

Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

(Established 1845.)

One copy, one year, for the U. S., Canada or Mexico.....\$3.00
One copy, six months, for the U. S., Canada or Mexico..... 1.50
One copy, one year, to any foreign country, postage prepaid. 4.00

The Scientific American Supplement

(Established 1876)

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, \$5.00 a year for the U. S., Canada or Mexico, \$6.00 a year, or \$1 1/2 s. d. to foreign countries belonging to the Postal Union. Single copies 10 cents.

Building Edition of Scientific American.

(Established 1883.)

THE BUILDING EDITION OF THE SCIENTIFIC AMERICAN is a large and splendidly illustrated periodical, issued monthly, containing floor plans and perspective views pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety.

Export Edition of the Scientific American

(Established 1878)

with which is incorporated "LA AMERICA CIENTIFICA E INDUSTRIAL," or Spanish edition of the SCIENTIFIC AMERICAN, published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number contains about 100 pages, profusely illustrated.

The safest way to remit is by postal order, express money order, draft or bank check. Make all remittances payable to order of MUNN & CO.

Readers are specially requested to notify the publishers in case of any failure, delay, or irregularity in receipt of papers.

NEW YORK, SATURDAY, JULY 16, 1898.

Contents.

(Illustrated articles are marked with an asterisk.)

Acetylene gas exhibition 39
American and Spanish warships, analysis of 35, 38
Antarctic exploration 39
Ball bearing* 36
" Bourgoigne," loss of 34
" Brooklyn," cruiser* 41
Camera, magazine land* 36
Cervera's fleet, destruction of 34
Commerce, our foreign 35
Cruiser " Brooklyn " 40
Hospital ship " Relief " 35
" Brooklyn," cruiser* 41
Inventions recently patented 44
Lightning explodes mines 39
Locomotives, geared* 33, 39

TABLE OF CONTENTS OF Scientific American Supplement No. 1176.

For the Week Ending July 16, 1898.

Price 10 cents. For sale by all newsdealers.

I. BOTANY AND HORTICULTURE.—Sinningia Concinna (Stenogastra Concinna).—1 illustration..... 18891
II. CIVIL ENGINEERING.—A Proposed Mountain Railroad for the Tyrol.—3 illustrations..... 18854
III. COMMERCE.—Trade and Industries in the Philippine Islands..... 18862
IV. ECONOMICS.—The Right to Property in an Idea..... 18854
V. FORESTRY.—Historical and Mythological Trees..... 18860
VI. MARINE ENGINEERING.—The Spanish Battleship "Pelayo."—8 illustrations..... 18847
The Transport "Alphonso XIII."—1 illustration..... 18850
The Loss of the French Steamer "Bourgoigne."—1 illustration..... 18851
VII. MEDICINE AND SURGERY.—Military Medical Services in Cuba..... 18852
The Causes of the Explosive Effect of Small Caliber Bullets.—3 illustrations..... 18858
Variations in the Form of the Heart.—7 illustrations..... 18858
VIII. MICROSCOPY.—Notes on Microscopical Technique..... 18853
IX. MISCELLANEOUS.—Engineering Notes..... 18857
Miscellaneous Notes..... 18857
Selected Formulae..... 18857
X. PHOTOGRAPHY.—Animated Pictures..... 18862
XI. PHYSICS.—The Bolometer.—By Dr. S. P. LANGLEY..... 18853
XII. TECHNOLOGY.—Colors Used in the Manufacture of Soap..... 18851

CONTENTS

Of the July Number of the SCIENTIFIC AMERICAN, BUILDING EDITION.

(Illustrated articles are marked with an asterisk.)

Advice to young architects 3
Architectural carvings, novel design for* 18
Arts Club, the 2
Boilers, "Kewaunee" 18
Builders' transit* 17
City colonial architecture* 3
Cleaning varnished and antique furniture 17
Cottage at Woodmont-on-the-Sound, Conn.* 4, 15
Deadlock over the Public Library 2
Dwelling, modern, at Scranton 15
Dwelling, modern, at Derby, Conn.* 14, 15
Dwelling, modern, at Bokota, N. J.* 5, 16
Electric mail delivery 18
Expansion bolt* 18
Hygiene of the stable 2
Heaters, "Little Giant" 18
Incline elevator at Park Hill, N. Y. 8, 9, 16
"Mineral wool" for houses* 18
Money in waste lands 17
Pipe laying without excavation 16
Prize for a design for artisans' homes 2
Registration of architects in Illinois 16
Residence at Lawrence Park, Bronxville, N. Y.* 15
Residence at Bath Beach, L. I.* 10, 16
"Rock Villas," a double residence at Park Hill-on-the-Hudson, N. Y.* 12, 15
Roman monoliths 17
Row of six modern dwellings at Bensonhurst, L. I.* 13, 16
School for animal painting and sculpture in the New York Zoological Park 2
Staining bricks 17
Steam heater, the "Royal Torrid" 17
Strength of white pine, bricks and stone 17
Treatment of oak parquet floors 17
Water lift, new* 18
Work of sculptors abroad 16

Subscription, \$2.50 a year Single copies, 25 cents.

THE DESTRUCTION OF CERVERA'S FLEET.

Before the opening of the present war the world was asking whether the destructiveness of our weapons of naval warfare was as great as theoretically it could be proved to be. The question has already been answered in two hemispheres. At Manila a fleet of nine cruisers, fighting beneath the shelter of friendly fortifications, was annihilated in the course of a single morning; at Santiago de Cuba as fine a squadron as ever sailed the sea, comprising four swift armored cruisers and two of the largest and most powerful torpedo boat destroyers in the world, was wiped out of existence in less than sixty minutes.

It is remarkable that in both cases the beaten fleet was overwhelmed by the same element of a ship's offensive powers—the gun. In neither case was there any call for the services of the ram or the torpedo.

The war between China and Japan gave us an inkling of the importance of the gun in modern naval warfare. Manila and Santiago have established it as par excellence the deciding factor (always supposing, of course, that it is well handled) of the sea fight of the future. Had it not been for the accuracy, heavy caliber and great carrying power of our guns, the speedy ships of Admiral Cervera's fleet would now be anchored in Havana Harbor, and our whole plan of campaign, both naval and military, would have been upset. As it is, thanks to the splendid marksmanship of our men, we were able to "wing" the flying cruisers, close in with them, and complete their inevitable destruction.

Just why Cervera elected to run the gauntlet of our fleet is a matter of speculation. Either he foresaw the speedy fall of Santiago and feared to be caught between the guns of army and navy, or, as is reported, he acted under the instructions of General Blanco to make a dash for Havana Harbor. There was much to be gained by such a move if it could be successfully carried out. Once out of Santiago, Cervera's fleet would have constituted a serious menace to our communications, and its escape would have removed the ostensible object for which the army was landed, namely, the capture of the fleet. The center of operations would have been transferred to Havana, where the strength of the Spanish army is gathered, and the system of defense is by this time enormously strong.

Whatever the cause, the fact remains that, after taking on as full supplies as were obtainable, the fleet moved at full speed out of the harbor, and attempted to break through the blockading fleet by steaming along the coast to the westward. Its chances of escape were good, all things considered. The four cruisers, "Christobal Colon," "Teresa," "Oquendo," and "Viscaya," were all of 20 knots speed, the last, indeed, having made 21 knots on her trial, and the destroyers, "Furor" and "Pluton," were supposed to be good for 28 and 30 knots. Against them were the "Iowa," 17-1 knots; "Oregon," 16-8 knots; "Texas," 17-8 knots; and the "Brooklyn," 21-9 knots, together with a couple of converted yachts of 16 or 17 knots speed. Our ships were lying some 2 1/2 miles from the entrance, and, as the Spanish ships turned sharply to the west and hugged the coast, their escape from all but the "Brooklyn" was assured, unless they could be brought down by some well-placed shells. Moreover, judged by the canons of modern warfare, the possession by the Spaniards of powerful and numerous rapid-fire batteries gave them a decided advantage in a running fight, for, by concentrating their fire on the unarmored ends of our ships, they should have been able to retard their speed to such an extent as to make their own escape certain.

They came out of the harbor with every gun shotted and opened a heavy fire as they steamed past, the attack being concentrated on the "Iowa," as being the most formidable ship of the fleet. The plan of battle was to disable the "Iowa" and draw after them the swifter "Brooklyn," hoping to close in and cripple her when they had drawn away beyond range of the heavy guns of the battleships.

The plan, so far as the ships were concerned, was feasible. Had the conditions been reversed, and the Spanish fleet been in American hands and vice versa, it would undoubtedly have been successful. As it was, American gunnery won the day, and won it in very short order. In less than twenty five minutes from the moment that the bow of the "Christobal Colon" first showed at the mouth of the harbor two of the Spanish ships had been driven on the beach; in less than three-quarters of an hour another had surrendered, and in fifty-six minutes, according to one of the officers on the "Iowa," the whole fleet of six ships had been driven in a sinking condition upon the coast.

The Santiago fight has served to blast the reputation of the torpedo boat destroyer, which had already been shaken by the repulse of the "Terror" a few days before at San Juan by the ocean liner "St. Paul." The converted yacht "Corsair," now the "Gloucester," engaged these two vessels with such success that one of them, at least, appears to have been sunk by her fire. It is true the destroyers were designed for attacking torpedo boats, and their opportunities for offensive operations against larger craft are supposed to be con-

finied to foggy weather and dark nights. Yet we cannot but feel that with their great speed something might have been done, even on this bright Sunday morning. As it is they have proved the easiest kind of prey for ships which have only recently and hastily been converted from uses of pleasure and commerce to those of war.

We spoke last week of the undying value of the personal equation in modern warfare. Santiago adds its eloquent testimony to the truth that to-day, as of old, it is the "man behind the gun" that wins the fight.

OUR ARMY AT SANTIAGO.

The rank and file of the American army has again demonstrated its ability to fight its way to success through and in spite of difficulties that might well have dismayed a veteran army. In estimating the work done by our men in the fighting of Friday and Saturday, July 1 and 2, we must remember that they were not only attacking seasoned troops entrenched in strongly fortified positions, but the attack was made under a tropical sun and in a climate which is known to be one of the most trying in the world. The difficult nature of the country prevented the bringing up of supplies fast enough to provide the troops with full rations, and the execrable condition of the roads rendered it impossible to bring to the front sufficient artillery to cover the advance of our attacking columns.

In view of the frightful cost in killed and wounded at which the heights were stormed and taken, much of it due to the shrapnel which was used with deadly effect by the Spanish artillery, it will be asked why the attack was not deferred until we had time to bring up an adequate number of guns to silence the enemy's batteries and properly cover the advance of our men. It is probable that the deadly nature of the climate, and the desire to attack before our ranks had been thinned by sickness, had much to do with the precipitancy with which our troops were rushed against the Spanish entrenchments.

But without entering into criticisms which must at best be based upon partial information, the country may feel a just pride in the splendid fighting qualities displayed alike by our regular and volunteer regiments. The taking of El Caney and the storming of San Juan heights have shown that the combined dash and steadiness which were conspicuous on both sides in the great Civil War may still be counted on to win the country's battles when we are called on reluctantly to take up the sword.

It was a soldier's fight, in which the gallant leadership of the officers met a noble response from the men; and the heroism of those two days is witnessed by the endless stream of dead and wounded that moved slowly to the rear during the long hours of that memorable struggle.

THE LOSS OF THE "BOURGOGNE."

Our readers are already familiar with the harrowing details of the loss of the "Bourgoigne," with 560 lives, in the North Atlantic. We have no intention of entering into a discussion of her general features of the disaster further than to observe that, as contrasted with the detestable cowardice and villainy of the crew, it is a mournful gratification to know that the officers did their duty to the last and to a man perished with the ship.

The awful suddenness with which the ship went down as the result of the complete failure of her watertight compartments will shake the confidence of the public, already rudely strained, in the system of watertight bulkheads as a means of keeping an injured vessel afloat. The "Oregon," the "Elbe," and now the "Bourgoigne" testify that, however perfect it may be in theory, the subdivision of a modern liner is not a sure guarantee against foundering.

We wish to draw attention to one feature of the wreck which is very suggestive, and indicates that there is a faulty element in the arrangement of the bulkheads which may have been answerable for their failure to keep the vessel afloat. We refer to the fact that the ship commenced to heel heavily from the moment she was struck, and that the decks before she went down were inclined at an angle of 45°. This heel was due to the fact that the longitudinal bulkhead which divides a ship from stem to stern into two equal halves prevented the inrushing water from passing clear across the vessel, and threw her out of trim. As the heel increased, the water must have risen above the lower and possibly the upper row of gangways and portholes, and finding its way in through these it must have hastened to the end.

It was the longitudinal bulkhead that caused the British battleship "Victoria" to capsize after she was accidentally rammed by the "Camperdown." Had the water been free to flow clear across the vessel, she might have sunk until her bow was almost awash, but it is probable that she would have kept afloat long enough to be towed into harbor or run ashore. As it was, the starboard compartments being filled, while those to port were empty, the ship was thrown over to starboard until the water, rushing in through the gunports, completed the capsize.

It is a question well worth considering whether th

safety of a vessel would not be better secured by making the transverse bulkheads more numerous and dispensing with the longitudinal bulkhead except as a division between the engine rooms. In this case, if a couple of compartments were filled by the smashing of a bulkhead in collision, the ship would be filled clear across from side to side, and she would merely settle low in the water, without any dangerous list to one side or the other.

The question is well worth the careful consideration of our marine architects and builders.

OUR FOREIGN COMMERCE.

The most remarkable eleven months in the history of American commerce is graphically told in the last summary prepared by the Bureau of Statistics, which has appeared a month earlier than is usual with these tabulations. Ordinarily this pamphlet is rather dull reading to all who are not in any way interested in finance or commerce, but the present issue contains remarkable figures, which are startling to all who have not closely watched the fiscal year which has just drawn to a close. These figures show in brief that our exports more than doubled the imports, and more manufactured goods are exported than are imported, and more gold has been brought into the country than in any preceding year.

An analysis of the tables is interesting, especially in view of the fact that for many months we have had the menace of war hanging over our heads, and some of the time actual warfare, which usually tends to decrease export trade; but this has not been the case in the period we are considering.

During the eleven months ending with the last day of May, 1898, our imports of free and dutiable merchandise amounted to \$563,770,032, against \$679,547,391 for the corresponding period of 1897. This is offset by the export of domestic goods to the amount of \$1,117,284,973 in 1898, against \$960,120,120 in 1897. In other words, foreign countries owe us \$553,501,941 for the value of goods which they received from us in addition to the goods which they have sold us for our consumption, or \$280,572,729 increase in a year.

The ratio of imports to exports is best told by the annexed tables:

IMPORTS INTO THE UNITED STATES.		
	Value.	Per cent.
Articles of food and live animals.....	\$164,666,161	29.42
" in a crude condition.....	186,852,835	33.14
" manufactured for the mechanic arts.....	64,190,123	11.39
" for consumption.....	75,930,142	13.47
Luxuries, etc.....	72,130,771	12.58
	\$563,770,032	100.00

EXPORTS FROM THE UNITED STATES.		
	Value.	Per cent.
Products of agriculture.....	\$795,114,328	71.17
" manufactures.....	261,655,784	23.42
" mining.....	17,831,022	1.59
" forest.....	34,049,528	3.05
" fisheries.....	5,203,499	0.46
" miscellaneous.....	3,430,812	0.31
	\$1,117,284,973	100.00

The greatest reduction in the imports considered by classes was in manufactured articles ready for consumption, which fell off from \$117,352,182 in the eleven months of 1897 to \$75,930,142 in the same period in 1898. For the first time American exports of manufactured articles are exceeding imports, which is of deep significance, owing to the special facilities for manufacturing which Europe affords because of the cheapness of labor and the utilization of water power, cheap fuel, etc.

Of the \$563,770,032 worth of articles imported into the United States, \$267,448,136 came in duty free, or 47.44 per cent of the total imports. The duties collected on the \$296,321,896 worth of goods which were subject to duty amounted to \$135,263,865, a falling off of \$19,492,376, a sum which we can readily spare when we think of the splendid balance of trade in our favor.

The tables are capable of more minute analysis, but this would probably be fatiguing to the average reader, and the 1878 pages in the annual volume to date may well be left to the statistician; it is enough for the average reader to know and rejoice that in our year of trial over \$550,000,000 has been or is to be paid to us, so that we are receiving nearly \$2,000,000 for each working day, a truly magnificent sum to be charged up on the credit side of the ledger.

THE HOSPITAL SHIP "RELIEF."

The War Department has had this vessel fitted up in the most approved style for the comfort of the sick and wounded soldiers in the army. The ship is divided into five large wards and contains besides store rooms, mess rooms, operating rooms and officers' quarters. There is also a complete equipment of every appliance known to modern medical or surgical science including, among other things, two complete X-ray outfits, a microscopic laboratory, perfect facilities for photographing, and electrical apparatus of various kinds. Electrical fans everywhere abound to fan the sick.

The wards are models in their way. The walls are painted white, the floors covered with rubber tiling, and the beds of iron, enameled white.

Baths abound; they are connected with all the

wards, with all the private quarters of the medical staff and with those of the ship's officers. There is a special shower bath for sick officers, and it is so arranged that the shower throws hot or cold, fresh or salt water. All the bath rooms have rubber floors.

The ship sailed recently for Santiago de Cuba, where it will be most useful and acceptable to our soldiers injured in the battles about that place.

It is probable this will be the first extended use of the X-ray apparatus in war, and reports of its success will be watched with interest.

"THE ENGINEER'S" ANALYSIS OF AMERICAN AND SPANISH WARSHIPS.

In our issue of May 7 we replied to an article in The Engineer, which compared the Spanish and American navies in respect of the speed and batteries of their fighting line. It will be remembered that The Engineer gave figures to prove that the Spanish line of battle was superior in every respect but that of total displacement. Its energy of fire per minute was estimated at 1,529,516 foot-tons, as against 1,120,323 foot-tons for our own, and its average speed 23.67 knots, as against 19.63 knots for our ships. In our reply we showed that, if the same types of ships as The Engineer had selected in making up the Spanish line were included in the American line, the table would be reversed. By offsetting our protected "Cincinnati" and "Marblehead" class against the Spanish protected "Alfonso XIII." and "Lepanto" and including the monitors (The Engineer included the Spanish but omitted the American protected cruisers, ignored the monitors altogether and forgot to mention the "Oregon" and "Texas"), we showed that the energy of fire of our line would be raised from 1,120,323 foot-tons to 2,820,883, and that on every point save that of speed we possessed a considerable superiority.

Since these articles were penned, the naval engagements of Manila and Santiago have been fought. A dozen sunken hulks in Cavite Bay and half a dozen more strewn along the southern coast of Cuba are the Spanish fruits of a struggle out of which our ships have come at the cost of one man killed, scarce a dozen wounded, and not a ship even temporarily disabled.

The Engineer made a strong point of the fact that our fighting line was practically devoid of rapid-fire guns, and in our reply we showed that not only were forty-two of these weapons carried on the ships enumerated in its tables, but that the protected cruisers, which should have been included, carried forty of these weapons, making eighty-two in all.

In reply to our criticism, The Engineer has published in its issue of June 10 an exhaustive comparison of our own battleships and armored cruisers with those of the leading naval powers in respect of the energy of their heavy rapid-fire armament. Our contemporary admits the truth of our corrections, except as regards the rapid-fire armament of our battleships, and to substantiate its position enters into a careful review of the present status of our own and other battleships and armored cruisers in this respect. Inasmuch as The Engineer limits the discussion to battleships and armored cruisers only, the article which we reprint cannot be considered as an answer to our reply. We take it that, with Manila and Santiago in mind, The Engineer is now willing to admit that both on paper and in fact we have established the superiority of our fleet over that of the plucky but badly worsted Spaniards. We publish The Engineer's article in another column, both for its own intrinsic interest and for the reason that it draws attention to a fact which we as a nation shall do well to carefully take note of, namely, the enormous development of rapid-fire batteries in the later warships of the world.

While we do not attempt to deny and have, indeed, always deplored the fact that our battleships, as distinct from our cruisers, are weak in rapid-fire energy, it is but fair to point out that the "Indiana," "Massachusetts," and "Oregon" were authorized as far back as 1890, or previous to the period in which, as The Engineer shows, the rapid-fire gun was introduced. The special, we had almost said the sensational, feature in these ships is the battery of eight 8-inch guns with which they are equipped. The guns are carried behind 6 inches of Harveyized steel, at an altitude of 26 feet above the water line, and even the most ardent advocate of the rapid-fire gun must admit that these 40-caliber guns, with their armor-piercing capacity, high command, great carrying power, and good protection, are a fair offset against the unprotected rapid-firers of other navies.

This, at least, is the lesson taught by the brief 55-minute engagement off Santiago. The 6 and 5.5-inch rapid-fire batteries of the four armored Spanish cruisers should have made our gun-positions untenable, yet all the damage done to our fleet in that artillery duel of 55 minutes was a few shot holes and one man killed. Meanwhile our 12 and 8-inch guns were crashing through 12-inch armor belts, crippling engines and boilers, and driving the Spaniards to beach their ships in the endeavor to escape foundering in deep water. Verily the armor-piercing gun has received its vindication, and another argument is placed in the mouths of those

naval men (and they are not a few) who deplore the passing of the 8-inch gun and its substitution by the 6-inch rapid-firer.

We can anticipate the reply which will be made by our contemporary, to the effect that the full potentiality of a gun can only be realized when there is a marksman behind it. We know that the Spaniard has the reputation of being a notoriously bad gunner, and that in this conflict the value of the technical lessons to be learned is greatly lessened by the woful inaccuracy of Spanish marksmanship. At the same time, after making due allowances, the naked fact remains that the Spanish ships, with their rapid fire batteries, are strewn along the Cuban coast, while the ships that were weak in this type of weapon have scarcely a scratch to show for the conflict.

There is fashion even in such an unsentimental matter as warship design, and it is the fashion just now to develop the rapid-fire gun to a point at which it is the chief element of offense in the ship. Our new battleships will be conspicuous examples of this tendency, and their broadside batteries of fourteen 6-inch rapid-firers will place them in the very front rank among modern warships.

At the same time there is every reason why the four 6-inch slow-firers on the "Indiana" and her type should be replaced with rapid-fire weapons. Their offensive power would be quadrupled by the change. Moreover, we hope that one of the first changes to be made at the close of the present war will be the substitution, in every case, of rapid-fire weapons for the slow-firers, which are still to be found on some of the crack cruisers of our navy. The change was urgently recommended by Ex-Assistant Secretary of the Navy Roosevelt, and has been carried out on ships like the "Chicago," which are now undergoing refitting at our navy yards. When a similar change has been made on the "Baltimore," "San Francisco," and others of their class, the fighting efficiency of these ships will be increased fully fifty per cent.

Limitations of space forbid our discussing this very live question at further length in the present issue, but we hope in an early issue to take up the matter at fuller length and show the exact status of our ships in respect of rapid-fire armament.

On the question of "feeding" the guns, concerning which our contemporary asks for enlightenment, we follow its excellent rule of withholding information on such an important question until the international sky is less overcast. When the present war is over, we shall be prepared to say more upon this question.

The Floating Machine Shop "Vulcan."

The floating machine shop of the United States navy has been named the "Vulcan," and this vessel is now with Admiral Sampson's fleet and was ready to repair any damage which might have been sustained at the hands of Admiral Cervera; but it is likely that now she will devote her attention to saving some of the wrecked vessels in conjunction with the wrecking companies. It is said that \$300,000 was spent in altering and equipping this vessel. Officially the "Vulcan" is an engineers' repair ship, and formerly she was the steamer "Chatham." Shortly before the war, Engineer in Chief Melville recommended that two vessels be purchased which could be transformed into engineers' repair ships and attached to the Atlantic and Flying squadrons. Only one steamer was purchased by the Auxiliary Board, and she was transformed at the Boston navy yard. While the ship is not intended for fighting purposes, she carries two rapid-fire 6-pounder guns. The "Vulcan" is to follow in the wake of the fleet, and she has a large coal capacity which will give a wide radius of action. She will also supply fresh water to other vessels and make such repairs as may become necessary. The bow of the boat is devoted to a stock room; back of this is the blacksmith shop, foundry, and machine shop. There are also evaporators and distillers of a capacity equal to a daily output of 10,000 gallons of water. There is a complete foundry with a cupola, which will enable castings to be made on the boat. She has two steam cranes with 10 foot arms, which are especially designed for moving weights from a man-of-war and for transferring machinery to a disabled ship. There are also plate-bending rolls, punches, shears, lathes, planers, drills, milling machines and other machine tools, which will enable them to repair the hulls, engines, and boilers or guns. The "Vulcan" carries a large complement of first-class mechanics, and the repair shop has some of the finest engineers in the country. It is doubtful if any vessel has yet started out to war which has carried such a large complement of well-trained and well-educated men. The "Vulcan's" captain is Lieut.-Commander Ira Harris, who has been general manager of the Chicago Drop Forge and Foundry Company. The chief engineers are Gardiner Sims, the head of the Armington-Sims Engine Works, of Providence, Rhode Island, who has thirty of his best mechanics aboard, and Prof. Aldrich, of the University of Virginia, one of the best electrical experts in the country. Out of her entire crew of two hundred men, ninety-two have the right to wear the officer's cap.