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NEW YORK, SATURDAY, DECEMBER 22, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PLANS OF OUR 20,000-TON BATTLESHIP.

In response to the Navy Department's request for plans for the 20,000-ton battleship authorized by the last Congress, ten designs were submitted. Some of them were drawn by private concerns, and the others by the Bureau of Construction and Repair. The Department favors one of the designs drawn up by its own bureau, and Secretary Bonaparte has, accordingly, recommended its adoption by Congress.

The greatest interest attaches to this ship. It is our answer to the "Dreadnought," a vessel which has come to be considered as the type ship for future battleship construction. Naturally, comparison will be made with that vessel; and in the absence of detailed information as to distribution of weights, and the thousand-and-one elements which go to make up the total efficiency of a ship, it is certain that the Department's plan will be subject to much unfavorable criticism. For, on the face of it, it will appear to the layman that with 2,000 tons more displacement, we are building a ship that is no more powerful than the "Dreadnought."

As a matter of fact, our new ship will be just 2,000 tons, or 11 per cent, more efficient than the British prototype. The same arguments with which, in a recent issue, we urged that the 18,000-ton "Dreadnought" must of necessity be superior to the 16,000-ton "Michigan," will now apply to the question of the relative efficiency of our 20,000-ton new battleship and the 18,000-ton "Dreadnought." Displacement means power, either for attack or defense, and if, as we shall see below, our new ship carries no more guns, and has no greater speed than the British ship, it must inevitably follow that those guns are better disposed, more amply protected, and the security of the whole ship more certainly assured, in the exact proportion of the difference in the size of the two vessels.

Compared with the "Dreadnought," our new battleship, 510 feet long, is 10 feet longer on the water line; has 3 feet more beam, or 85 feet; and is of 20,000 tons displacement, or 2,000 tons more than the "Dreadnought." Her coal bunker capacity is about 400 tons less, and her estimated speed the same. She carries the same armament of ten 12-inch guns; but her secondary battery for repelling torpedo attack is heavier, consisting of fourteen 5-inch rapid-fire guns, as against about twenty 3-inch rapid-firers.

Judging from the fact that the weights allotted to guns and motive power appear to be about the same, it follows that considerably more weight must have been allowed in our new ship to be the most important element of stability and protection. Although the belt armor of the two ships is the same in its maximum thickness, there is no doubt whatever that the Department design calls for a continuation of the maximum thickness of this armor over a greater length of the ship's hull amidships. The belt armor is 8 feet in width with a maximum thickness of 11 inches and its cross section is uniform throughout the length of the belt. Remembering how terribly effective was the heavy gun fire of the Japanese against the unarmored or lightly-armored ends of some of the Russian battleships, our designers are carrying the full thickness of the belt armor much farther forward and aft than has been usual in previous warships which, of course, adds greatly to its weight.

The side above the main belt armor is protected by an upper belt 7 feet 3 inches in width, and of a maximum thickness of 10 inches. This belt also carries its maximum thickness farther fore and aft than has been the usual practice, and serves to afford unusual protection to the substructure of the 12-inch gun mounts. Furthermore, the side of the ship above the second belt is protected by 5 inches of armor, which protects the base of the smoke pipes and the majority of the guns of the 5-inch battery. Particular attention has been paid to the subdivision of the ship, which has been so worked out that everywhere three separate walls of skin plating will intervene between an exploding mine or torpedo and the magazines.

The guiding principle in working out the hull and the armor plan has been the recognition of the necessity of making the modern battleship more secure against sinking or capsizing, and the larger part of the increased displacement of this ship has been spent in producing a hull that will stand up on an even keel under the prolonged and combined attack of the torpedo, the mine, and of 12-inch batteries of the modern battleship.

The announcement that the design calls for only ten 12-inch guns will produce disappointment among those people, lay and professional, who delight in the spectacular; but this battery will be more powerful, or, rather, more effective, than that of the "Dreadnought," for the reason that all of the guns will be mounted along the central axis of the ship, and will be available on either broadside. This will enable our new ship to oppose to a ship of the "Dreadnought" type a broadside 25 per cent more powerful. At the same time this is done at some sacrifice of end-on fire, which will consist of four 12-inch, as against the six 12-inch of the "Dreadnought."

After all is said and done, it is certain that the Department plan will be criticised on the ground that the battery is not sufficiently powerful for the ship. We understand that among the designs submitted by private concerns was one for a battleship 540 feet in length carrying fourteen 12-inch guns; but, of course, if the greater portion of these guns are mounted in broadside turrets, six of them may be masked when in action by the corresponding six on the opposite beam, and the total broadside available may be no greater than that of the Department's plan, in which the ten guns, being mounted on the longitudinal axis, are available on either broadside.

SANDY HOOK COAST DEFENSES.

The invitation by the United States government to the members of the American Society of Mechanical engineers to pay a visit to that most sacred of all government reservations, Sandy Hook, was a greatly appreciated courtesy to one of the most distinguished and influential technical bodies in this country. The invitation was extended in connection with the recent convention of the society, and as usual, the government treated its guests exceptionally well, $8,000 being appropriated for the practical exhibition of the working of the many elements of defense in the way of guns, mines, mortars, etc., which render Sandy Hook one of the most formidable of our seacoast defenses. The seven hundred guests of the government were taken down to Sandy Hook in a special train of ten cars, and the first stop was made at the southerly end of the Proving Grounds for the purpose of visiting the great 16-inch army gun, the largest and most powerful rifle in existence. This piece is still mounted on the temporary trial carriage on which it was proved some two or three years ago. The gun weighs 130 tons and fires a shell weighing 2,450 pounds with a velocity of slightly over 2,300 feet per second, and an energy of about 80,000 foot-tons, over 600 pounds of smokeless powder being necessary to secure these results. Although it is not likely that the gun will be re-duplicated, the piece will be permanently mounted at Sandy Hook, and will form a very valuable element in its defenses. It may be remarked in this connection, that the recent determination of the Ordnance Board to abandon the manufacture of guns of high velocity in favor of larger guns of low velocity, lends a new significance to the 16-inch gun, and if it should be decided to adopt for this piece the 2,000-foot-seconds velocity, which is to be the service velocity of the future, the 16-inch gun will become in a sense rejuvenated, and may be considered to have before it a long period of future usefulness. Two or three hundred yards to the east of the big gun, the visitors were shown two targets representing the side armor, backing, and framing of our latest armored cruisers and battleships, which have lately been erected for the purpose of testing their resisting power to the attack of modern shells. It was noticed that the targets, instead of facing the guns, have been built with their face at a sharp angle to the line of fire; and it was explained that this was done in order to test the resisting power of the armor when struck by shells delivered at an angle 20 degrees from the normal. As a matter of fact the majority of the projectiles which reach a ship strike her obliquely; comparatively few of them are delivered normal to the plate.

The visitors were next taken down to the massive concrete emplacements upon which the various guns which are submitted for proof are tried out. Here, two rounds were fired at a velocity of 3,000 feet per second from one of the latest type of 6-inch rapid fire guns mounted on a barbette carriage. The small interval of time before the shell struck the water, over a mile away, afforded a dramatic illustration of what is meant by a muzzle velocity of 3,000 feet per second. Then followed five rounds from a 15-pounder, semi-automatic, rapid-fire gun, and three rounds of shrapnel from a 3-inch field gun which were timed to explode above the water at about 1,000 yards range. As the shots were fired to leeward before a 35-mile gale, the sound of the exploding shells could not be heard, and the only evidence that the heavy rain of fragments was being duly scattered was the appearance above the water of a little white ball of smoke, looking for all the world like a puff ball hanging in mid-air. Other tests at this battery consisted of the firing of a 4.7-inch siege gun, mounted on a long recoil carriage; and a 2.38-inch field gun; and ten rounds from one of the famous 1-pounder pompom automatic guns. From the spectacular point of view, the most interesting exhibition was the firing, with full charge, of a 10-inch rifle mounted on one of the Buffington-Crozier disappearing carriages. This mount, whose design is chiefly due to Gen. Crozier, of the Board of Ordnance, who was present to receive the guests, is now the standard type of mounting for all the heavy guns of the United States coast defenses. The shell struck the water at a range of about 2½ miles, throwing high into the air a huge geyser of water. Ricocheting, it took another great leap of fully a mile and a half, when it struck again, throwing up another large column of spray, before it finally passed out of sight.

The party then passed on down the beach to the formidable fort known as Battery Richardson, where a large number of 12- and 10-inch guns are mounted on the Buffington-Crozier disappearing carriage. After a 12-inch gun had been raised into battery, traversed, and returned to the loading position, Gen. Murray, mounting the parapet of the emplacement, delivered an address in which he contrasted the best firing results obtained in target practice a few years ago with those of the present year. Five years ago the best results that could be obtained with the 12-inch gun were one shot in 3 minutes, and the percentage of hits was 50 at a range of from 4,000 to 4,500 yards. During the intervening years, thanks to the admirable system of fire control (that is, the method of locating the target, and ranging the guns), the work of our gunners has improved so greatly that last year more than half of the guns fired made a record of 100 per cent in hits, the range has been increased to 4,000 yards, and the average time between shots reduced to one minute.

The visitors then passed on down through the fort to another emplacement, where they were treated to an exhibition of sub-caliber target practice, in which a rifled tube, representing a 1-pounder gun, is placed centrally within the bore of a 10-inch rifle, and all the motions of unlocking a breech, loading, closing the breech, sighting, etc., are gone through exactly as though a full-weight shell and powder were being used.

Considerations of expediency prevent any detailed description of Fort Richardson, and it must suffice to say that the provisions for the safe storage of the powder and shells, the arrangement of the lifts for bringing the ammunition up to the guns, etc., are thoroughly up-to-date and render this fort one of the most complete and formidable of its kind in the world.

All systems of defense of the entrance to the harbors include, in addition to the heavy guns for the attack for armored vessels, provisions for sowing the channels with the deadly submarine mine. The submarine defenses of the Sandy Hook channels are particularly complete. They are arranged on the electrically-controlled system, and have been carried out on the lines which have been illustrated from time to time in the various issues of the Scientific American. By this system it is possible to discriminate in the treatment of friend and foe. When a ship strikes a floating mine, an electrical contact is made which gives notification to the operator within an armored casemate on the shore. If the ship be a friendly vessel, it is allowed to pass on; but if not, the operator immediately throws a switch and explodes the mine.

From the mining casemate the visitors were next taken to the hidden mortar batteries, from the crest of which they looked down 60 or 70 feet into a series of huge rectangular pits, at the bottom of each of which were four short, massive, rifled mortars, capable of throwing a 12-inch shell to the extreme range of 7 miles. For the benefit of the visitors, a salvo of four guns was fired with reduced charges, the guns having an elevation of about 50 degrees. At the word of command there was a reverberating crash, and instantly the eye was able to follow the skyward sweep of the four projectiles which, keeping the same relative four-square position in which they left the muzzle of the guns, could be seen soaring into the blue, drawing together under the effect of perspective, and diminishing until they were lost to sight. A few seconds later, after they had described a vast curve, whose highest point was a mile and a half above the earth, a cloud of spray thrown up from the ocean some three miles distant from the shore marked the point at which they fell. The exhibition closed with the firing of shells loaded with high explosive or with black powder, and the explosion of a powerful land mine. The latter lifted what appeared to be a veritable mountain of sand, earth, and broken timbers high into the air, and afforded a most impressive demonstration of the destructive power of this, the most formidable of all methods of attack.

NOTES ON RECHARGING OXYGEN GAS TANKS.

BY RANDOLPH BOLLING.

In laboratories situated in isolated districts like ours, the expense of getting oxygen tanks recharged is considerable, the express charges from Sydney, Nova Scotia, to New York city and back, plus customs duties amounting to about $15 on a small, 15 cubic feet capacity tank. This made it highly desirable to find some means of securing a supply of oxygen at something like reasonable prices. The idea of gas bags or gasometers occurred to the writer, but as these are at best cumbersome and rather obsolete methods of storing gas, and besides none being within a thousand miles of our laboratory, it was decided that we ourselves, should recharge our tank, which had recently become exhausted. The tank was one of those pressed-steel cylinders without seams and rivets, and guaranteed to stand a pressure of 600 pounds to the square inch, and to hold 15 cubic feet. In Hempel's "Methods of Gas Analysis," translation of E. L. Dennis, a chapter is devoted to the design of a calorimeter using oxygen under very high pressure, the gas being generated in a length of iron pipe with suitable couplings. This method of Hempel's appeared to be a simple arrangement and one easy to carry out, so the writer decided to use Hempel's apparatus, substituting the oxygen tank for the calorimeter bomb.

To set up the apparatus, a heavy brass coupling was screwed to the oxygen outlet of the tank, threaded to take an iron T pipe of ½ inch inside diameter. Into one opening of the T was screwed a pressure gage reading up to 200 pounds. The generator was made of a piece of double extra-heavy steel pipe, 2 feet long by 2 inches diameter, one end closed by a steel coupling and a heavy cast-iron plug. The other end had fitted to it a suitable reducing nipple and a piece of ½-inch pipe 6 feet long, threaded at the end. The mixture for generating oxygen was prepared by heating one kilo of manganese peroxide for about six hours on a thin steel plate over four Bunsen burners, in order to burn off all organic matter. I had the commercial article on hand, and it was far from pure, containing bits of sawdust, roots, and trash very intimately mixed, and not caring to risk an explosion, I took the precaution to get rid of the organic matter. After cooling the peroxide, it was all passed through a 40-mesh sieve and then mixed with one kilo of potassium chlorate, also ground to pass a 40-mesh sieve. The chlorate and the peroxide were carefully mixed together and 400 grammes weighed off. A small portion was then heated in a test tube to test its behavior, and although it sparkled somewhat freely, possibly due to a little organic matter still retained, I judged it was safe enough for use. The generator was then all ready to be connected up to the tank; but remembering the habit of pipe fitters in lavishly using lubricating oil in threading up pipe, I decided to heat the generator pipe and the connecting pipe to a red heat for a few minutes to get rid of the oil, which if mixed with potassium chlorate would cause a bad explosion. As I expected, a good deal of smoke issued forth, showing that this precaution was necessary. After the pipe cooled, a piece of brass gauze about 6 x 10 inches was rolled up loosely and rammed down the generator. This is recommended by Hempel as a good means of removing any traces of chlorine given off, and it also acted as a sort of porous plug to prevent the chlorate peroxide mixture from falling out when the generator was being charged. The apparatus now being all ready, the generating mixture of potassium chlorate and manganese peroxide was poured into the generator and the plug tightly screwed on, the pipe tapped to settle the powder at the end, and the tank with its pressure gage attached was taken out into a nearby field, so that if anything went wrong an explosion would cause no damage. The tank was stood upright on the ground, the pipe connecting the generator screwed on, and the needle valve to the tank opened. A lot of kindling wood piled around the generator was lighted, and then the operator retired to a safe distance to await results.

After about twenty minutes the fire burned out, and everything being apparently all right, I advanced to the apparatus and closed the needle valve on the tank. The gage showed 21 pounds pressure. This experiment showed that the charging could be done in this manner with perfect safety, and that a larger weight of reagents only was needed to get our tank properly charged. The generator was then disconnected from the tank, the plug taken out, and the hard, compact mass of potassium chloride and manganese peroxide dislodged by a chisel bar. The generator was then filled with 800 grammes and the same process repeated; this time the needle of the gage showed 65 pounds. The connections were examined for leaks under this pressure, and as several bad ones showed, the connections were then unscrewed and coated with a paste made of zinc oxide and zinc chloride, which I have found an excellent material for the purpose, and the charging was begun again until the gage showed 200 pounds. It was then decided to stop further charging, as this was sufficient gas to last for some time, and as we had no gage available reading up to 600 pounds. To secure this pressure of 200 pounds it required 2 kilos of potassium chlorate (commercial), worth about $1, and 2 kilos of manganese peroxide, worth about 40 cents. The material for fittings and labor cost about $1.50, but the generator is good for hundreds of chargings operations.

After one has the apparatus made, which is simple enough, a boy can charge a tank in two hours. This gas was used for carbon determinations in steel, for hastening the combustion of graphitic carbon in the determination of silicon in pig iron, and also used for burning off coke quickly in the determination of ash in coals for coke.

I find this method of charging oxygen tanks safe and economical. I have never used more than 800 grammes of the mixture for generating oxygen, not because I did not consider it safe, but on account of the size of the generator. No doubt one could calculate a charge that would fill a tank of a certain capacity up to any pressure that the fittings and connections would stand, but unless the apparatus is made of pipe known as the "extra heavy," the pressure could not be increased over 200 pounds with safety. In these notes I have given an account of my method of recharging oxygen tanks and it is hoped it may be useful to those chemists similarly situated in steel works laboratories.

LONG-DISTANCE OCEAN RACE FOR MOTOR BOATS.

CONDITIONS GOVERNING THE RACE FROM NEW YORK TO BERMUDA.

The conditions for the Long-Distance Ocean Motor Boat race from New York to Bermuda, to be held under the auspices of the Motor Boat Club of America and the Royal Bermuda Yacht Club, for the James Gordon Bennett Trophy have just been completed by the committee and are as follows:

Race.—To be from the station of the Motor Boat Club of America, on the Hudson River, New York City, to stake boat at Bermuda, placed by the Royal Bermuda Yacht Club.

Conditions.—Open to seaworthy motor boats of not less than 39 feet over all and not more than 60 feet over all. A seaworthy boat is a substantially-built, full-decked vessel, having motor power and living accommodations housed in and being equipped with all the tackles and appliances necessary to enable her to perform a long passage in open water.

Propelling Power.—Any form of internal combustion motor may be employed for propulsion purposes.

Fuel.—The committee comprehending that those entering the race have a thorough knowledge of the fuel necessary to make the passage, does not specify any quantity, but same must be sufficient to complete a distance of at least one and one-half times the distance between New York and Bermuda. No ingredient shall be used to increase the power of fuel.

Sails.—Boats must be equipped with suitable spars and rigging to carry sufficient sail to give them steerage way in a moderate breeze. This sail can be spread in any shape, but the total area of the canvas must not exceed 6 square feet for each foot of over all length. A steering sail and storm tri-sail may also be carried.

Stores and Water.—Stores and water sufficient for thirty days must be carried.

Crew.—No boat will be allowed to start with less than five men on board, one of whom shall be a practical navigator, one a practical engineer, and at least half of each crew must be amateurs. The committee earnestly recommends that no member of any crew shall be under 21 years of age, and that all members of the crew shall have had previous nautical experience.

Equipment.—A tender or life raft must be carried and a ring buoy or life jacket for each member of the crew. A full set of navigating instruments, a spare compass, sea anchor, oil bag and at least one gallon of crude petroleum or other oil, and fire extinguishers must be carried. Suitable arrangements for fitting an emergency tiller must be made. An assortment of spare parts and gear to the satisfaction of the committee must be carried.

Rating.—Will be calculated under the 1905 rules of the American Power Boat Association, except that the constant used in figuring the horse-power of the two-cycle motors shall be 850 instead of 750.

Time Allowance.—Shall be figured at 50 per cent of the American Power Boat Association time allowance table. The distance for computation for allowance to be on a basis of 650 miles.

Entries and Measurement.—Entries will be received up to twenty days before the start of the race, upon blanks which will be furnished by the Secretary of the Motor Boat Club of America, 314 Madison Avenue, New York City. All contestants must be measured by the club's measurer at least forty-eight hours before the start. An entrance fee of fifty dollars must accompany entry as a guarantee of good faith, same to be returned if boat starts.

Protests.—Protests covering the rating or eligibility of any boat must be made in writing within twenty-four hours after the finish of the race.

Inspection.—All contestants must report at the anchorage of the Motor Boat Club of America, or at such time and place as the Regatta Committee shall designate for the purpose of inspection and measurement.

Start.—The start shall be made from the station of the Motor Boat Club of America on Saturday, June 8, 1907, at 3 P. M.

The committee reserves the right to reject any entry if in their judgment the boat is unseaworthy or unsuitable for long distance racing, or is deficient in any particular. All entries will be accepted subject to inspection and approval by the regatta committee previous to the start.

The committee urges strict compliance with the letter and spirit of the conditions as above stated, and will be pleased at any time to inspect plans or boats under construction.

SCIENCE NOTES.

A remarkable collection of great archeological interest is to be disposed of in London. This comprises the extensive array of Egyptian curios collected by the well-known Egyptologist Mr. R. de Rustafjaell, and it is of a most complete description. The collection has been carefully classified and annotated and affords an informative and interesting history of this ancient country for a period of some 6,000 years, from the earliest time of the Egyptian nation 4,400 years B.C. to the present day. The pre-dynastic era is represented by an extensive array of flint implements; the dynastic period by sculpture, bronze, pottery, and fresco paintings; and the times nearer allied to the present by numerous personal ornaments, treasures, and trophies gathered from Egypt proper, the Sudan and surrounding tribes, including the famous praying board of the Mahdi found with the body of the Khalifa after the battle of Omdurman, and which is regarded with religious awe by the Dervishes, as it is popularly supposed to have been handed down to their chief through successive generations from the great Mahomed.

The technical professions now demand of their members for the higher planes of successful practise the same general educational preparation for professional study as that required by the best law and medical schools. Without entering into a discussion as to the relative merits of the educational work done by the small college and by that forming a subordinate member of the university, it is sufficient to say that this part of a well-rounded course of professional study harmonizes completely with the university system and is in fact an essential element of it. Both for technical efficiency, therefore, and for the broadest and best educational motives the technical school is bound to find its strongest development in an environment of universal study and investigation. The university has long since lost the character, if it ever properly had it, of a place where abstractions of learning, separated from the things which only give them life, are to be dispensed after the manner of instruction to men who are never to deal with the affairs of life. It has come to be an intensely practical working agent. It is effective and worthy of support only in so far as is makes itself felt in the real life of the community. If it is to be a true and real center of instruction it is imperative that it shall carry knowledge into every useful calling, governmental, corporate, or private. The time will soon come, if indeed it is not already reached, when it only can prepare men to administer and extend in a rational and moral way the great industrial activities which at the present time form the foundation of the material prosperity of the modern world.

OPENING OF THE NEW GRAND CENTRAL TEMPORARY STATION.

The opening of the temporary station, situated on the ground floor of the Grand Central Palace Building, corner of 43d Street and Lexington Avenue, in this city, occurred on Thursday, December 13.

From fifteen to sixteen additional tracks have been built in the large excavated area between 44th and 51st Streets, also between Fourth and Lexington Avenues, with a further sub-trackage of considerable dimensions. It was a novel sight to see the electric smokeless engines move about silently doing switching work. Owing to the delay in completion of signals, they will not run on the main line for a few days.

For the time being only the Harlem Division through and local trains will use the new depressed yard, which, it is thought will greatly simplify operations in the old yard. Ninety-seven trains daily will be accommodated on this division. The number of other trains run into and departing daily from the old station are one hundred and thirty-seven for the New York, New Haven & Hartford Railroad, and one hundred and twenty-six for the New York Central.