THE FIRST-CLASS BATTLESHIP "MAINE."

On the accompanying page we present our readers with the first accurate engraving that has yet been made of the new battleship "Maine." The illustrations of this ship that have already appeared in several illustrated journals are based upon the original designs for an eighteen-knot vessel of inferior armament. The accompanying engraving is made from the latest amended designs, and includes the two additional 6-inch rapid-firers in the main deck battery, the substitution of two boat cranes for four, and other changes of a minor character.

In the three battleships of this type, the "Maine," "Ohio," and "Missouri," we shall have fighting ships at once the equals of anything abroad and reflecting credit upon our naval advancement. To the persistent stand of Engineer in-Chief Melville on the vital question of speed is the betterment of these ships over their predecessors, the "Illinois" and type, in the main due, and the increase of armament followed as a natural consequence upon the expansion of the original displacement of 11.525 tons.

The principal dimensions and general features are:

Length on load water line	388 ft 00 in.
Beam, extreme	72 " 2·5 "
Draught, at normal displacement	23 " 6 "
Displacement, normal	12,500 tons.
Indicated horse power	16,000
Speed, maximum	18 knots.
Coal bunker capacity	2,000 tons.
Complement, officers, seamen, and marines, about	600

The hulls of the ships are substantially similar to the "Illinois" type refined by the added length of twenty feet amidships. The inner bottom extends fore and aft throughout the major length of the vessels and reaches from the keel up to the lower edge of the armor belt, four feet below the normal load water line of 23 feet 6 inches. This double bottom space is divided into the usual watertight subdivisions and is under the reasonable control of powerful pumps. The interior of the vessels is also well cut up by the usual watertight subdivisioning, which is likewise under thorough pumpage and drainage control.

The ships have a freeboard forward of nineteen feet and a freeboard aft of eleven. The upper deck reaches from the stem aft to the after turret, and at the bow is flared out to a considerable extent. The main purpose is to make the ships drier in a head sea, but incidentally it affords ampler deck room for various purposes and more space on the deck beneath.

The details of the armor have not yet been finally determined, even though it has been decided that the armor shall be treated by the Krupp process, but there is every reason to believe it will remain practically as follows: The side waterline belt will be of armor having a maximum thickness of 12 inches for a depth of 4 feet, thence tapering to 8 inches at the armor shelf 3½ feet below. This maximum thickness will reach from a line nearly abreast the forward end of the after turret to a point just abreast the after end of the forward turret, and thence will taper to 4 inches at the stem. The protective deck will rest flatly on the inner ledge of this waterline belt throughout the engine, boiler and magazine spaces, and will be 2¾ inches thick, in two courses. Forward and aft of this region it will slope to the bow and to the stern. At the sides, aft, the deck will be 3 inches thick, amidships 1¾ inches thick, and forward the side slopes will be 2 inches thick, the armor of the waterline belt without making a greater thickness needless. The diagonal athwartship bulkheads at the extremities of the thickest part of the side armor will be 10 inches thick. The side armor above the armor belt and about the amidship battery of 6-inch guns will be of 5½ inches backed by two courses of half-inch hull plating. The casemate armor on the upper deck and the protection about the two 6-inch guns on the main deck way forward will also be of 5½-inch armor.

The turrets and barbettes will have a maximum thickness of 14 inches. The original design submitted contemplated a distribution and thickness of armor similar to that on the "Illinois" type, and the present reduction is due to the superior defensive qualities of the plating treated by the Krupp process. A very considerable reduction in weight is thus secured, and it is not yet certain that more widespread protection will not be given to the hull just above the waterline belt. A coffer dam about 36 inches wide extends forward and aft to the bow and to the stern from the athwartship armor bulkheads in the space between the protective and the berth decks. It will be filled with briquettes of corn-pith cellulose. On the berth deck there will be another coffer dam so filled and of like thickness. The efficacy of this cellulose belt has already been well established in actual conflict.

The ships will be propelled by two sets of triple expansion engines actuating twin screws. These engines will be put in separate watertight compartments. They will be of the three cylinder, vertical, inverted cylinder, direct-acting type, and the cylinders will be of 38½, 59, and 92 inches in diameter, with a common stroke of 42 inches. The high pressure cylinders will be forward and the low pressure cylinders aft. The collective indicated horse power of the propelling, air-pump and circulating pump engines will be 16,000 when the main engines are making in the neighborhood of 126 revolutions a minute.

Steam will be supplied by twenty-four boilers of the Niclausse water tube type, constructed for a working pressure of 250 pounds to the square inch, reduced to 200 pounds on the steam pipes at the high pressure cylinders. The boilers will be placed in four watertight compartments, and there will be four fire rooms, two double and two single. The boilers will be arranged in groups of eight. There will be three smokestacks, the tops of which will be practically 100 feet above the grate bars. Blowers will be fitted for forced draught.

The coal bunker capacity of 2,000 tons promises a very considerable radius of action in conjunction with the wholesale use of the more economical water tube boiler; and at a cruising speed of 10 knots the ships will have an exceptionally fine reach of action.

The armament will consist of four 12-inch breech-loading rifles, sixteen 6-inch rapid-fire rifles, twenty 6-pounder and four 3-pounder guns, and a couple of smaller pieces. The 12-inch guns, which will be of 40 calibers, will be of the new high powered type designed to use smokeless powder, and with a muzzle velocity of 3,000 feet per second, and firing an 850-pound shell, it will have the enormous energy of 48,000 foot tons, equal to the penetration of 4 feet of solid iron at the muzzle. There will be a considerable saving in weight. These guns will be mounted in two elliptical, balanced barbette turrets, and will have arcs of fire of 280 degrees. The sixteen 6-inch rapid-fire guns will be distributed four on the upper deck and twelve on the main deck. All will have wide arcs of fire, will carry heavy shields, and will be separated, one from the other, by splinter bulkheads 1¾ inches thick. Two of the 6-pounders will be mounted on the main deck just abaft the two bow 6-inch guns, four will be placed way aft on the berth deck, and the remaining ones up on the bridges and in the superstructure. The 3-pounders and the Gatlings will be mounted in the tops.

There will be two torpedo tubes of an under-water type, and they will be located where they will be practically beyond the ordinary reach of shot or shell.

The ammunition supply will be a large one.

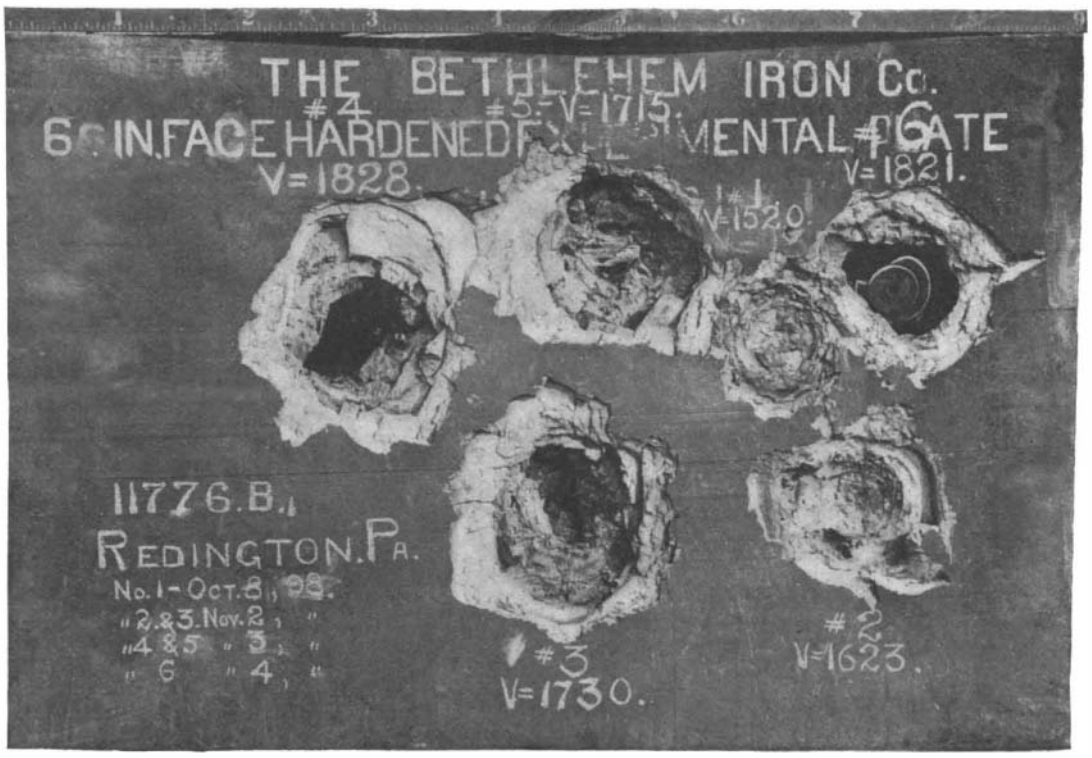
Electricity will constitute the motive energy for many of the auxiliary engines. It will run the ventilating blowers, it will hoist ammunition, turn and control the turrets, besides furnishing light within the craft and light without in the form of four searchlights and a double set of Ardois night signals.

There will be a dense air refrigerating plant with a daily output equivalent to the cooling qualities of two tons of ice. There will be a distilling plant, consisting of four evaporators and two distillers, with their accessories, having a combined capacity of 8,000 gallons of potable water daily.

Wood will be used but sparingly, and, with the exceptions of the main deck without the superstructure, the upper deck, and the bridges, the decks will be covered with linoleum, rubber tiling, wire mats, or cement. Such wood, other than decking, will be carefully fireproofed, but wherever possible, light metal work will supplant wood altogether, unless in the shape of gratings and such things easily removed and thrown overboard before going into action.

It has been suggested that a comparison of the British "Magnificent" with these new ships might be interesting. The "Magnificent" is of 14,900 tons displacement, and has a battery of four 12-inch, twelve 6-inch, eighteen 12-pounders, twelve 3-pounders, and eight machine guns. The weight of our four additional 6-inch guns is somewhat accounted for in the "Magnificent" in the extremely powerful force of 12 and 3-pounder guns and their ammunition, which is an item of moment. At the same time, the armament of the "Maine" is unquestionably the heavier. The waterline armor of the British ship is only 9 inches thick, but it reaches up the sides to a height of 18 feet, and extends fore and aft for a distance of 220 feet. The "Maine," however, has a decided advantage in the fact that the waterline belt is continuous up to the stem. The casemate armor about the 6-inch guns of the "Magnificent" is 6 inches thick. The protective deck is 2½ to 4 inches thick, the athwartship bulkheads are 14 inches thick, maximum. The conning tower is 14 inches thick, while the barbettes and barbette shields are 14 and 10 inches respectively. The coal supply is lighter by 156 tons, but the crew is composed of 757 persons, and the stores for the additional force are heavier. The ship makes about half a knot less speed than our ships, and, being a bulkier craft, to make that, her engines are heavier. Her boilers, too, of the Scotch type, are correspondingly weightier, and some of the structural accompaniments are of proportionate weight. The comparison shows how the most recent practices and our own system of hull protection yield certain savings of weight, which permit the weight of the defensive and offensive elements of the ship to be augmented to that extent.

The contract price for the "Maine" and her sister ships was $2,885,000, based upon the Cramps' bid.



TEST OF A BETHLEHEM, KRUPP-PROCESS ARMOR PLATE.

From photograph of plate after attack by six 8-inch armor-piercing projectiles. **Thickness of plate,** 6¼ inches. **Striking velocities,** 1,530, 1,623, 1,730, 1,715, 1,828, and 1,821 feet per second.

SUCCESSFUL TEST OF 6¼-INCH KRUPP PROCESS PLATE BY 8-INCH GUN.

BY LIEUT. G. L. CARDEN, ORDNANCE OFFICER, U. S. S. "MANNING."

A 6¼-inch Krupp process plate holds, to date, the armor record in the United States. In ordnance circles the plate is referred to as the "Champion." It was recently fabricated by the Bethlehem Iron Works, of South Bethlehem, Pa., and was tested during November on the Redington proving grounds.

The records show that the new plate has exceeded the requirements demanded of a 10-inch Harvey plate when attacked by an 8-inch gun. Six shots in all were fired at the Krupp plate, 8-inch armor-piercing projectiles being employed. The velocities recorded were 1,530, 1,623, 1,730, 1,715, 1,828, and 1,821 foot-seconds. The projectile fired at 1,828 foot-seconds velocity succeeded in partly getting through, while none of the others reached the backing. The 1,821 foot seconds shell was welded into the plate, but it did not succeed in piercing the target. The other projectiles were broken up on impact.

The Navy Department requirements, at present, for a standard 10-inch Harvey plate, when attacked by an 8-inch gun, call for two shots at 1,491 and 1,786 foot-seconds velocity. The 1,491 foot-seconds shell must neither crack nor perforate the plate, while that at 1,786 foot-seconds must not perforate, but may crack the plate.

The accompanying illustration shows the new plate

after its final attack on the proving grounds. The absence of cracks is a noticeable feature in the result.

It is now learned on the best of authority that the specifications for the new battleships will call for Krupp process plates, with the usual proviso that the plates be fabricated in the United States. The superior resisting qualities of this armor will render it unnecessary in the future to place such massive plates upon the sides, barbettes and turrets of our battleships, and the modifying effect of the improved quality of armor is clearly shown in a comparison of the new battleship "Maine" with the "Oregon" and ships of her class. The superior quality of Krupp armor enables us to reduce the thickness of the belt from 18 inches in the "Oregon" to 12 inches in the "Maine," and a proportionate reduction is made in turret and barbette armor.

It is gratifying to realize that the latest product of our own armor-plate establishments is of such excellent quality as to maintain our high position in this industry.

The Cultivation of Walking Canes.

The fashion for congo canes has attained such gigantic proportions in the United States of late that some details regarding their manufacture and origin may not be without interest to the hundreds of thousands of men in America who use these popular walking sticks. Congo canes were first designed by a Frenchman, and the manufacture of the same was for a time confined wholly to France. They are made of the common overgrowth of wood that springs up from the stumps of ordinary chestnut trees soon after the trees have been felled. For a few years France did a thriving business in this new line of manufacture, the simplicity and handsome appearance of the canes winning rapid favor both at home and abroad. After a while, however, the trade reached such rapidly increasing dimensions that it attracted the attention of several large Austrian business men, who forthwith began to consider the feasibility of starting a competition in the same line, for in certain parts of Austria and Hungary, such as the provinces of Croatia and Krain, the growth of chestnut is enormous. They rented large tracts of land from the owners, agreeing to pay in return for the wood they should take away something like half a cent for every stick. Workingmen were easily obtained that would cut the sticks, working ten hours a day for the nominal wage of 80 kreuzers (32 cents) per day, so that the first steps in the cost of production were reduced to a minimum. The trade once started, good results were at once noticeable, and thus the industry which is to-day one of the most important in this monarchy was started.

The preliminary steps to be taken in the growth and manufacture of canes are very simple. In the early spring care must be taken to insure a good crop of sticks. Workmen are sent into the groves with nippers, and every stick that is to be cut later on must first be nipped. March is the best month for the nipping process, for in this month the shoots begin to sprout, and by the time autumn arrives they are ready to be gathered. Forestry laws here step in with restraining regulations by providing that a certain number of sticks in every grove must be left standing until they grow to a sufficient height to be used as telegraph poles. This does not take so long as one might think, however, for Austrian telegraph poles, it may be stated, resemble closely good-sized American bean poles, the wires being strung along the sides instead of on crossbars attached to the top of the poles.

The maximum length which the sticks reach in one season's growth—and if they are nipped in the spring the law specifically states that they must be gathered in the fall of the same year—is two meters; in thickness they vary all the way up to forty millimeters. Sticks which do not attain full growth by autumn must also be taken and be paid for at the regular price, but these are saved from waste by being bent and prepared to serve as umbrella handles. Thus every piece of material is utilized. When the entire crop has been gathered, the sticks are stripped of twigs and thrown into a bath of boiling water, which loosens the bark and makes the work of peeling quite easy. It is interesting to look on while the workmen deftly snatch the blistering hot sticks from the steaming pool and with bare hands draw the bark off in large pieces, as unconcernedly as any other person would handle the cane in a finished state.

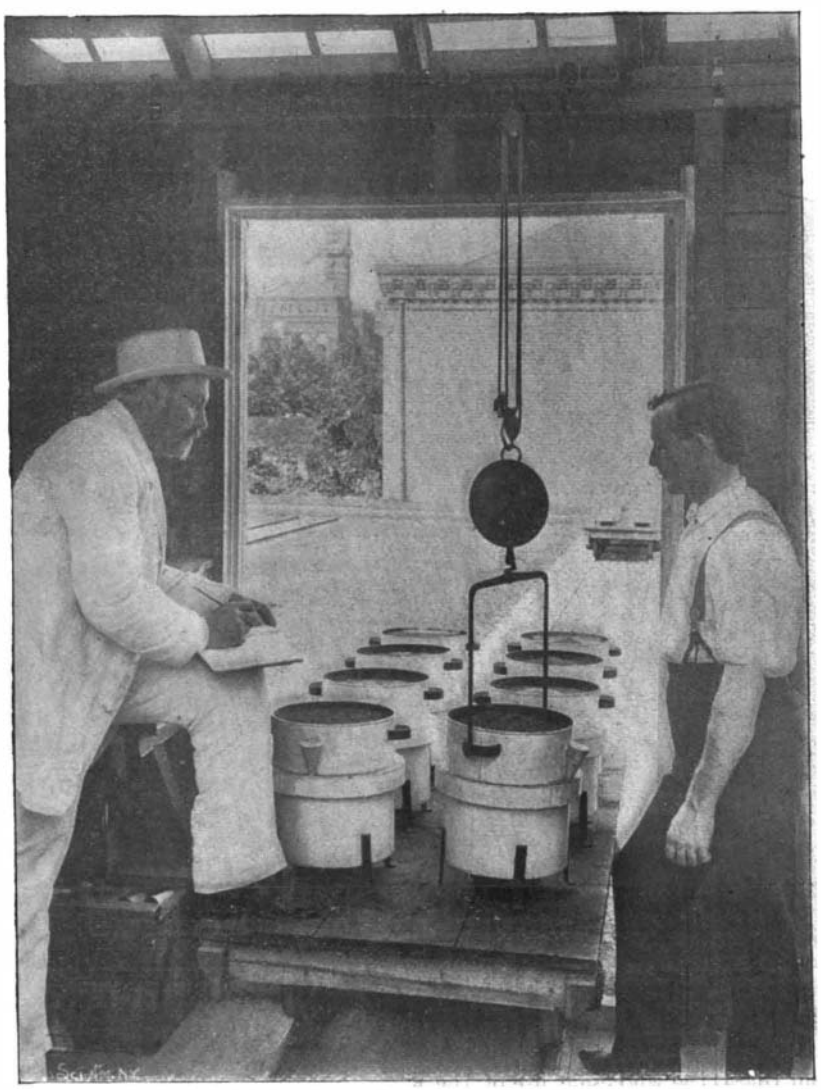
The industry of peeling and preparing the rough sticks for the future processes of bending, smoothing, and polishing is what is known here as a "Hausindustrie," a widespread and practical institution in Austria-Hungary. The "Hausindustrie" obtains in all branches of manufacture where the tools used are of the simplest and rudest kinds and the entire work may be done in the workingmen's homes. The advantage accruing to the laborer in thus accomplishing his work at home is great, for all the members of the family may take hold more or less and the small wage earned by the average "Tagelöhner" (day laborer) is increased twofold. In some parts of Germany, for example in the toy districts of Thüringen, the "Hausindustrie" has grown to so great an extent that many families have built up a large business, and their workshops are now more on the order of small factories. But the cane industry has by far not yet reached this point of development.

In order to take advantage of the clause in the present American tariff which places raw unmanufactured wood on the free list, all canes intended for shipment to the United States are sent over in the rough and finished by American buyers. It is estimated that from two to three millions of congo sticks are exported annually to the United States alone. England consumes a like amount, but the canes that go thither are exported in a finished state. The wholesale price of unfinished sticks in Austria is quite low, averaging from 14 to 17 kreuzers (5 to 7 cents) for the middle qualities and slightly more for the higher grades. These same canes, which are so inexpensive in Austria, when polished and fitted with silver tips and bands, retail in the United States for several dollars. As may be seen, the business is a paying one for the American retailer. Formerly, when the trade was in its infancy, land owners charged but a kreuzer per stick, and were glad to get rid of them at that price, but with the increased demand prices were raised, and now manufacturers cannot buy them for less than 3 kreuzers (1½ cents).

After the cane industry became firmly established and large tracts of land had been rented, fear became prevalent that the demand would not continue for a sufficient length of time to warrant large expenditures in developing the foreign market. This was the case with cherry wood several years ago, and cherry may now be purchased at prices that are considered next to nothing. But at present it appears that the market for chestnut will last for some years yet, unless a sudden change in fashion drives congo sticks out of use in the United States.

C. E. CARPENTER.

Vienna, Austria.



WEIGHING VEGETATION POTS.

THE rapid rise of the land about Hudson Bay is said to be the most remarktble gradual upheaval of an extensive region ever known. Driftwood-covered beaches are now 20 feet to 60 feet or 70 feet above the water, new islands have appeared, and many channels and all the old harbors have become too shallow for ships. At the present rate, the shallow bay will disappear in a few centuries, adding a vast area of dry land or salt marsh to British territory in America.

Thermophones.

The periodic changes of length or bulk produced by an oscillating current may be utilized for the electrical propagation of sound. The effect may be indefinitely increased by superimposing a steady current upon the variable current. A bolometer is inserted in the secondary circuit of a small induction coil. As long as the secondary current alone traverses the bolometer, no sound is heard. But as soon as an independent constant current is made to traverse the bolometer, every impulse of the induced current produces a noise in the bolometer, which in this case acts like a telephone. The loudness increases with the strength of the steady current. On replacing the induction coil by a microphone, nothing is heard. But even then, the sound may be brought out by Simon's sensitive arc. This is due to the strong steady current traversing the arc. If three or four secondary cells are put in circuit with a bolometer and a microphone, anything spoken into the latter is distinctly reproduced by the microphone. The bolometer may be replaced by strips of thin brass.—Braun in Annal. Phys. Chem.

THE STUDY OF TYPICAL SOILS.

BY MARCUS BENJAMIN, PH.D.

The Department of Agriculture in Washington has been wise in retaining during several successive administrations its able Chief of the Division of Chemistry. The result has been that during the years of his tenure of office, Dr. Harvey W. Wiley has been able to plan and complete several valuable series of experiments. None of these, perhaps, have occupied his closer interest and attention more than those which have had for their object the study of the growth of various plants under similar conditions but with varying soils. In fact, the investigation may be designated as a study of typical soils, and is perhaps the first attempt ever made in this country to study any number of soils under like conditions.

In a way the work is an extension of that most excellent series of studies that have been carried on at the celebrated Experiment Station in Rothamsted, England, under the direction of Sir John Henry Gilbert and Sir John Bennett Lawes, who for more than half a century have had charge of the scientific work in that place.

Typical soils from between thirty and forty places scattered throughout the United States were procured through the agencies of the Department of Agriculture, and a direct comparison was instituted with samples of soils of known constituents obtained from Rothamsted.

A plot of ground in the rear of the main building of the Agricultural Department was set aside for these experiments, which were begun in 1892, and a small green-house erected in which the plants are kept during the night and in rainy weather, but at other times they are rolled out into the air. This is easily accomplished, as the pots are all on trucks which may be moved at will along the tracks, as shown in illustrations.

For a portion of the season oats and beans were grown in duplicate samples of typical soils. After the crops from these plants had been harvested, the soil in the pots was again prepared for planting, and a crop of buckwheat grown. By this means two crops are secured during each season, so that the value of the experiment is largely increased, in consequence of duplicating the data obtained.

Very careful attention is naturally given to the water supplied to the pots, and formerly at proper intervals a known amount of distilled water was added to the soil by means of glass measuring vessels, but as the work has progressed, these have been discarded and a number of tin vessels, each holding two pounds of distilled water, have been substituted. As the amount of water added to every pot must be known (so that the conditions may be identical), this improved method makes it possible to add one portion of water to each of the pots in the course of two hours. This is accomplished by inserting the tin funnels containing water in the funnel holder on the side of the pot, as shown in the illustration.

Next perhaps in importance to the addition of water to the soil is the determination of the amount of moisture contained in the pot at any given period. For a long time this factor was determined chiefly by an inspection of the surface, with an occasional weighing of the pot. This method, while capable of yielding excellent results when under the immediate supervision of an expert, was frequently interrupted, owing to the absence of Dr. Wiley, who was liable to be called elsewhere by other duties. Accordingly it was deemed advantageous to have a more rigid control of the quantity of moisture present. Consequently, weekly weighings of the pots are now made, so that the quantity of moisture which has been evaporated