SCIENTIFIC AMERICAN

NAVY SPECIAL

THE 42,000 MILE CRUISE

C. McKnight-Smith

SCIENTIFIC AMERICAN.

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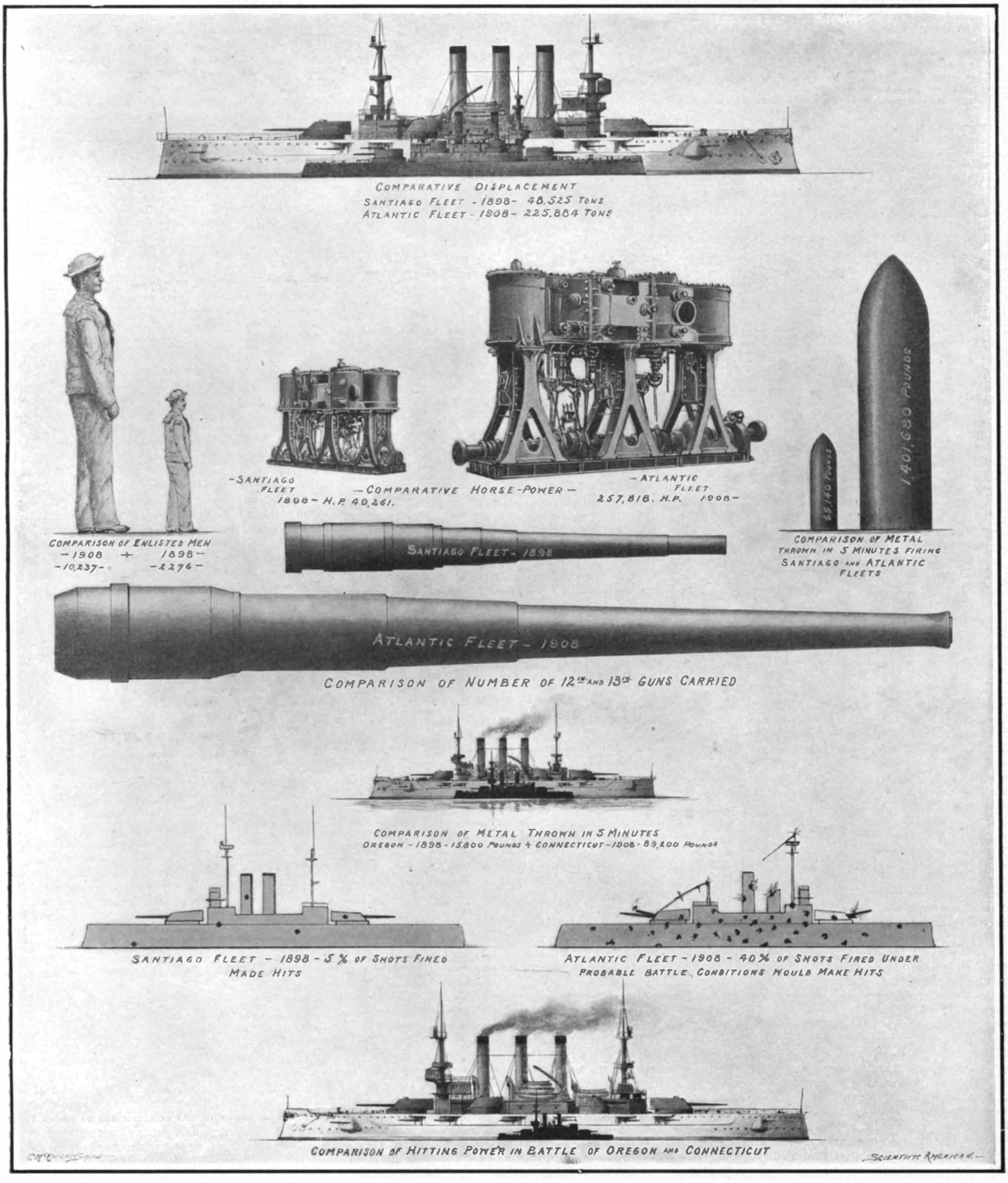

DIAGRAMMATIC COMPARISON OF THE SIZE AND POWER OF THE FLEET WHICH FOUGHT AT SANTIAGO IN 1898 WITH THAT OF THE ATLANTIC FLEET OF 1908, WHICH HAS RECENTLY CIRCLED THE GLOBE.—[See page 150.]

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NEW YORK, SATURDAY, FEBRUARY 20, 1909.

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.

LESSONS AND RESULTS OF THE BATTLESHIP CRUISE.

In view of the bitter criticism with which it was assailed, when the proposal to send a fleet of sixteen battleships from the Atlantic to the Pacific coast was first made public, the return of this same fleet to Hampton Roads after a 42,000-mile cruise around the world, with every ship in first-class shape and the *morale* of officers and men greatly improved, is a tribute to the far-sighted sagacity which projected the voyage.

It must be admitted, even by the most conservative, that the spectacle of this most imposing array of first-class fighting ships, steaming in perfect order and on schedule time from port to port across all the seven seas, has had the effect of raising the prestige of our navy in every quarter of the world. To those of us who keep in close touch with the development of naval construction, and are familiar with the pages of the naval annuals, the numbers and quality of the fighting ships of our navy and its relative strength, would be pretty well known, even if no opportunity were given to look at the ships themselves. But for the great world at large, diagrams and tabular comparisons give, after all, only a vague idea of what a fleet of modern battleships actually means. And, therefore, the presence of our ships in the leading ports of the world has afforded an object lesson as to the appearance, quality, and power of the fighting material of the American navy, which could have been obtained in no other way.

One of the most gratifying results of the cruise has been the enthusiastic and unmistakably friendly reception which was accorded at every port where the ships let go anchor. If any American imagined that the rapidly-increasing power and wealth of this country was regarded with suspicion, distrust, or active envy, surely the whole-hearted cordiality with which this concrete expression of our strength was everywhere received will effectually banish the idea from his mind. Our national policy of friendly isolation; of careful detachment from the entanglements of foreign alliances; has not been misinterpreted. It is significant, moreover, that the most splendid receptions of all were those accorded by the countries over which fly the British and Japanese flags; a fact that proves surely, if it proves anything at all, that keen naval and commercial rivalry need place no necessary embargo upon international amity and good will.

The fact that the fleet covered 42,000 miles without a breakdown of any consequence, and this, in spite of the fact that some very heavy gales of wind were encountered, should set at rest any doubt as to the quality of the machinery—a point upon which many fears were expressed at the outset of the cruise. Furthermore, the successful navigation of the fleet is a fine tribute to the ability of our officers to handle the largest ships in fleet formation, take them into and out of harbors of widely different character, and navigate them through seas and straits that require professional skill of the highest order when, as in this case, many ships are sailing the same course in close proximity to one another. Not a single ship has grounded or been in collision throughout the whole fourteen months of voyaging.

The ill-timed criticism made at the commencement of the cruise, to the effect that the time would be wasted and that the ships had much better be employed in regular practice cruises, maneuvers, and target practice, is shown to have been ill judged by the fact that, during the trip, the ships were constantly engaged in maneuvers and had lengthy target practice, and that during the latter, records were obtained which show the hitting power of our ships to be greater than at any period in their history. And just here it is fitting to say a word in praise of the enlisted men. Admiral Evans, in his recent autobiography, makes no effort to conceal his unbounded admiration for the American sailor; and he has repeatedly, during the last two or three years, stated his belief that man for man, our enlisted men are the equals, and in some respects the superiors, of any afloat. That his estimate is not too high is proved, surely, by the many tributes as to the fine appearance and behavior of our men, which have been freely given by government officials and the press in general at the various ports visited. In physique, education, intelligence, self-respect, and patriotism, the enlisted men of to-day stand at a higher level than ever before in the history of the American navy.

There is one fact brought out by the cruise, however, which must go far to offset the general satisfaction which must be felt at its successful completion. We refer to our great shortage of colliers, and to the fact that, had it not been for the foreign bottoms in which coal was shipped to the fleet at the various points of rendezvous, it would have been impossible for this voyage to have been made. It is not stretching a point too far to say that here we find the most important lesson of the whole cruise. Had war flamed out at the shortest notice, when our fleet was, let us say, on the coast of Australia, or at Suez, it would have been as helpless, and even more so, as a fleet of dismantled frigates in the days of sail power and the smooth-bore. With coal declared a contraband of war; with no colliers of our own available to carry the necessary fuel; our sixteen battleships, for all their tremendous fighting power, would have been as useless, as far as active operations on the high seas are concerned, as so many anchored, floating batteries. Undoubtedly, the greatest need of the navy to-day is a fleet of large and fairly fast colliers, built expressly for naval purposes.

Finally, the successful completion of the cruise must be considered as a sharp rebuke to those critics of our navy who, at the very hour that it was starting out from Hampton Roads, endeavored to persuade the people of America that these selfsame ships were poorly designed and defectively armored, and that in anything of a seaway the most important of their guns would be completely drowned out by the heavy water that would come aboard. None of these predicted troubles occurred. That the windward broadside batteries on the main deck would be washed with spray under certain conditions, such as did actually occur during the cruise, was fully expected; but this is a condition that obtains in the ships of every navy that carry broadside batteries on this deck. With this exception, our vessels have lived fully up to their designation as *seagoing* battleships; and the people of the United States may rest satisfied that ship for ship, gun for gun, they are the equals of any vessels of the same size and date in the navies of the world.

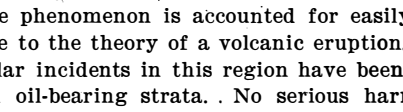
THE ELECTRIC POTENTIALITY OF FRUIT AND VEGETABLES.

In the course of some investigations in fruit and vegetable physiology an interesting discovery has been made by an English electrician. This is the conclusive fact that fruit, including nuts as well as grapes, apples or oranges, and vegetables are small secondary batteries or storage cells. True the degree of electric potential is slight, varying with the nature of the fruit or vegetable, but nevertheless a certain amount of electricity is stored within, the presence of which can be detected if a sufficiently delicate galvanometer is used.

The fact that the earth is always charged with negative and the air with positive electricity is well known, the charging of the earth being secured by water, which acts as the electrolyte. Familiarly in plant and vegetable life the electrolyte represented by the sap is in constant circulation so long as the soil conducts, and the cells of the plant become converted into small low-powered accumulators, there being at least one cell so charged by the earth and air in all representatives of the plant kingdom, whether tree, fruit, or vegetable. Moreover, this electric charge is retained, so perfect is the insulation by Nature, until the latter is either broken down by man or from the effects of decay which last named action serves to destroy the natural insulation between the positive and negative cells.

The process by which fruit becomes electrically charged is very simple. Negative electricity is supplied by the earth to the soil and the extent of such conductivity varies with the degree of moisture in the soil. Dry earth is a non-conductor, and this fact is strongly evident from the fact that unless the roots of the plant secure a certain percentage of moisture the plant dies. The moisture in the soil provides the sap which spreading upward flows to the uttermost extremities of the plant through the various arteries existing for such circulation. The leaves commence to burst forth, the buds becoming charged with negative electricity from the earth through the electrolyte. As the leaf expands it also becomes inductively charged with positive electricity from the air, as likewise do the flowers. When the fruit commences to form, however, nature provides an impermeable insulator represented by the rind or peel enveloping the fleshy portion of the fruit, but at the same time the negative charging continues from the earth to the seed center or core through the stalk, this central negative cell being insulated from the positive fleshy cell by a thin skin.

In order to test this thesis the experimenter secured a specially designed instrument of sufficient sensitiveness to record such an infinitesimal flow of electro-motive force as exists in the fruit. This constituted a Kelvin astatic galvanometer of 80,000 ohms resistance, in which the magnetic reflecting indicator is so light as to be suspended by the single thread of a spider's web. This instrument indicates the flow of current upon a special scale divided into millimeters. This scale may be represented by the following diagram:



When the negative terminal of a battery is attached to this instrument at the left-hand terminal the needle deflects to the right and *vice versa*.

The experimenter, instead of a battery, attached the stalk end of the apple which is the negative pole of the fruit, and the same effect was produced, but upon the lower end or positive pole being connected, the reverse deflection occurred. Such a reversal of sign could not occur merely by reversing the fruit if the action were due to chemical agency. Furthermore, such reversals were observed not to be momentary in character, but remained constant until the insulation was broken down or decomposition set in. In the course of his experiments with several types of fruit the investigator found the apple to be the most powerful cell, i. e., having the greatest degree of electric potential, while the orange was also found to be of large capacity. In this latter instance, and the peculiarity applies to all such fruits where the flesh is divided into separate sections, each alternate division is positively charged, the cells being insulated from one another by the skins inclosing each section. Such fruits therefore constitute in reality a combination of storage cells, additionally insulated by the rind or peel. In the case of the apple or pear the positive cell was found to comprise the fleshy portion, the core constituting the negative cell. By cutting such a fruit in half, the construction of the system may be plainly followed.

The experimenter is continuing his experiments in the same direction and many interesting developments respecting Nature's electric system, and the possible value of such from a dietetic point of view, are anticipated. In the case of vegetables the same peculiarity exists, although in a less pronounced degree, since the skins of many are very porous and consequently are not so efficient an insulator.

PSEUDO-VOLCANIC ERUPTIONS.

Recently reports were printed in various California newspapers to the effect that a volcano had burst forth in one of the canyons of the Santa Monica Mountains near Los Angeles. The point at which the pseudo-volcano broke out is about 200 yards from the Pacific Ocean and some twelve miles from the city of Los Angeles. Here sulphurous smoke rises from a little mound of Miocene shale and a few inches below the surface the ground is red-hot, charring or even setting fire to sticks thrust into it. But throughout this region oil-bearing shales are found near the surface and the soil is soaked with petroleum. The shale may have ignited spontaneously; lightning or a fire set by campers may have started the combustion. In any case the phenomenon is accounted for easily, without recourse to the theory of a volcanic eruption. Reports of similar incidents in this region have been traced to fires in oil-bearing strata. No serious harm has resulted from the fires, as the nearest oil-producing wells are at least ten miles away.

Recently there were accounts in some French papers of an eruption in an abandoned mine-shaft, and some years ago it was stated that there was an active crater on the top of an Alpine peak. The burning shaft produced a highly creditable imitation of an active volcano, great, heavy clouds of black smoke rising from it, and a fine, warm dust falling on the surrounding houses and fields, followed by flames and stones rained on the dwellings. The inhabitants in terror took flight; but an investigation proved that the pseudo-volcanic eruption had been caused by an explosion of fire-damp in the shaft. The basis for the story of an active volcano on the Alpine peak was a forest fire on a lower mountain.

AERONAUTICS.

A prize of $500 has been offered for a flight of one mile by an aeroplane above the beach at Daytona, Fla., on any day from March 23rd to 26th inclusive. These are the dates between which the automobile races occur, and every facility will be given aviators to test their machines.

A national grand prize balloon race has been organized to take place next June. The race will start from Indianapolis, Ind., June 5th. It is open to all pilot members of the Aero Club of America or affiliated clubs. Balloons of 2,200 cubic meters (77,693 cubic feet) capacity, or under, must be used, and entrants for this race will also be considered as competing for the Lahm trophy.

The danger which is likely to be met with when a balloon race is started near the sea, has again been emphasized by the finding of the body of Lieut. Foertsch, which was recovered in the North Sea, January 8th last. Both he and his companion lost their lives as the result of their balloon "Hergesell" descending in the sea in the distance race that started from Berlin last October.

Roy Knabenshue, the well-known aeronaut, has an agency for Curtiss motorcycles and aeroplanes in Los Angeles, Cal. In order to show the possibilities of the airship for dropping explosives, he recently made a night flight in his dirigible, and dropped dummy shells upon the city hall and other public buildings. The accuracy with which he frequently hit the mark was a rather startling demonstration of the possibilities in this direction.

Entries for the international balloon race for the Bennett trophy close on March 15th. The fourth contest for this trophy will start from Zurich, Switzerland, next October, it having finally been decided that the race last autumn was won by a Swiss balloon. The Aero Club of America is entitled to three entries, and it is to be hoped that these will be made, and that every effort will be exerted to again capture this trophy, which, it will be remembered, was first won by Lieut. Lahm in 1906.

Entries for the new Bennett aviation trophy, which was recently offered in France, close on March 1st. The course which has been decided upon for the first contest is around a circuit having a perimeter of from 5 to 10 kilometers (3 to 6 miles), the total distance to be accomplished being not less than 20 kilometers (12 miles) from start to finish. The machines will be allowed to alight and start again while making a circuit of the course. The Aero Club of America is entitled to three entries in this contest.

On February 9th a joint entertainment was held by the Automobile Club of America and the Aeronautic Society, in the club house of the former, in New York city. Representative Butler Ames, of Massachusetts, described a new and very interesting type of flying machine of his own invention. This machine consists of a number of short rectangular planes, placed at right angles to each other upon a longitudinal axis and separated by vertical disks. Two rods set at a slight dihedral angle, and each carrying a number of planes, were revolved by a gasoline motor of about 30 horse-power, and Mr. Ames claims to have gotten off the ground once or twice for a short distance. A model of his machine was tested by the towing apparatus in the naval towing tank at Washington, where it was found that while the lifting power increased as the square of the speed, the resistance increased only directly as the speed. The machine resembles a number of air paddles. It is quite peculiar in appearance, and is extremely simple.

At the same meeting Mr. Hudson Maxim made an address upon the backwardness of America as far as governmental recognition of aeronautics is concerned. He stated that instead of not allowing the $500,000 appropriation which recently failed to pass the House of Representatives, that body should have granted $5,000,000 for aeronautical purposes. He showed how the perfecting of the aeroplane and airship will bring about the necessity of the defense of all places by similar aerial craft. His address was a stirring one, and it was received with great enthusiasm. Moving pictures were afterward shown of Wilbur Wright, Farman, and Curtiss in flight on their aeroplanes, and anyone seeing these could not fail to be convinced that the age of aviation has arrived at last. Mr. M. O. Anthony demonstrated a new method of wireless control for airships. Both his sending and receiving antennæ consisted of two parallel rods suspended one above the other some 6 feet apart. By means of other special apparatus he was able to start, stop, or reverse a small electric fan run by a storage battery and located at the other side of the room. He already has a 20-foot dirigible operating successfully under wireless control, and a new one three times as large, at present being constructed by Leo Stevens, will be ready in the near future.

ELECTRICITY.

In the British House of Commons a member has asked the consideration of a regulation compelling electric cars, among other vehicles, to carry speedometers, that the public be safeguarded against reckless speeding and the motormen protected against the charge of exceeding the speed limit.

A company has been formed in Cologne to lay a submarine cable connecting Germany with her colonies. The first section will be laid this year, running from Borkum to Teneriffe. Thence the cable will run to Monrovia, Liberia, and from this point to Pernambuco. The entire length of the cable will be 7,000 miles.

The Indiana Legislature is taking steps to insure better seating capacity in its interurban cars. A bill has recently been introduced, which will require those passengers who are not provided with a seat to pay only half fare. In case the passenger offers a ticket, the conductor must give him a rebate check, which can be cashed at any ticket office.

The Bureau of the Census has just published a preliminary report on the telephone industry in continental United States, exclusive of Alaska. The number of lines and systems is given as 22,971, with a total single-wire mileage of 12,999,369. Over these wires it is estimated that during the year 1907, as many as 11,372,605,063 messages were delivered. The telephone industry gave employment to 143,721 men and women, and the salaries and wages totaled $68,279,127.

The employees of the Spokane and Inland Empire Electric Railroad Company are now given the opportunity of becoming stockholders in the company. Arrangements have been made with a trust company of Spokane, to furnish any officer or employee of the company with shares of preferred stock at the market price, with a five per cent commission, which is the only profit made by the trust company. The stock may be purchased by paying 15 per cent of the purchase price in cash, and the rest in payments over a period of not longer than five years. It is believed that this arrangement will be of benefit to the employer and employee as well, because it will encourage the latter to work for the mutual good.

The value of wireless telegraphy, in case of danger at sea, was so conclusively demonstrated during the recent accident to the "Republic," that Congress is now considering the question of requiring all vessels that engage in coastwise trade or that touch at ports of the United States, to be equipped with wireless telegraph apparatus. In discussing the bill which is now before Congress, Lieut. Sweet of the navy brought out some interesting facts about wireless telephony, as used in the battleship fleet. He states that conversations were held over a distance of 12 miles, although in some instances the apparatus failed to work satisfactorily. It has been recommended that vessels on the Great Lakes be permitted to use the wireless telephone instead of the telegraph, if they so desire.

Very few of us have any trouble in counting our coin by hand. In mints, however, in banking houses, in the offices of electric railways, and in many other establishments, vast quantities of coin have to be counted and packed daily. An electrical machine lately devised counts coins of any size from pennies to dollars, and wraps them at the rate of 420 per minute as long as the current is transmitted and the coins are fed into the hopper. An expert, while he is in good working order, can count and wrap fifty coins a minute; so it will be seen that the machine does the work of eight men. It takes one man to run the machine. His work consists in sorting the coins, picking out plugged pieces, blanks, and buttons, which in some cases seem to get mixed with good money. The machine receives the sorted coins at one end, and delivers them all smoothly rolled in bunches to suit and with the wrapper pasted. It is the invention of a man whose business it was to collect coins from slot machines and to sort, count, and bundle them.

During the earthquake and fire at San Francisco, the trolley poles in the city were badly bent. How to repair this damage proved quite a serious problem. It was considered impractical to take out the poles, straighten them, and then replace them, and the other alternative of tearing them up and putting in new poles involved too much expense. The problem was finally solved by straightening the poles without removing them from their positions. The method of doing this, as described in a recent issue of the Electrical Railway Journal, is quite interesting. The apparatus used consisted of a 10-foot section of railway rail and two U bolts, with wooden fulcrum block. The rail was fastened to the upper end of the pole on the convex side of the bend by means of one of the U bolts, the legs of which passed through the flanges of the rail. Just below this the fulcrum block was placed, and then the lower end of the rail was forced inward against the pole by turning the nuts on the second U bolt. The cost of straightening the poles averaged about $3.50 each, whereas if new poles had been used to replace the bent ones, the cost would have been $40 each.

SCIENCE.

Capt. Roald Amundsen's polar expedition is now assured, for the Storthing has voted him a subsidy of $18,000, necessary for the outfitting of Nansen's famous ship, the "Fram."

Under the new laws in effect in New York State, there are oculists, opticians, and optometrists. The optician seems to have lost importance, as the optometrist is one who ascertains and prescribes the character of the lens. The technical optician simply grinds the lens in accordance with directions from the optometrist and manufactures spectacles and eyeglasses. The oculist is a surgeon who treats the diseases of the eye.

The Navy Department, by its specifications for supplies to the fleet, has ranged itself against Dr. H. M. Wiley, chief of the Bureau of Chemistry of the Department of Agriculture, in his fight to prevent the use of benzoate of soda as a food preservative. In a specification issued on October 23rd last year for the supply of 600 gallons of tomato catsup, it is expressly stated that the only preservative to be used is benzoate of soda, and the proportions are left to be filled in by the firm bidding for the contract.

Prof. Florence has devised a new method of examining and photographing opaque microscopic objects. Applying this method to the examination of traces of blood on weapons, he was able to recognize distinctly red blood corpuscles which had escaped discovery by expert examiners. The method, which is susceptible of other than medico-legal applications, is characterized by the fact that the light by which the object is illuminated is admitted into the tube of the microscope, whence it is reflected by prisms to the object glass, which converges it upon the object.

In a system of construction laid before the 14th international hygienic congress, which met this year in Berlin, each story of a house projects from three to six feet beyond the story next above, and the width of the terraces thus formed is increased several feet by balconies. By this means every story is abundantly provided with light and air and also with an open space for outdoor recreation. The system is recommended especially for sanatoriums and dwellings for the poorer classes. As building material, reinforced concrete is indicated, for structural as well as hygienic reasons.

It is proposed to erect a monument in honor of Prof. E. J. Marey, who may be called the father of the moving picture. The cost of the monument is to be defrayed by international subscription. The International Association of the Marey Institute has already received the promise of many contributions from various countries. In France a committee, of which the minister of public instruction is the honorary president and M. Chareveau of the French Institute is the active president, has been formed for the purpose of soliciting and receiving contributions from the friends, admirers and former pupils of the deceased scientist. Contributions may be sent to M. Carvallo, Institut Marey, Boulogne-sur-Seine, or to the publishing firm of Masson et Cie., 120 Boulevard Saint-Germain, Paris.

The number of recognized asteroids is now 659, and it is not unlikely that 700 of these minute planets will soon be officially numbered and catalogued. Photography is reaping a rich harvest in this field, and hunting for asteroids is pursued almost as a sport by Metcalf, Palisa, Kopff, Lorenz, and other astronomers. At Arequipa, Peru, 17 known and 47 previously unknown asteroids were photographed between 1898 and 1901. It will be readily understood that the discrimination between known and unknown asteroids caught by photography entails long and arduous work, and it is not surprising that a long interval of time sometimes elapses between the making of the photographs and the definite enrollment of the asteroid as a new one or its identification with one already known. The swarm of little planets between the orbits of Mars and Jupiter is far from having been exhausted, and smaller and smaller members will be added with each improvement in methods and instruments.

Lunar rainbows are seldom observed in the temperate zone. Very likely the physical phenomenon occurs frequently but is invisible because of the faintness of the moon's light. On September 12th, 1908, an observer at Coxyde saw, to the northwest, over the sea, a band of light, striped horizontally but without perceptible color. The band moved slowly eastward and remained visible nearly all night. On the following day this observer learned that a lunar rainbow had been seen at the epoch of full moon, on September 10th. In the tropics, where moonlight is more intense, lunar rainbows are more frequently observed. They are by no means rare at Reunion Island. At all places the phenomenon is most frequently seen at full moon when the moon's light is highest, but it has been seen in various phases of the moon. It was first observed by Aristotle. A lunar rainbow is produced at full moon by the spray of the great Victoria Falls of the Yguassu, in Brazil.

COMPARATIVE STRENGTH OF THE NAVIES OF THE WORLD.

There are few tasks that have proved more puzzling to the statistician than that of arranging the navies of the world according to their comparative strength. For the term strength, as applied to naval and military *materiel*, is an elastic term, and the value of any tabular comparison will depend upon the basis upon which it is made. If the total number of units in a fleet be taken as the basis we shall get one order of rating; if the total displacement, we shall get another. If it be considered that the number and displacement of battleships is a true test of comparative strength, the standing of the navies will receive still another readjustment; while if what we ourselves consider to be the true test, that of all armored vessels, whether battleships or armored cruisers, be adopted, there will be yet another change of position.

Among the many comparisons that are made annually of the relative strength of the world's navies, one of the best is that compiled at the end of each year by the United States Navy Department. The data on which it is based are compiled from government documents, and probably afford the most correct information obtainable. The figures which follow show the number and displacement of warships, built and building, of 1,000 or more tons displacement, and of torpedo craft of more than 50 tons. From these figures are excluded all vessels that are over twenty years old, except in cases where they have been reconstructed and rearmed since the year 1900. The vessels that are authorized, but not yet actually begun, are also excluded; as are also all transports, colliers, repair ships, torpedo-depot ships, converted merchant vessels, and yachts.

Taking, then, everything, big and little, subject to the above exceptions, we find that the British navy still maintains its commanding lead, including, as it does, 482 ships of a total displacement of 1,871,176 tons. France comes second with 516 vessels with a total displacement of 801,188 tons. Third place is held by the United States, with 173 vessels and 770,468 tons displacement; followed by Germany with 222 ships of 693,599 tons, and Japan with 179 ships of 444,903 tons. It is interesting to note that, although France leads the United States in total displacement and total number of ships, the average size of the individual unit is just three times as great in the United States as it is in the French navy, being 4,460 tons in the former case, and 1,553 tons for the 516 ships of the French navy.

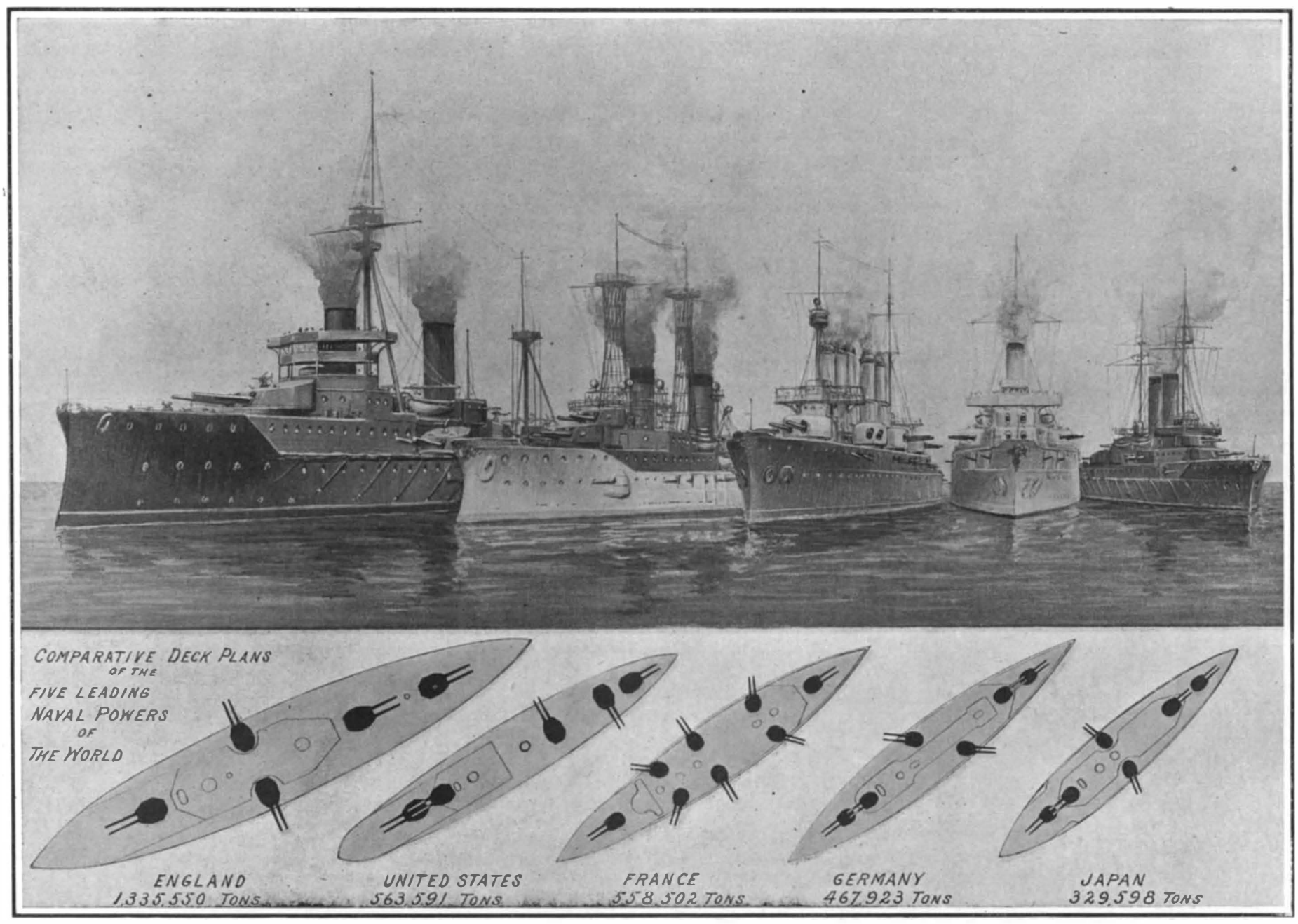
A most valuable quality in those officials who have charge of the planning and construction of the fighting material of a navy is the capacity to foretell, years ahead of its fulfillment, the trend of future developments; and it is to the possession of this quality by our Bureau of Construction, more than to the appropriations of Congress, that the United States owes its present strong position as the second naval power in the world. Many years ago we ceased building warships of the protected cruiser class, and began to put practically the whole of the displacement authorized by Congress into ships of the armored type, either armored cruisers or battleships. Pushing this policy still farther, after we had built a dozen armored cruisers, we ceased their construction altogether, and outside the building of a few scouts, torpedo boats, and submarines, have invested our displacement entirely in capital ships of the very first size and power.

As a consequence of this policy, in a comparison taking note only of armored vessels, that is, vessels whose sides at the waterline and for some distance above it and below it are protected by heavy armor, we find that Great Britain ranks first, with 76 armored ships of 1,335,550 tons total displacement. The United States is second with 41 ships of 563,591 tons displacement. France is third with 47 ships of 558,502 tons; followed by Germany with 38 ships and 467,923 tons, and Japan with 26 ships of 329,598 tons.

It may be objected that recent developments, especially since and including the Russo-Japanese war, have depreciated the value of the armored cruiser so greatly that the possession of a fleet of these ships should not be allowed to vitiate the value of a comparison of fighting strength, which can only be accurately made when battleships alone are included. Therefore, we submit herewith figures based on the number and displacement of battleships alone, in which it is found that Great Britain still heads the list with 58 vessels of 867,200 tons; followed by the United States with 29 ships of 406,146 tons; Germany, with 28 ships of 354,031 tons; France, with 24 ships totaling 337,520 tons; and Japan making a poor fifth with 191,498 tons.

It will be noticed, however, that we have preferred in the accompanying illustration of the comparative fighting strength of the navies, to base it upon the collective battleship and armored cruiser strength; for, although many of the armored cruisers, particularly in the French navy, carry armaments of comparatively small offensive power, the guns being few and of small caliber, it must be remembered, on the other hand, that many of the vessels included under the head of armored cruisers more strictly belong in the class of battleships, and this is particularly true of the British and German navies. The three armored cruisers of the "Indomitable" class, in the British navy, of 17,250 tons displacement, which are able to carry their batteries of eight 8-inch guns across the high seas at speeds of 25 knots and over, are surely more battleship than cruiser. The latest German armored cruisers, also, are 25-knot ships, carrying a battery of twelve 11-inch rifles. Japan also is entitled to call her latest armored cruisers battleship-cruisers, since they carry the 12-inch gun as their main armament. France, on the other hand, although she possesses twenty-three armored cruisers, whose total displacement is two-thirds of that of her battleships, does not possess a single vessel in the armored cruiser class that is entitled by virtue of its battery and protection to "lie in the line" against battleships and receive the hard knocks of a first-class engagement. Hence, although in total displacement of armored ships she exceeds Germany, strictly speaking she ought to take the fourth position, yielding the third place. Germany, on the other hand, includes among her battleships a large number of vessels which carry nothing heavier than a 9½-inch gun of rather low velocity, and these vessels go far to offset the advantage possessed by Germany in the number and power of the ships of the "Dreadnought" class which she now has under construction.

Attention is directed to the comparative deck plans of the five leading naval powers, as shown in the accompanying engraving. Each represents the type ship now being built by the various nations in the "Dreadnought" class; and, taken with the wash drawings of the ships as they appear afloat, they serve to convey a closely correct impression of these powerful fighting vessels. The British navy is represented by the "St. Vincent," one of a class of four. The length is 530 feet, beam 84 feet, displacement 19,250 tons, and the belt and 12-inch gun protection consist of 11 inches of Krupp armor. The armament consists of ten 12-inch



The deck plans show the number and disposition of guns on the latest ships of the "Dreadnought" type in each navy.

THE COMPARATIVE STRENGTH IN BATTLESHIPS AND ARMORED CRUISERS OF THE LEADING NAVIES OF THE WORLD.

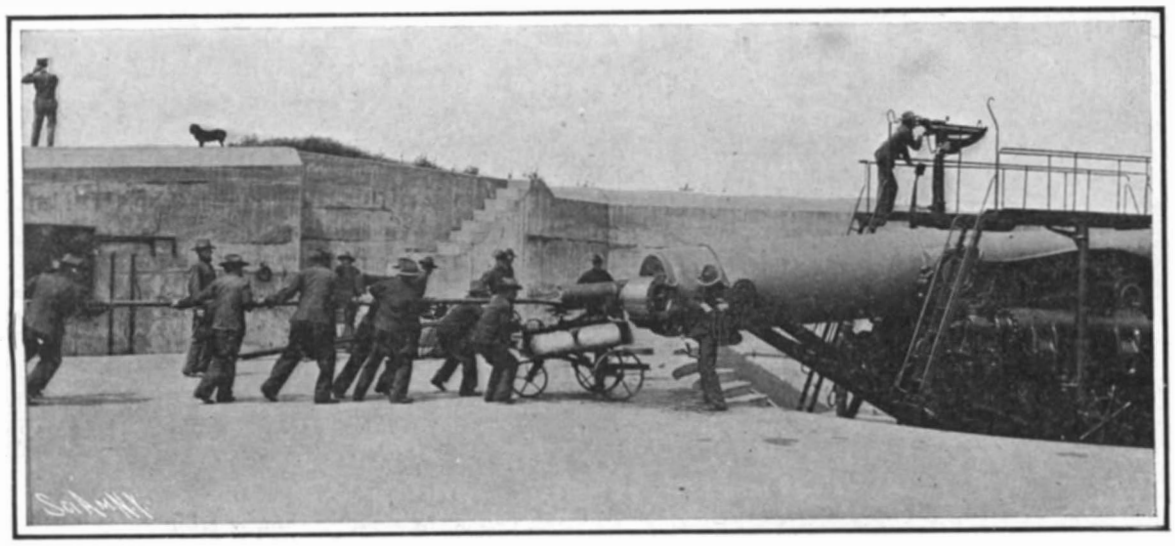
guns of 50 calibers length—a new piece with a velocity of 3,010 feet per second, and an energy of 54,200 foot tons. By placing two of the turrets amidships, one on each side of the superstructure, the end-on fire is increased at the expense of the broadside fire. Six 12-inch can be fired ahead, eight astern, and eight on each broadside. The forward pair are mounted on a lofty forecastle deck, and the wing guns and four after pairs of guns on the main deck, the forward of the two after pairs of guns being raised sufficiently to fire over the after pair. The "Florida" is the type ship of the American "Dreadnought." She is 518 feet long; 20,000 tons displacement; is protected by 11- to 12-inch armor, and mounts ten 45-caliber guns on the axis of the ship, so disposed that four can be fired ahead, four astern, and ten on each broadside. Her broadside fire is therefore 25 per cent greater than that of the "St. Vincent."

France is represented by the "Danton," 480 feet long; of 18,400 tons displacement; armed with four 12-inch 50-caliber guns, two forward and two aft, and twelve 9.4-inch 50-caliber guns mounted in turrets six on each broadside. The armor is from 10 to 12½ inches in thickness.

Germany is represented by the "Nassau," a 19,000-ton ship, 472 feet in length. If there was any mistake made in arming the earlier German battleships with too light a battery, no such criticism can be directed against this latest design. By mounting two of her turrets *en echelon* amidships, the Germans secure from their twelve heavy armor-piercing guns of 11-inch bore and 50 calibers length the heaviest broadside of any of the "Dreadnoughts"—the heaviest, at least, in the total number of large guns that it includes. At the same time, her end-on fire is also heavier than that of any other ship of the "Dreadnought" type. Two pairs of turrets are mounted forward, the guns of one firing over the other; two turrets are mounted similarly aft, with the result that the "Nassau" can deliver a fire of eight 11-inch guns ahead, eight astern, and twelve on each broadside.

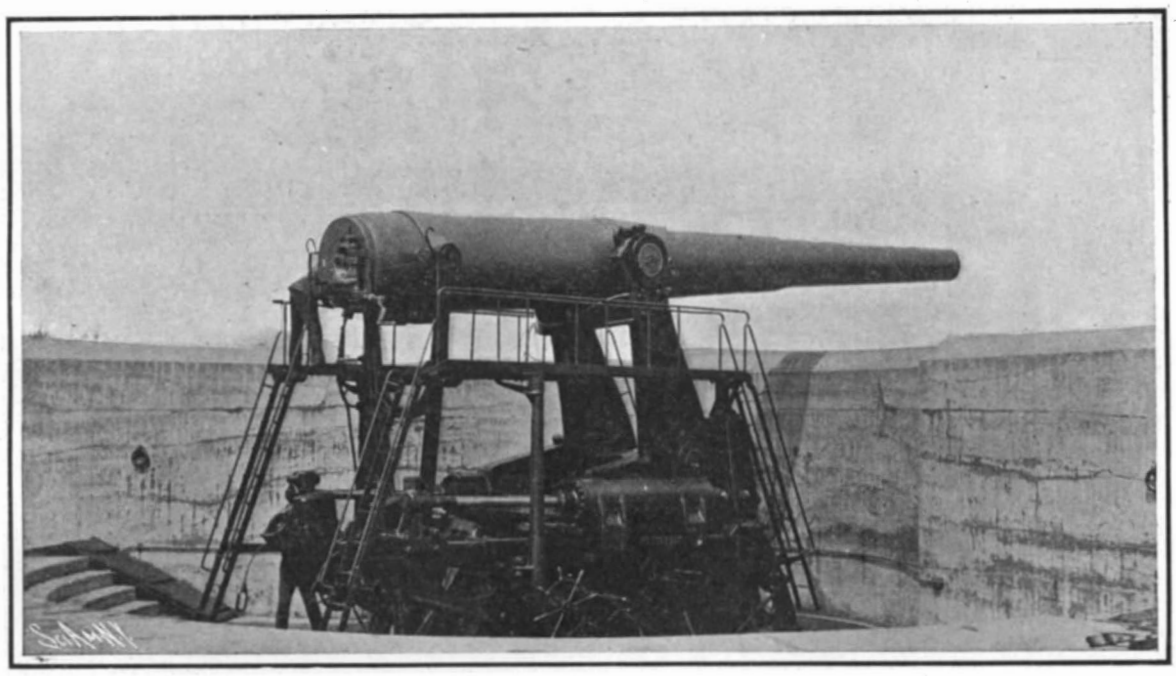
The Japanese are represented by a ship of about 21,000 tons displacement and 481 feet total length, carrying twelve 45-caliber 12-inch guns in six turrets, two forward and two aft, arranged as in our own "Florida," and two amidships, one on each broadside, the concentration of fire being eight ahead and eight astern, and ten on the broadside.

So much for a comparison of the fighting strength of the navies of the world based upon the total displacement of the battleships and armored cruisers. If the mere question of tonnage, or even of the number of guns carried and the thickness of the armor, alone determine fighting strength, the accompanying diagram would pretty closely represent conditions. But there is another element of strength, perhaps the most important of all, which might entirely alter the relative standing. We refer to the human element—the skill of the admirals and officers in strategy and tactics; the accuracy of the men behind the guns; the general *morale* of the whole fleet. Japan has recently proved her efficiency; and we know that in skill, discipline, and courage her navy apparently leaves little to be desired. The published reports of the target practice in the British navy and in our own would make it certain that the shooting of these two navies is of a very high order. In the United States navy, when the ships have been firing under battle conditions, the average of hits has risen, in the case of one ship, as high as eighty per cent, and the average for the Atlantic fleet is probably about sixty per cent. The results obtained on the recently completed voyage around the world would give us reason to believe that both the ships and the personnel have reached a point of excellence which is fully equal, and perhaps superior, to that of any other navy.

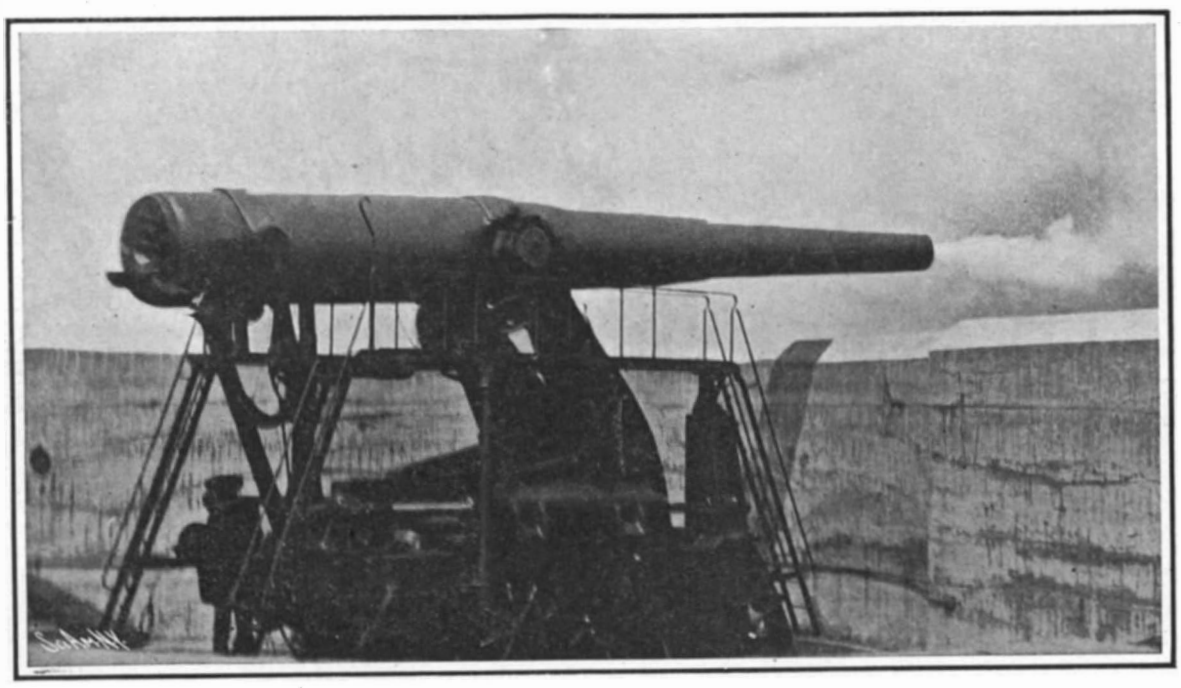


The gun is below the parapet, protected from the enemy's fire.

Loading a 12-inch coast-defense gun.



Loaded and elevated, ready to fire.



The recoil; gun swinging back and down to the loading position.

OUR SYSTEM OF SEACOAST FORTIFICATIONS.

The best system of defense of the seacoast of the United States is an adequate fleet of seagoing battleships, and the nearer this line of defense can be placed to the coastline of the enemy, the more secure from attack will be our own seaboard. If, however, a fleet of the enemy's battleships should arrive off our coast, after either meeting and destroying our own fleet, or skillfully eluding it, the defense of our maritime cities must depend upon fixed seacoast fortifications and their accessories. The present scheme for seacoast fortifications is outlined in the report of the National Coast Defense Board, under date of February 1st, 1906. The original scheme, as drawn up by a similar board, in 1886, has been practically completed, and our principal harbors and seacoast cities may be considered as well equipped for defense. The fortifications are equipped with batteries of 12-, 10-, 8-, 6-, 5-, 4.7-, and 3-inch guns. The heavy 12-inch and 10-inch guns are mainly relied upon to prevent the approach of the enemy through the channels and entrances defended. They are mounted upon heavy foundations of concrete, and protected in front by parapets of the same material and of great thickness, in front of which are deep sloping embankments of earth. The majority of the guns are mounted, similarly to the 12-inch gun which forms the subject of our illustration, upon what is known as the Buffington-Crozier disappearing gun carriage. In this mount the gun is pivoted at one end of a pair of massive levers, at the other end of which is suspended a weight which is sufficient, after the gun is loaded, to bring it into battery above the parapet. The gun is brought back and down to the loading position by the energy of the recoil. While in the loading position, it is entirely below the parapet, and both the gun and the gun detachment are fully protected from direct fire. The ammunition is kept in massive concrete ammunition rooms, from which it is wheeled on a truck, as required, up to the open breech of the gun, and loaded into the powder chamber. The sighting of the gun is done while it is in the depressed position. At the word of command a catch is released, and the heavy counterweights bring the gun into battery above the parapets. This disappearing mount is used for the 12-, 10-, and 8-inch guns.

Our latest 12-inch coast defense gun has an initial velocity of 2,550 feet per second, and a muzzle energy of 47,299 foot tons. If it strikes a normal blow (a blow at right angles to the plate) it can penetrate the 12-inch armor of battleships at 8,700 yards, and the 7-inch armor of armored cruisers at all practicable fighting ranges. To obtain this energy, it is necessary to use such a high pressure in the powder chamber that the corresponding high temperature and high velocity of the gases burns and abrades away the interior of the gun, shortening its life to such an extent that, after sixty rounds, it loses its accuracy. With a view to preventing this rapid deterioration, the Board of Ordnance have decided to build a bigger gun, firing a heavier projectile with a lower powder pressure, thus

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Gray Stain for Ivory.—Lay the parts in a solution of 1 part of pyrogallic acid in 20 parts of water, for about 20 minutes, allow them to dry thoroughly, then immerse in a solution of 1 part of green vitriol in 25 parts of water.

reducing the temperature of the gases and the consequent erosion. A 14-inch caliber has been adopted, and several guns are being built. The new 14-inch gun will fire a projectile of 1,660 pounds, with a muzzle velocity of 2,150 feet per second. It will have about the same penetrating power at 8,700 yards as the 12-inch gun; and it will carry a bursting charge of high explosive over fifty per cent greater than that of the 12-inch projectile. Because of its shorter length, its weight, 49.5 tons, will be about the same as that of the 12-inch gun.

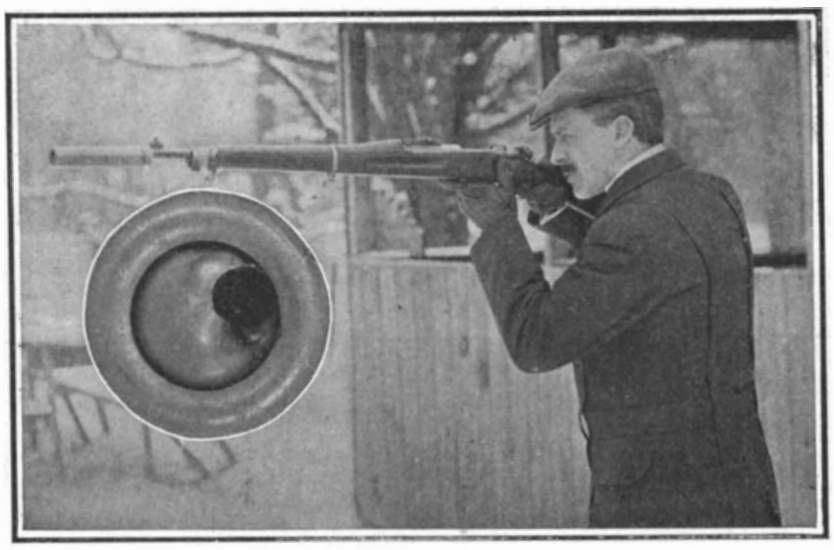
There are several objections to the 14-inch gun. In the first place, the rate of fire will be necessarily much slower than that of the 12-inch. Another objection is that the trajectory, or curve of flight, of the projectile is not nearly so flat as that of the 12-inch gun, and, therefore, the danger space, in which the enemy is liable to be hit, is less. On the other hand, instead of losing its accuracy after firing sixty rounds, the 14-inch gun would fire 245 rounds before deterioration set in. The original plan for arming our coast defenses included a large number of 16-inch guns. Only one of these, however, has been built. It is at present at Sandy Hook, where it underwent its trial successfully, but we believe it has not as yet been mounted in any permanent emplacement. This huge gun, the most powerful in the world, weighs 74 tons, and fires a 2,400-pound projectile with a muzzle energy of 77,000 foot tons, and a remaining energy at 8,000 yards of 40,540 foot tons. Its rate of fire is thirty rounds per hour, and it will lose its accuracy after 175 rounds. The gun cost nearly $200,000. It is too costly, and its rate of fire too slow, to make it a suitable weapon of defense against modern 50-caliber 13½- and 14-inch guns, such as are now being contemplated by foreign navies, whose striking energy will be not very much less at ordinary fighting ranges, and whose rate of fire will be at least four times greater. Hence, we are not likely to build any more 16-inch guns.

Although the heavy guns mainly will be depended upon to prevent the approach of the enemy, there will be two auxiliary elements, the submarine boat and the submarine mine, which, in our opinion, will be even greater deterrents in keeping the enemy well off-shore. The submarine is no longer an experiment, at least for sea-coast defense. An enemy's fleet attempting to enter, let us say, New York harbor, must be prepared, at any time after it has passed the three-mile limit, to receive the blow of the torpedo, delivered by an unseen and practically undetectable enemy. Should the fleet evade the submarines, at a distance of five miles it would come within range of the 10-, 12-, and 14-inch guns, and, because of the wonderful accuracy of modern range finders, these guns would be laid with deadly accuracy. Should the attacking fleet, however, pass without mortal injury through this five-mile zone of armor-piercing fire directed upon it from Sandy Hook, and through another five miles of fire of triple intensity, rained upon it from the combined batteries of Sandy Hook, Fort Wadsworth, and Fort Hamilton, it would have to pass through one or more fields of submarine mines laid in the manner described and illustrated in our issue of January 23rd, 1909.

Now, a modern battleship costs from $8,000,000 to $10,000,000, and it might take but one blow by gun, torpedo, or mine to so cripple the ship as to place it at the mercy of the coast defenses. Moreover, the bombardment of cities will prove merely a strong irritant, and can never exercise a conclusive effect in determining the issues of a war. It is very unlikely that the costly battleships of the future will engage seacoast fortifications—certainly they will never risk the enormous losses involved in forcing an entrance through well-defended harbors such as those of New York, Boston, or San Francisco.

THE SILENT GUN.—COUNTERPART OF SMOKELESS POWDER.

The public demonstration by the inventor, Mr. Hiram Percy Maxim, of his silent gun introduces a weapon which is destined to affect the conduct of military operations of the future in much the same way, and to almost the same degree, as did the introduction of smokeless powder. For many years past the military authorities have been devising ways and means for rendering the presence and movement of troops invisible. The first successful step in this direction was the introduction of smokeless powder, and this was followed up by a careful study of the uniform and equipments, in the effort to secure those colors which would blend most completely with the surrounding landscape, and render the presence or movement of troops difficult of detection. Smokeless powder and earth-brown khaki suits have done wonders in this direction. So perfect is the concealment, that, were it not for the rattle of the discharge of musketry, it would be well-nigh impossible definitely to locate the positions of a line of skirmishers, or even of a large body of troops taking advantage of natural cover. In determining the position of the enemy and strength of the attacking force, the leader of a body of troops is dependent almost entirely upon the sound of the enemy's rifles. In reading descriptions of battles, either by war correspondents or as contained in official reports, one frequently comes across such a phrase as this: "There was a sound of heavy firing on our right." If the sound of discharge could be eliminated, the principle of concealment would be worked out to theoretically perfect conditions; for it would be possible for an attacking force to deliver its fire, without the enemy having the slightest idea as to the range or direction from which it was delivered, or the strength of the force engaged.



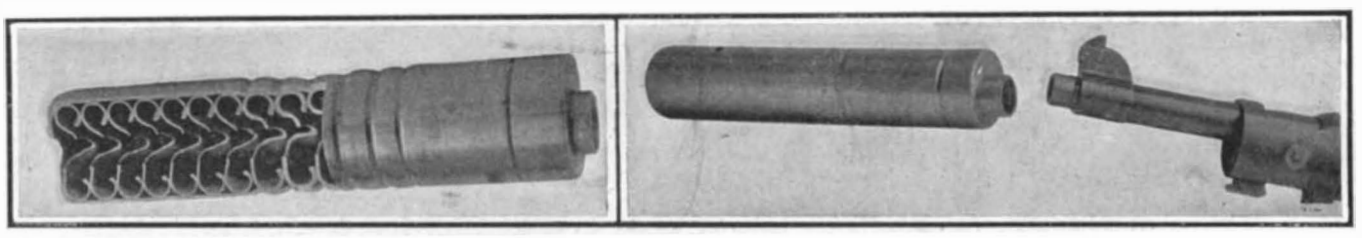
Front view of a disk.

A military rifle with silencer attached.

The recent public demonstration made before a party of invited guests, including a representative of the Scientific American, occurred in an office building in this city, where a temporary shooting range, about 15 feet in length, had been erected, at the far end of which was a box of sand to receive the bullets. For the purposes of the test, a dozen modern rifles of high power, in which were included the best-known military rifles of Europe and America, had been provided, and from each of these a couple of shots were fired—one without the silencer, and the other with it attached.

The silencer is a small sheet-steel tube, 1½ inches in diameter, and from 4 to 6 inches in length according to the gun to which it is attached. For a .22-caliber rifle, it is about 4 inches long, and for a .30-30 rifle it is 6 inches long. The weight varies from 6 to 9 ounces. The silencer is attached by pushing it home on the barrel, and giving it a quick three-quarter turn to engage the threads. The report of a rifle is due to the sudden liberation of the powder gases, which occurs immediately after the base of the bullet has left the muzzle. The gases, rushing out, expand into mushroom form, and their impact on the air causes the characteristic sound of a swiftly-delivered blow. The object of the silencer is to arrest these gases; change their forward direction into a rotary one; slow down their velocity; and allow them to pass out through the air so gradually as to produce a but slightly audible sound. The principle upon which this is done was illustrated in a very homely way by the inventor, when he likened it to the effect produced when the stopper is taken out of a basin full of water, and a swift rotary motion is imparted to the contents, when the centrifugal force holds the water against the sides of the basin. As the rotary motion decreases, the water begins to descend and flow through the plug hole, the basin being slowly emptied. In the silencer, the gases are caught upon a series of spiral vanes, where their motion is turned from a rectilinear to a circular one. After the velocity is decreased, they flow out gently and without sound.

The construction of the silencer is shown very clearly in the half-sectional view, and in the photograph of one of what might be called the small turbine elements. Each of the latter consists of a sheet-steel disk, having a hole near the center slightly larger than the bullet, and with its outer edge turned over, so as to form an annular path in which the gases rotate. The inventor describes the action of the device as being practically the reverse of that of a turbine engine. In a turbine-driven engine the gases advance in an approximately rectilinear line, parallel with the axis of the turbine; and their effect is to make the bucket wheel revolve. In the silencer the bucket wheel or rotary blades are held fast, and as a result the steam, or gases, as in this case, are given the rotary motion. The central holes in the disks are all aligned perfectly with the axis of the rifle; and, as they are slightly larger in diameter than the bullet, the latter passes through them without being in any degree affected as to its velocity or accuracy. The gases, as explained above, are caught in the successive disks; their motion is changed from a rectilinear to a circular or spiral one, and their velocity is gradually reduced to a point at which they fail to make any audible concussion on leaving the silencer. In the demonstration referred to, the audible sound was mainly that produced by the impact of the bullet in the bed of sand and the click of the firing mechanism. In tests which had previously been made by the army authorities, observers standing several hundred yards away from the gun were able to hear only the ripping sound of the bullet as it cut its path through the air, and the blow as it struck the target.



Half sectional view, showing the method of assembling the spiraled disks.

The silencer ready for screwing on to the threaded end of barrel.

THE SILENT GUN.—COUNTERPART OF SMOKELESS POWDER.

SANTIAGO AND ATLANTIC FLEETS COMPARED.

It is probable that few people, outside of the navy, appreciate the astonishing growth which has taken place in the fighting power of our ships during the ten years intervening since the Spanish war.

We can vividly recall the profound impression of the destructive power of our little fleet of battleships under Admirals Sampson and Schley, which we all felt on reading the dispatches of July 4th, 1898, announcing that in a few brief hours their guns had completely annihilated the ships of Cervera's squadron, setting them on fire; driving them ashore, or, as in the case of the torpedo boats, quickly sending them to the bottom. In the present hour, when the Atlantic fleet of sixteen battleships have returned intact to a home port after a voyage of 42,000 miles around the world, it is opportune to compare this armada with that which made the eventful voyage to the south coast of Cuba to find and destroy the fleet of the enemy.

To state that in the fleet of 1908-9 there are sixteen battleships as compared with the five which we were able to muster off the south coast of Cuba, is to merely lay the foundation for our comparison. In the intervening period there has been a steady increase in the size of the battleship, until the largest unit, represented by the flagship "Connecticut," is over fifty per cent heavier than the "Oregon," our most powerful fighting ship in 1898. The Santiago fleet consisted of five battleships: the "Oregon" class, of 10,288 tons displacement; the "Iowa," of 11,410 tons; and the "Texas," of 6,300 tons. The total displacement of the fleet was 48,525 tons. The Atlantic fleet as it steamed into Hampton Roads consisted of five battleships of the "Connecticut" class, each of 16,000 tons; five of the "Virginia" class, of 14,948 tons; two of the "Ohio" class, of 12,500 tons; two of the "Alabama" class, 11,552 tons; and the "Kearsarge" and "Kentucky," of 11,500 tons; the total displacement of the fleet being 225,884 tons. In displacement, then, the Atlantic fleet is four and three-quarter times that of the fleet that fought at Santiago.

Mere size, however, is of little value, unless it is taken in connection with other elements of efficiency; and the first among these that we will consider are those of horse-power and speed. The "Oregon" class were designed for 9,000 horse-power and 17 knots speed; the "Iowa," for 11,000 horse-power and 16.5 knots; the "Texas," for 8,000 horse-power and 17 knots

speed. At the time of the Santiago engagement, these ships were good for from 15 to 15½ knots with clean bottoms, and the total horse-power of the fleet was about 50,000. When we come to consider the Atlantic fleet, there is a marked increase in speed and power. The five ships of the "Connecticut" class, designed for 16,500 horse-power and 18 knots, developed, on trial, from 19,000 to 20,000 horse-power, and speeds of from 18.3 to 18.8 knots. The five ships of the "Virginia" class developed from 20,000 to 24,500 horse-power, and all steamed at over 19 knots on trial. The "Maine" and "Missouri" made over 18½ knots for 16,000 horse-power; the "Illinois" and "Wisconsin," 16.2 and 17.2 knots for 11,000 and 12,300 horse-power; and the "Kearsarge" and "Kentucky" made 16.8 and 16.9 knots with 11,788 and 12,179 horse-power. The total horse-power of the whole fleet, as developed on trial, was 258,000, as against 50,000 developed on trial by the Santiago fleet. This is an increase of 500 per cent in power. There is no corresponding increase in the cruising speed of the fleet as a whole, since it is governed by the speed of the slower ships of the "Alabama" and "Kearsarge" class, whose sea speed is probably not much better than that of the Santiago fleet. The ten ships of the "Connecticut" and "Virginia" class, however, have a sea speed two to three knots greater.

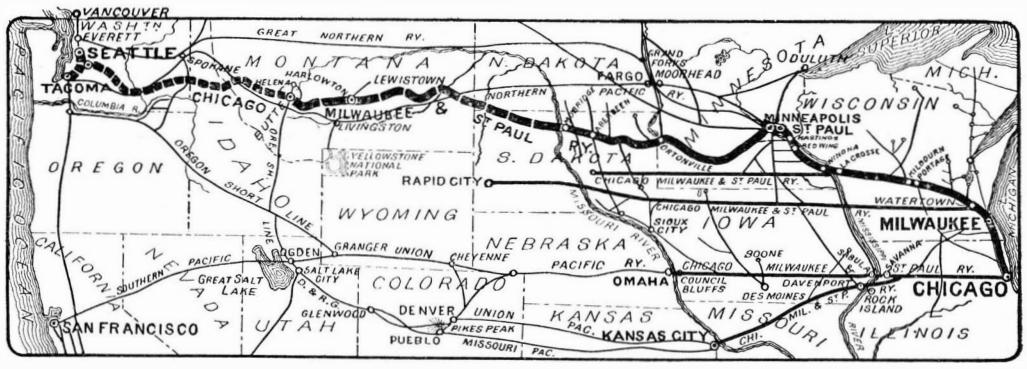
In a comparison of the crews of the two fleets, there is the same increase of from 450 to 500 per cent. The total number of officers and men in the Santiago fleet, if they contained the regular complement, was 2,276, and in the battleships of the Atlantic fleet, it is about 10,237. It is probable, however, that the crews were temporarily increased during the Spanish-American war, and we know that large numbers of extra men were carried on the cruise around the world.

Equally impressive are the two diagrams in the accompanying drawing, showing the relative power in the number of heavy armor-piercing guns of 12- and 13-inch bore. In the Santiago fleet there were mounted twelve 13-inch guns and six 12-inch. The Atlantic fleet mounted altogether sixty-four 12-inch guns. It should be noted, however, that the above comparison is based merely upon numbers, and takes no account of the enormous increase, both in the rapidity of fire, and in the striking energy of each projectile as it left the gun. To get an accurate idea of the comparative weight of metal thrown by the two fleets in a given time, we must turn to the diagram showing, by the outlines of the two projectiles, the comparative amount of metal which could be thrown from the broadsides of the two fleets, during five minutes of an engagement. The enormous difference is explained by the fact that improved methods of mounting the guns, improved ammunition hoists, breech mechanism, rammers, etc., have increased the rapidity of fire about five times, so that for every single shot delivered from a 12-inch gun in 1898, the crew of a 12-inch gun on the Atlantic fleet can deliver five shots. There has been a similar increase in the rapidity of the smaller guns, and the result is shown in the total metal delivered, which in five minutes' firing by the Santiago fleet would amount to only 69,140 pounds, as against 1,401,680 pounds, which could be delivered in the same time from the broadsides of the Atlantic fleet, an increase of 2,000 per cent.

But this is not all; for not only has there been an increase in the rapidity of fire, but the energy of a given weight of metal thrown has also been greatly increased. In the intervening ten years there has been a great improvement both in the powder and the guns. The old brown powder has given way to smokeless powder, and the length of the guns has been increased from 30 and 35 calibers to 40 and 45. The smokeless powder, giving off greater volumes of gas, exerts its accelerating pressure upon the base of the projectile through a greater length of bore, and the energy imparted, which varies as the square of the velocity, has risen, in the case of the 12-inch gun, from 25,985 foot-tons to 44,000 foot-tons. Applying these results to the two fleets, we find that in five minutes' firing with all guns on one broadside, the metal delivered by the Santiago fleet would have a total energy of 2,146,738 foot-tons, whereas the total energy of five minutes' broadside from the Atlantic fleet would be over thirty times as great, or 66,328,910 foot-tons.

But it is not the amount of metal that leaves the muzzles of the guns that determines the issue of a sea fight, but rather the amount of it that lands on the enemy—"it is the hits that count." Therefore, we will now substitute two individual ships for the two fleets, and compare the actual ability to inflict damage on the enemy of the "Oregon" of 1898 and the flagship "Connecticut" of 1908. The "Oregon" in five minutes' firing from all the guns which she could train on one broadside was capable of hurling at the enemy 15,800 pounds of metal. In the same time the "Connecticut," from her 12-, 8-, 7-, and 3-inch guns could deliver 89,200 pounds of metal. After the battle of Santiago our ordnance officers made a count of the number of hits on the sunken Spanish ships. Comparing this with the number of shots fired, which, of course, was known for each of our vessels, it was found that only two per cent got home on the enemy. It is generally believed, however, that more hits than this were made. Many of the shot holes being below water could not be counted; many shots must have entered previous shot holes; and additional hits were probably made upon portions of the vessel which were subsequently blown bodily away. Let us then assume that the average of hits at Santiago was five per cent, as shown in the accompanying left-hand diagram representing a modern battleship. In our latest target practice, conducted as nearly as possible under battle conditions, the average efficiency of the ships of the Atlantic fleet is sixty per cent of hits. But in an actual engagement the shells of the enemy would be getting home upon our own ships, and therefore, to a certain extent, disturbing the aim of our gunners. On the other hand, there would be no smoke, as at Santiago, to hide the enemy. We have therefore cut down the average to forty, and represented in the right-hand drawing the same modern battleship as she would appear after the first five minutes of an engagement with the "Connecticut." Applying this comparison of accuracy to the diagram showing by the size of the ships the relative amount of metal thrown, we find that the "Connecticut" from being over five and a half times as large must be represented, as in the lowest diagram, by a ship forty-five times as large as the "Oregon"; or, to put it in other words, the "Connecticut," during a five minutes' engagement with the "Oregon," would land forty-five times as much metal on the "Oregon" as the "Oregon" would land on the "Connecticut." Furthermore, this preponderance is yet further increased by the fact that the relative energy of this metal, as thrown, is, shell for shell, from 30 to 40 per cent greater in the case of the "Connecticut."

This brings us face to face with the astonishing fact that the "Connecticut" of 1908 would be probably more than a match for the whole Santiago fleet of 1898. Having an advantage of three knots in speed and of the greater range and accuracy of her high-velocity guns, she could maintain a position beyond the effective hitting range of the older ships, and cripple or sink them in detail.



Map showing the extension of the Chicago, Milwaukee & St. Paul Railway from the Missouri to the Pacific coast.

Steam shovel work at Lock Bluffs, Montana.

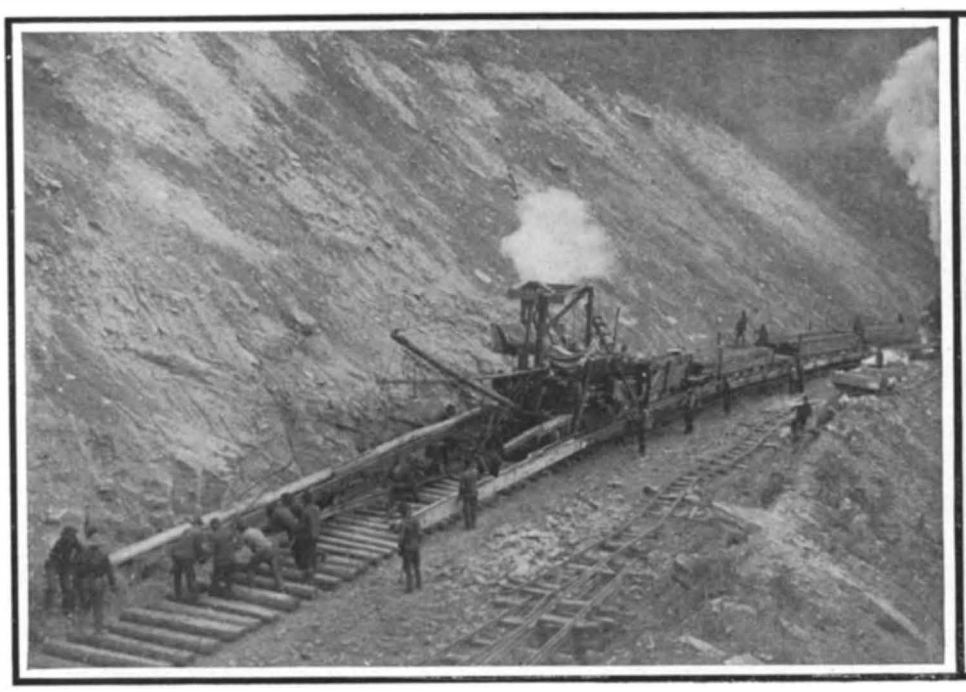
THE EXTENSION OF THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY TO THE PACIFIC COAST.

THE EXTENSION OF THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY TO THE PACIFIC COAST.

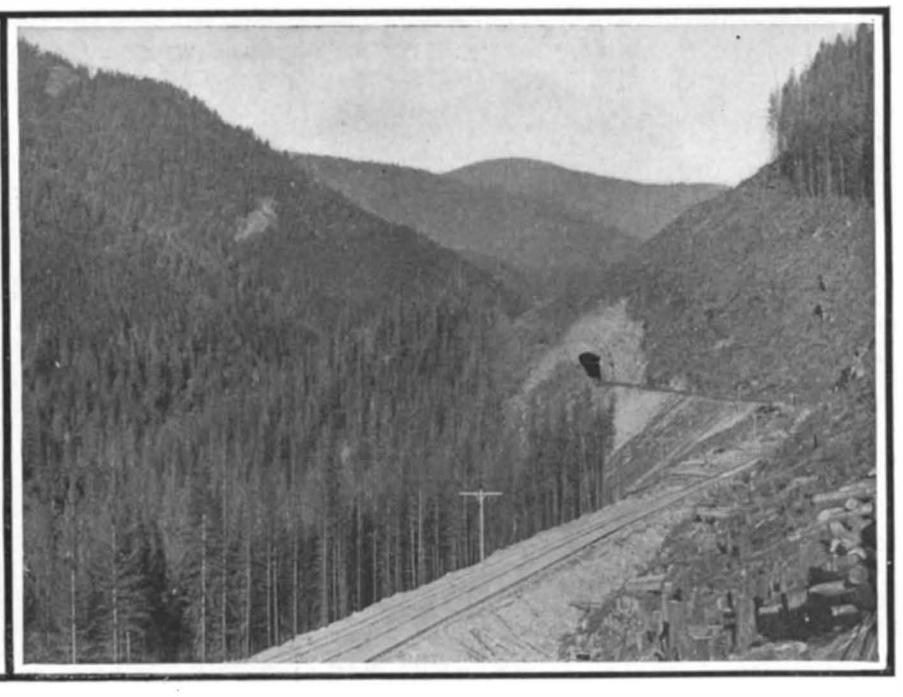
With the completion to the Pacific coast in the near future of the extension of the Chicago, Milwaukee & St. Paul Railway (now known as the Chicago, Milwaukee & Puget Sound Railway) one more of the great railroad systems of the West will be entitled to rank as a transcontinental line. For the beginnings of this great railway system we must go back to the year 1865, when the Minnesota Central, now known as the Iowa and Minnesota Division of the Chicago, Milwaukee & St. Paul Railway, was completed to Faribault, Minn. This road reached the Iowa line in 1866, and was completed to St. Paul in 1867. Since that time the growth of the system has been rapid, the total mileage reaching 4,721 miles in 1884, 6,065 miles in 1892, 6,382 miles in 1903, 7,264 miles in 1907, and 7,451 miles in 1908. The total length of the extension now being completed from the Missouri River to the coast is 1,400 miles, and by the time it is opened the total mileage of the whole system will have reached 9,000 miles.

It is probable that by the time of its completion the new line will have created a record for rapidity of construction. Work was begun in April, 1906, and if the expectations of the engineers and contractors are fulfilled, the last main line rail will be laid by April 1, 1909, and the whole stretch of 1,400 miles will have been built in the remarkably short time of three years. During this period 60,000,000 cubic yards of material will have been excavated, 360,000 yards of tunnel driven, 20 miles of bridges erected, and 200,000 tons of 85-pound rails laid, at a total cost of $85,000,000.

The new line being the latest of the transcontinental roads to be built, has all the advantages which come from accumulated experience in the construction of similar roads that have already been built. From the standpoint of operation, the most important question is that of grades, and particularly what is known as the "ruling grade," this last being the maximum degree of grade occurring on any given stretch of the line. No matter how short its extent may be, the ruling grade determines the total weight of train which can be hauled over the division upon which the ruling grade obtains. If a short stretch of only a quarter of a mile of two per cent grade occurs on a division of say 100 miles, where there is no stretch of grade exceeding say 0.5 per cent, the maximum trainload must be reduced on that division to the maximum which an engine can haul unassisted over the short stretch of two per cent grade, or additional pusher engines must be maintained at the ruling grade to assist the trains over this quarter of a mile of track. The new line, however, is characterized by favorable gradients and easy curvature. Between the Missouri River and Marmarth, N. D., the ruling grade eastbound is 0.5 per cent, and between Marmarth, N. D., and Melstone, Mont., a distance of 235 miles, it is 0.4 per cent. From Melstone, Mont., to Harlowton, Mont., 104 miles, there is no adverse east-bound grade; the entire distance being a very gradual descent conforming to the valley of the Musselshell River. The maximum grade of the Montana Railroad, when revised, will be one per cent. Between Lombard, Mont., and Piedmont, Mont., the maximum east-bound grade is 0.3 per cent, and between Piedmont and Butte, crossing the continental divide, the ruling grade is 1.66 per



Laying track on the Chicago, Milwaukee & Puget Sound Railway.



Tunnel near the summit of one of the mountain passes.

cent, compensated, as in all other instances, for curvature.

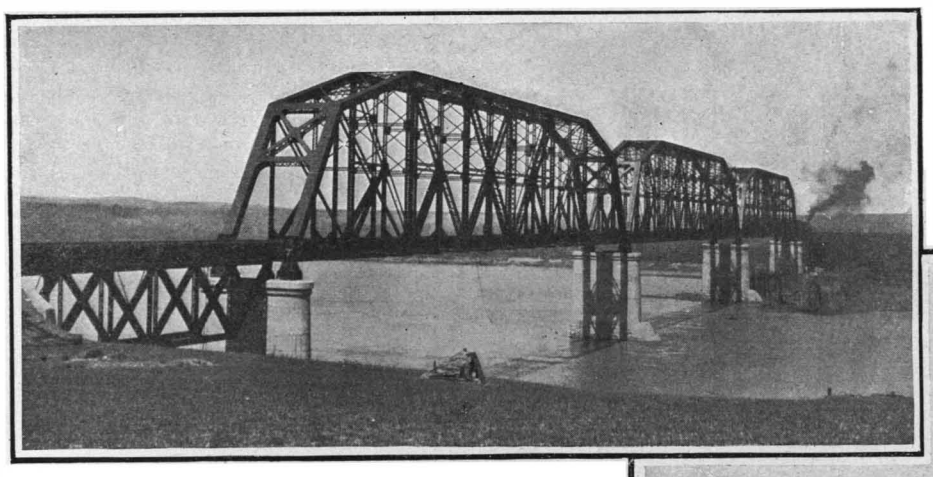
Between Butte and the Bitter Root Mountains the line follows the Deer Lodge, Hell Gate, and Missoula rivers, and the ruling east-bound grade is 0.4 per cent, except between Deer Lodge and Butte, where it is 0.6 per cent. The Bitter Root Mountains are crossed with a maximum grade of 1.7 per cent, and from there to the Columbia River the maximum of 0.4 per cent is maintained. Johnson Creek summit, about 20 miles west of the Columbia River, is crossed with a maximum east-bound grade of 1.5 per cent, and the Cascades will be crossed with a maximum of 1.7. On the approach to the Cascades from Puget Sound the maximum grade is 0.8 per cent.

The new line begins at the town of Mobridge in South Dakota, and crosses the Missouri at a point about 100 miles due west of Aberdeen by a handsome steel bridge, which forms the subject of one of our illustrations. It is carried upon four concrete and stone piers, the foundations for three of which were put in by the pneumatic caisson process. Pier No. 3 was sunk to a depth of 90 feet 6 inches below low water. The bridge consists of a steel through-truss span of 128 feet on the east approach, followed by three steel through-truss spans each 423 feet 4 inches in length, which form the main bridge. The west approach consists of 281 feet of steel viaduct and 1,289 feet of timber trestle. The filling of the timber trestle will be completed this season. After crossing the Missouri the line parallels the State line through the Standing Rock Indian Reservation, and swings into North Dakota, touching several small towns, including Marmarthon on the Little Missouri River, where one of the division points will be established. Thence, it proceeds to Terry, Mont., on the Yellowstone River, and 4 miles to the west of Terry it crosses the Northern Pacific by an overhead bridge, and follows the line of the Yellowstone River to Miles City, Mont., where large division terminals are being built. The road passes through the valley of the Musselshell River, and at Harlowton joins the Montana Railroad, on which a large amount of work has been done in the way of reducing grades and curvature to accommodate the expected heavy traffic. At Lombard the new line again crosses the Northern Pacific Railway, and then climbs the great continental divide between Piedmont on the eastern side of the Rockies and the city of Butte on the west. At an elevation of 6,350 feet, the road pierces the mountains at the head of Pipestone Pass. The summit work includes two tunnels respectively 2,268 and 1,148 feet in length, and three steel trestles over ravines from 100 to 160 feet deep and from 400 to 600 feet wide.

From Butte the road will pass by way of the broad and fertile Deer Lodge valley to Garrison and Missoula, Mont., and at Hangan, Mont., will commence the long climb over the Bitter Root Mountain range. At the summit it will pass through a tunnel 8,751 feet in length, and after crossing St. Paul Pass at an elevation of 4,160 feet it will pass through the famous

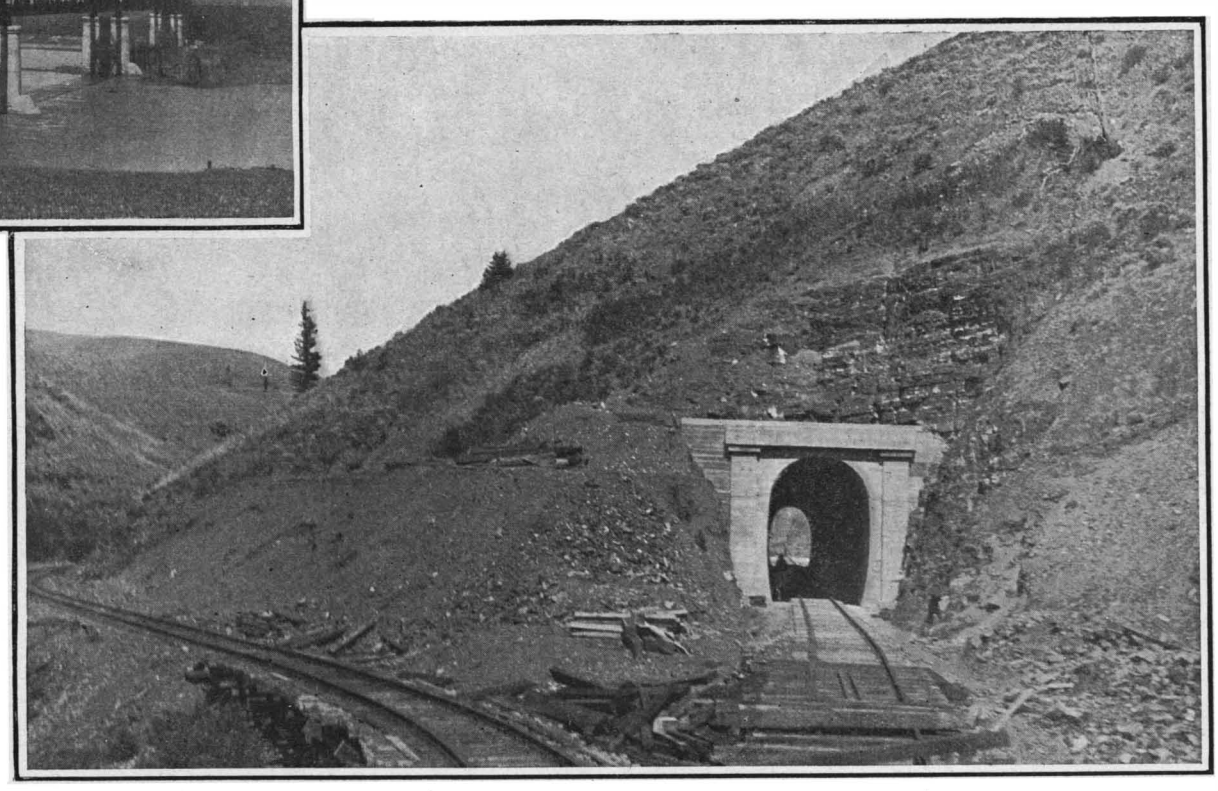
(*Continued on page 156.*)

View showing the remarkable development of the grades through the mountains west of the St. Paul Pass tunnel.



The three 423-foot spans of the Missouri River bridge.

A 200-pound keg blast at the Lock Buttes.



Relocation; the new line through the tunnel takes the place of the longer line around the hill.

THE EXTENSION OF THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY TO THE PACIFIC COAST.

CARNEGIE INSTITUTION MAGNETIC SURVEY OF THE WORLD.

History tells us that when Columbus made his memorable western voyage, his sailors mutinied because among other things the needle of the compass no longer pointed to the North Star; which showed that this phenomenon was observed but not understood. Since then all mariners have had to make allowance for the variations of the compass; for while in one part of the ocean the needle practically points due north, in other localities the variation, as the mariner terms the angle of departure of the compass from true north, is several degrees. Off the coast of Oregon and Washington there is a variation as high as twenty to twenty-five degrees. This variation does not exist only on the oceans, but is also found on land.

At present in the United States the line of no variation along which the needle points "true to the pole," or due north, begins in the eastern part of Lake Superior and Michigan and runs through Ohio about half way between Cincinnati and Columbus, and after passing through the eastern parts of Kentucky and Tennessee, cuts through South Carolina and enters the Atlantic Ocean near Beaufort. On the east side of this line the variation of the needle is west and on the west side the variation is east, and as a rule the further a place is from this line in our country the greater is the variation. In the northwestern part of Maine the compass points 21 deg. west of north and at Vancouver it points 25 deg. east of north.

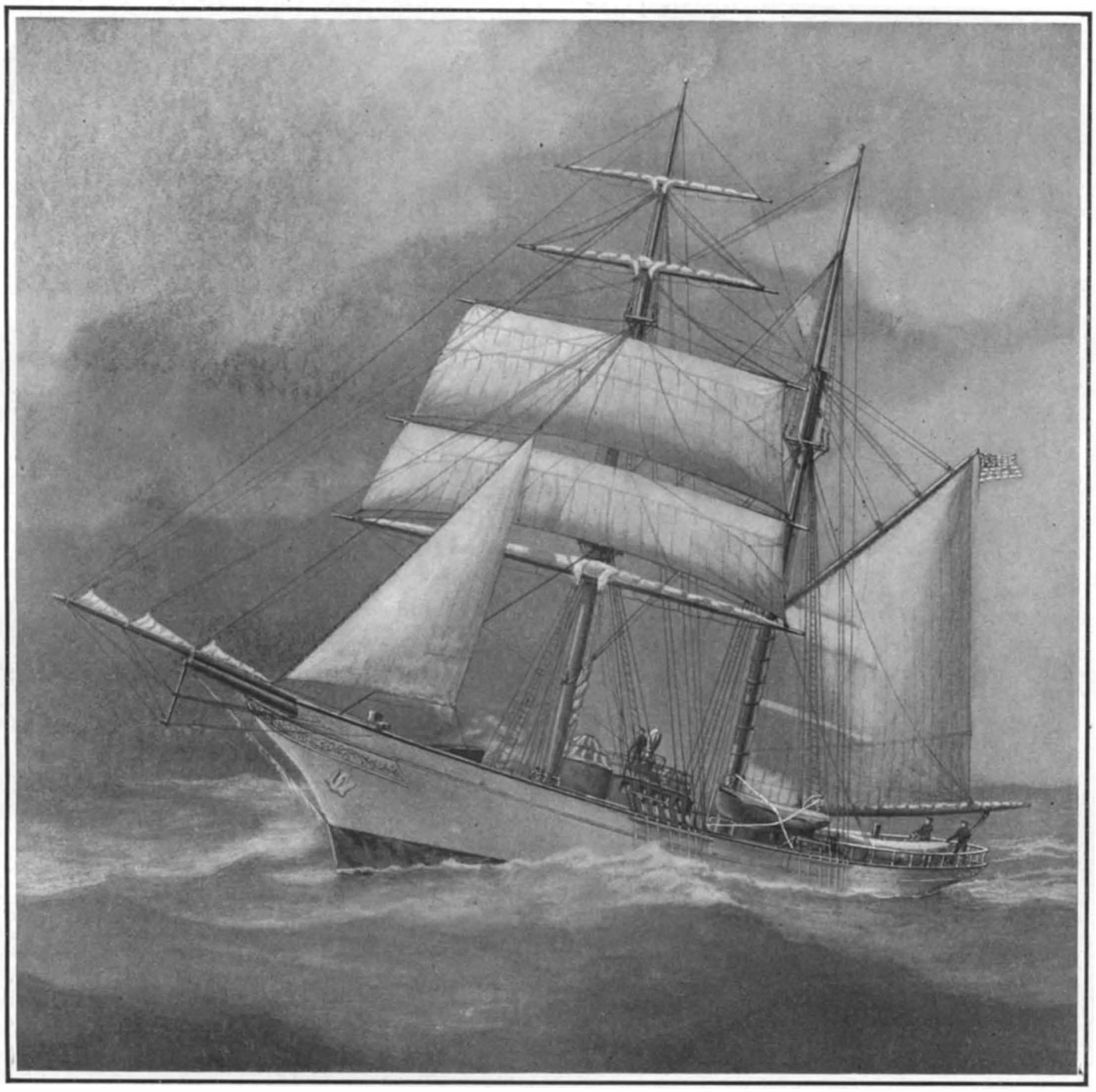
The position of the line of no variation, as given, is that assigned to it on the magnetic charts issued by the United States Coast and Geodetic Survey. This line has for many years been moving southwestward. How long this motion will continue scientists do not know. The true north pole and the magnetic north pole are not identical. The true north pole is stationary, except for the very small motion recently discovered by astronomers; but the magnetic pole appears subject to considerable motion with the lapse of time, the actual path being as yet unknown, because of lack of data covering a sufficient period of time.

Humboldt recognized the importance of terrestrial magnetism and suggested that four times in every century an expedition of three ships should be sent out to examine as nearly as possible the state of the magnetism of the earth. This plan has never been adopted and the surveys that have been made have been more or less incomplete. Some notable surveys have been made, but all the work done has covered hardly more than one-tenth of the navigable waters of the earth. The most notable contributions to our knowledge were those made by Sir James Clarke Ross (1839-45) in connection with his memorable Antarctic expedition, and the data gathered by the "Challenger" expedition (1872-76) regarding the magnetic conditions along the paths traversed by the ship.

About four years ago the Carnegie Institution of Washington undertook to make series of systematic surveys. A department of research in terrestrial magnetism was organized and the work placed in charge of Dr. L. A. Bauer, who was formerly in charge of the magnetic survey of the United States under the Coast and Geodetic Survey. The first step in the ocean work was to make a survey of the Pacific Ocean, where until then little had been done except shore observations on some of the islands along the coast since the notable voyages of the "Challenger" and the "Gazelle," more than thirty years ago.

Observations were made from the converted wooden yacht "Galilee" which between August 1st, 1905, and May 31st, 1908, made three successive voyages in the Pacific tracing the great circle route, zigzagging in and out of the islands and covering with a network of tracks all the places left uncovered by the "Challenger." The "Galilee" cruised more than 60,000 miles. The most northerly point visited by the "Galilee" was Sitka, Alaska, and the most southerly Lyttleton, New Zealand.

This was only the beginning of the work. The Institute has already made observations in many parts of the world and now has two expeditions in Africa, has just sent another to China, has one in Persia and Asia Minor, and has covered a part of South and Central America and British North America and Greenland. It is estimated that a magnetic survey of the world can be completed in about ten years more.

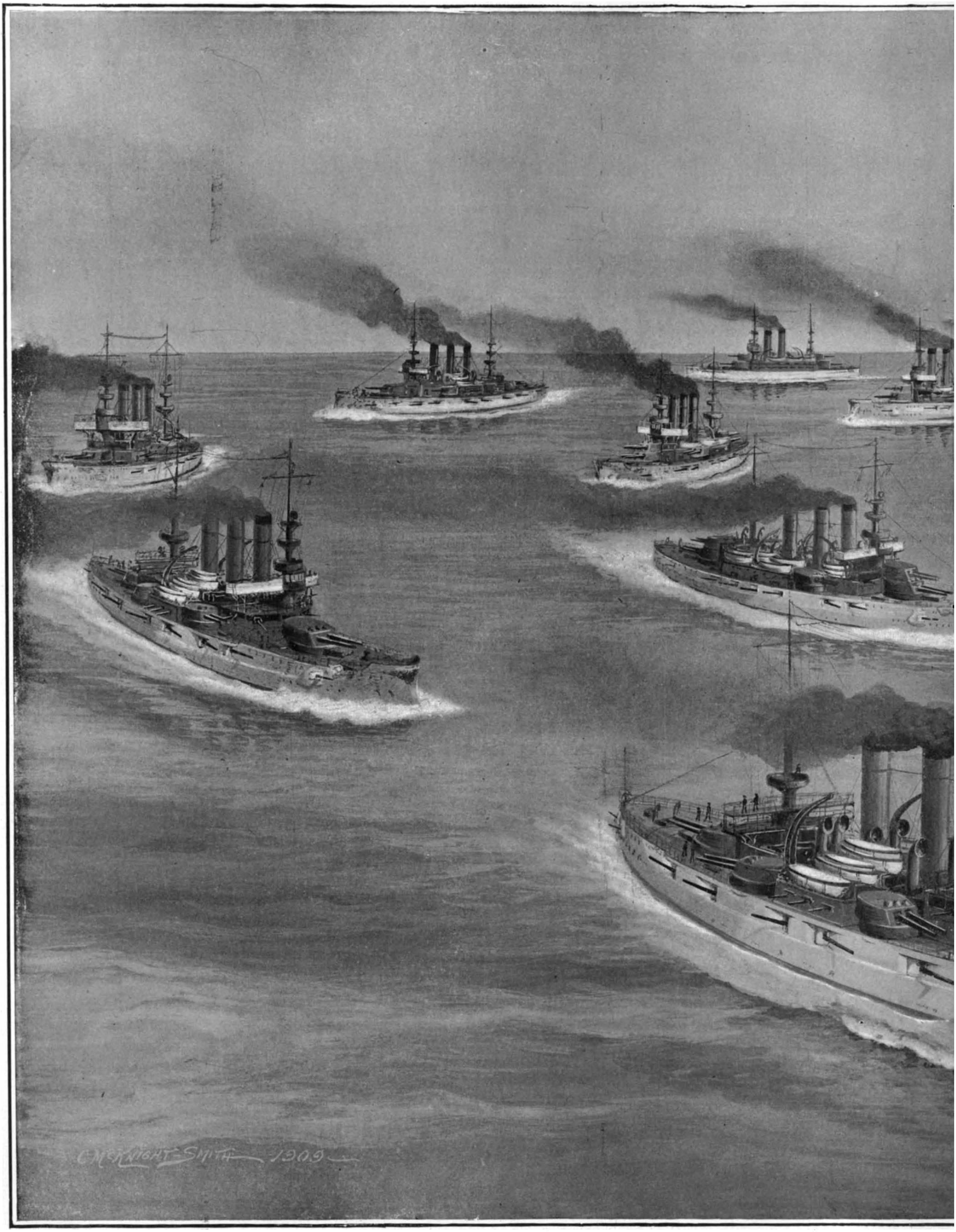


This interesting vessel is being built for the Carnegie Institution at Washington. Her survey of the oceans will form part of a comprehensive survey of the whole world, on land and sea, by which the magnetic variation of the compass is to be determined. No iron, steel, or other magnetic material will be used in her construction.

NON-MAGNETIC VESSEL FOR MAKING A MAGNETIC SURVEY OF THE OCEAN.

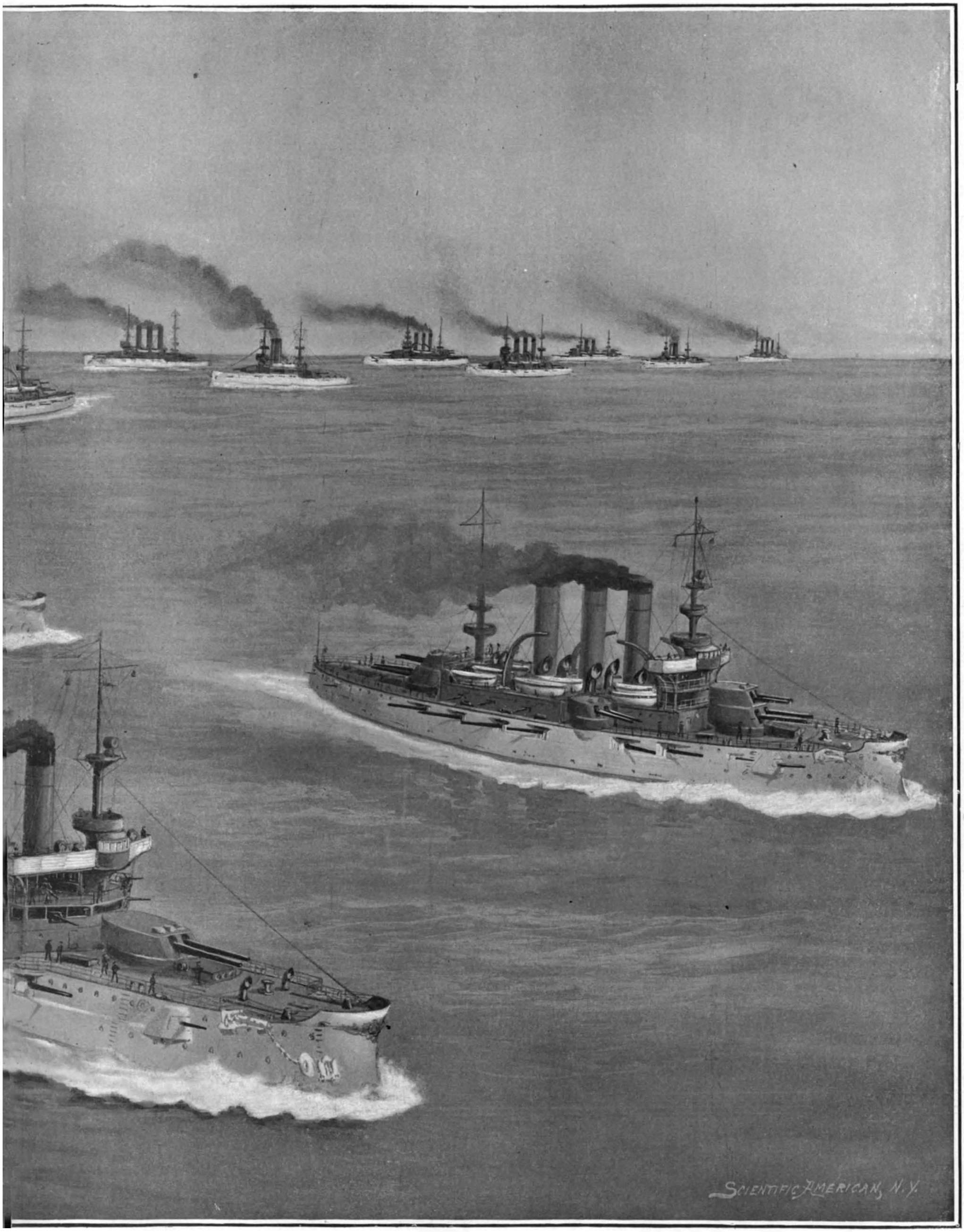
For the purpose of making systematic surveys to determine the magnetic conditions on all the deep-water seas of the world, the Carnegie Institution is having constructed a magnetic survey vessel, which has been specially designed for this work by Henry J. Gielow, the designer of some of our most successful racing yachts, to whom we are indebted for the following details of her design and construction: The ship is entirely original, being the first of her kind to be constructed. In order to render her practically non-magnetic, no magnetic metals, such as iron and steel, have been allowed to enter into her construction. The only magnetic material used is the thin, cast-iron liners of the cylinders of the internal-combustion engine with which she is fitted. Outside of the liners and the steel cams for the valves this engine is constructed entirely of bronze. As she is built for ocean surveys, the vessel is constructed in a particularly substantial manner, and combines with the strength of a merchant vessel all the beauty of finish and workmanship of a yacht. Her dimensions are: Length over all, 155 feet 6 inches; length on load waterline, 128 feet 4 inches; molded beam, 33 feet; depth of hold, 12 feet 9 inches; draft, 12 feet 7 inches; displacement, with all stores and equipment on board, 568 tons. She will have full sail power, with a brigantine rig carrying about 12,900 square feet of plain sail. The lines of the hull are fair and easy, and indicate both power and seagoing qualities throughout. The keel, stem, stern post, frames, and deadwood will be of white oak, the deck beams, planking, and ceiling of yellow pine, and the deck of Oregon pine. The fastenings will consist of locust treenails, copper and Tobin bronze bolts, and composition spikes. All through bolts will be riveted over rings both inside and outside. All metal deck fittings, metal work on spars and rigging will be of bronze, copper, and gun metal. The six-cylinder, internal-combustion engine is for the purpose of maneuvering the vessel when in port or crowded roadsteads, or during a calm at sea. It is capable of developing 125 indicated horse-power at 350 revolutions per minute, which, driving a feathering propeller of special design, will give the vessel a speed of six knots in calm weather. The shaft will be of Tobin bronze and the propeller and its feathering gear will be of manganese bronze. The engine will be operated by gas generated in a producer gas plant having a capacity to gasify 130 pounds of anthracite pea coal per hour, producing a fixed, well cleaned gas, containing 80 per cent of the heat units possessed by the coal. The vessel will carry twenty-five tons of coal in her bunkers, which will give her a cruising radius of 2,000 miles at a speed of six knots.

The living quarters for the officers, crew, and scientific staff are all below the main deck; and, for safety, the vessel will be subdivided into seven watertight compartments. The crew will be berthed forward in the forecastle. Then will follow the officers' messroom and staterooms. Abaft the officers' quarters are the accommodations for the scientific staff, from which a mahogany stairway will lead to the observation room on deck. By reference to our engraving, it will be noted that this observation room is located amidships between the foremast and mainmast. It consists of a central observation room, 14 feet 6 inches in length by 16 feet in width, which will be provided with the necessary desks, drawers, and tables, etc., for the work of the staff, and at each end of this room will be a circular observatory, 7 feet 6 inches in diameter, each of which will be fitted with a revolving dome constructed of bronze framework and plate glass. These two domes are shown in our engraving on a level with the deck of the observation room, and immediately forward and aft of the same. The construction of this exceedingly interesting craft is now proceeding at Tebo's yacht basin, Brooklyn.



Vermont, 16,000 tons ; 18.3 knots.
Louisiana, 16,000 tons ; 18.8 knots.
Minnesota, 16,000 tons ; 18.8 knots.
Kearsarge, 11,520 tons ; 16.8 knots.
Rhode Island, 14,948 tons ; 19 0 knots.
Georgia, 14,948 tons
Virginia, 14,948 tons ; 19.0 knots.
Flag

ATLANTIC FLEET RETURNING TO HAMPTON ROADS AT TH



Missouri, 12,500 tons ; 18.2 knots. **Nebraska,** 14,948 tons ; 19.1 knots. **Kentucky,** 11,520 tons ; 16.9 knots. **Ohio,** 12,500 tons ; 17.8 knots.

19.3 knots. **Wisconsin,** 11,552 tons ; 17.2 knots. **Kansas,** 16,000 tons ; 18.1 knots. **Illinois,** 11,552 tons ; 17.5 knots.

ship **Connecticut,** 16,000 tons : 18.8 knots. **New Jersey,** 14,948 tons ; 19.2 knots.

IE CLOSE OF ITS 42,000-MILE TRIP AROUND THE WORLD.

COMPOSITION OF THE FLEET WHICH SAILED AROUND THE WORLD.

Whether by design or accident, the fleet of battleships which was selected for the 42,000-mile cruise around the world, contained two or more representatives of every class of battleship which has been built for our navy from the close of the Spanish war to the present time. Moreover, it does not include a single ship that was in commission during that war, or took any part in its active operations. So that to any student of naval affairs (and there must have been many a score of such at the various ports of call) the visit of the fleet presented an unrivaled opportunity to trace the development of the United States navy, at least as far as its capital ships are concerned, during this, the most active decade of construction in the history of our navy.

During the progress of the war, when we had but four first-class and one second-class battleships in commission, frantic efforts were being made to rush to completion two sister ships, which, about the time of the outbreak of hostilities, had been launched from adjoining slips in the Newport News yard. These were the two battleships "Kentucky" and "Kearsarge," vessels of 11,520 tons displacement and a little less than 17 knots speed. They are characterized by a low freeboard of 13 feet, and by the fact that they mount their main battery of four 13-inch and four 8-inch guns in superposed, or two-deck, turrets, a device which has the distinction of having been installed against the bitter opposition of the naval constructors, and of being to-day cordially disliked by the line officers to whom its design and installation was originally due. Designed with the object of securing a maximum all-round fire for a maximum number of guns, it is open to the objections that too many guns are carried upon a single turntable, preventing independence of training; that there is an undesirable concentration of heavy weights; that the matter of ammunition supply is complicated; and that a single high-explosive, heavy armor-piercing shell might at one blow put half of the main armament out of commission. However, the superposed turret makes a brave show, and it cannot be denied that excellent target results have been achieved by guns mounted in this way.

The next two ships in point of importance in the fleet are the "Illinois" and "Wisconsin," of the "Alabama" class, vessels of about the same displacement and speed as the foregoing, and carrying four 13-inch guns in two 2-gun turrets, fore and aft, and a broadside of fourteen 6-inch rapid-fire guns disposed behind the armor of a central box battery. Ships of this class are easily recognized by their two elliptical smokestacks, placed abreast of each other, in the English fashion of the period when the "Alabama" class was designed. Their seagoing qualities, as compared with the "Kentucky" and "Kearsarge," are improved by the addition of a forecastle deck, giving a freeboard forward of between 19 and 20 feet on normal displacement.

Next in importance are the "Ohio" and "Missouri" of the "Maine" class. Originally, the three ships of this class were designed to be of the same size as the preceding "Alabama" class; but they were subsequently lengthened 20 feet, the displacement being raised to 12,500 tons, and the speed from 17 to 18 knots. The 13-inch gun gives place to a 40-caliber, 12-inch piece, of higher velocity and greater power. Four of these guns are carried in two turrets, and there is a powerful secondary battery of sixteen 50-caliber 6-inch guns. In the five ships of the "Virginia" class, a great advance was made both in size and power over the "Maine" class. The superposed turret was reintroduced, as was also the 8-inch gun. The ships are of slightly under 15,000 tons displacement, and all of them, on trial, made over 19 knots an hour. The armament is unusually powerful. It consists of four 40-caliber 12-inch guns, eight 40-caliber 8-inch, twelve 50-caliber 6-inch, and twelve 50-caliber 3-inch guns. The four 12-inch and four of the 8-inch are carried in two superposed turrets forward and aft, and the other four 8-inch are mounted in two turrets, one on each beam. The twelve 6-inch pieces are mounted behind casemates on the main deck. These five ships were the first battleships in our navy to have a continuous, unbroken upper deck from stem to stern, with a freeboard of 19 feet or over. Because of the superposed turret mounting, the "Virginias" possess a heavier broadside, even, than the "Connecticut" class which followed them, the total amount of metal that can be thrown from one broadside in five minutes being 98,800 pounds, as against 89,200 pounds for the "Connecticut" class.

In the "Connecticut" class our designers have turned out one of the most successful battleships designed for any navy. They are about 1,000 tons larger, though about one knot slower than the "Virginia" class. The main battery consists of four 45-caliber 12-inch guns mounted in two turrets; four 45-caliber 8-inch in four turrets; twelve 50-caliber 7-inch guns mounted in casemates on the main deck; and twenty 50-caliber 3-inch guns. The "Connecticut" represents the highest development of what might be called the mixed-caliber battleship, as distinct from the all-big-gun type, which was introduced by the "Dreadnought." As such, she is comparable with the "King Edward" of the British navy, which carries four 9.2-inch guns in her intermediate battery, as against the eight 8-inch guns of the "Connecticut."

All the ships of the fleet are heavily armored, the older vessels carrying from 16½ to 13 inches of Harveyized armor, and the latest ships from 11 to 6 inches of Krupp armor on the waterline and upon the principal gun positions. There has been a steady increase in coal-carrying capacity and, therefore, in the steaming radius, the bunker capacity being as follows: "Kearsarge," 1,500 tons; "Illinois," 1,275 tons; "Missouri," 1,825 tons; "Virginia," 1,900 tons; and "Connecticut," 2,275 tons. The complement has grown from 586 men in the "Kearsarge" to 916 in the "Connecticut."

It is interesting also to compare the steady increase in the amount of metal which can be thrown from a single broadside in the successive ships, the figures for five minutes continuous firing of all guns being as follows: "Kearsarge," 70,720 pounds; the "Illinois," 74,970 pounds; the "Missouri," 85,150 pounds; the "Virginia," 98,800 pounds; and the "Connecticut," 89,200 pounds. The great improvement in rates of fire and energies of projectiles, in the later guns, shows clearly in a comparison of the relative energy, the total energy of discharge for one broadside for the ships of each class in the Atlantic fleet being as follows: "Kearsarge," 2,035,520 foot-tons; "Illinois," 2,354,490 foot-tons; "Missouri," 4,490,670 foot-tons; "Virginia," 5,191,370 foot-tons; and "Connecticut," 4,522,140 foot-tons. It might be supposed that the "Connecticut," with her 45-caliber 8's and 12's and her 50-caliber 7's, would show a more powerful total muzzle energy than the "Virginia," with her 40-caliber 8's and 12's and 50-caliber 6's. But the "Virginia" can concentrate two more 8's upon the broadside, and the greater rapidity of fire of her 6-inch guns more than offsets the greater energy of the slower-firing 7-inch piece; the total energy for five minutes of the 7-inch battery being 1,508,810 foot-tons, and of the 6-inch battery, 2,057,040 foot-tons. In the same way, the eight 6-inch guns of the "Maine" account for 2,742,720 foot-tons of her total energy.

If, however, we take account of the "remaining energies," which determine the punishing power of the guns at the fighting ranges of from 6,000 to 8,000 yards, the "Connecticut" heads the list by a good margin, and the "Maine" drops far behind.

The total muzzle energy of the whole fleet's broadsides during five minutes engagement would be 66,328,910 foot-tons. This would be sufficient to raise the battleship "Kentucky" over one mile into the air.

THE EXTENSION OF THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY TO THE PACIFIC COAST.

(*Continued from page 152.*)

Coeur d'Alene district. At Beverly, Wash., the line reaches the Columbia River. The last stretch of the new road passes through the virgin timber lands of Snoqualmie Pass in the Cascade Mountains, which are probably the richest timber lands in the State of Washington; and then after following the Cedar River valley to Maple valley, it runs into the populous and thriving cities of Seattle and Tacoma on the Pacific coast. The line to Tacoma runs through Kent and Auburn, passes through Sumner and North Puyallup, crossing the river of that name, and then entering the famous seaport of Tacoma.

Although for a considerable portion of its distance the new line traverses approximately the same country as the Northern Pacific, for the greater part of the distance it will open entirely new sections, in which are included some large areas of fertile agricultural country, and extensive districts that are rich in mineral and forest wealth. The new line will have an advantage over the present lines to North Pacific coast points in lower grades and shorter mileage. The devolpment of the country through which it passes, and the carriage of freight and passengers to and from the large areas which will be tributaries to the line, are not by any means the sole objects for which it has been built. Its promoters are looking beyond the broad Pacific, in the expectation of sharing that large and ever-accumulating trade, which has already assumed considerable proportions, between the Orient and the leading ports of the Northwest. Traffic arrangements have already been made with certain lines of steamers to operate in connection with the new transcontinental route.

According to a consular report, Sir Oliver Lodge has recently demonstrated the efficiency of his fog-clearing apparatus in Liverpool. He succeeded in clearing a thick fog over a radius of 60 feet. The Lodge system consists in discharging electricity at high voltage from a series of disks, with the result that the fog is condensed and falls to the ground. The apparatus will soon be tested in London.

Correspondence.

A SUGGESTION FOR INVENTORS.

To the Editor of the Scientific American:

Regarding all of the information that has been published about the collision in the sinking of the steamship "Republic," there is one comment from a passenger of the "Florida" which is, I believe, of particular interest. It is as follows:

"As I got to the deck," said Roberto, "I saw the big hull of the 'Republic' a faint blur in the darkness, and immediately there came over the water the boom of a rocket, and the darkness was for a second illuminated. The bow of the 'Florida' was in bad condition, and there was a running and scurrying of men down there, investigating the nature of the damage and repairing it as best they could."

The question arises that if as soon as the distress rockets were sent off they illumined the ocean sufficiently to make out the whereabouts of the "Republic," why would it not have been a good plan to send off rockets before the collision? This, of course, brings up the entire question of what kind of lights, if any, will penetrate or illuminate in a fog.

Palmer H. Langdon.

New York, February 6, 1909.

A YACHT DESIGNER'S OPINION OF THE NAVY SITUATION

To the Editor of the Scientific American:

To your editorial in the Scientific American of December 19, 1908, commenting on President Roosevelt's recommendations in regard to the reorganization of the navy's bureaus, kindly accept, from one who has helped a little to make his country's navy the "best ever," a modest but sincere and hearty "encore."

Only by frequently repeating such clear and effective statements of the problems involved, can those who are entirely unfamiliar with them be shown the technical difficulties to overcome in the building of our naval vessels.

Your excellent illustration of the troubles that would result from an application of the general principle in the President's proposal to the question of a design for the defender of the "America's" cup, appeals strongly to one who has wrestled with the problems many years as a yacht designer.

As one who was moreover intimately connected with the design work on the ships under Lewis Nixon and the late J. J. Woodward, and more recently in constructing them under the eminent ex-Chief Constructor F. T. Bowles, allow me to second the expression of your hopes that our ships may continue to be designed by the technically expert.

Marblehead, Mass., December 21, 1908. J. R. P.

ALCOLINE.

To the Editor of the Scientific American:

Surely he who finds a short cut between an idea and its expression in this day, when railroads are spending millions in shortening and leveling their lines, is worthy of as much honor as Swift thought due the man who made two ears of corn grow where only one grew before. Now, it is patent to all that the appellation "denatured alcohol" cannot pass into current use. It is too long, clumsy, and contradictory for our monosyllabic age, and in its place I suggest the caption of this letter, *Alcoline*, and submit the following points in its favor:

First, it puts it into articulation with the other well-known fluid fuels: gasoline, kerosene, benzine, etc. The popular mind will very readily grasp the analogy, even if it should be etymologically incongruous.

Second, it would obviate or at least minimize the danger of such mistakes as have strewn the path of "wood alcohol" with twisted corpses. Possibly the world may not lose much by the departure of any chance boneheads who cannot understand that some kinds of alcohol kill more quickly than others, but some otherwise good and useful men might be tempted to try the new brand, "denatured alcohol," just as otherwise sensible people will dab at a freshly-painted surface, just to see if it is drying, so this point has some weight.

Third, it gives this substance, which is plainly destined to occupy an increasingly important place in our industries, a single, unconfusable name. "Denatured alcohol" is too long, confusing, and misleading. If it is "denatured," it no longer has a right to the name alcohol. To follow the analogy, the Scientific American is printed upon "denatured spruce" by type made of "denatured ore." The presses are operated by "denatured" lightning, which is generated by "denatured water" power, denatured by "denatured" forests of the Carboniferous era! Let us have a name as well as a place for everything, without qualifying words to trip us up!

Ward Morse.

Genoa, Nance County, Neb., January 6, 1909.

The Current Supplement.

The current Supplement, No. 1729, contains a large number of interesting contributions. Among these may be selected William H. Booth's paper on "Coal, Its Composition and Combustion," Friedrich Hartmann's instructive article on "Amalgams," a succinct statement of steam engine efficiency in the light of modern thermo-dynamic conceptions, an illustrated article on the government's efforts to stop the appalling loss of life in mines, a picturesque description of the wonderful cavern of Proumeyssac in France, an enumeration of recent earthquakes that preceded the great Italian cataclysm, a summary of the scientific attempts to stop bodily decay and prevent death, a review of some recent processes of making artificial unwoven cloth, an account of the surgical instruments of antiquity, a popular statement of the sewage problem, and a continuation of the treatise on aeronautic motors begun in the last number of the Supplement.

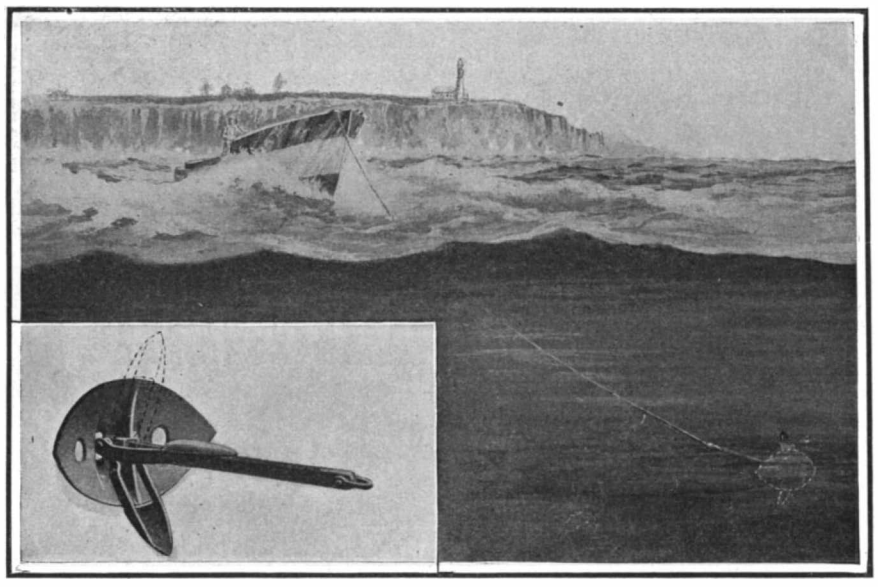
A COMBINATION ANCHOR.

So little real development has been made in anchors during the past few decades, that considerable interest attaches to the Hall combination anchor, the most important feature of which is the combination of a fluke anchor and a mushroom anchor. From the records of the Patent Office there appears never to have been a serious effort to accomplish this. The accompanying engraving of the anchor shows that it meets the most exacting demands of both of the former types.

It is a well-known fact, proved by years of universal experience, that for anchoring vessels where the bottom or holding ground is mud or very soft sand, the mushroom type of anchor excels any sort of fluke anchor. It is equally well known that, in bottoms of hard sand, rocks, or other hard material, the anchor with sharp prongs or flukes holds best. Theoretically, then, a vessel's safety would require that it be equipped with both types of anchor. But the mushroom is unwieldy in the extreme, difficult to stow aboard ship, and has therefore been universally discarded for portable use. It is, however, in general use as a permanent mooring. And as a properly made fluke anchor, either with one or two flukes, holds to some extent in soft bottoms, upon it has depended the safety of the vessel, regardless of the character of the bottom into which it is placed. Yet it is acknowledged to be eminently not adapted to hold in soft bottom. And even if a vessel were equipped with both types of anchor, the bottoms for which each is adapted merge into each other, through various degrees of hardness and softness, in which neither one could be depended upon for a secure hold. When the anchor is lowered and strikes the bottom, it falls so that the elliptical head rests on one of its broad sides, and the fluke on that side drops down of its own weight and drives its point into the bottom. As the mushroom is an elongated ellipse, it must always rest on one of its sides, and thus keep the plane of the flukes at right angles to the surface of the bottom, i. e., one fluke or the other must always engage the ground.

When the vessel's weight pulls the anchor forward, the fluke is driven deeper into the bottom until it reaches its maximum angle of 55 degrees with the shank, during which time the entire weight of the anchor, being concentrated at the mushroom end of the shank, drives it deeper. The edges of the mushroom are sharp, and the head itself is of such shape as to maintain the greatest possible hold on the bottom for each inch of penetration. Thus in soft bottoms the mushroom sustains an effective hold, which is augmented by the deeper hold of the fluke; while in bottoms too hard for the mushroom to penetrate, the fluke sustains a strong hold, which increases with the pull of the vessel, owing to its carefully studied shape and angle of penetration.

It has been proved, after exhaustive tests, that this type of anchor will hold more pounds of strain per pound weight of anchor than any simple type of anchor in any bottom.



A COMBINATION ANCHOR.

THE ITINERARY OF THE CRUISE.

The composition of the United States Atlantic fleet and the second torpedo flotilla, on their voyage from Hampton Roads to San Francisco, was as follows: The first division, under Rear Admiral R. D. Evans, commander in chief of the fleet, consisted of the four sister ships "Connecticut," "Kansas," "Vermont," and "Louisiana." The second division, Rear Admiral W. H. Emory commanding, consisted of the sister ships "Georgia," "New Jersey," "Rhode Island," and "Virginia." In the third division, under the command of Rear Admiral C. M. Thomas, were the "Minnesota," one of the "Connecticut class," and the sister ships "Ohio," "Missouri," and "Maine." In the fourth division, commanded by Rear Admiral C. S. Sperry, were the sister ships "Alabama" and "Illinois" and the sister ships "Kearsarge" and "Kentucky." Accompanying the fleet were four auxiliaries, the "Culgoa," "Glacier," "Panther," and "Yankton." In the torpedo flotilla were the destroyers "Whipple," "Truxtun," "Lawrence," "Stewart," "Hopkins," "Hull," and the storeship "Arethusa." Leaving Hampton Roads on December 16th, 1907, the fleet steamed to Trinidad, at which port it arrived December 23rd, after covering a distance of 1,803 miles. The next leg, one of the longest on the cruise, was from Trinidad to Rio Janeiro, a distance of 3,399 miles, the fleet leaving on December 29th, 1907, and reaching Rio January 12th, 1908. After a stay of nine days, a start was made on January 21st for Punta Arenas, 2,374 miles distant, which was reached February 1st, 1908. After navigating the Straits of Magellan in safety, the fleet entered the Pacific and turned north for the port of Callao, Peru, which it reached without incident after covering 2,838 miles. Callao was left on February 29th, and a stretch of 3,010 miles carried the fleet to Magdalena Bay, where it arrived on March 12th. Here, after a stay of one month, during which the fleet indulged in extensive target practice, the ships weighed anchor for the last leg of the course to San Francisco, 1,017 miles in length, and arrived in San Francisco Bay on May 6th, having covered a total distance of 14,441 miles since leaving Hampton Roads.

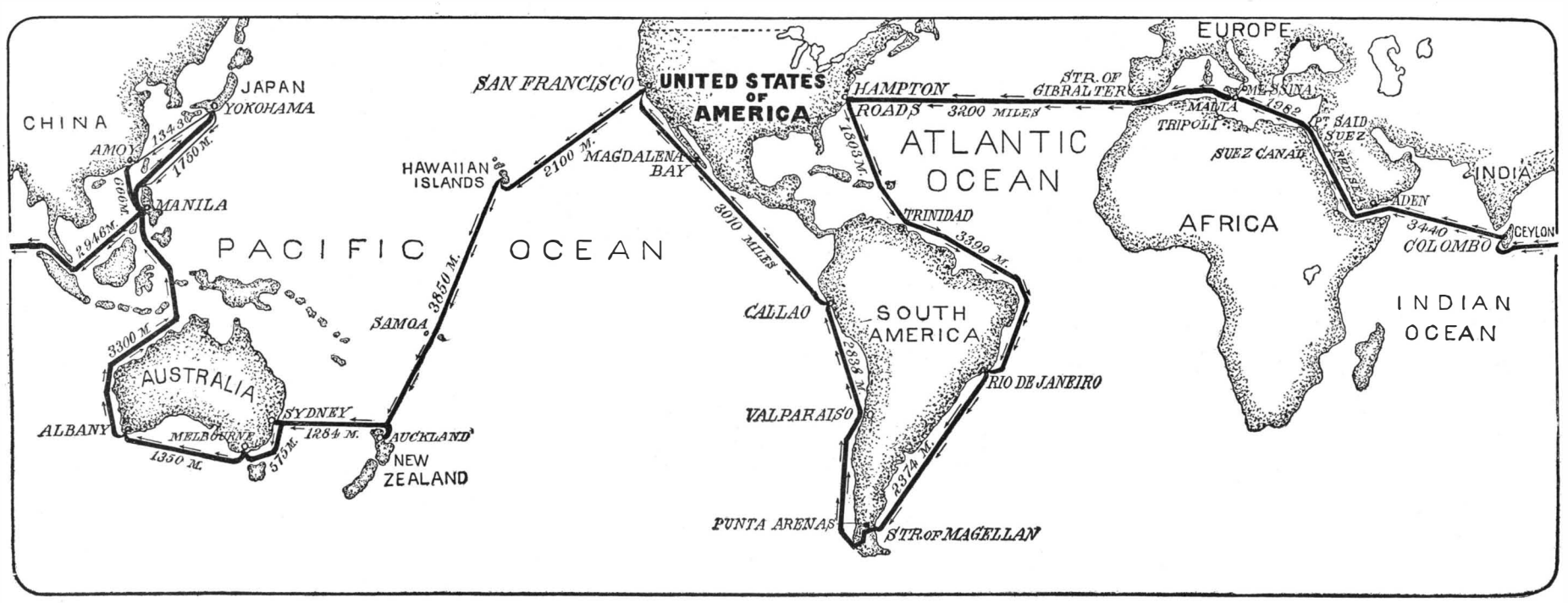
The torpedo flotilla followed the same general route, in shorter stages, making twelve calls between Hampton Roads and San Francisco, where it was timed to arrive on the same day as the battleship fleet.

Prior to leaving San Francisco, the Atlantic fleet was changed by the detachment of the second torpedo flotilla and the "Arethusa," and the substitution of the "Nebraska" and "Wisconsin" for the "Alabama" and "Maine," the two latter preceding the fleet to the United States *via* the Suez Canal. The fleet left San Francisco on July 7th, and after covering 2,100 miles reached Honolulu on July 16th, whence it sailed on July 22nd for the longest voyage of the whole cruise of 3,850 miles to Auckland, New Zealand, at which port it arrived on August 9th. Leaving Auckland after six days stay, the 1,284 miles to Sydney, Australia, were covered by August 20th; and after a stay of eight days the fleet sailed on August 28th on the shortest leg of the cruise, 575 miles, to Melbourne, Australia, which was reached on August 29th. Sailing again on September 5th, the fleet steamed to the westward for 1,350 miles to Albany, Australia, whence, after coaling, it sailed on September 18th for the Philippines, another long leg of 3,300 miles. The Philippines were reached on October 2nd, and on October 10th, a start was made for Yokohama, Japan, 1,750 miles distant, at which port the ships arrived October 17th. Here the fleet was divided, and on November 4th it set sail again for Manila, the second squadron going by way of Amoy, China. The first squadron reached Manila on October 31st, and the second squadron on November 7th. The total distance covered from San Francisco to Manila was 16,218 miles.

On December 1st, 1908, the fleet sailed for Colombo, Ceylon, 2,946 miles distant, which was reached December 14th, 1908; and on the 20th, it started upon another long leg of 3,440 miles to Suez, which was reached January 5th, 1909. With a view to visiting as many of the principal ports of the Mediterranean as possible, the ships scattered at Port Said, and Messina, Naples, Villefranche, Marseilles, Beirut, Smyrna, Malta, Tripoli, Athens, Salonica, and Algiers were visited; the fleet finally assembling at Gibraltar for the 3,200-mile voyage across the Atlantic Ocean to Hampton Roads.

MAP OF THE MEDITERRANEAN, SHOWING THE PORTS VISITED BY THE VARIOUS SHIPS AFTER THEY SCATTERED AT PORT SAID.

From a discussion on the subject before the Illuminating Engineers' Society it is noted that daylight commonly runs as low as one-tenth, or even one-hundredth of a candle-power to the square inch. Although it has been claimed that the injurious effects of artificial light were due to the ultra-violet contained therein, it was here pointed out that there is less ultra-violet light in the rays of various incandescent illuminants than there is in direct or reflected sunlight, so that the injurious effects of the artificial means are traced to the greater intrinsic brightness.



MAP SHOWING THE COURSE OF THE ATLANTIC FLEET ON ITS VOYAGE OF 42,000 MILES AROUND THE WORLD.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

CLEAT FOR ELECTRIC WIRING.—R. McLENNAN, Ballston Spa, N. Y. This invention refers to certain improvements in cleats for electric wiring, and more particularly to cleats for securing a plurality of substantially parallel wires to a wall or ceiling at a bend or turn in the wires, as, for instance, at a corner of the room.

ELECTRIC SAFETY-RAZOR.—L. BRUNACCI, New York, N. Y. In this case the invention relates to safety razors, and the object is to produce a razor of simple construction having blades operated by electrical means, and shielded in such a way that they may be applied to the face without danger of cutting the skin.

Of Interest to Farmers.

MANUAL PLANTER.—S. A. SIERRA, Caracas, Venezuela. The device embodies a seed box, a discharge chute extending above the bottom of the box having an opening, and an elevator having a seed holder, means forcing the elevator downwardly and normally retaining the seed holder at the bottom of the box, and means for raising the elevator against the tension of the last-mentioned means to bring the holder into register with the opening and deliver the seed into the chute.

MACHINE FOR DIGGING ROOTS.—T. H. MALEY, Goodhue, Minn. One purpose of the invention is to provide a machine especially adapted for eradicating the roots of quack grass, by which the roots are dug, conducted to the rear of the machine, and are there acted upon by strippers and delivered into a receptacle supported upon the frame of the machine at the rear.

HUSKING-ROLLER.—G. H. GEHRKING, Elk Mound, Wis. This invention pertains to corn husking and fodder shredding machines, and its object is to provide a pair of husking rollers, arranged to prevent crushing of the ear of corn, and to insure an easy gripping of the corn stalks, thus permitting of running the machine with a minimum expenditure of power.

Railways and Their Accessories.

TRACK-STRAIGHTENER.—M. E. LOEHR, Claypool, Ind. In view in this case is the combination of a cable, a member composed of two principal sections threaded together, one designed to be applied to a rail, the other to a cable, clamps for engaging the rail at opposite ends of the cable and having means for locking them to the rail when the cable is placed under tension, and oscillatory means operable in both directions of its movement to separate the sections of the member and force the rail and cable apart.

RAILROAD-TIE.—R. L. BOWER, Blandburg, Pa. The tie is formed of a sheet of metal rolled up into tubular form, and having overlapping portions on the top to render the tie exceedingly strong and to form firm seats for the rails, the tubular tie also having pairs of upwardly-extending members for receiving and holding rail fasteners and for determining the seats for the rails and consequently the gage of the track.

Machines and Mechanical Devices.

WIRE-TIER FOR BALING-MACHINES.—J. H. GREGORY and M. L. SIAS, Farwell, Mich. The aim in this invention is to avoid the necessity for using wire with a special head or loop, and to firmly secure together the plain overlapping ends of ordinary wire, the fastening operations being brought about by the movement of the material within the baling press.

PULP-SCREEN.—B. W. BOYD, Readsboro, Vt. In this instance the invention is an improvement in pulp screens of a simple and compact nature, adapted to effectively and rapidly separate the coarse product of pulp and such similar materials from the fine pulp and water, by centrifugal action.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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HOW TO MAKE AN ELECTRICAL Furnace for Amateur's Use.—The utilization of 110 volt electric circuits for small furnace work. By N. Monroe Hopkins. This valuable article is accompanied by detailed working drawings on a large scale, and the furnace can be made by any amateur who is versed in the use of tools. This article is contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 1182. Price 10 cents. For sale by MUNN & Co., 361 Broadway, New York City, or by any bookseller or newsdealer.

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Advertising in this column is 75 cents a line. No less than four nor more than ten lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Further information sent on request.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry **may** be repeated.

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FOR SALE.—Patent No. 909,585 Jan. 12, 1909. Train-order holding and delivering device for delivering orders to moving trains. Address L. J. Greene, Camden, Ga.

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FOR SALE.—An interest, or outright, a sanitary invention in the plumbing line. Now on the market. Address H., Box 773, New York.

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FOR SALE.—U. S. Patent No. 909,519. Canada Patent No. 115,693. Guard Rail Chair. No bolts, no creeping of guard rail. Guard rail not in way or disturbed when changing worn or broken main rails. Cash, or part cash and royalty deal. For full particulars address Eben P. Batchelder, Siskiyou, Ore.

Inquiry No. 8877.—For manufacturers of convex glass for pictures.

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PARTNER WANTED.—Who can furnish money to construct an airship as per my patent No. 909,681. For particulars address William Rumble, 1802 Crotona Avenue, New York.

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MISCELLANEOUS.

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Inquiry No. 8908.—For a dealer in tapes and cords for Venetian blinds.

Inquiry No. 8909.—For a machine to paint shade or blind rollers.

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Inquiry No. 8918.—For manufacturers of "Wydt's Electro-Catalytic Sparking Plug.

Inquiry No. 8920.—For a still for extracting alcohol from saw dust.

Inquiry No. 8921.—For the manufacturers of gilt paper.

Inquiry No. 8922.—Wanted the address of Worthington Boiler Co.

Inquiry No. 8925.—For an explosive turbine or rotary gasoline engine 6 or 8 H. P., must have a vertical shart.

Inquiry No. 8926.—Wanted to buy a tree digger of steel plates which are forced down beside the tree and locked in position.

Inquiry No. 8927.—Wanted to buy an apparatus for sterilizing water at the tap by an ozonizer.

Inquiry No. 8928.—For the manufacturers of a steam rotary excavator as described in the Scientific American of December 12, 1908, page 347.

Inquiry No. 8929.—For makers of automatic gates that can be opened without the driver of a vehicle getting out.

Inquiry No. 8930.—For the address of the manufacturers of revolving gasoline motors.

Inquiry No. 8931.—For parties who manufacture the Western Stump Borer for boring stumps.

Inquiry No. 8933.—Wanted to buy machinery for the manufacture of hair mattresses.

Inquiry No. 8934.—Wanted to buy seal and book of blank stock certificate.

Inquiry No. 8936.—Wanted machinery used to spin or wrap paper pencils in the manner that paper pencils are made.

Inquiry No. 8938.—For firms making rotary gasoline engines.

Inquiry No. 8939.—For parties who build ammonia cold storage for eggs.

Inquiry No. 8940.—Wanted to buy machine or bender for rounding angle iron, flat iron and round end oblong tanks.

Inquiry No. 8941.—For manufacturers of machinery for making fly screens.

Inquiry No. 8942.—Wanted to buy apparatus to enable anyone with rheumatism or other causes to hold a penholder.

Inquiry No. 8943.—Wanted a portable hand machine for breaking stones for installing road surface. To be worked by two or three men.

Inquiry No. 8944.—For the address of the manufacturers of the king or lever collar button.

Inquiry No. 8945.—Wanted address of manufacturers of casana starch machinery.

Inquiry No. 8946.—For the address of manufacturer or dealer of Floss cotton candy machine,

Inquiry No. 8947.—For the manufacturers of a machine to compel deep breathing called "Pneumaxeter."

Inquiry No. 8948.—For manufacturers of gearing, noiseless or otherwise, suitable for speed of 3,000 to 4,000 r. p. m, for wheels 5 inches diameter.

Inquiry No. 8949.—For manufacturers of a suction or vacuum street sweeper.

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Thill support, S. H. Story 911,775
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Threads by twisting, joining, W. R. Landfear 911,886
Threads, lustering and finishing silk, E. Pohl 911,906
Ticket holder, C. C. Gill 912,110
Ticket punch, C. B. Livermore 912,142
Tile ditching machine, E. A. Anderson 911,564
Time recorder, autograph, Cottrill & Leihammer 912,230
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Turbine, Ljungstrom & Forsberg 911,662
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Wrench, J. Ertel 911,814
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Wrench, C. B. Green 912,117
Wrench, J. Ryan 912,177
Wrist developer and strength tester, V. M. del Valle y Zeno 911,925
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Notice to Contractors.

SEALED PROPOSALS for dormitory at Inwood, construction including heating, plumbing and electric work, at St. Lawrence State Hospital, Ogdensburg, N. Y., will be received by the State Commission in Lunacy at the Capitol, Albany, N. Y., up to 3 o'clock P. M., on February 24, 1909, when they will be opened and read publicly. Proposals should be accompanied by a certified check in the sum of $750, and the contractor to whom the award is made will be required to furnish surety company's bond in the sum of $6,500. The right is reserved to reject any and all bids. Drawings and specifications may be consulted and blank forms of proposal obtained at the St. Lawrence State Hospital, Ogdensburg, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the State Architect, Franklin B. Ware, Albany, N. Y.

T. E. MCGARR, Secretary, State Commission in Lunacy.
Dated Albany, N. Y., February 1, 1909.

WANTED.—LABORATORIANS. Pay from $3.04 to $4.00 per diem. A competitive examination will be held simultaneously at the Navy Yards, Boston, Mass., Brooklyn, N. Y., Philadelphia, Pa., and Washington, D. C., March 24, 1909, for the purpose of establishing an eligible register of laboratorians. Applicants should make application to the Commandant of the Yard at which they desire to be examined.

ELECTRIC LAUNCH MOTOR.—THE design in this paper is for a motor of unusual simplicity of construction, which can easily be built by an amateur at small cost. It is intended for a boat of about 24 feet over all and 4 feet 6 inches beam, drawing 18 inches, and is capable of propelling such craft at a speed of 7 miles per hour. Illustrated with 21 cuts. See SCIENTIFIC AMERICAN SUPPLEMENT, No. **1202.** Price 10 cents by mail, from this office and from all newsdealers.

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"Bokert Water," for natural mineral spring water, Bokert Springs Mineral Water Co.	14,628
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"Corset Francais de Bon Ton," for corsets, Royal Worcester Corset Co.	14,640
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A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address **Munn & Co., 361 Broadway, New York.**

SMALL HOUSE NUMBER of AMERICAN HOMES AND GARDENS

THE artistic and inexpensive house is the chief demand of the home seeker of to-day. For that reason the April, 1909, number of American Homes and Gardens will be a **SPECIAL SMALL HOUSE NUMBER.**

This issue will contain a vast amount of valuable information for the prospective home builder. It will tell him how to select a country site, how the various rooms of the house should be planned; the style of architecture in which the house should be designed; the material of which it may be built; the kind of plumbing fixtures to be used; the heating system to be selected; the choice of the hangings for the walls, doors and windows; appropriate furniture for the home; the interior decoration of the home; and the laying out of the grounds surrounding the house, as well as the planting of them.

THE ARTISTIC EXPRESSION OF THE SMALL HOUSE is well explained in an article by Francis Durando Nichols, illustrated with fifty engravings showing exterior and interior views and floor plans of a group of model houses of small size and small cost.

PLUMBING FOR A SMALL COUNTRY HOUSE, by John A. Gade, is a very important subject. No part of a house needs greater attention than the laundry, kitchen and bath room. Hence the economic and convenient placing of the plumbing fixtures, the kind to use, and the cost of the same are matters of interest to all prospective home builders.

THE MAKING OF AN IRIS GARDEN, by Samuel Howe, is an illustrated article showing how a swamp or lowland can be developed and transformed into a beautiful iris garden.

DECORATIVE FEATURES IN THE SMALL HOME, by Alice M. Kellogg, presents in a brief way with ten illustrations artistic schemes of covering the floors and walls of the house, harmonious and appropriate hangings for the doors and windows, with numerous suggestions for the decorating of the various rooms of the house.

A GROUP OF MODEL MOTOR HOUSES FOR THE SMALL COUNTRY PLACE, by Ralph de Martin, forms two pages of illustrations and sets forth the best designs for a small motor house suitable for the accommodation of one motor car and with sufficient space for a work bench.

HOME-MADE NOVELTIES FOR THE COUNTRY HOUSE, by Mabel Tuke Priestman, treats of the conversion of unlikely things into useful articles, and the illustrations show the results.

THE EVOLUTION OF THE SMALL HOUSE PLAN, by Joy Wheeler Dow, is an important article by a well-known architect on the economic planning of a small house, costing from $2,500 to $8,000. The plan and the arrangement of the rooms is the first thought given to the house and is one in which the layman should be most interested.

A FORMAL GARDEN AND PERGOLA, DESIGNED BY AN AMATEUR, by Alexander R. Holliday, informs the reader how an amateur planned and laid out his garden and how he built his pergola. Illustrated with plans and scale drawings.

PROPER FURNITURE FOR THE SMALL HOUSE, by Esther Singleton, with illustrations showing the artistic and appropriate furniture for the house, and the proper position in which it is to be placed, together with an accurate treatment of the fireplace and mantel.

THE USE OF CONCRETE IN THE BUILDING OF A SMALL COUNTRY HOUSE, by Benjamin Howes, is a timely and comparatively new subject, and is one in which much interest is shown at the present moment. The article is profusely illustrated with fifty engravings showing exterior and interior views and floor plans of small houses of various styles of architecture in which concrete is used with artistic results.

THE HEATING APPARATUS FOR THE SMALL COUNTRY HOUSE, by Allyn Frogner, is the title of an article treating in a practical manner one of the most important features of a small country house. How to heat and what is the cost? That is a question which has been well answered for the three respective systems of hot air, steam heat and hot water.

PROBLEMS IN PLANNING THE GROUNDS OF A SMALL COUNTRY PLACE, by Charles D. Lay. Mr. Lay has explained in a very concise form how the grounds around a small country place may be planted at a very low cost, and enumerates the best and most effective shrubs and plants to be used.

This **SMALL HOUSE NUMBER** will contain 165 illustrations covering 52 pages, which will be inclosed in a striking colored cover.

The price will be fifty cents. Those now subscribing for American Homes and Gardens for the year will receive it at the regular rate. Subscription price $3.00 a year.

MUNN & COMPANY, Publishers, 361 Broadway, New York City

Collier's

The National Weekly

COLLIER'S has made a place for itself with every one interested in the automobile. By pen and picture it has stimulated the industry and this is why among magazines Collier's has maintained a particularly strong position during the past six years, leading all mediums every year excepting one. (See table below.)

COLLIER'S is worthy of the minute study of every automobile advertiser who seeks a broad, national market. It invites inquiry and the opportunity to submit more facts which can not fail to be interesting.

The readers of Collier's pay over $2,500,000 a year in subscriptions. This is the largest subscription income obtained by any publication. Our readers can and do afford the best.

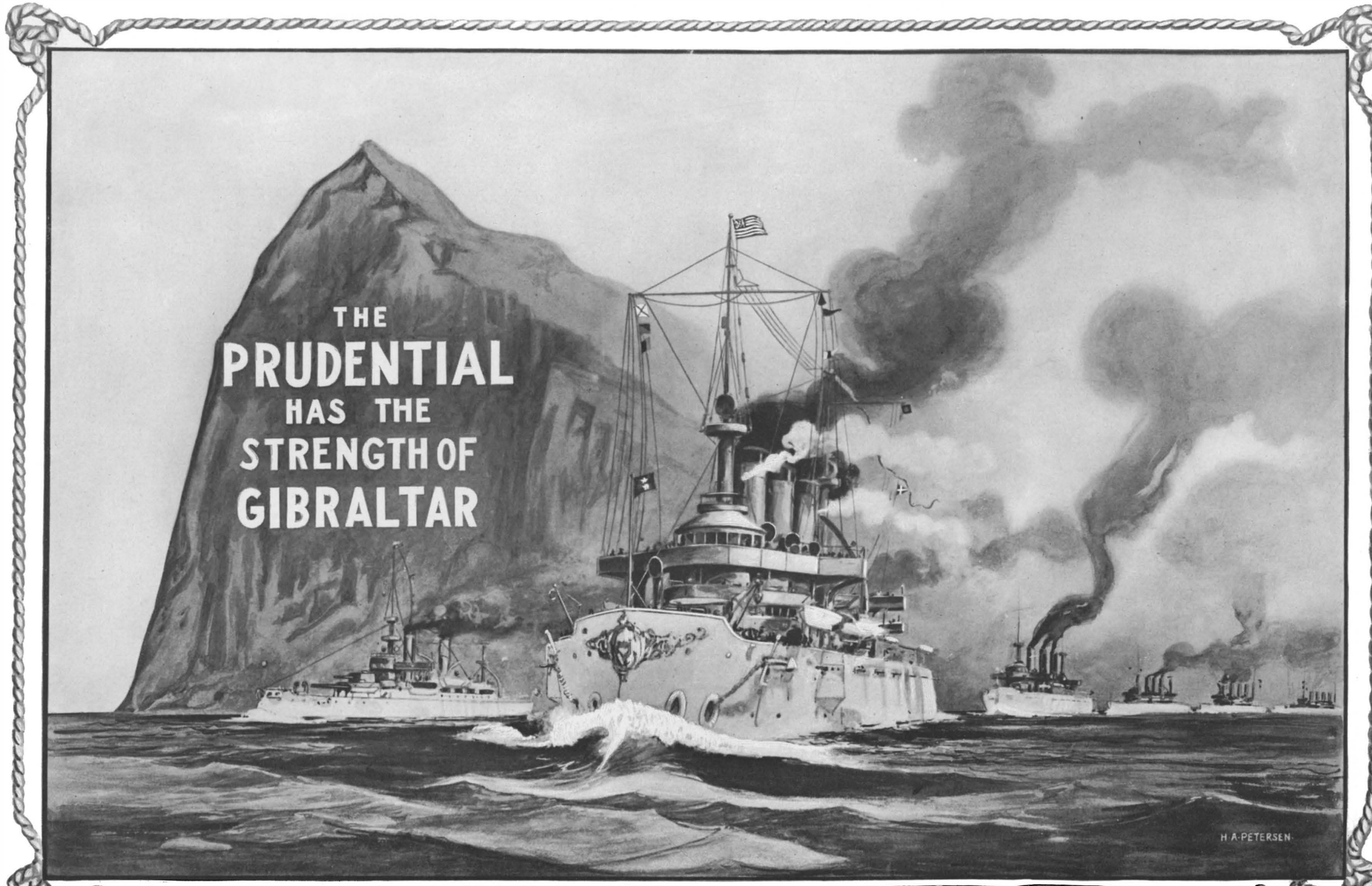
Where Automobile Manufacturers Place Their Advertising

The figures show the total number of agate lines of automobile advertising published by the five leading mediums during the past six years.

1903	Lines	1904	Lines
Collier's	30,585	Collier's	32,503
S. E. Post	23,585	S. E. Post	29,030
McClure's	20,136	McClure's	26,244
Harper's	18,098	Harper's	22,396
Scribner's	16,453	Life	20,350
1905		**1906**	
Life	45,378	Collier's	45,956
Collier's	45,239	Life	38,691
McClure's	33,480	McClure's	36,116
S. E. Post	31,548	Everybody's	27,188
Harper's	29,568	Century	26,614
1907		**1908**	
Collier's	50,591	Collier's	36,511
Life	43,908	S. E. Post	32,027
Country Life	29,172	Life	31,054
McClure's	27,566	McClure's	18,161
Scientific American	25,133	Everybody's	17,753

These figures, covering a period of six years, are an indication of how the Automobile industry ranks the leading advertising mediums.

E. C. PATTERSON
Advertising Manager
NEW YORK BOSTON CHICAGO



The FLEET PROTECTS *the* NATION — PRUDENTIAL LIFE INSURANCE PROTECTS *the* HOME

A copy of this inspiring picture in colors will be sent free if you will write, requesting it, to Dept. 121, The Prudential Insurance Company of America. John F. Dryden, President. Home Office, Newark, N. J.

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