the central station. By this three-wire system greater efficiency is insured.

Color and Germination of Grains.

M. Hoedeffeiss has recently made some observations upon the relation which may exist between the color of grains and their germinative value. It is rare that the different grains of the same plant do not present differences in their intensity of coloration. In the case of rye, which the experimenter has specially observed, two groups of grains are noticed as to color, the green and the yellow. To these differences of color correspond differences in germinative aptitude. The green grains appear to germinate more quickly and have a greater germinative aptitude; however, it is found that there is no apparent relation between the color of the grain and the development of the plant formed from the latter. The plants springing from the green grains, and in consequence having come up the sooner, seem to arrive at smaller dimensions in general, and form their grains later.

The Current Supplement.

The current SUPPLEMENT, No. 1324, is a particularly interesting number. The remarkable skin treatment by electric light at the Finsen Institute at Copenhagen is illustrated and described in detail. "A Curious Old Church in Spoleto" is accompanied by an attractive engraving. There is an excellent picture of the "Shamrock" being towed. "Mechanical Traction in Paris" is the subject of a very full article. "Amadou, Touchwood, Tinder or Spunk: Its History and Uses" is a valuable botanical article by Frederick Le Roy Sargent. "The Corpuscular Hypothesis," which is referred to elsewhere in this issue, is the subject of a most excellent critical article. "A Primitive Frame for Weaving Narrow Fabrics," by Otis T. Mason, is illustrated by 12 engravings, and is a most interesting article. The usual Trade Suggestions from United States Consuls, Trade Notes and Receipts, and Selected Formulæ are published.

Contents.

(Illustrated articles are marked with an asterisk.)	
Atoms, bodies smaller than.....	306
Automobile notes.....	310
Books, new.....	315
Chimney, concrete.....	*308
Christmas Island.....	*310
"Constitution," launch of.....	*312
Corpuscular theory.....	306
Electrical notes.....	311
Eros, variability in light of.....	307
Gas battery.....	*310
Glass, manufacture of plate.....	311
Grains, color and germination of.....	314
Gun, coast defense.....	206
Gun, Gathmann.....	*913
Ice conveyer.....	*308
Inventions, recently patented.....	315
Malaria and its prevention.....	*314
Mastodon.....	*312
Patents, Marconi.....	311
Rubber, cultivation of.....	307
Science notes.....	307
"Shamrock" and "Constitution".....	306
Tobacco industry.....	*309
Traction systems, electric.....	305
Tramways, electric, London.....	314
Transport service, army.....	306
Trolley poles.....	*308