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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.

THE REUTERDAHL ATTACK ON OUR NAVY.

I.—WHO DESIGNED OUR NAVY? WAS THE SEA-GOING OFFICER IGNORED?

The present reply to the recent attack on the ships of our navy and the men who design them is, it is needless to say, in no sense inspired. It is written purely in the interests of truth, being based upon facts with which we have long been familiar, and most of which have appeared in earlier issues of the SCIENTIFIC AMERICAN; and it is devoid, of course, of any personal feeling. When Mr. Reuterdahl states that he is highly appreciative of the American navy, we believe him—and this in spite of the fact that, if all he alleges be true, the ships of that navy, under certain battle conditions, would be unable to fire their guns, and must promptly be sent to the bottom. Moreover, we are prepared to admit that some of the points in this article, and particularly those dealing with the bureau system and the scant encouragement shown to the American inventor, are well taken. But having made this reservation, we do not hesitate to say that, from first to last, the article is so full of technical errors regarding the ships themselves—errors which range from slight variations from the facts up to absolute misstatements—that, for any one who has an intimate knowledge of the material and methods of the navy, it carries its own direct refutation. But, unfortunately, of the thousands of American citizens who may have read this article, not one in ten thousand, probably, has any such knowledge of the facts; and hence it follows that no end of people, who have always taken a patriotic and very proper pride in our navy, must necessarily find their faith rudely shaken. Unfortunately, there have not been wanting certain officers of the line who have lent themselves freely to the questioning of the newspaper reporter, and have so far indorsed the general trend of the article, as to convey the impression that the whole of it is true; and this, in spite of the fact that they must know perfectly well that much of it is a gross exaggeration.

In the first place, then, let it be clearly understood that the present controversy is as old as the navy itself, and that many of the criticisms now made public have been urged over and over again; carefully debated; and action taken upon them in the secret, and very properly secret, deliberations of the Navy Department. It is the bold publication of the whole matter in an article whose inspiration seems to bear strong internal evidence of being semi-official, that has brought the subject so prominently and suddenly to the wide attention of the public. It is not our intention to enter, in the present issue, into any detailed refutation of the many misstatements made by Mr. Reuterdahl regarding the material, i.e., ships, guns, armor, etc., of our navy. This matter we shall take up in a succeeding article. What we wish to do here is to clear the ground, and put our readers in a position for judging the question more intelligently, by showing how it has become possible that there should be such an apparently wide divergence of opinion between the men who design our ships and the men who command and fight them. And let it be noted here, very carefully, that we speak of an *apparent* divergence of opinion; for we shall show that, so far from the sea-going officers having nothing whatever to say about what kind of vessels shall be built, they have been in the actual majority on the many boards that have determined the characteristics of our ships, *and on some questions have outvoted the constructors at the ratio of ten to one.* The Navy Department has been scrupulously careful to give them every opportunity to express their views, and, indeed, has been in the habit of sending out official letters inviting the most frank discussion and the freest offering of suggestions.

The designing of battleships and cruisers is without doubt one of the most complicated and difficult tasks in the world—so rapidly do new ideas become old, so swiftly do novel and revolutionary methods become popular. And the naval constructor would be more than human if, in the midst of these ever-changing standards and ideals, he should always succeed in building a ship that embodies only those elements which are bound to remain permanent in the years to come. At his best he is but human. He is no seer or prophet. At times he is bound to make mistakes; a fact which, as the official records show, he is perfectly willing to admit.

One serious fault and crying injustice in the whole of this discussion is the fact that the impression has been conveyed, and purposely conveyed, that the work of determining the characteristics of our warships is exclusively confined to the Bureau of Construction and Repair; that this bureau is a kind of "close corporation," extremely jealous of its prerogatives, and slow to accept any suggestions from the outside; and that it is peculiarly marked by that narrow range of outlook which is supposed to distinguish the purely technical, the "office" man, from the "practical" outside man. Now the merits of this question are necessarily of a nature which can be determined only by reference to the official records of the Navy Department; in which, fortunately, for this discussion, is to be found a full history of the deliberations which preceded the final choice of plans for the ships of our modern navy.

Who is it, then, that is responsible for the design of our warships, and what share, if any, had the sea-going officers in determining the characteristics of the ships which a certain clique among them now so freely condemn? There is a provision of the navy regulations by which the "general supervision over the designing, constructing, and equipping of new vessels for the navy" is delegated to what is known as the Board on Construction, which is composed of the chiefs of the four Bureaus of Equipment, Ordnance, Construction and Repair, and Steam Engineering, with an additional officer of the sea-going branch. The chiefs of the first two named bureaus are sea-going officers, and these two, with the additional officer above named, serve to place the sea-going element, as compared with the Construction Corps, in the proportion on this board of three to one. That does not look as though the constructive branch had any arbitrary control over the design of ships, or that sea-going officers were without adequate representation. Moreover, on the 1st of July, 1907, there were thirty-four sea-going officers serving as assistants in the Bureaus of Ordnance and Equipment, and on duty under the Bureau of Ordnance at the Washington navy yard. These thirty-four officers are thoroughly representative of the sea-going branch of the naval service, and are in close and constant touch with the chiefs of their respective bureaus; and advantage is taken of their wide practical knowledge in matters affecting the preparation of new designs. By this arrangement, the Board on Construction has the advantage of suggestions born of the practical knowledge of the sea-going officers, upon such features as magazine arrangements, ammunition stowage, coaling arrangements, and the location and method of installation of all mechanisms coming under the cognizance of the bureaus concerned.

Clear proof of the important part played by the sea-going officer in determining the military features of our ships will now be given in connection with the battleships which have been designed since the Spanish war; and just here, it will be well to draw attention to the fact that at the close of the war, and at the request of the Bureau of Construction and Repair, a special order was issued by the Secretary of the Navy to commanding officers of vessels, requesting that those who served during the war make reports as to the operation of their ships, specifying both the good points and the bad points, and suggesting any improvements which might be desirable. An analysis of the numerous reports submitted indicates that in the opinion of the sea-going officers of that period, such defects as existed were not of a serious character. The criticism was the result of the experience, under war conditions, of seventy-five officers; and they were so favorable as to lead the chief of the Bureau of Construction to state in his next annual report that *with regard to the strength, stability, seaworthiness, and maneuvering powers of the vessels of the various classes, the war experience tended to confirm the favorable opinions previously arrived at, and to demonstrate the general success of the designs.*

At the close of the war the three battleships of the "Illinois" class were in course of construction; and encouraged by the results of the war as indorsing the general system of construction, the plans of the new "Maine" class provided for vessels of the same general character as the "Illinois," but with more speed and greater displacement. Thus it will be seen that as far as the military features of the six battleships of the "Illinois" and "Maine" classes are concerned, *they were substantially indorsed by the specific reports of seventy-five officers who saw active service during the war, and that they were worked out by a board, the majority of whose members were sea-going officers.*

The SCIENTIFIC AMERICAN holds no brief for the Board on Construction; and we bring these facts before the public simply to correct the absolutely false impression that the determination of the leading features of our warships is restricted to a single bureau, and that it does not embody the rich and valuable experience of the sea-going officers of the line.

Following the "Maine" came the five ships of the "Virginia" class, whose otherwise admirable qualities are marred by the fact that they carry the double-deck turret—one of the most unfortunate mistakes ever committed in any navy. The double-deck turret was nothing new in our service. It was the design of a young ordnance officer which was enthusiastically taken up by the sea-going officers of the line, and, because of its *theoretical* advantages, became extremely popular. *It is on record in the files of the Navy Department that the naval constructors, to a man, bitterly opposed the introduction of this type of mounting, and it was installed upon the "Kentucky" and "Kearsarge" against their strong protest.* They opposed the turret on several grounds, among which were the following: That there was a lack of independent action of the 8-inch guns; that four guns of two different calibers on one single mounting would deliver a less volume and a less accurate fire than if the two types were separately mounted; that the great concentration of weight at the ends of the vessel and the enormous weight on the roller path were objectionable; that the efficiency of four important guns was dependent upon one controlling apparatus; and that the error of one gun pointer enters into four guns.

Unfortunately, after a bitter fight to keep it out of these five splendid ships, the influence of the sea-going officers was successful in incorporating the double turret. In the first plan for the "Virginia" class, the majority of the Board on Construction proposed an armament of four 12-inch guns in two turrets and eight 8-inch guns in four turrets, mounted amidships; but one sea-going member of the board dissented from the majority report, and recommended that four of the 8-inch guns be superposed upon the 12-inch turrets. This opened up the old controversy of the "Kearsarge" period, and in order to have the subject well thrashed out, the Navy Department made an addition to the original Board on Construction of eight additional sea-going line officers, thus forming a special board for the purpose. This board approved by a majority report the use of the superposed turret. Later, another special board was convened, consisting of the Board on Construction with the addition of two rear admirals and five captains; and, as a final result, ten out of the twelve members signed a majority report in favor of installing the superposed turret in the "Virginia" class. One rear admiral and the naval constructor signed a minority report. *In these two boards the ratio of sea-going officers to naval constructors was respectively ten to one and eleven to one, so that the superposed turret must ever be looked upon as the special protégé of the sea-going officer.*

The superposed turret, moreover, came very near being emplaced upon the "Connecticut" and the "Louisiana"; a minority report of the board which decided on their plans advocating an armament of four 8-inch guns superposed on the 12-inch turrets, and four 8-inch guns in broadside turrets. The final designs for these ships, from which the superposed turret was excluded, were adopted only after an extended discussion, in which the question of the battery arrangement alone was made the subject of report or suggestion by upward of eighty naval officers.

The designs for the following three ships, "Vermont," "Kansas," and "Minnesota," are practically identical with those of the "Connecticut," some slight changes being made in the distribution of the armor.

The faults of the two battleships "Idaho" and "Mississippi" are directly chargeable to the mischievous custom of Congress, by which it specifies the limits of displacement of the ships which it authorizes. This was put at the ridiculously low figure for a modern battleship of 13,000 tons, and on this limited displacement the board was requested to design, forsooth, "two first-class battleships carrying the heaviest armor and the most powerful ordnance of vessels of their class." Under the circumstances something had to be sacrificed. Four of the five members of the Board on Construction, including two of the three sea-going members, recommended a vessel with battery arrangement similar to that of the "Connecticut," but carrying four less 7-inch guns; with a lower freeboard aft; and having one knot less speed; submerged torpedo tubes

being also omitted. The Navy Department, before approving this report, invited an expression of opinion from nine officers of large experience in the navy, which was duly offered. In submitting its final report, the Board on Construction stated that the designs of these 13,000-ton ships did not "represent its opinion of what first-class battleships should be, nor what the United States navy should have."

The Naval Appropriation Act of March 9, 1905, authorized the construction of two 16,000-ton battleships, and the final plans of these vessels, which are now known as the "South Carolina" and "Michigan," embodied the all-big-gun idea. These ships were the first to embody an arrangement of turrets which, although it was subjected to much criticism at the time of its first publication, seems now likely to become the standard practice throughout the navies of the world. We refer to the method of mounting the eight 12-inch guns in four center-line turrets, so as to allow all of the guns to fire upon either broadside. This arrangement, like that of the emplacement of eight 8-inch guns in four turrets arranged quadrilaterally, as in the "Oregon," originated in the Bureau of Construction, and it bids fair to be a permanent feature in future battleships. The excellence of the design of these ships is beginning to meet with the approval which it merits; and we give the following quotation from a well-known *foreign* paper, which is devoted exclusively to naval matters: "Few, if any, ships are likely to be built in the future which cannot use all guns on either broadside. This may be taken as certain. America, in the 'South Carolina,' led the way in this direction, and the ship of the future is bound to be some improved variation of her.

There is some good reason to believe that, taking all things into consideration, the 'South Carolina' type is the best all-big-gun ship yet in hand."

The plans of the 20,000-ton battleships "Delaware" and "North Dakota" were unanimously approved by the Board on Construction, the majority of whose members are, as we have seen, sea-going officers. They were subsequently referred to and approved by a special board, the majority of whose members were sea-going officers, and finally were indorsed by special act of Congress.

It will be evident from the foregoing review of the *facts* regarding the responsibility for the design of our warships, as recorded in the files of the Navy Department, that the ships of our navy represent the accumulated experience and critical judgment, not merely of one bureau of the department, but of the very pick and flower of the personnel of the navy. Having fully established this fact, we shall, in our succeeding issue, take up seriatim the charges made by Mr. Reuterdahl against the material of the navy, and we shall show that though, in one or two cases, the charges are to the point, they are, as a general rule, grossly in error.

INAUGURATION OF ELECTRIC TRAINS UNDER THE HUDSON AND EAST RIVERS.

The year 1908 will be memorable for the beginning of subaqueous travel on a large scale between this city and Brooklyn and Hoboken, New Jersey, respectively under the East and Hudson Rivers, which for so long have only been traversed by the slow-going ferryboat, subject to delays of winds, fog, ice, and passing tows.

On Saturday afternoon, January 4, the first electric train, restricted to the officials and friends of the New York and New Jersey Railroad Company, made its first trip through the Hudson River tunnel from Hoboken, N. J., to the Christopher Street station, this city, a distance of two miles, in seven minutes. Under the river section a maximum speed of thirty-five miles an hour was attained. The new steel cars built for this service are provided with side and end doors, all pneumatically operated from one place in the car, which will facilitate the ingress and egress of passengers. The construction of this work was described in the SCIENTIFIC AMERICAN of March 26, 1904, and December 9, 1905. The tunnels connect with the subway now under construction under Sixth Avenue to 34th Street, and from Sixth Avenue east through Eighth Street to the present subway at Fourth Avenue and Eighth Street in this city. The president of the company carrying on this work is William G. McAdoo, who is also president of the company constructing the two tubes for suburban trolley lines under the Hudson River connecting Cortlandt Street, New York, with Jersey City.

Shortly after midnight on Wednesday, January 8, the Brooklyn extension of the Broadway Rapid Transit Subway passing under the South Ferry Subway station east at a 3.1 per cent down grade, by means of two separate tunnels under the East River and upward on the Brooklyn side through Joralemon Street (at which point the two separate tunnels merge into one) to Borough Hall, Brooklyn, located at the junction of Fulton Street with Joralemon Street, was opened by the first regular passenger train passing through from Broadway to Borough Hall station a few minutes before one A. M., January 9. There was a great celebration in Brooklyn over the event, many officials participating. Trains were run the rest of the night and all day on the 9th without any delays, to the great convenience of the Brooklynites. The average run from Borough Hall, Brooklyn, to the Battery station in New York was four minutes. From this station trains were run over the regular Subway *via* the Lenox Avenue route under the Harlem River to the terminus in the Bronx Borough. The time from Borough Hall, Brooklyn, to the Bronx Park terminus was 57 minutes. The distance is about 13½ miles.

It was found that the Brooklyn Bridge New York terminus was reached fifteen minutes earlier by the Subway than by the regular Brooklyn Elevated Railroad and Brooklyn Bridge route. On the first day some 27,000 passengers are reported to have been carried under the river. The diameter of each of the twin tunnels under the East River is fifteen and a half feet.

WHY NOT AN AMERICAN "SCIENTISTS' CORNER" IN THE CATHEDRAL OF ST. JOHN THE DIVINE?

The interment of the late Lord Kelvin in Westminster Abbey in a spot which the London Saturday Review, with some phonetic misgivings, designates as "Scientists' Corner," calls to mind the circumstance that we have made no similar provision in this country for cherishing the memory of the men who have substantially contributed to the advance of science. More than any other country in the world, the United States of America owes its eminence to the practical application of discoveries made in the laboratory of the physicist and the chemist and in the workshop of the electrician. We have produced poets and painters of distinction, but we are great among the nations of the world because of our achievements in engineering and science.

Any effort to pay to American *savans* a tribute as noble as that which fell to the lot of Lord Kelvin is at once met with the difficulty that we have as yet no edifice commensurate in dignity with Westminster Abbey. In England, the Church and the State are bound by ties centuries old, and the Abbey may accordingly be regarded as an ecclesiastical monument which admirably serves the purpose of both Church and State. Robbed of its old religious character, but no less commanding in respect is the Pantheon in Paris, which serves for the burial of noted French poets, statesmen, scientists and other men adjudged worthy of fame. With these eminent foreign examples before us, the want of any similar mausoleum in the United States is naturally felt.

Inasmuch as we seem to have no State building of sufficient majesty, not taxed to its utmost capacity by the affairs of the government, for the realization of any similar project, we turn to the larger churches. The only structure which seems at all fitting for the purpose is the Cathedral of St. John the Divine, now in course of tedious erection on one of the highest points, if it may not indeed be considered the acropolis, of New York city. Here we have a pile which by reason of its architectural importance and hugeness will ultimately compare favorably with the cathedrals of Europe, and which in ecclesiastical importance surpasses any building of its kind in this country. Surely a corner may well be set aside in the finished cathedral for the fitting burial of the scientific men who have elevated their country to its present position and whose memories the nation must surely desire to cherish.

The pilgrimage which will be made to such a spot will lose nothing in reverence compared with those which are now made to the Poets' Corner of Westminster Abbey. The epic thought that weaves into a splendid, all embracing system the falling of a pin and the wheeling of stars ineffably remote, is surely comparable with that of "Paradise Lost." In imaginative power the creative scientist yields nothing to the creative poet, and a journey to the grave of the one should be as devout as a pilgrimage to the tomb of the other, however different the two types of pilgrims may be.

THE USE OF GLASS FABRICS IN THE ELECTRICAL AND CHEMICAL INDUSTRIES.

In view of the very important part which glass has for a long time played in the electrical and allied industries, especially as an insulating material, it seems strange that glass wool, which is otherwise largely used, should hardly ever be employed in this connection. This is partly due to the scarcity of records on glass wool found in technical literature. An article on this subject by R. Lee was recently published in the Elektrotechnischer Anzeiger. The art of glass spinning was practised thousands of years ago in Egypt, but did not assume any importance until developed in Venice, when toward the end of the eighteenth century it spread as far as France and Bohemia. Glass spinners were then to be regularly seen as vagabond artists at the fairs of all countries. The art of glass spinning in its simplest form consists of rapidly attaching the end of a thin glass rod softened in the glass blower's lamp to a rotating disk, which draws it out to a thin thread. The diameter of the drum, which is running at a speed of 12 revolutions a second, being generally about 40 inches, the bobbin of the wound-up fabric will after being cut yield threads about 10 feet in length. Endeavors to obtain longer threads by unwinding the fabric were first made with some success toward the middle of the last century, when J. de Brunfaut designed a method of obtaining from a specially tough glass very fine threads, which would not break on being woven. The glass used by Brunfaut was made up of 68.93 parts of silica, 1.96 parts of alumina and iron oxide, 9.82 parts of lime, 0.49 part of magnesia, 14.13 parts of soda, and 3.92 parts of potash. These threads were used in connection with various kinds of fancy goods. Brunfaut, who may be said to be the author of the Bohemian glass spinning industry, further knew how to produce curled threads—glass wool and glass wadding—but kept this art a secret. His methods were improved by recent inventors, among whom should be mentioned the Brothers Weisskopf at Morchenstern, who first produced curled glass threads (glass wool and glass wadding) on a commercial scale. The chemical composition of the glass plays an important part in this connection. Glasses of different hardness, and accordingly different contractiveness, such as for instance a soft lead glass and a hard potash or soda glass, are melted simultaneously at a given ratio in the pointed flame of the blower, and this mixture is thrown on a rapidly-rotating wheel of rods. The thin thread thus produced, being made up of a juxtaposition of hard and soft glasses, is bound to curl on cooling. The fineness of these threads will be gaged from the fact that a glass-wool thread about 140 miles in length weighs only about one-third of an ounce. This glass wool, which as to its outward appearance perfectly resembles silk wadding, is a snowy white, and is such a bad conductor of heat as to produce by its simple touch a feeling of warmth. It is used to advantage against gout and rheumatism, and also for obtaining imitations of ostrich feathers or other ornaments. However, its most valuable application is for chemical and electrical purposes, glass being the best insulator for electrical conductors, in which respect it is far superior to silk, cotton, or India rubber. Glass wool and glass fabric have been used recently in producing a certain type of accumulators, in filling dry cells, and in manufacturing igniter accumulators for motor cars. It would afford a perfect material for insulating wires and cables; but at present it is too expensive to be used in this way, and the fact that glass threads are difficult to twist has been so far found another drawback. There are certain kinds of glass wool which will resist the action of a 20 per cent sulphuric acid solution, and similar wadding is used as filtering material. Glass-wool waste has been further used in insulating steam pipes; and as the manufacture of this article is now pushed very actively, its use will doubtless become far more widespread in the near future.

THE CURRENT SUPPLEMENT.

The modifications made in the materials used in the building of all kinds of machinery have, without doubt, been greater during the past few years than in any preceding period. This improvement, covering practically the entire field of metallurgy, is ably considered by E. F. Lake in the opening article of the current SUPPLEMENT, No. 1672. Injectors are regarded as trustworthy boiler feeders, but there are numerous points to be learned and remembered concerning their operation and care, neglect of which will usually result in their failure when they are most needed. These points are considered by W. H. Wakeman in an article on the operation and care of injectors. Prof. A. E. Watson's ninth installment of the series of papers on "Elements of Electrical Engineering" is published. Motors for traction purposes are discussed. The recently constructed electric mountain railway on the German frontier has been placed in operation between the Schlucht Passage and Muenster. The road is described and illustrated in an article by Frank C. Perkins. The effect of vanadium in steel is considered by E. T. Clarage. In almost all branches of the manufacture of victuals and palatable foods, sweets play a prominent part. The most important of these are considered in an exhaustive article. An excellent biography of Sir William Crookes, accompanied by a portrait, is published. The author is P. Zeeman, who is most competent to write upon the great British scientist, for the reason that he has experimented himself in the same field. "The Star Vault and the Moving Observer" is the title of a paper by Jacob B. Brown, in which are discussed certain appearances on the star vault which ensue upon certain changes in the position of the observer. The usual Engineering, Electrical, and Science Notes will be found in their accustomed places.

The French government has adopted a method of treating macadamized roads with hot coal tar thinned with about 10 per cent of oil. The cost is said to work out at about four-tenths of a penny per square yard.