RECENTLY COMPLETED BATTLESHIP "NEBRASKA."

The largest class of battleships of the United States navy is the "Georgia" class, which comprises five ships—the "Georgia," "Nebraska," "New Jersey," "Rhode Island," and "Virginia"; and of these the last to be completed will be the "Nebraska," which forms one of the subjects of illustration on the front page of this issue. Especial interest attaches to this ship because of the fact that she was built in the young State of Washington and at the thriving city of Seattle, which, a quarter of a century ago, was not much more than a village in size. The construction of a modern battleship calls for the highest skill and a thoroughly complete and costly shipbuilding plant, and that this great vessel, with a displacement of about fifteen thousand tons, should have been built and engined in an industrial center so modern is certainly a striking evidence of the material development of this flourishing maritime city of the extreme Northwest.

The "Nebraska" and her sisters are distinguished among battleships by the extraordinary concentration of fire of the guns of the main battery of which they are capable, being in this respect, at least in the number, if not in the weight of shell which they can deliver in any direction, unsurpassed either in our own or any other navy. This concentration is obtained by the method of mounting the 8-inch guns, of which four are carried at the great elevation of 32 feet upon the roofs of the turrets containing the 12-inch guns. The other four 8-inch are mounted amidships, 26 feet above the water, in two turrets, one on either broadside. This disposition enables the "Nebraska" to concentrate two 12-inch and six 8-inch guns directly ahead or astern, while on either broadside she can deliver the fire of four 12-inch and six 8-inch guns. In the secondary battery she carries in broadside on the gun deck twelve 6-inch rapid-fire guns, and for repelling torpedo attack she mounts twelve 3-inch; twelve 3-pounders, and eight 1-pounders. She also carries two 3-inch field guns and eight small-caliber automatic guns. Her torpedo armament is also an exceedingly powerful one, consisting of four of the new 21-inch torpedoes driven by turbine engines, of the kind described in the Scientific American of January 6, 1906, which are capable of a speed of 36 knots at a range of 1,200 yards, and a speed of 28 knots at a range of 3,500 yards.

The distribution of armor on the "Nebraska" is as follows: She carries a water-line belt which is continuous from stem to stern and varies in thickness from 11 inches amidships to 4 inches at the ends. With this is associated a deck 3 inches in thickness. The main barbettes and turrets carry 10 inches of armor and the secondary turrets 6 inches. The broadside battery is protected by side armor 6 inches in thickness which extends between the main barbettes from the top of the main armor belt to the upper deck. There are 9 inches of armor on the conning tower, and the 14-pounder guns also are protected by 2 inches of armor. The total weight of armor is 3,690 tons.

The ship is driven by twin reciprocating engines, which are designed to give a speed of 19 knots with 19,000 horse-power. The maximum coal supply is 1,700 tons.

The ship has a water-line length of 435 feet; her beam is 76 feet 2½ inches, and her maximum draft 26 feet. Her complement of officers and men will consist of 41 officers, 675 enlisted men, and 60 marines. On her builders' trial, carried out on July 2 of this year, she made a speed of 18.95 knots.

OUR LATEST BATTLESHIPS, "SOUTH CAROLINA" AND "MICHIGAN."

The recent letting of contracts for the construction of the two new battleships "South Carolina" and "Michigan" to the Cramp Ship and Engine Building Company and to the New York Shipbuilding Company, has brought these two formidable vessels into special prominence, and a description of the leading features of their design will be timely.

Particular interest attaches to these vessels because of the fact that they are the first battleships to be designed by our Navy Department subsequently to the conclusion of the Russo-Japanese war, and that in their design they embody the valuable experience gathered during that great conflict. The most marked feature is the complete elimination of the intermediate battery, which in our earlier ships consisted of a large number of 5-inch, 6-inch, 7-inch, or 8-inch guns. The customary number of guns in the main battery has been doubled, so that instead of four 12-inch carried in two turrets, the new ships have eight such guns mounted in four turrets. The numerous battery of small rapid-fire guns is retained, since its service will always be necessary for the repelling of torpedo-boat attack. In length and displacement the new vessels are approximately the same as their predecessors, the "Louisiana" and "Connecticut," though with greater beam and ½ knot more speed. They are also more effectively armored than those ships, and in fighting power they are believed to be vastly superior; that is to say, if the new theories as to the probable tactics of future naval conflicts prove to be correct.

The general dimensions of the vessels are as follows: The length on the load water line will be 450 feet; the breadth is greatly increased over that of the "Connecticut," being 80 feet 2⅝ inches. The mean draft at trial displacement must not exceed 24 feet 6 inches, on which draft the displacement must be 16,000 tons.

The General Appearance of the New Battleships.—The two ships when completed will, in appearance, be distinctly different from any of our other battleships. The most noticeable feature, of course, will be the four 12-inch turrets and their guns, mounted in pairs on the axial line of the ship, two forward and two aft of the superstructure. The doubling up in the number of 12-inch turrets, and the placing of them one ahead of the other, has necessarily shortened the length of the superstructure, and crowded the masts, smokestacks, etc., into a shorter space amidships, a fact which is readily noticeable on looking at the engraving of the new ships. In order to save weight the freeboard of the ship has been reduced by the depth of one deck, or about 8 feet, from aft of the superstructure to the stern. Hence the "South Carolina" and "Michigan," while they will have the same freeboard forward as the "Connecticut" and "Louisiana," will have a lower freeboard by about 8 feet throughout the after third of the vessels' length. The most forward pair of 12-inch guns is carried at about the same height as the 12-inch guns of the "Connecticut," or say about 24 feet above the water line. Immediately abaft of these is the second pair of forward 12-inch guns, which are so mounted as to fire clear across the roof of the forward turret, the barbette for these guns being increased in height by about 8 feet in order to give the requisite elevation. The guns have the great command of 32 feet above the water line. The after pair of turrets with their four guns are mounted similarly, although at an elevation in each case 8 feet lower than that of the forward guns.

The shortening of the superstructure has been accompanied also by a moving of the two military masts toward the center of the vessel, and a distinct novelty is seen in the placing of these masts, not on the longitudinal axis of the ship, but diagonally, the forward mast being moved over to starboard and the mainmast to port. Advantage is taken of this new position to mount the boat cranes on these masts, with, of course, a considerable saving of weight.

Armor and Armor Protection.—The armor protection has been exceedingly well worked out, and forms one of the most commendable characteristics of these vessels. Its most important element is a water-line belt 8 feet in width, and more than 300 feet in length. The midship portion of the belt varies in thickness from 11 inches at the top to 9 inches at the bottom, while that in the wake of the magazine is 12 inches thick at the top and 10 inches at the bottom. The casemate side armor above this water-line belt is nearly 300 feet long; it will be 8 inches thick at the top, 10 inches at the bottom, and will be about 8 feet 1 inch wide amidships. This is a casemate protection which, in extent and in thickness, has never been approached in our previous battleships. Triangular athwartship armor, 10 inches thick, will be fitted at the after end of the belt armor, between the slope of the protective deck and the extension of the flat protective deck. Also an athwartship armor bulkhead, extending entirely across the ship between the upper platform and the protective deck, will be fitted at the forward end of belt. This will be 10 inches thick throughout. Furthermore, an athwartship casemate armor bulkhead will be fitted between the shell plating and the barbettes between the berth and main decks at forward and after ends of casemates; this will be 8 inches in thickness throughout.

Barbette Armor.—The forward barbette extends from the protective deck to about 4 feet above the upper deck, and it varies in thickness from 10 inches to 8 inches, according as it is flanked by the side armor of the ship. The after forward barbette extends to a height of about 12 feet above the upper deck, and carries the same general thickness of armor. The forward after barbette extends from the protective deck to 12 feet above the main deck, and the barbette aft of this extends from the protective deck to 4 feet above the main deck. In the case of each of the four turrets, the port plate will be 12 inches in thickness, the rear and side plates 8 inches, and the top plates 2½ inches in thickness.

The vessels will be propelled by vertical twin-screw four-cylinder triple-expansion engines of 16,000 horsepower. The steam pressure will be 265 pounds in the high-pressure valve chest, and the revolutions per minute will be 125. Steam will be supplied by twelve water-tube boilers fitted with superheaters, carried in three water-tight compartments. The vessels will be lighted throughout by electricity, and the operation of the turrets, ammunition hoists, and, indeed, most of the mechanical work throughout the ship, will be performed by electrical power. The coal bunkers will be arranged with a direct reference to the rapid and efficient supply of coal to the fire rooms, and with especial reference to efficient water-tight subdivision of the vessel. There will be provided for coaling the ships not less than five winches, ten booms, wire spans, with the necessary whips at all the usual chutes and other openings, special provision having been made for the rapid coaling of the vessels. There will be a bridge both forward and aft, built according to the latest practice. The masts will be fitted with searchlight platforms, and arranged for wireless telegraphy. There will be one signal yard on each mast, a battle gaff on the mainmast, and a lookout platform on the foremast.

Distribution of Weight.—It is instructive to study the distribution of weights in these new vessels; the guns, mounts, ammunition, and ordnance stores will represent about 7 per cent of the trial displacement; the motive power, including engines, boilers, piping, etc., about 10 per cent, and the total armor protection reaches the great figure of more than 25 per cent of the trial displacement.

Concentration of Fire.—It will be seen at once that by arranging the two extra pairs of 12-inch guns at a sufficient height to enable them to be fired across the roofs of the adjoining turrets, the theoretical all-round concentration of fire is remarkably powerful. Forward, when in pursuit of the enemy, or when fighting in the end-on position, it will be possible to concentrate four 12-inch guns, which is double the number that can be trained in a similar direction on the "Connecticut" and "Louisiana." Aft there is a similar concentration of four 12-inch guns, while on the beam these ships will be able to train eight 12-inch guns.

In a previous issue of the Scientific American we have criticised this method of placing the armament, on the ground that previous experience with the "Oregon" and her class showed that if heavy guns were fired across the roofs of the adjoining turrets, the work of the gun crews in these turrets would be seriously interfered with. We are informed, however, that particular attention has been given by the Navy Department to this difficulty, and that by virtue of the improved sighting ports and the closely-fitting port shields employed, and other arrangements, it will be possible, in an emergency, to fire any of these 12-inch guns in any position of training without serious interference with the work of the other gun crews. If this should prove to be the case, our Navy Department will be the subject for congratulation on having produced, in proportion to their displacement, by far the most powerful fighting ships built or building in the world to-day; for it must be remembered that these vessels are of but 16,000 tons displacement, while the latest battleship designs of other governments are of from 18,000 to 19,000 tons displacement.

There are many novel details of construction in these vessels, which, for obvious reasons, it is not expedient to make public at the present time—such, for instance, as the more complete water-tight subdivision of the vessel, and provision against heeling due to damage in action; and the protection of the vessels' longitudinal strength when damaged by gun fire, the provision of adequate longitudinal strength being particularly important in view of the concentration of the weight of the barbettes and heavy guns so near the extremities of the ship.

Distribution of Patent Office Models.

It appears, according to an act of Congress passed on June 22, 1906, the Secretary of the Interior is authorized to dispose of a part or of all the model exhibit of the Patent Office, either by sale, gift, or otherwise. Acting Commissioner E. C. Moore has issued a notice to the effect that immediate requests from polytechnic schools and colleges having technical courses for portions of the exhibit will be considered in the disposition of the models.

It is presumed that the pressing need of additional space in the Patent Office building is the reason for this general clearing out of models.

An opportunity is now afforded for technical schools to secure models of interesting and well-known inventions pertaining to important industries. Inquiries should be addressed to the Commissioner of Patents, Washington, D. C.

According to the recent report of the British consul for New Caledonia, the indigenous Canaques are rapidly becoming an extinct race. Owing to the inroads of disease, more especially the more virulent maladies of phthisis and leprosy, combined with the abuse of alcoholic liquors, the natives are becoming greatly degenerated, and the people do not now number more than 17,000 souls in all. Although the disposal of spirits is forbidden to the natives, they yet obtain enormous quantities by surreptitious methods, and it kills them very quickly. Moreover, the children now born are for the most part very stunted and seldom attain adult age. The consul is of opinion that it will not be many years before the Canaques become totally extinct.

Return of Finlay's Periodic Comet.

BY PROF. WILLIAM R. BROOKS, SMITH OBSERVATORY.

Finlay's periodic comet, recently detected on its return by Koph at Heidelberg, was observed at this observatory on the morning of July 19 with the 10-inch equatorial refractor. Its position at that time was right ascension 23 hours 53 minutes 30 seconds; declination south 13 deg. 3 min. This places it on the tail of Cetus, and rather singularly, quite close to the place where the writer discovered an interesting periodic comet in July, 1889, having a period of about seven years.

Finlay's comet is at present slowly moving in a northeast direction. It is a faint telescopic object at present, slightly oval in form, with the major axis in an east and west direction, with no central condensation and no tail. The comet, however, will increase in brightness until the first week in September, when it arrives at perihelion.

This comet was discovered by Finlay at the Cape of Good Hope on September 26, 1886, and was observed for several weeks by the writer from the old Red House Observatory. The period of this comet's revolution about the sun is about six and one-half years. It was quite generally observed at its first return in 1893, but at its next return, in 1899, the comet was in such an unfavorable position that it escaped observation. At this, its third return, it is very favorably placed for observation in the eastern morning sky.

From the following ephemeris the general path of the comet may be seen, and its place projected for a little time beyond the dates here given:

	R. A.	Dec. S.
July 25	0 h. 48 m.	7 deg. 59 m.
July 29	1 h. 21 m.	5 deg. 0 m.
August 2	1 h. 56 m.	1 deg. 42 m.
		North.
August 6	2 h. 36 m.	2 deg. 35 m.

The comet, it will be seen, is moving along the back of Cetus. On August 2 it will be nearly between the stars Alpha and Mira, and early the following week in the head of that large constellation.

How Alcohol is Made from Potatoes in Germany and How the Government Controls Its Production.

The potatoes (which must be produced on the land of the proprietor) are first washed by machinery. They are then steamed and pulped, and driven through a strainer into the mash-tun where they are mixed with a small percentage of malt. The wort is then passed into the fermenting vats. Each vat is gaged, and its content marked on the outside, together with the number of the vat. The wash is left to ferment for thirty hours, and is then conveyed to the still, which is of the patent still type. On issuing from the condenser the spirit passes first through a domed glass case in which is a cup. In this cup, into which the spirit flows and from which it overflows, there float a thermometer and a hydrometer, to indicate the strength of the spirit passing. From this apparatus the spirit flows into a (Siemens) meter, fitted with an indicator which records the quantity, reduced to the standard of pure alcohol, of spirit transmitted, and from the meter the spirit passes on to the receiver.

The system of control in Germany does not require the continuous attendance of excise officers, but is compounded of (1) mechanical contrivances, (2) book entries, and (3) liability to visitation at any time.

(1) Mechanical Contrivances.—Up to the point at which the wash passes into the still, these are limited to the gaging of the vats and to the plumbing under revenue seal of all joints of the pipes leading from the vats to the still. From that point onward to the receiver every vessel is locked and sealed, and no access to the spirit can be obtained by the distiller.

In the small distilleries the meter, which no doubt is an expensive apparatus, is dispensed with, and the quantity of spirit distilled is ascertained by the excise officer from the receiver. Whether there be a meter or not, the receiver is of course under lock, and is not accessible to the distiller.

(2) Book Entries.—The regulations require entry of the quantity of materials used. But this is regarded as of little practical value, and little attention is paid to such records. It is manifest that they cannot be susceptible of any real check.

The important entries are those of the times of charging and discharging the several fermenting vats, and of the quantities of wash in each. These entries can of course be checked against the spirit found in the receiver, and on them is computed the vat tax and the distillery tax, which have to be paid by the distiller.

(3) Liability to Visitation.—It will be seen that the control under (1) and (2) provides no security against abstraction of wash from the fermenting vats. Visitation at frequent and uncertain intervals would seem to be an essential feature of the system. Visits of excise officers are even unpleasantly frequent. Whether they are so in more remote distilleries may be open to doubt.

In any case the system of control rests so heavily upon confidence that, while it may be satisfactory with a low duty on spirits and with a system of rebates of duty that makes the excise a source of profit to the smaller distiller, it could not safely be adopted where the duty is high and invariable in its incidence.

The vast majority of German agricultural distilleries are to be found in the eastern provinces of Prussia and Saxony, where the soil is poor, and the cost of conveying agricultural produce to a remunerative market is high.

In normal years the return from potatoes used in the agricultural distilleries does not exceed some $5 per ton (exclusive presumably of bonuses), and in many cases is less. The average is about $4.50 per ton.

The yield of alcohol from a ton of potatoes may be taken at about 25 gallons of pure alcohol, or about 44 proof gallons.

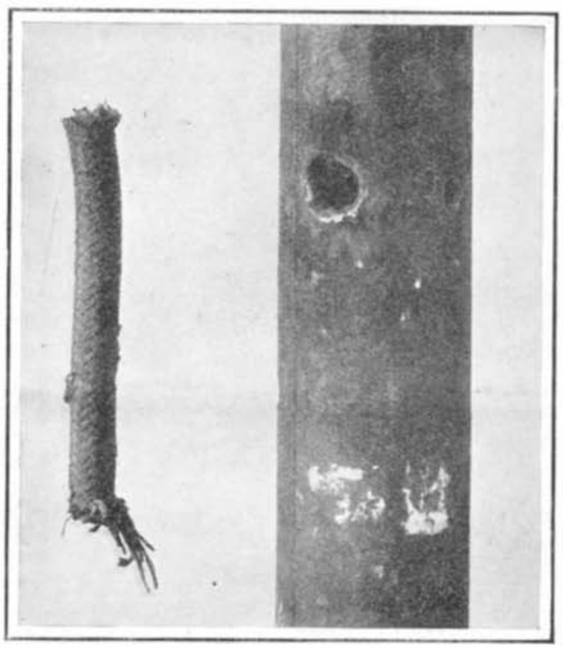
Correspondence.

Thunderstorms and Electric Wiring.

To the Editor of the SCIENTIFIC AMERICAN:

As a matter of interest and instructive value to your many readers, I am reporting an unusual and significant incident that occurred at the branch office of the SCIENTIFIC AMERICAN at Washington, D. C., during a thunderstorm on the 11th of July, 1906.

During the progress of the storm, lightning struck the electric wires that supply the office with light and power. The fuses of the various lights and fans were instantly burned out, and simultaneously therewith a torrent of water poured from the floor of the building where the wires entered, evidently flowing from the water pipe supplying the various radiators of the water-heating system, which, as is usual, had not been



HOLE BURNED IN A WATER PIPE BY LIGHTNING.

cut off for the summer months, since it is not generally considered necessary or even desirable to do so.

Careful inspection disclosed the fact that the electric wiring was close enough to the water circulation pipe to permit electricity of high voltage to jump to the fine ground connection which the water pipe afforded, and in doing so it burned a hole fully three-eighths of an inch in the water pipe, with the result above noted. I am inclosing you a section of the pipe showing the holes, of which there are two, a large and a small one, and also a piece of the wire. The torrent of water which immediately followed the discharge shows that the larger hole was the result of the discharge. The smaller one may have been produced by a ground during the removal of the pipe, as the water-heating engineer states that a flash occurred as the pipe was unscrewed preparatory to removing it, he having undertaken the work without opening the electric switch.

The lesson which the incident teaches is, first, the value of adequate lightning arresters; and second, the importance of keeping all electric wiring away from water and gas pipes. The electric wires were properly insulated, and carried by porcelain sleeves through the wooden joists of the building, but the lightning's voltage was heavy enough and the ground connection so good as to make the jump possible. If the pipe had been a gas instead of a water pipe, needless to say a fire would have occurred, which would have been difficult to control in daytime, and disastrous at night.

Washington, D. C. EDWARD W. BYRN.

A London inventor has succeeded in evolving a novel improvement upon the ordinary celluloid film used for cinematographic purposes. The pictures are taken in a spiral manner upon circular glass plates, thereby enabling a long series comprising several hundred pictures to be contained in a small space. The diameter of the plate is 15 inches, while the photographs themselves do not exceed half an inch in length. In this way it is possible to record a story lasting about four minutes upon one plate. Very slight alterations are necessary to the projecting lantern, and by revolving the plate the pictures are thrown upon the screen.

TUNNELING THE EAST RIVER.

Subaqueous tunneling, particularly in soft ground, is hardly past the experimental stage, despite the fact that its history dates back to the time of the Assyrians, who built a tunnel 15 feet high and 12 feet wide under the Euphrates River. It may seem remarkable that such an engineering enterprise could have been carried out before compressed air was known, but the ancients often displayed remarkable originality and simplicity in their methods of overcoming apparently insurmountable difficulties. The idea of tunneling the Euphrates proved no great problem to them. They merely diverted the course of the river, built up their brick tunnel in the dry bed, and then restored the waters to their original channel.

Strictly speaking, then, this work was not of a subaqueous character, so that the true history of subaqueous tunneling in soft ground properly begins with the Thames tunnel, which was built about eighty years ago. Since then, a dozen or more such tunnels have been built, but despite the experience they afforded, there is still a great deal to learn on the subject. Each tunnel has its own individual characteristics, and offers its own puzzling problems. For example, three different lines of tunnels are now being built under the East River, two of which are within a half mile of each other, yet the material through which they are being cut is different in each case and, furthermore, is of an entirely different character from that encountered in the Harlem River and the Hudson River. Not only do these tunnels differ in the nature of the soil and rock through which they pass, but also in their depth below the surface of the water and in their size, which variations govern the air pressure necessary in the tubes and working chambers and introduce complications that do not appear at a casual glance.

The furthest advanced of the tunnels now building under the East River is the Rapid Transit Subway tunnel, which comprises two tubes running from the Battery to Joralemon Street, Brooklyn. At present, the two shields of the northern tube are less than 800 feet apart, while 940 feet of rock and sand intervenes between the headings of the southern tube.

Before commencing these tubes, careful borings were made in the river bed along the line of the tunnel. At first, wash borings were made, these consisting in sinking a tube into the river bed with a water jet until it struck rock. The mud and sediment in the tube indicated the nature of the materials of which the river bed is composed. A large number of these borings were made. They might be called soundings rather than borings, because they did not penetrate the rock but merely indicated the depth below water level at which rock was encountered. Such borings in themselves are apt to be quite misleading, because only the surface of the rock is indicated and there is no way of determining whether the rock is solid or merely a large bowlder. Only by diamond drill borings into the rock itself carried below the depth of the tunnel floor, is it possible to make an accurate estimate of the conditions which will be met when driving a tunnel. With a diamond drill a core is cut out which serves as an actual sample of the rock or other materials encountered; consequently it was decided to verify the wash boring statistics with diamond drill borings. But the driving of a diamond drill boring from the surface of a body of water subject to such tidal currents as prevail in the East River is no small task. In borings of this type it is imperative that the drill be kept in perfect vertical alignment. This necessitated the building of a firm, stationary platform in the river wherever a boring was to be made. A pile driver was used to carry the drill-operating mechanism, and the working platform was supported on piles driven into the river bed. Much difficulty was experienced in maintaining the working platform, as barges in the river were frequently swung by the tide against the piles, knocking them down or out of alignment. Several drills were lost by accidents of this character. But results proved that the precaution of verifying the wash borings was well taken. The original profile showed rock near the Brooklyn shore, but when the rock was drilled, it was found to be merely a large bowlder beneath which, in the line of the tunnel, there was nothing but soft material. Discrepancies were also found in other places, so that the true profile which we publish here differs very much from the original one based on wash borings.

The rock profile along the New York and Long Island Railroad tunnel at 42d Street, popularly known as the Belmont tunnel, was also based on diamond drill borings and a number of wash borings. A novel method of establishing working platforms for the borings was used. The water here was deeper than at the Battery and pile foundations were out of the question. Instead, a steel tower 68 feet high was procured, one which had