SCIENTIFIC AMERICAN

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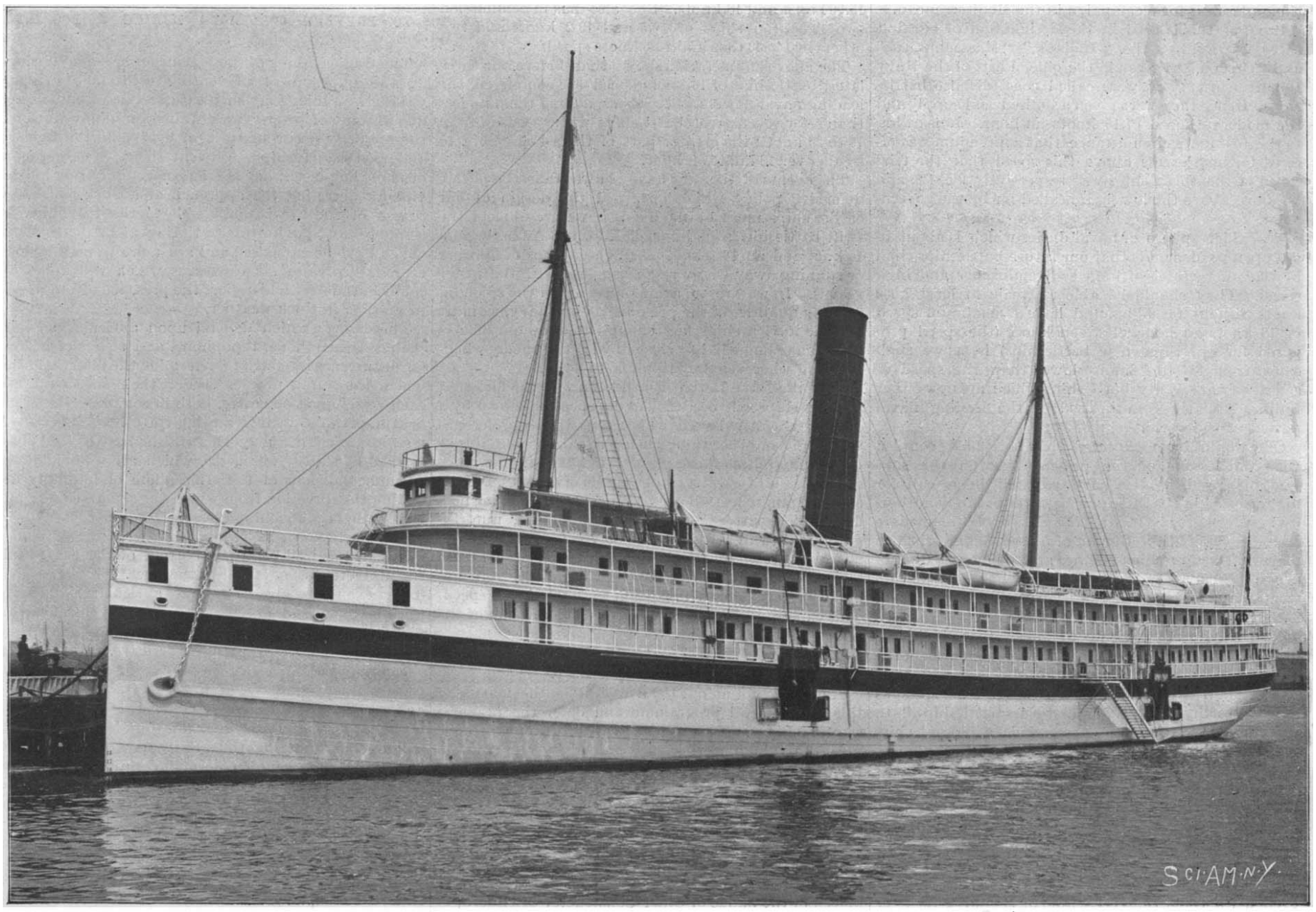
MAIN DECK, FORWARD WARD OF "RELIEF."



Photograph by E. Muller.

UNITED STATES ARMY HOSPITAL STEAMSHIP "RELIEF."—[See page 88.]

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NEW YORK, SATURDAY, AUGUST 6, 1898.

HIGHER SPEED FOR OUR NEW BATTLESHIPS.

The country has every reason to be proud of the achievements of its navy. From the very day that war was declared its operations have been brilliantly successful. We have seen one fleet of the enemy wiped out of existence by our protected cruisers, and later have witnessed our battleships administer a crushing defeat to one of the finest and most modern squadrons of armored cruisers and destroyers that ever sailed the seas. Moreover, our ships have been doing things which by all the sacred canons of modern naval warfare they should never have attempted. Protected cruisers, as at Manila, have forced their way past shore batteries, and have not only dared to engage them, but silenced them. Battleships have chased and overhauled fast cruisers, while a converted and unprotected yacht has boldly engaged two of the omnipotent torpedo boat destroyers and promptly sent them to the bottom.

Evidently our ships have done all and more than they were designed to do.

Looking to the future, we must endeavor to build up our navy with strict reference to the new responsibilities which have fallen upon us as the result of the war. When we entered upon the construction of our new navy we had no distant possessions to guard. The Hawaiian Islands, Cuba, Porta Rico and the Philippine Islands were not in our thoughts. It was considered that the duties of the navy, at least as far as the battleships were concerned, would be confined to the defense of our own coastline. No one would have dared to suggest that within the next decade we should be fighting the battles of Manila and Santiago, and fitting out a fleet for a campaign in the Mediterranean.

Proof of this is seen in the designation of our first three battleships, the "Indiana," "Massachusetts," and "Oregon," as given in the official lists of the Navy Department. They were called coast defense battleships. Hence they were given a limited coal supply and the moderate speed of 15 knots an hour. It is owing to the fortunate circumstance that a premium was offered for any excess above this speed that the trial speed of the three ships was respectively 0·5, 1·2, and 1·8 knots above the low figure called for by the government.

The wider sphere of naval duties which is about to fall upon us demands that our future battleships shall be sea-going vessels of large coal endurance and high speed. They should be able to steam at least 7,500 knots without recoaling, and have a maximum speed of 18 knots an hour. Sixteen knots (the speed proposed for our three new battleships) is, as we shall show, from 1½ to 4 knots slower than the speed of some sixty or seventy battleships which are now either built, building, or authorized by the leading naval powers of the world.

One would have expected that this fact, coupled with the lessons of the present war on the subject of speed, would have resulted in a call for higher speed in the three new battleships lately authorized by Congress. It was the desire of Commodore Melville, Chief of the Bureau of Steam Engineering, to place in the new ships engines and boilers capable of driving them at 18 knots an hour; but, for some inscrutable reason, the proposition was overruled, and designs were drawn up for 16-knot ships.

Now we do not hesitate to affirm that while the armor and armament of these vessels render them the most powerful fighting machines in the world, they will be so greatly handicapped by their slow speed as to be unworthy of the title "first-class battleships." In these days of 18 to 20 knot armorclads, a 16-knot ship, we care not how heavy her armor or armament, must be relegated to the second class, for the limited duties of coast defense. This is actually being done in the European navies.

If any reader is disposed to doubt our position, we beg him to picture our 15 and 16-knot vessels being dispatched 3,000 miles from a friendly dry dock to "capture, sink, or destroy," in its own waters, a fleet of French ironclads that is capable of steaming its 18 or 19 knots, if called upon to do it. Without detracting in the least from the laurels won by our navy at Manila and Santiago (nothing can do that), we affirm that no similar success would await the attempt, if it be true the French navy is kept in the high state of efficiency with which it is universally credited. The splendid gunnery which won in the Philippines and off the Cuban coast would be useless against a fleet with which it was impossible to get within fighting range.

That the speed proposed for our new battleships is entirely too slow is shown by a comparison with the ships of a similar class which are either built, building, or proposed for the leading navies of the world. The following figures are taken from official lists, or gathered from other authentic sources:

Commencing with the English navy, as being the largest, we find that it contains no less than 33 first-class battleships, of between 10,500 and 15,000 tons, whose speed ranges from 17 knots to 18·75 knots per hour. Of these ships, one is of 10,473 tons and 17·25 knots; eight are of 14,150 tons and 17·5 to 18·2 knots; nine of 14,900 tons and 17·5 to 18·4 knots; three are of 15,000 tons and 18 knots; two of 10,500 tons and 18·5 knots; one is of 12,350 tons and 18·75 knots; six are of 12,950 tons and 18·75 knots; and the three latest designs are of 15,000 tons displacement and a speed of 18·75 knots.

France has afloat, on the stocks, or in contemplation, ten battleships of 17 knots speed and over. Four of these are of from 11,395 tons to 12,200 tons displacement and from 17·1 to 17 9 knots speed, and the other six range from 11,275 to 12,052 tons displacement and have speeds of from 18 to 18·5 knots per hour.

Chile has her "Capitan Prat," a most efficient ship, of about 7,000 tons and 18·3 knots, and the formidable "O'Higgins," 8,500 tons (more battleship than cruiser), with the high speed of 22 knots an hour.

Germany has in hand three powerful battleships of the "Kaiser Friedrich" type, whose speed is to be 18 knots an hour.

Italy has always realized the value of speed in battleships, and was ten years ahead of the other naval powers in this respect. Her lists include two battleships of 11,000 tons and 17 knots; one of 9,800 tons and 18 knots; two of 14,400 tons and 18 and 18·4 knots; two great vessels of over 13,500 tons and 19 knots; and the celebrated "Sardegna," of 13,860 tons and 20 knots speed.

Russia is credited with one battleship of 12,480 tons and 17 knots; three of 10,960 tons and 17·5 knots; and two of 12,674 tons and 18 knots.

The latest naval power, Japan, is in line with modern developments, in the construction of one great ship (to be the largest and most powerful in the world), of 15,200 tons and 18 knots. She also has in commission two 12,320-ton ships of 18·5 and 19·2 knots and two others of 14,850 tons and 18·5 knots speed.

The above enumeration shows that, before our three latest battleships of 16 knots speed are completed, the leading naval powers will possess among them no less than sixty-seven great battleships with speeds of from 17 to 20 knots, the greater part of them being able to steam over 18 knots an hour.

The events of the war have shown that the purely defensive policy which governed the design of our earlier ships must be modified, if we are to meet the swift battleship squadrons of Europe. As between a 16-knot and an 18½-knot fleet, the option of fighting or running away would rest altogether with the faster vessels. If we are to avail ourselves of the splendid fighting qualities of the personnel of our navy, we must provide it with ships fast enough to allow our officers and men to immediately close in with the enemy whenever and wherever they think fit to do so.

That the Navy Department is aware of the fact that the new ships will be deficient in speed is shown by a circular recently issued which says that "preference will be given, other things being equal, to such bids as offer to guarantee the highest rate of speed and greatest coal endurance, the total weights of engines, boilers, and coal and spaces allowed therefor to remain as now fixed." The latter clause of this statement, unfortunately, takes all the value out of the former, for without an increase in displacement and a more liberal allowance for motive power, it will be impossible to make any considerable addition to the designed speed. This can only be secured by an entire revision of the plans.

MAKE HASTE SLOWLY.

Should we not at once call a halt in the matter of this year's naval programme and defer the preparation of designs, not to mention the letting of contracts, until the valuable experience gained by our ships in the present war has been filed with the Bureau of Construction?

Prudence, common sense, and the best interests of the nation demand that not a design should be passed as final until the very last item regarding the behavior of ships, guns, projectiles, armor, and general protective devices has been carefully noted, drawn, and placed in the hands of Chief Constructor Hichborn, of the navy.

Lying on the mud of Manila Bay and on the beach of the South Cuban coast are some eighteen or twenty vessels of more or less modern construction, from whose battered remains our naval constructors can learn the very truths for a practical demonstration of which the naval world has been impatiently waiting during the purely tentative and experimental work of the past twenty years. On our own ships, moreover, are to be found the marks of the enemy's shells. Battleships, cruisers, and torpedo boats have been struck by projectiles large and small, and delivered both horizontally and vertically by mortar fire. Every shell that struck has its own lessons to teach, and the different effects of projectiles against side armor and deck armor will afford valuable data for our future guidance.

Not less important in its bearing upon future designs is the behavior of the various types of gun mounts. It has been stated persistently in the daily press that many of the mounts are badly in need of overhauling; and rumors of this ship and that needing repairs to her gun-carriages have come thick and fast since the scheme for sending Watson's fleet to Spain was first broached. All of these weak points will have to be noted and the mounts modified and strengthened in our future warships.

It will at longest be but a matter of a few months before the war is closed and the whole of its invaluable data in the hands of the Construction Department, and it cannot but happen that this data will suggest the modification of existing designs in various important particulars. As at the Santiago as well as the Yalu fight, armor, even of moderate proportions, has proved to be wonderfully effective, as witness the almost complete immunity of the "Cristobal Colon" due to her plentiful protection of 6-inch armor. We think it will be decided, among other things, that by using the improved Krupp process it will be possible to greatly reduce the thickness of the armor on the new battleships and put the weight so saved into engines and boilers. Are we really justified in the construction of the four monitors and sixteen torpedo boats? Neither type has proved itself so useful as the battleships and cruisers. There is every reason why we should defer their construction until our various admirals and captains can turn in exhaustive reports upon the services rendered by these much debated types of vessels.

In view of the fact that it will be probably three or four years before this year's programme has been completed and put in commission, we can well afford to delay its commencement a few months, in order to incorporate in the new ships the experience which we are gaining at a costly expense in blood and treasure.

TO PREVENT COLLISIONS DURING A FOG AT SEA.

The tragic sinking of the "Bourgogne" again brings up the question of preventing collisions in foggy weather. While many such catastrophes are no doubt due to want of proper watchfulness and precautions, the majority occur in spite of every effort of science and good seamanship to prevent them. The supreme need of the present day is some thoroughly reliable device for detecting the approach of a ship which, by reason of the fog, is not visible to the lookouts. It is safe to say that, in spite of the ingenious instruments which have been devised and are more or less in use, there is at present no apparatus which will under all conditions detect and report the presence of one vessel to another in thick weather.

The devices which depend upon auricular signals, such as the eophone, topophone, and others of a similar nature, are intended to determine the direction from which the sound proceeds. For their successful use each vessel must be active, both in sounding its sirens or trumpets and in intercepting the other's signals. A transatlantic liner may be furnished with eophones, worked by skilled observers, which are capable under normal conditions of the atmosphere of infallibly detecting the direction from which the signals come; but unless the approaching vessel is equally careful to sound its foghorn at regular intervals, the eophones might just as well be at the bottom of the sea for all the protection they afford to the liner.

But even if we assume that auricular signals are faithfully sounded and received, there yet remains a fruitful source of accident which may at any time render the foghorn or siren inoperative. We refer to the curious eccentricities which have been observed in the action of sound waves under certain atmospheric and geological conditions—eccentricities which render it uncertain that signals that are sounded by one ship will be heard by another that may be well within hearing distance under normal conditions. The investigations made by Major Livermore for the United States government have shown that under certain conditions sounds that were inaudible near the surface of the water could be plainly heard at some distance above it, and sounds from a distance which are heard at one end of a vessel may be quite inaudible at the other end. The explanation offered is that sound waves may, under certain conditions, be thrown upward and

descend at some distance to resume their original course.

The ideal system of signaling would be one whose action was at all times entirely automatic and unaffected by atmospheric conditions. We have lately received from Mr. Hermann Herberts, of Newark, N. J., a description of a beautiful, scientific device of this kind, which, for want of space, we publish in the current issue of the SUPPLEMENT. Mr. Herberts discards the field of acoustics and calls to his aid the wonderfully sensitive and infallible powers of the thermopile. This delicate instrument in its most recent and highly developed form will register changes of temperature as small as $\frac{1}{1000000}$ degree Centigrade. An ordinary thermopile will indicate the radiant heat from a person's hand at a distance of a yard or more, and Prof. Boys has been able to detect the heat of a candle that was a quarter of a mile distant from the thermopile.

Mr. Herberts' instrument consists of two thermopiles, each provided with a funnel for collecting the heat rays, which point in opposite directions and revolve in a horizontal plane upon a fixed standard, so that the full circle of the horizon is swept twice in every revolution of the pair. The piles are connected with a galvanometer scale and with a local circuit provided with call bells. If a ship is approaching from a given quarter, its heat radiations are caught in the revolving funnels every time they swing past the ship, and as she draws nearer, the strength of the current set up in the thermopile increases until the alarm bell is rung. By means of a revolving position indicator, an observer is able to determine the direction of the approaching ship. The increasing or diminishing action of the thermopile tells whether the ship is approaching or receding. The same laws of radiation make it possible for the instrument to indicate the approach of an iceberg, and in many cases the proximity of a sunken wreck or of the land itself. The instrument is a most ingenious adaptation of science to commercial uses, and it gives promise of solving one of the most perplexing problems connected with deep sea travel.

THE APPROACHING SCIENTIFIC JUBILEE.

BY HORACE C. HOVEY.

A widespread interest is felt in the elaborate preparations that are now in progress for the fiftieth anniversary of the American Association for the Advancement of Science, to be celebrated in Boston, from the 22d to the 27th of August. The council will have its headquarters at the Copley Square Hotel, while those of the association will be in the Rogers Building. The general and special meetings will be held in the rooms and halls of the Boston Society of Natural History, the Harvard University Medical School, and the Massachusetts Institute of Technology, all in the vicinity of Copley Square, where are also located the Boston Public Library, the Museum of the Fine Arts, and other buildings of interest. The place is easily accessible from suburban points by electric lines. Round-trip tickets may be had on all the railroads for one and one-third fare, good from August 18 to September 15, on certificates from local agents officially indorsed at Boston. Lunch will be furnished daily without charge to members, and most of the hotels offer reduced rates. Special arrangements will be made as to mail, telephone, telegraph, and express facilities.

Preliminary programmes have been issued as to the general and sectional meetings, from which it is evident that Boston is to have one of the most remarkable scientific gatherings ever held in this country. Every branch of science will be represented, and the members and guests will come from all parts of the continent and from many foreign lands. There will be addresses and papers on a vast variety of topics, many of them made clear by experiments or illustrated by the stereopticon. The first general session will be held in Huntington Hall, at 10 A. M., Monday, August 22, when addresses of welcome will be made by Governor Walcott, Mayor Quincy, and President Crafts, to which President F. W. Putnam will reply. Then will follow meetings of the nine sections into which the association is divided, to listen to addresses by their respective vice-presidents. These will be at different hours, to enable as many to hear them as possible. The address by the retiring president, Prof. Wolcott Gibbs, of Newport, R. I., will be Monday evening, and his subject will be, "Some Points in Theoretical Chemistry." Following the address will be a general reception. The wealth of material to be brought out by the sections may be inferred from the fact that nearly two hundred papers are already announced and many more are to follow.

Wednesday, August 24, will be "Salem Day," the association being the guest of the famous Essex Institute. In a similar manner Friday will be "Cambridge Day," on the invitation of the faculty and alumni of Harvard University. Numerous excursions are to be enjoyed, as the members may find the time and inclination, to localities of historic or educational interest in the vicinity of Boston. And after the adjournment of the association, more extended trips are planned to Cape Cod, the White Mountains, and other attractive resorts for pleasure or instruction.

Information as to the presentation of papers may be had by addressing the secretaries of the respective sections. Letters as to the general business of the body should be sent to the Secretary of the Association, Salem, Mass., previous to August 15, who will also receive assessments and nominations to membership. Prof. H. W. Tyler, local secretary, A. A. A. S., Boston, Mass., will give all desired information as to local arrangements.

SPAIN'S LOSSES ON THE SEA.

Now that Spain has definitely made overtures looking toward a cessation of hostilities and eventually peace, it is time to make an estimate of her losses at sea, which have been severe. Some fifteen or twenty merchant vessels have been seized as prizes and eighteen war vessels have been destroyed or captured. It is probable that the total money loss inflicted by the sunk or captured war vessels is not far from $35,000,000, as the fleet of Admiral Cervera is alone estimated to have been worth $20,000,000. The first merchant vessel which was captured was the "Buena Ventura," which was seized on April 22. Then followed the capture of the "Pedro," "Catalina," "Saturnina," "Panama," "Ambrosia," "Guido," "Bolivar," "Lopez," "Reina de los Angeles," besides a number of schooners, tugs, etc. We give below a table of the principal war vessels which were sunk or captured. No mention is made of such unrated gunboats as the "Alvarez," captured in Santiago Harbor after the surrender, the gunboats "Baracoa" and "Lijera," and the tugs "Rapido" and "Hercules."

Name.	Material of Hull.	Displacement.	Length.	Beam.	Maximum Draught.	Indicated Horse Power.	Armor. Belt.	Armor. Gun Position.	Armor. Deck.	Armament. Guns.	Armament. Torpedo Tubes.	Speed.	Normal Coal Supply.	Complement.
		Tons.	Ft. In.	Ft. In.	Ft. In.		In.	In.	In.			Kts.	Tons.	Men
Almirante Oquendo	Steel.	7,000	340	65	21 6	13,000	12	10½	3	Two 11-in.; ten 5·5-in.; eight 2.2-in. Q. F.; eight 1·4-in.; two machine guns.	6	20	1,200	500
Infanta Maria Teresa	"	7,000	340	65	21 6	13,758	12	10½	3	Two 11-in.; ten 5·5-in.; eight 2·2-in. Q. F.; eight 1·4-in.; two machine guns.	6	20	1,200	500
Vizcaya	"	7,000	340	65	21 6	13,000	12	10½	3	Two 11-in.; ten 5·5-in. Q. F.; two 2·7-in.; eight 2 2-in.; four 1·4-in.; two machine guns.	6	21	1,200	500
Cristóbal Colon	"	6,840	328	59 8	24	14,000	6	6	1½	Two 10-in.; ten 6-in. Q. F.; six 4·7-in.; ten 2·2-in.; ten 1·4-in.; two machine guns.	4	20	1,000	450
Furor	"	380	220	22	5 6	6,000	....	....	....	Two 12-pdr.; two 6-pdr.; two 37-mm. automatic.	2	28	100	67
Plutón	"	400	225	22 6	5 8	7.500	....	....	....	Two 12-pdr.; two 6-pdr.; two 1-pdr.	2	30	100	70
Reina Mercedes	"	3,090	278 10	42 7	16 5	3,700	....	....	....	Six 6·2-in.; two 2·7-in.; three 2·2-in. Q. F.; two 1·5-in.; six 1·4-in.; two machine guns.	5	17 5	600	375
Alfonso XII	"	3,090	278 10	42 7	16 5	4,800	....	...	..	Six 6·2-in.; two 2·7-in.; six 6-pdr. Q. F.; four 3-pdr.; five machine guns.	5	17·5	600	300
Jorge Juan	Wood	935	203 5	29 6	12 2	1,100	....	...	...	Three 4·7-in.; two 2·8-in.; two machine guns.	....	13	130	146
Reina Christina	Steel.	3,520	282 2	42 7	16 5	3,970	....	....	....	Six 6·2-in.; two 2·7-in.; three 2·2-in. Q. F.; two 1·5-in.; six 6-pdr.; two machine guns.	5	17·5	600	370
Velasco	Iron.	1,152	209 11	29 3	12 5	1,500	....	....	....	Three 5·9-in.; two 2·7-in.; two machine guns.	....	14·3	220	173
Don Antonio de Ulloa	"	1,130	210	32	12 6	1,600	...	....	....	Four 4·7-in.; two 2·7-in.; two Q. F.; five machine guns.	2	14	210	130
Don Juan de Austria	"	1,130	210	32	12 6	1,600	....	....	....	Four 4·7-in.; three 2·2-in. Q. F.; two 1·5 in.; five machine guns.	3	14	210	130
Isla de Cuba	Steel.	1,030	185	30	11 6	2,200	....	....	..	Four 4·7-in.; four 6-pdr. Q. F.; two 3-pdr.; two machine guns.	3	16	160	160
Isla de Luzón	"	1,030	185	30	11 6	2,200	..	....	....	Four 4·7-in.; four 6-pdr. Q. F.; two 3-pdr.; two machine guns.	3	16	160	160
Marqués del Duero	Iron.	500	157 5	25 7	8 5	550	...	....	....	One 6·2-in.; two 4·7-in. smooth bores; one machine gun.	...	10	90	98
General Lezo	"	524	157 5	25 7	8 6	600	....	....	....	Two 4·7-in.; one 3·5-in.; two Q. F.; one machine gun.	2	11	80	97
Elcano	"	524	157 5	25 7	8 6	600	....	....	....	Three 4·7-in.; two Q. F.; two machine guns.	1	11·5	80	116

It is impossible to get accurate figures of the cost of the cruisers which were sunk in the battle of Manila. Many of them were practically worthless, although their first cost may have been very great. The cost of Cervera's fleet is figured by "El Nacional"—and the value of the vessels certainly would not be overestimated by this paper—as follows:

Vizcaya	$3,600,000
Oquendo	3,600,000
Maria Teresa	3,600,000
Cristóbal Colon	4,400,000
Plutón	500,000
Furor	500,000
Artillery	3,800,000
Total	$20,000,000

That is to say vessels whose value was $20,000,000 were lost to Spain in less than four hours. These figures check fairly well with those given in Brassey's Naval Annual. To the loss of territory and indemnity which Spain will have to pay should be added the $35,000,000 worth of vessels sunk or captured, and to this will also have to be added an immense sum for the loss of freight and passengers which would have been carried in Spanish bottoms had it not been for the war. All this is a part of Spain's punishment.

A Unique Map of the Philippines.

A truly magnificent present has been received by the widow of the assassinated Spanish premier Canovas from the friends of her deceased husband in the Philippines. The gift consists of a splendid map of the Philippines made of solid gold, with all the provinces in relief; each city is marked by a ruby, every inscription consists of sapphires, and the dedication of brilliants of the choicest beauty. The map is inclosed in a beautiful frame, likewise composed of gold and precious stones and surmounted by a golden bust of Canovas. The whole creation rests in a case of the finest wood, which is likewise a work of art. The gift represents a value of 120,000 marks ($30,000). The Duchess of Canovas intends to exhibit it publicly for the benefit of the national subscription.—Gold und Silberw. Industrie.

Rapid Transit in Paris.

The law authorizing the city of Paris to erect a system of metropolitan railways having been promulgated, the municipality have published the terms of the convention concluded in July last with the General Traction Company, which undertakes to form within six months a special company for working the lines when constructed, with a capital of not less than 25,000,000 francs ($5,000,000). The total length of the system of lines is forty English miles, but only twenty-five miles will be taken in hand at first, the city undertaking to construct the first portion in eight years.

As this is perhaps the first example of such a considerable work being undertaken by a municipality, details of the working convention may be of interest, says The London Economist. It has already been stated that the amount of the loan to be raised for the execution of the first portion of the lines is 165,000,000 francs ($33.000,000). The Traction Company, which has obtained the working concession, undertakes to employ only Frenchmen, and to have all its plant and rolling stock made in France. The board of directors of the working company must be exclusively French; the company will be permitted to have its depots and works outside the city, but they must pay the octroi duties on the materials employed, as if the buildings were within the city walls; the names of the stations must be of a uniform color and must be so placed that they may not be confounded with advertisements; the minimum wages or salary to be paid to any of the company's servants or employes will be 150 francs per month, or for workmen engaged temporarily 5 francs per day; the wages must be paid in full during the period of military instruction; the day's employment must not exceed ten hours, with a whole day or two half day's rest weekly, and ten days' holiday annually without deduction of wages; in case of sickness wages must be paid in full for at least a year; in case of accident, until complete recovery, without prejudice to the indemnity to be paid if permanently disabled, wholly or partially.

The fares are fixed at 25 centimes (5 cents) first class and 15 centimes (3 cents) second class for any distance. Passengers before nine in the morning may have for 20 centimes (4 cents) a return ticket, available at any hour in the day. Children of the municipal schools are to pay a fare of 5 centimes (1 cent) only when traveling collectively, accompanied by a master. The working company will pay to the city for the use of the lines 10 centimes (2 cents) per first class passenger and 5 centimes (1 cent) second class, increased progressively should the number of passengers carried during the year exceed 140,000,000. Children traveling for 5 centimes are not to be taken into account for the payment or the number. The stations and means of access to the platforms to be at the charge of the company, but the platforms are comprised in the work executed by the municipality. The concession is for thirty-five years, but the city reserves a right of purchase from the year 1910.

AN IMPROVED TYPE OF ZEISS FIELD GLASS.

The Galilean telescope, while an improvement over the ordinary astronomical telescope fitted with terrestrial eyepiece, possesses the disadvantage of having a small field and requires object lenses of considerable diameter and moderately long focus in order to give a fairly flat field with suitable illumination.

It has long been a live problem with opticians as to how the field might be enlarged and the bulk reduced while maintaining good illumination and sharp definition. The solution of the problem has been reached in a manner which increases the optical efficiency of the field glass in every possible way by the application of Porro's prism—invented independently by Porro and Prof. Abbe—in the new Zeiss field glasses, now being

BAUSCH & LOMB—ZEISS FIELD GLASS.

manufactured in this country by the Bausch & Lomb Optical Company, Rochester, N. Y.

These glasses are the invention of Prof. Abbe, of Jena, to whom optical science owes so many recent improvements.

It is only within the last few years that the optical manufacturer has attained the refinement which enables him to produce this class of work.

The illustration shows the Zeiss binocular field glass partly in section, with the Porro's prisms in position. It will be noticed that the light first passes through the objective lens, is reflected twice by the first prism, and enters the second prism placed at an angle of 45° to the first, where it is again twice reflected, emerging parallel to its original direction, where it is magnified by the eyepiece, which is of the compact Kellner construction.

The three principal defects of the ordinary binocular field glass are overcome by the use of these prisms, which have the effect of erecting the inverted image formed by the object glass, shortening the telescope by two-thirds, and at the same time giving a means of placing the object glasses farther apart than the eyepieces are.

The amount of this displacement is variable within wide limits and has the effect of increasing the stereoscopic effect possessed to a certain extent by ordinary binocular glasses, giving greater relief and appearance of solidity to the images of objects seen at a distance.

The relation of aperture to magnification has been so calculated that the largest possible amount of light is made to enter the pupil of the eye, the actual diameter of which has been taken into account in calculating the eyepieces. In order to reduce weight, the cases are made of aluminum covered with leather.

Adjustment for the correct pupillary distance of any user is made by moving the two parts of the binocular about the axis of the hinge. A click setting device enables any individual user to determine his own pupillary distance and set the click to that distance permanently. Each ocular is focused separately, so that in case there are differences in the foci of the eyes they may be compensated for in the field glass, giving correct coincidence of the two images and increasing the distinctness of the combined image.

The extraordinary depth of focus of these glasses makes it unnecessary to change the focus after it has been once determined for the eyes of the user, except for objects extremely close to the observer.

A NEW INSULATOR.

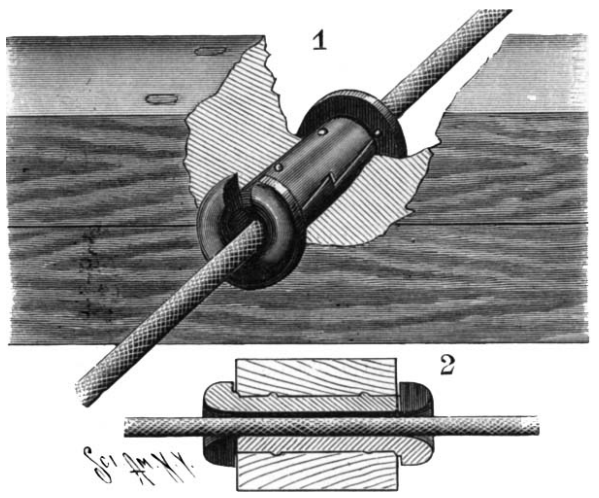
The insulator which forms the subject of the accompanying engraving is constructed in the form of a tube, divided into longitudinal sections, each of which has interlocking shoulders and a head at its outer end, so that the sections may be fitted together to form a continuous tube, securely and effectively holding the conductor.

Of our illustrations, Fig. 1 is a perspective view and Fig. 2 a sectional view, both showing the insulator in position.

The insulator is made in two duplicate sections, each having its edges provided with interlocking shoulders, as shown in Figs. 1 and 2. By this means the two sections can be made to fit exactly together. The head of each section is outwardly beveled to prevent chafing of the wire, and is provided with a notch through which the wire may be passed. Projections on the sections are adapted to be embedded in the material and hold the insulator, to prevent the sections from turning and, therefore, displacing the insulator. As indicated in the engraving, the insulator is adapted to be held in the joist or other framing of a building through which the wire is to be passed.

By means of this device, the wires may be securely held and leakage prevented. The insulator may be applied after the wiring is done, or the insulator may be first placed in position and the wire then run through it. When once in place the insulator cannot be accidentally removed.

The device is the invention of Charles L. Wingard, Walla Walla, Washington.



WINGARD'S INSULATOR.

THE CRITERION AUTOMATIC ACETYLENE HOUSE GENERATOR.

Herewith are presented illustrations of two styles of acetylene gas generators manufactured by J. B. Colt & Company, and especially intended for lighting single dwelling houses, country seats and outbuildings, small and medium manufacturing plants, etc., though the system can be made to embrace larger establishments. There appears to be no limit in this direction.

The first illustration represents machines with a single set of four carbide holders. The form shown in the second illustration shows the possibility of doubling the charge of carbide without increasing the floor space, by employing a double row of holders.

It is obvious that several stands, either with a single or double row of holders, may be used with the one gas holder and water valve, thus enabling a very large charge of carbide to be used.

These machines are so simple that they can be managed by any one having ordinary intelligence, and the convenience and rapidity with which they can be loaded are among the special advantages. The automatic arrangements whereby the production of gas and the regulation of its flow is governed in consonance with the necessities of demand and supply, are positive in their action, and no gas is wasted. The machines are strong and durable.

Each apparatus consists of a gasometer, a stand supporting the carbide holders, connections between the two being had by means of a pipe, one end of which springs from the top of the stand, the other joining the condenser at the bottom and left hand side of the tank and at the same time acting as a guide. A water pipe is connected in reverse order. In the generator shown in the larger engraving a water tank is added to the stand above the upper set of holders. Otherwise the details of the two machines are identical.

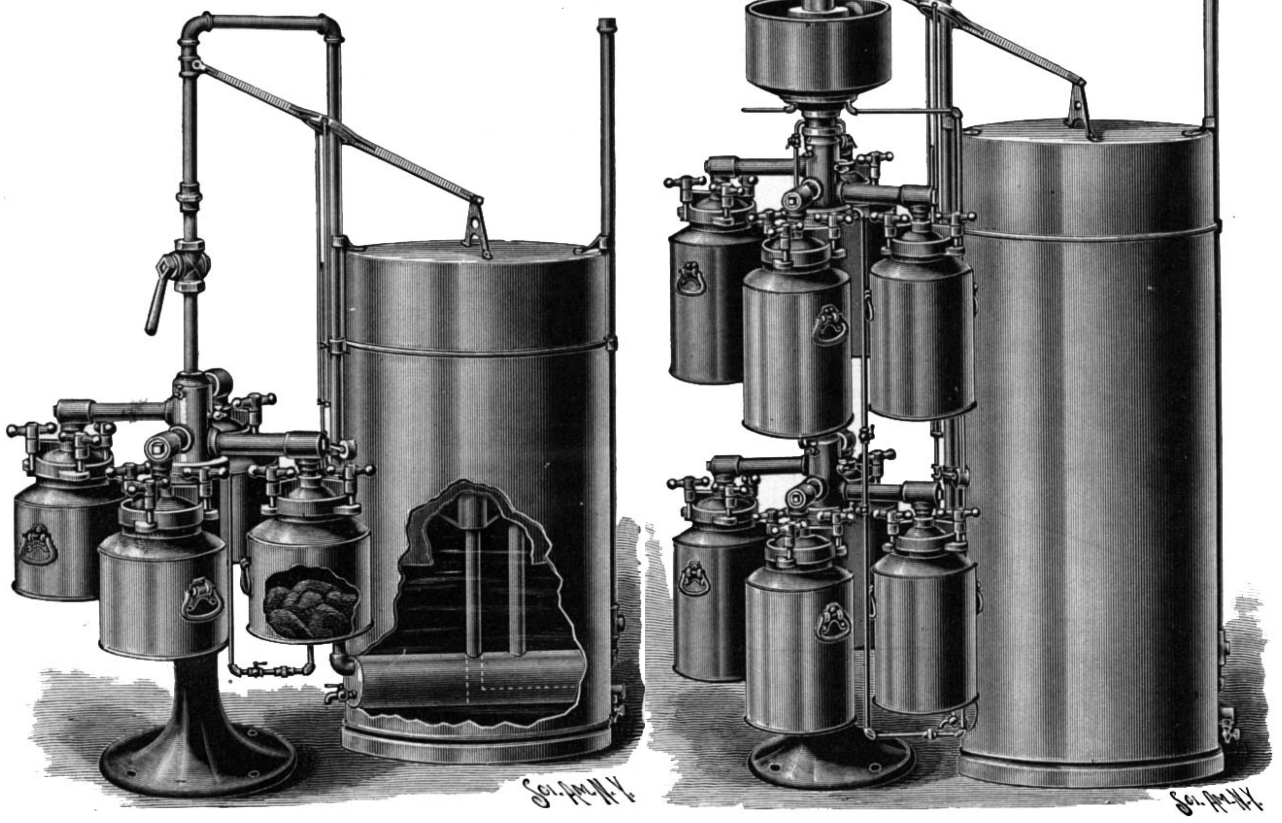
In setting up the Colt acetylene generator, the pipes between gasometer tank and stand are connected, and also the water supply pipes, carbide is introduced into the holders, and the water turned on. Meantime the stopcock and condenser drip is opened to allow free exit for contained air, permitting the gasometer to sink to its lowest level. Gas from the holder, entering the connecting pipes, expels the air from the machine, when stopcock and water regulator are closed, causing the gas to flow into the gasometer, which immediately begins to rise. When sufficient quantity of gas has been secured in this way, gas is admitted to the service pipe, the residual air is forced out through different burners which are opened for this purpose. When the flame no longer reveals a bluish tinge, the last trace of residual air has been got rid of.

When water is admitted to a carbide holder, gas is immediately but slowly and gradually evolved. Water, however, can only reach one holder at a time, and it is only when the carbide has been thoroughly exhausted, and its receptacle filled with water, that the water can enter the next one of the series; and whenever the flow of the gas is too great, or the gas too rapidly evolved, water ceases to flow into the holder, it being forced back by the flow of the gas.

The gas produced in the holder passes out through the pipe connecting to the stand and is conveyed into condenser, where it is cooled and parts with its moisture. It then rises into the gasometer, where it is stored, or passes on through the service pipes for combustion. When an excess of gas is being sent to the gasometer it rises, and by means of levers closes the water supply, when the production of gas ceases; but when consumption is again begun and the gasometer falls, the lever descends and the water is again turned on. The complete isolation of the holders is effected without the use of valves. By this means the carbide in each holder is entirely protected from moisture until it is required for the production of gas.

The gas pressure may be increased by placing weights on top of the gasometer; this is often rendered necessary when gas has to be forced to considerable distances, or through many diverging service pipes. The gas is preferably used under a pressure of from two to three inches of water. Water requires to be renewed in the tank only as often as the holders are charged with carbide. The carbide expands when slaked to twice its volume; therefore, the receptacle should be filled only about one-half.

The greatest convenience about the machine is the ease of reloading it is not necessary to



AUTOMATIC MULTICHARGE ACETYLENE GENERATOR.

transfer the residue from the holders, but each holder may be carried out independently, thus avoiding soiling the clothes and hands.

These machines are manufactured by Messrs. J. B. Colt & Company, of 125 West Thirty-seventh Street, New York, with branches in Chicago and San Francisco.

Danger in New Hunting Rifles.

When one comes to discuss rifles, range, and the average distance at which game is shot, he is likely to strike contradictory opinions. A prominent hunter, in speaking recently of the great effectiveness of the American rifle, said that in his experience, elk, moose, bear, and white-tailed deer were most generally killed within a range of 175 yards; and that this was so because they were apt to be discovered within this distance, not because of any lack of carrying power in the rifle. When this statement is contrasted with the prospectus of the latest rifle, which has a first sight of 250 yards, a flat trajectory, and a maximum range of 2,200 yards, what is the average hunter to think?

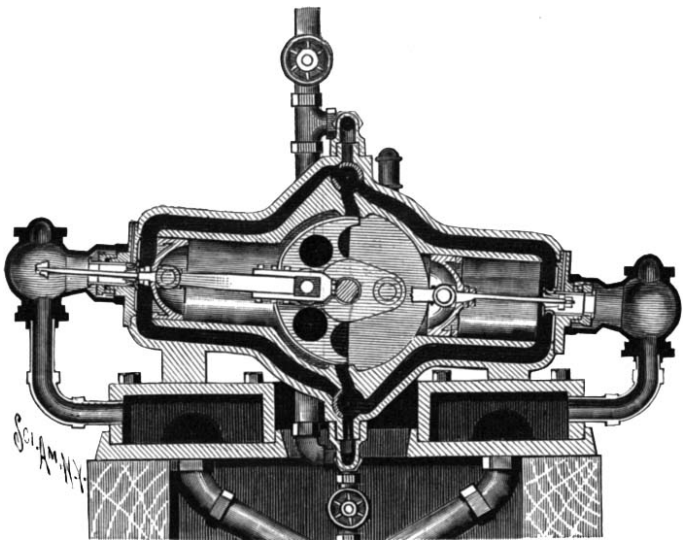
Of one thing there is no room for doubt, and that is that this year many people are preparing to go to the woods deer shooting, and will take with them the new rifle. Its wonderful range and penetration are due to the new smokeless powder employed in conjunction with a bullet sheathed in copper so as to present a harder surface to the rifling than lead. This projectile is forced through a barrel from 20 to 24 inches long, the rifling of which has about one turn to every 8 inches. The great objection raised by experienced hunters to such an arm as this is, that with the long range one never knows where the bullet is likely to bring up once it has left the gun. A few years ago a hunter fired at a deer at a distance of 183 yards as measured after death. The animal was standing at the foot of a slight bluff of loamy sand in which not a stone or rock was to be seen. The rifle was fired and the deer fell, the bullet having gone clear through the heart, missing the ribs on both sides. Immediately after a hail was heard from a point about 200 yards back of the shooters, and an angry man was heard asking where in thunder they were shooting, as the bullet had just skimmed over his head. A close examination showed graze and leaf holes four feet above the heads of the other party of hunters, and it would seem that the bullet had traversed two sides of a triangle, from the rifle to the quarry, and back from the quarry to the other base corner of the triangle. If such a thing is possible with an ordinary rifle sighted to 100, 150, 300, and 500 yards, what would be the possible result with the copper-sheathed bullet, low trajectory, and 2,200-yard range in a wooded district?

In still another case a well known hunting writer from the West, now residing in New York, chanced upon a moose feeding about 200 yards away, and, with the idea of taking the second shot himself, told his companion, an amateur, to try the first shot. The bullet was seen to strike the ground nearly four feet in front of and about six feet short of the moose. When an examination was made, it was found that there had been two moose feeding within 100 yards of each other, and that on the trail of the far one was blood. Following the trail the moose was eventually bagged, and it was found that the bullet had entered at the lower side of the stomach, and was lodged in the fat of the hump, showing clearly that the animal had been hit by the ricocheting missile. An examination of the spot where the turf flew showed a flat piece of rock, an inch or so under the surface, which the bullet had hit and glanced from. Many similar stories might be related of the vagaries of glancing bullets, and the possible dangers are making a number of hunters very chary of going out with these new rifles, which, whatever advantages they may have in other places, are not believed to be suitable for deer shooting in the Eastern States. Apparently, English sportsmen are also entertaining similar fears, for a prominent big game shot recently advocated a restriction in the matter of the rifling.

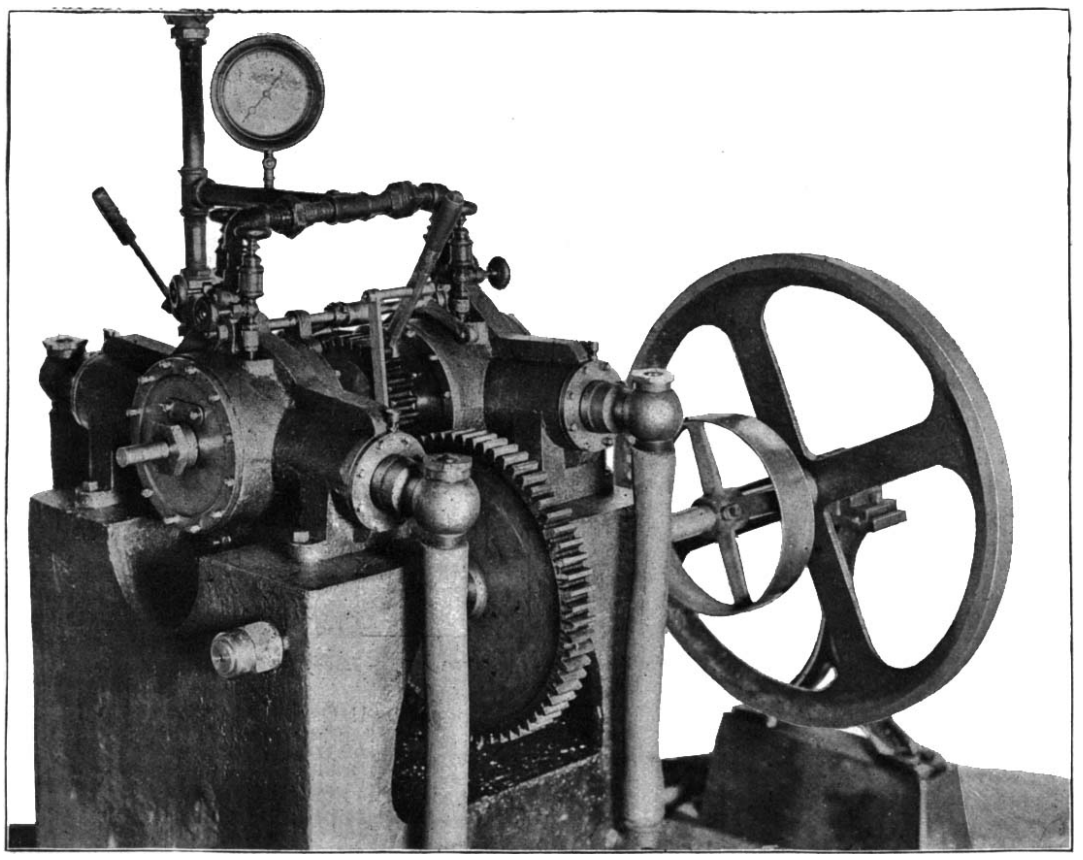
Both English and American hunters appear to hold the idea that the wound inflicted by the metal-sheathed bulled fired from the exceedingly long range rifle, is not of the type best calculated to stop the game, but that the bullet will, rather, pass completely through the body without shattering opposing bones, or tearing a large hole in the softer opposing substances, so that if the animal be not hit in the brain or heart it may travel a long way before loss of blood brings it down. The experience of most hunters is in favor of a 45-caliber bullet composed of one part tin and forty of lead, weighing 350 grains, propelled by from 90 to 110 grains of good black powder. This bullet will not have the same ricocheting power as the other.—New York Sun.

A NEW STEAM MOTOR.

We give engravings of a steam motor recently finished and tested at the works of The Merrell Manufacturing Company, Toledo, Ohio. It has been called a rotary engine by its makers, on account of the intimate connection of the reciprocating parts with the revolving parts, and the perfect balancing, which insures a smooth action. The engine is very compact, and, as it runs at high speed, it can be used to advantage in driving dynamos and other machines running at high velocity.



LONGITUDINAL SECTION OF ENGINE.



SINGLE CYLINDER DOUBLE EXPANSION ENGINE.

One of the views shows the motor in perspective; the other shows a longitudinal section of the motor. In operation, the steam or air is admitted from the bottom and enters between the pistons, driving them outward to the position shown at the left. When the pistons are in this position, the cam-valve opens the top port and closes the feed port, thus allowing the steam or air to escape from between the pistons and pass to the opposite side of the pistons, driving them inward to the position shown at the right hand. When this stroke is completed, the extension-stems on the piston open the end or exhaust valves, which remain open until the pistons complete their outward stroke. To reverse the motor, steam is supplied from the top instead of the bottom. The motor, as shown, is so arranged as to admit of using the steam or air but once and exhausting, or it can be used twice as above explained. It is stated that, with a 5-pound pressure, using the steam but once, the motors run at a speed of 80; and with the same pressure, using the steam twice, the speed was increased to 176 revolutions. When this motor was connected with a dynamo the voltmeter showed 75 volts when the motor was run on the compound system, and but 20 volts without the compound, the pressure remaining the same.

The engine, as built, was made simply for the purpose of demonstrating the principle involved. The motors have been tested by a brake test to 9½ horse power with but 35 pounds of steam. The engines were designed by R. D. Watson, of Toledo, and patents covering same have been issued.

The Romance of Aluminum.

In "Naturæ Historiarum" (lib. 36, cap. 26), in which reference is made to an incident in Roman history which, up to the time of Sainte-Claire Deville, had been overlooked by scientists for many centuries, it is related by Pliny (23 A. D. to 79 A. D.) that during the reign of the Emperor Tiberius (41 B. C. to 37 A. D.) a certain worker in metals (faber) appeared at the palace and showed a beautiful cup composed of a brilliant white metal that shone like silver. When the artificer was presenting it to the Emperor he purposely dropped it on the floor of the chamber. The goblet was so bruised by the fall that it seemed to be irretrievably injured; but the workman took his hammer, and in the presence of the court repaired the damage without delay. It was evident that this metal was not silver, though it had almost the same brilliancy, besides being much more ductile and considerably lighter. The Emperor questioned the artificer closely, and learned from him that he had extracted the metal from an argillaceous earth — probably the clay known to modern chemists as alumina. Tiberius then asked if anyone besides himself knew the process, and received the proud reply that the secret was known only to himself and Jupiter. This answer was sufficient. The Emperor had reflected that if it were possible to obtain this metal from so common a substance as clay the value of gold and silver would be greatly reduced, so he determined to avert such a lamentable catastrophe. He caused the workshops of the discoverer to be wholly destroyed, and the luckless artificer was seized and decapitated, so that his secret might perish with him. M. Sainte-Claire Deville had no doubt that this metal was aluminum, and he asserted that the wanton cruelty of Tiberius had deprived the world of this valuable metal, which remained unknown for eighteen centuries. The extracting of aluminum, discovered by the Roman craftsman in the first century of the Christian era, thus became one of the lost arts. —Aluminum and Electrolysis.

The "Oregon's" Brave Men in the Fireroom.

Sergt. Frederick A. Ramsey of the battleship "Oregon" writes in a letter to his father, in McMinnville, Ore., under date of July 7: "When the 'Maria Teresa' had beached herself and hauled down her colors, we shaped our course for the 'Vizcaya,' which was about 500 yards ahead of us and steaming her best. We opened fire on her with our two forward 13-inch, four 8-inch, and two 6-inch guns. The gunners kept firing as fast as they could. All the time the fight was going on we were steaming under forced draught, which was very hard on our fireroom force. The heat in the fireroom was 165 degrees. You will wonder how men can stand such heat, but they did it, and we give them the credit which they are justly entitled to. The officers sent down dozens and dozens of bottles of iced beer to revive them, and we stationed men along the passages leading down to the firerooms to herald the news to them; and every time we sent a ship to the beach or shot away her colors, they were told, and the cheers came up to our ears through the ventilators, which run up on deck. They would say, 'Sink them; sink them,' 'Remember the "Maine," boys,' and 'We will catch them or blow the boilers out trying.'"

CONTRACTS for the four new boats to be built for the North German Lloyd Company have now been placed. Two cargo boats, each of about 8,100 tons carrying capacity, are to be constructed at the Tecklenborg Shipbuilding Yard, Bremerhaven, for the Bremen-Baltimore service, and two cargo and passenger boats of about 10,000 tons capacity, each will be built at the Blohn & Voss Company's yard, Hamburg, for the New York line.

Correspondence.

A Military Trolley Line.

To the Editor of the SCIENTIFIC AMERICAN:

Perhaps the greatest difficulty in the Santiago campaign was in the lack of transport, and I would like to ask if a military trolley line would have been feasible. A discussion might interest your readers in general. If a vessel had been sent with the squadron completely equipped for setting up and working a trolley, could not the reserve troops under guidance of experts have rapidly felled trees and made a road, with or without rails? A trolley would have added immensely to the efficiency of the commissariat. And it may be asked why contractors who furnish poor food and clothing are not as sharply looked after as are those contractors who furnish poor munitions. An army deserves to be as scientifically provisioned as were Nansen's expeditions. Certainly if a cake of kola chocolate and a lemon had been carried by the troops advancing on Santiago, the service would have been far more effective. Does not our scientific civilization involve the superseding of the army mule, hardtack and sowbelly? In short, has not the art of war as regards munitions advanced far beyond the land transport and commissariat departments? It appears to me that a discussion of these matters by the SCIENTIFIC AMERICAN at this time would be of great value and interest.

HIRAM M. STANLEY.

Lake Forest, Ill., July 19, 1898.

Vertical versus Inclined Armor.

To the Editor of the SCIENTIFIC AMERICAN:

In view of the recent advances in the manufacture of armor-piercing projectiles, I should like to ask about the relative values of the American and British systems of battleship protection for the "vitals."

It seems to me that the English device of curving the protective deck to meet the bottom of a thin belt will be found to be more efficient in the future than our own use of a single thick belt.

For example, take a United States ship with a 10-inch belt and an English battleship with equivalent armor of say a 6-inch belt reinforced by a 3-inch sloping deck; all the armor to be of Harvey reforged nickel steel. Then assume a capped shot with just sufficient energy to completely penetrate the 10-inch belt. In the United States ship we have now complete penetration; but in the British vessel, in penetrating the 6-inch belt the projectile loses its cap, and so has to attack the 3-inch inclined armor without the protection of a cap and with a point more or less weakened. Under these circumstances, I should think that the projectile would be broken up on the hard face of the 3-inch deck and fail of penetration.

I wish very much to get your opinion on this point, which seems to be of some importance.

GEORGE B. MOODY.

214 Broadway, Bangor, Me., July 24, 1898.

[There is much to be said in favor of both the systems above referred to. Their relative value will depend somewhat upon the type of projectile used by the enemy. If a solid armor-piercing shot is used, the thinner side armor and sloping deck will prove more effective, for the reasons suggested by our correspondent. In the other case, after passing through the vertical armor, the capless shot, if it were not shattered against the sloping deck, would probably be deflected and never reach the vitals. If armor-piercing shell were used, we think the vertical 10 inches would be preferable, for the reason that it would, in all likelihood, be burst before it got through, whereas it would stand a good chance of passing through the 6 inches of vertical armor and bursting in the bunkers and against the sloping deck. The great effort of designers is to give a ship such defensive armor that shells will burst outside the ship, and for this purpose the vertical armor is, we think, preferable.—ED.]

The Ancients' Hospitals.

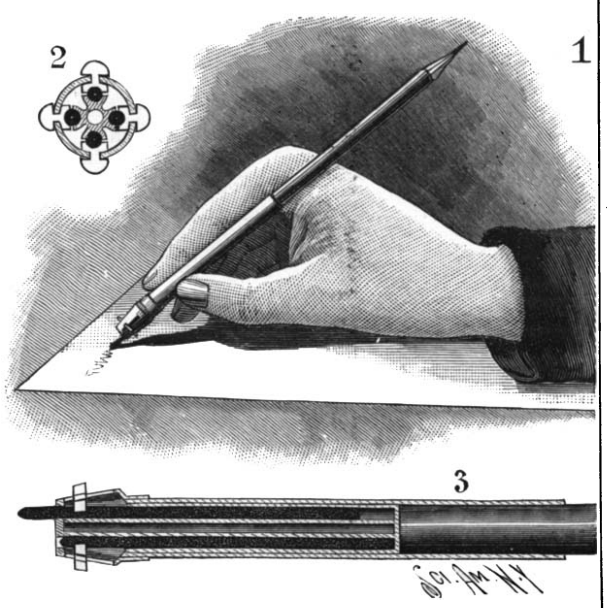
A very interesting and pleasing discovery is announced from Baden, near Zurich. The learned have been discussing for ages whether anything in the way of hospitals was known to the ancients—it is not to be said that they have been disputing, for there was not material enough hitherto to support a lively argument. One might read the whole volume of Greek and Roman literature, carefully, too, without noticing one passage that might be interpreted as an allusion to a hospital. The works of Hippocrates could not fail to speak of them surely, if any existed; but nothing is there beyond a reference to the notes of "cases" observed in the Temple of Æsculapius. So it is generally assumed that there were no hospitals in those days; the Aesclepia were "baths" with massage treatment. Scholars who hold to the other opinion can adduce only hints in its favor. But now we hear that one has actually been discovered at Baden, containing "fourteen rooms, supplied with many kinds of medical, pharmaceutical, and surgical apparatus, probes, tubes, pincers, cauterizing instruments, and even a collection of safety pins for bandaging wounds"—but these things are familiar. "There are also medicine spoons in bone and silver, measuring vessels, jars, and pots for ointment, some still containing traces of the ointment used." The latest date of the coins found appears to be in the reign of Hadrian. Probably it was a military hospital, for this was the station of the Seventh and Eighth Legions. But the find is certainly not less interesting on that account, for the army medical service of Rome and Greece is one of the deepest mysteries of archæology. Cæsar refers only once to his regimental surgeons—is there a single distinct allusion elsewhere? We hail with puzzled gratitude the casual remark of Xenophon that the Spartans sent their doctors to the rear when a fight impended—but we look vainly for more information from him or anybody else.

AN IMPROVED LEAD PENCIL.

A lead pencil has recently been patented by Gotthelf M. Seidel, of Easthampton, Mass., which is arranged to hold different movable leads, any of which can be readily projected and locked in place for immediate use.

Referring to our illustrations, it will be seen that the pencil is provided with a casing, one end of which is open and adapted to receive an ordinary pencil or eraser. The other end, however, has a number of longitudinal chambers or recesses containing leads of different colors or of different degrees of hardness. Each lead may be extended through a head on this end of the casing when in use, and may be locked in place by any suitable means. The locking device illustrated in Figs. 2 and 3 consists of a slide fitted to move on inclined guideways formed in the head. When the slide is moved outwardly, its inner end presses against and locks the lead in place.

When it is desired to use one of the leads, the corresponding slide is moved rearwardly to release the lead, and upon tilting the casing slightly, the lead is projected outwardly and may be locked in place by moving the slide forward.



SEIDEL'S LEAD PENCIL.

Photograph of the Holy Shroud by Electric Light.

In Turin, the other day, according to Il Osservatore Romano, a photograph by electric light was taken of the Holy Shroud, which gave an admirable reproduction of the body of Christ, says The Electrical World. The Holy Shroud was recently exposed to veneration, and King Humbert, who is its hereditary guardian, at first hesitated to give authority to have it photographed, lest the photographs should be speculated in. However, his Majesty at length gave the requisite permission to Signor Secundo Pia, a lawyer and member of the committee on sacred art, who had offered to photograph the Holy Shroud at his own expense. Signor Pia prepared his plates according to a special method, rendering them sensitive to the yellowish tint of the Holy Shroud by means of powerful electric reflectors. "Formerly," says Il Osservatore, "the appearance of the Holy Shroud gave an idea of the contour rather than the facial lineaments and body of Christ. On the other hand, the photographs, on being developed, showed a perfect representation of the face, hands, and limbs of Christ, the general effect being that of a photograph of Christ and not of his shroud."

Street Cars of Manila.

If Manila surrenders without being bombarded by Rear Admiral Dewey, the American troops may feel very much at home there when they ride through the streets of Manila in street cars which were built in this country, says The Railway Review. The total street car equipment of the "Tranvias de Filipinas" was built by the J. G. Brill Company, of Philadelphia.

Miscellaneous Notes and Receipts.

Testing Sumac.—Prof. W. Eitner says, in Der Gerber, that sumac is best tested for purity by using a microscope. The leaves of Rhus coriaria, from which the Sicilian sumac is prepared, are covered with very fine hair upon both sides, especially on the back, which covering is so glaring that the detection of a sophistication is easy.

Waterproof Gelatine Paper.—The paper is coated on both sides with a solution consisting of 1 part gelatine, 4 parts water, and 1 part glycerine. Coagulate the gelatine and immerse the paper in a solution of 750 c. cm. of formol in 5 liters of water. The paper thus treated is, after drying, impervious even to steam.—Nueste Erfindungen u. E.

New Thermometer Fluid.—In determining low temperatures, thermometers filled with toluol alone or with a mixture of toluol and alcohol were employed heretofore. These latter thermometers could only be used as far as minus 100 degrees (below zero), because the said mixture solidified in a lower temperature. According to Kohlrausch petroleum-ether, whose freezing point lies as low as about 190 degrees (C.?), is very suitable as a filling for thermometers to determine low temperatures.—Pharmaceutische Centralhalle.

A simple method to restore the illuminating power of mantles was reported by Franck to the Polytechnic Society, at Berlin. As is well known, the mantles relax in illuminating power after they have been in use for some time. This luminosity may be restored to a certain degree, by blowing out the mantle from the inside during the burning, which can be accomplished with the aid of a small glass or paper tube. The president of the said society stated that he had personally tried this medium and had found it effective and, in consequence, recommendable. In order to facilitate the carrying out of the process, the German Incandescent Gaslight Company manufactures a tube, mounted in a rubber ball, which is very convenient for the said purpose.—Nueste Erfindungen und Erfahrungen.

A Superior Solvent for Nitrocellulose.—Artificial silk prepared in the well known manner from cellulose has not met with the favorable reception expected. This is principally due to its behavior in presence of water. In a moist condition it loses 90 per cent of its strength, and this characteristic, without taking into account the objections raised by customers by reason of this peculiarity, renders the manipulations of dyeing and finishing difficult. To correct this evil an English inventor has been issued letters patent for remedying the hygroscopicity of artificial silk—that is, its inclination to absorb water. The process consists in the addition of formaldehyde, acetaldehyde, paraldehyde, benzaldehyde, or any other substance belonging to this group, to the solvent of the nitrocellulose, or in treating the drawn thread with a solution of these substances. The quantity of the formaldehyde or the agents required for the treatment before the denitration of the finished spun threads may be as much as 15 per cent of the weight of the nitrocellulose. Since formaldehyde or the above mentioned agents, in combination with ethyl alcohol or methyl alcohol, ether, etc., is an extremely active solvent of nitrocellulose, it is advisable to add the formaldehyde, etc., when commencing to treat the nitrocellulose and to mix it.—Leipziger Faerber Zeitung.

Testing Commercial Albumen. — Gelatine, dextrine, and mucilage are generally used for adulterating the dry commercial albumen. Again, the albumen may also be worthless through partial coagulation. For testing a sample, 2 grammes are stirred into a small quantity of distilled water, by which a sophistication with flour may be recognized. The mass is next diluted with water to make 200 c. cm.; if the albumen contains no coagulated admixture, the solution remains clear. To 100 c. cm. of the solution are next added 35 c. cm. of a 1 per cent tannin solution and about 0·2 gramme of a pure commercial tartar. This mixture is agitated and filtered. One-half the filtrate is mixed with a 0·5 per cent gelatine solution (of which 25 c. cm. correspond to about 0·1 gramme of pure commercial tannin). If the sample is pure albumen, there must in no case be a precipitate. Should the gelatine cause a precipitation, then an excess of tannin is present; the albumen contains in this case either adulterants or else it is coagulated in part. If a precipitate is caused at the second addition of tannin to the albumen solution, the albumen is adulterated with gelatine or similar substances. From the quantity of tannin required for the second precipitation may be determined approximately the gelatine present, as the latter is capable of precipitating about four times as much as the same weight of dry albumen.

The presence of gelatine and of dextrine in albumen may also be ascertained by heating the solution of the product in a water bath. The albumen coagulates thereby and may be separated by filtering. If the sample is pure, the filtrate will give no precipitate with tannin. Dextrine and gum arabic can be found in the filtrate by the usual test methods.—Ann. Chim. Anal. Appliq., 1897, p. 241.

Alinit.

Under this name a manufacturer of coloring matter in Elberfeld (Germany) has put on the market a product in the form of yellow powder which, according to the inventor, will make the production of cereals possible independent of the richness of the soil in nitrogen; in other words, it is supposed to play the same part in feeding these plants that nitrogen does in feeding leguminous plants.

A farmer of the name of Caron, to whom we owe the discovery of this product, says that "alinit" is the cultivation of a germ of the soil which causes the nitrogen in the air to enter into chemical combinations especially adapted to the nourishment of cereals. In experiments conducted in the laboratory and also on the farm, the plants treated with alinite produced from 10 to 30 per cent more than those not treated. Therefore, alinite would do away with the use of azotic manures, nitrates, sulphate of ammonia, etc., in the cultivation of cereals.

These experiments are certainly promising and worth being verified. This is what Dr. Hartleb, who communicated the results of his work to the congress of naturalists recently held in Brunswick, has just done.

The cultivation of "alinit" is supposed to consist of the bacteria of putrefaction, and should resolve nitrogenous materials into nitrogen gas instead of causing them to enter into chemical combinations useful to plants.

We must note that Hartleb was content with mixing "alinit" with earth without sowing any grain therein; objections have been made, and they have weight, that the alinite germs cannot attack the nitrogen of the air except on condition that they live in common, in symbiose as scientists say, with the growing grains.

In the last issue of the Revue Agronomique du Temps, M. Grandean reports on the observations recently made on "alinit" by M. Stoklasa, a professor of Prague. In common with those of Hartleb, they establish the fact that the "alinit" germs, to which Caron gives the name Bacillus ellenbachi, is not a new species, but that it is the Bacillus megatherium discovered by Bary on putrefied cabbage leaves, and which also exists abundantly in the earth and in water. Cultivated in a soil containing a nitrate, it decomposed 20 per cent of this salt in the space of two months and a half. It would, therefore, seem that B. megatherium would be more harmful than useful, because it destroys the nitrogen which nourishes the plants. Besides this, it has two other extremely remarkable qualities. Stoklasa pretends that "alinit" really attacks the nitrogen of the air, but only in the presence of a growing plant. During a trial growth of barley which lasted sixty days, one kilogramme of prepared earth attacked seventy milligrammes of nitrogen.

In order to get an idea of the importance of this amount, I call attention to the fact that a hectare of earth 20 centimeters deep weighs about 4,000,000 kilogrammes. Admitting an absorption equal to that claimed by Stoklasa, in the space of two months a hectare would have absorbed 280 kilogrammes of nitrogen, which is more than enough for three excellent crops of grain.

This is not all. M. Stoklasa also claims that Bacillus megatherium increases the assimilative power of nitrogenous substances of an organic nature. Turf containing 0·83 per cent of nitrogen (after having been impregnated with alinite) contained, at the end of seventy-two days, 42 per cent of its nitrogen soluble in water.

The result of this experiment is that "alinit" would increase the fertility of soils rich in black mould.

It would not be wise at present to take sides in such a complicated and little known question as that of alinite; it offers such wonderful prospects to agriculture that it will not fail to cause numerous researches by scientists in all parts of the world. Practical persons will do well to await the results of the scientists' experiments before making an extensive use of a product whose efficacy is not yet firmly established.

The above article was published recently in Le Phosphate. In order to learn what opinion was held by our own authorities on this subject, the editor wrote to the Department of Agriculture and received the accompanying exhaustive and courteous reply:

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
WASHINGTON, D. C., July 8, 1898.

To the Editor of the SCIENTIFIC AMERICAN:

DEAR SIR: I take pleasure in sending you the following statements in regard to "alinit," which have been prepared in the Division of Chemistry of this department in response to your request of June 29.

Since the announcement in 1885 of the experiments of Berthelot which indicated that the free nitrogen of the atmosphere is brought into chemical combination with other elements by the action of micro-organisms contained in the soil, and the experimental demonstration in 1885 by Hellriegel and Wilfarth of the part played by micro-organisms in the assimilation of free nitrogen by leguminous plants, numerous investigators have been strenuously endeavoring to discover the conditions under which these organisms may be made to supply field and garden crops with nitrogenous food with certainty and with profit to agriculturists. Methods have been patented for inoculating soils and seeds with the organisms which live in symbiosis with leguminous plants in the nodules on their roots, and thus enable them to utilize the uncombined nitrogen of the air for the construction of the nitrogenous substances which are especially abundant in the plants of that family. Pure cultures of these organisms are manufactured and offered for sale by Farbwerke vormals Meister, Lucius & Brüning, Höchst a. M., Germany, under the trade name of "nitragin."

The advertisement of this firm, on the last page of the recent issues of the Deutsche landwirtschaftliche Presse, states that the treatment of one morgen (0·63 acre) of land with "nitragin" costs 2·75 marks (69 cents). This method of soil inoculation has been tried with varying success in Continental Europe, in Great Britain, in the United States, and perhaps in other parts of the world.

However, the only way to obtain a supply of nitrogenous food from the air for the use of wheat, rye, corn, oats, barley, and other crops not belonging to the leguminous family by means of the root-nodule bacteria, is to first grow a leguminous crop and plow it under as a "green manure," or to feed it to farm animals and apply to the land the manure produced. The evident need of the agriculturist is an organism which will bring the nitrogen of the air into the form of a chemical compound suitable for the nutrition of non-leguminous agricultural plants. The nitrogen of the air is free; nitrogen in forms suitable for food for cereal crops costs the farmer 6 to 13 cents per pound. A German agriculturist of the name of Caron, Rittergutsbesitzer at Ellenbach, in the province of Hesse, claims to have found this organism in the bacterium which he calls Bacillus ellenbachensis α. Pure cultures of this organism are manufactured and offered for sale to agriculturists under the name of "alinit" by the Farbenfabriken vormals Friedrich Bayer & Company, Elberfeld, Germany. The cost of the material for the treatment of one morgen (0·63 acre) of land is from 2·775 to 3 marks (69 to 75 cents), according to the quantity purchased. Caron began experimenting earlier than 1894, and since that time has used his method of soil inoculation extensively at Ellenbach for the growth of various non-leguminous plants. He claims an increase in the harvests of as high as 35 per cent in some cases.

"Alinit" and the process for its manufacture are protected by English patent No. 5,574, March 2, 1897, and undoubtedly by patents in other countries also. The commercial material is described as a brownish yellow amorphous powder sealed in a tube of yellow glass, packed in a cardboard box and accompanied by directions for its use and a pamphlet setting forth the results of Caron's experiments. The powder contained in the tube is prepared from dry cultures of the organisms, of which a very large proportion of the individual cells have passed into the resting spore stage, and are thus enabled to retain their vitality when stored for a long time. For the practical use of the material, it is mixed with water and the infusion obtained is applied to the seeds before they are sown. Five hundred to one thousand individuals of the organism are said to be made to adhere to each seed.

Stoklasa, of Prague, has subjected "alinit" to a careful study, and claims that the organism contained in it is identical with Bacillus megatherium (De Bary), an organism that is very abundant in soils and natural waters. He found that in a soil inoculated with the organism and seeded with barley, there was a fixation (bringing into chemical combination) of nitrogen amounting to 0·07 gramme of free nitrogen per kilogramme of soil in sixty-two days. He also observed that the organism was especially active in rendering soluble the nitrogen contained in peat and in soils rich in humus. Stoklasa has published papers on this subject in the scientific journals as follows:

Centralblatt für Bakteriologie, Zweite Abtheilung, 1898, iv., 39–41, 78–86, 119–130, 284–289.

Deutsche landwirtschaftliche Presse, 1898, xxv., 243.

Chemiker Zeitung, 1898, xxii., 181–182.

His results have been discussed in Annales Agronomiques, 1898, xxiv., 171–180 and 253–254.

Stutzer and Hartleb, of Bonn, have also studied "alinit," and have reported their results in the Centralblatt für Bakteriologie, Zweite Abtheilung, 1898, iv., 31–39, 73–77. They also report the organism of "alinit," Bacillus ellenbachensis alpha (Caron), to be identical with B. megatherium (De Bary). They were unable to detect any fixation of nitrogen when the organisms were grown in various culture media.

Lauck, of Jersitz-Pozen (Centralblatt für Bakteriologie, Zweite Abtheilung, 1898, iv., 290–295; Deutsche landwirtschaftliche Presse, 1898, xxv., 243), finds the bacterium of "alinit" to be Bacillus subtilis, an organism closely related to B. megatherium and of very common occurrence in the soil and on agricultural plants; in fact, it is commonly known as the "hay bacillus."

Miczynski (Deutsche landwirtschaftliche Presse, 1898, xxv., 393), working in the laboratory of the Agricultural Institute of Göttingen, found "alinit" to contain two organisms: B. mesentericus vulgatus, the "potato bacillus," and B. subtilis.

Frank (Annales Agronomiques, 1898, xxiv., 253) found the organism of "alinit" to be B. tereginus.

Dr. Paul Wagner, Director of the Agricultural Experiment Station at Darmstadt, a most skillful, careful, and experienced investigator, has tried "alinit" in pot and field experiments with various crops and obtained negative results.

The value of "alinit" is, therefore, at present an open question which future experiments must settle. Theoretical considerations point to two conclusions: First, it seems logical to expect that if we plant with the seed large numbers (500 to 1,000 for each seed) of an organism capable of rendering available the humus nitrogen already contained in the soil and endowed with the power of absorbing more nitrogen from the air, our young plants should begin their growth with a vigor and rapidity that would insure an abundant harvest. On the other hand, it is a well known fact that almost every bacterium multiplies at an astonishingly rapid rate whenever it is placed in a pabulum suited for its growth. The wide distribution of the organisms under discussion argues therefore that we should study how to insure their abundance in the soil by making it a medium favorable for their growth rather than by adding relatively small numbers of them in the form of artificial cultures to soil which is deficient in them because of its unsuitability for their growth.

While "alinit" and the methods proposed for its use may be devoid of value, the study of the question which it has called forth undoubtedly hastens the writing of one chapter of the history of the development of our knowledge of the microscopic organisms of the soil.

Respectfully,
JAMES WILSON, Secretary.

Opening of the Waterloo and City Electric Railway.

The formal opening of the Waterloo and City Electric Railway, London, took place July 11 in the presence of a distinguished company, which traveled over the road by two trains. A representative of the SCIENTIFIC AMERICAN was among the invited guests. The new electric underground line, which we hope to illustrate in another issue, connects Waterloo Station on the Southwark side of the Thames with the "City," the terminus being at the Mansion House opposite the Bank of England—a distance of a mile and a half. Access to it is obtained from Waterloo Station, whence the tunnels, two in number, pass under York Road at a depth of only eighteen feet from the surface, and then descending toward the river they cross Waterloo Road, a few inches below the main sewer of the London County Council. Proceeding along the line of Stamford Street to Hatfield Street, they then pass under the river in a northeasterly direction, emerging under the Victoria Embankment in front of the Royal Hotel, at Blackfriars, whence they pass under Queen Victoria Street till a commodious terminal station is reached opposite the Mansion House. The stations at each end are spacious and attractive, the tunnels are lighted from beginning to end with the electric light, the carriages are commodious and well arranged, the ventilation is good, and the trains passed from end to end with an ease and rapidity that left no ground for misgivings as to the thorough and practical way in which the work had been done.

Our Progress in the Manufacture of Iron.

The official report on the production of iron made by the American Iron and Steel Association shows conclusively our pre-eminence in this branch of industry. In the first half of 1898 our output was the largest known, either in the United States or any other country for the same period, and more than half a million tons greater than in any other half year of our existence.

The following figures give the production of the last half year and of the other periods which have in any degree approached it. They show a progress such as no other country has attained.

	Production.
1898, first half	5,909,703
1897, second half	5,249,204
1897, first half	4,403,476
1896, second half	3,646,891
1896, first half	4,976,236
1895, second half	5,358,750
1892, second half	4,387,317
1892, first half	4,769,683
1891, second half	4,911,763

Production has increased so as to reach 984,950 tons a month, and the apparent consumption has increased even more, reaching 991,391 tons. The highest production and the highest consumption have both been attained with low prices, both for pig iron and for finished products.

THE largest barracks in the world are at Warsaw, Russian Poland. About 38,000 men can be accommodated there. The barracks at Aldershot, England, hold 20,000 men.—Le Chasseur Français.

OUR ARMY AND NAVY HOSPITAL SHIPS.

The United States has now in commission two very complete hospital ships, and it is understood a third will be soon added. The "Solace," formerly the coastwise steamship "Creole," was the first fitted out, and under the auspices of the Navy Department, but was soon followed by the "Relief," erstwhile the Portland Steamship Company's "John Englis," which belongs to the War Department. Neither is a hospital ship, in the general acceptance of the term, since their main purpose is solely to afford communication between the hospitals in the field and the ships on sea duty and the general hospitals, naval and military, along the seaboard.

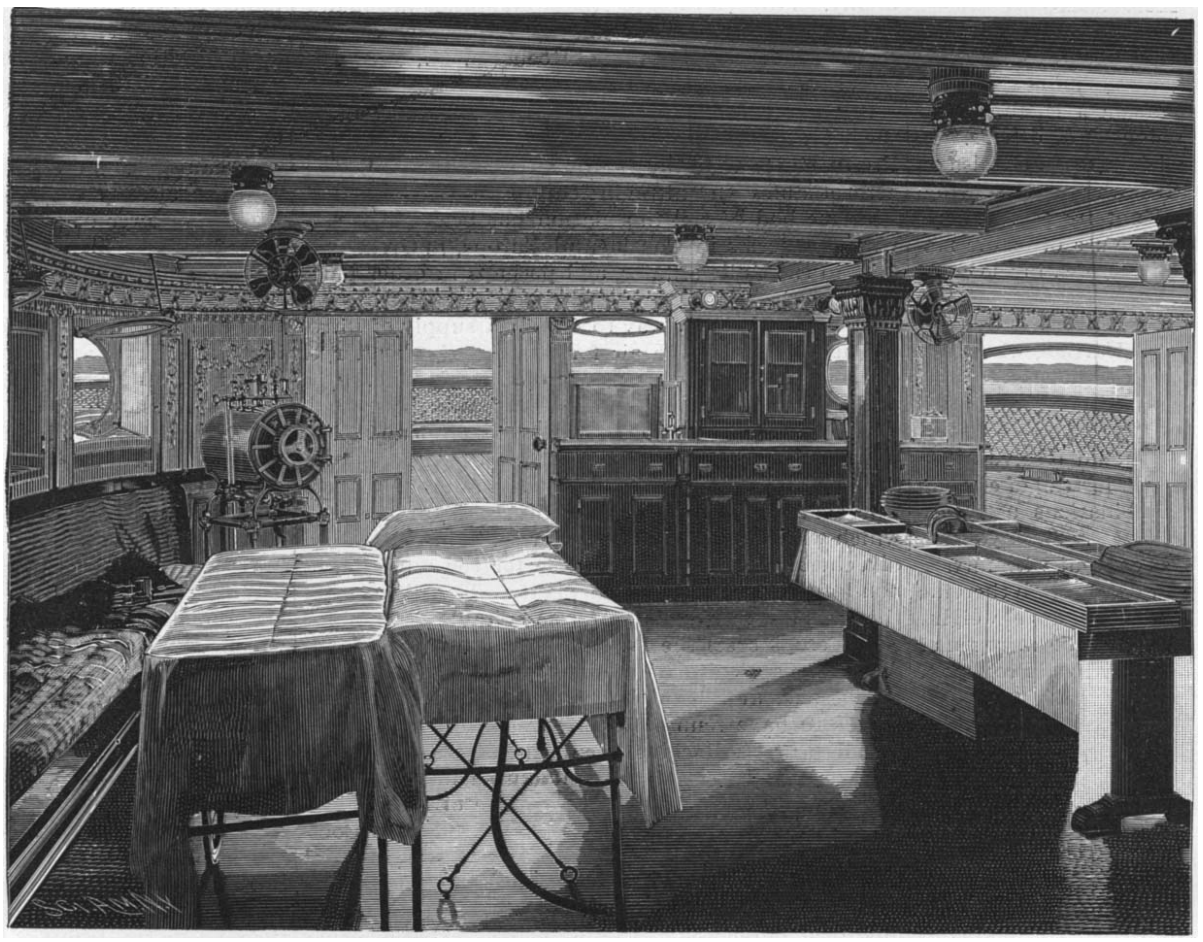
The "Solace" is 375 feet long, of 3,800 tons displacement, and capable of a speed, in emergency, of sixteen or seventeen knots per hour. Aside from the reservations for fuel storage — and the bunkers alone accommodate 850 tons—the hold and cargo deck are given up to stores —ship's stores, pantry supplies, medical, surgical, and hospital necessaries—and a large sterilizing plant. On the main or berth deck are blowers for promoting artificial ventilation, quarters for the crew, hoisting engines, etc. and immediately abaft a large ward, with berth and cot accommodations for one hundred patients; well aft is the emergency ward with fifty swinging cots. Both wards have closets, bath rooms, and an abundant supply of hot and cold water contiguous, and communicate with the deck above, the forward one with an elevator to the operating room, the latter with the cabin reserved for convalescents and general lounging purposes. Between the berth deck wards are the laundry, drying, cold storage, and engine rooms, the artificial ice plant, and quarters and mess room for apothecaries, petty officers, nurses, etc.

Forward, on the cabin deck, is the operating room before mentioned, tiled with interlocking rubber disks, and ceilings and bulkheads white with enamel paint, permitting thorough cleaning and sterilization. The furnishings, too, are of enameled steel, and a complete outfit of surgical instruments and appliances, including sterilizing apparatus, are furnished. Adjoining are lavatories and dispensary, the latter connected by telephone with the wards and surgeons' quarters. The cabin and mess room of the senior members of the medical staff are immediately abaft the operating room, next to the gangway and boiler space. Then follow the space occupied by the engines, the state rooms for invalid officers and junior members of the medical staff, and, lastly, the convalescents' cabin and mess room.

Everywhere an abundance of both light and ventilation is conspicuous. The quarters for the ship's officers are on the promenade deck, the afterpart of which is fitted with stanchions and appliances for housing in with canvas screens and awnings, to form an isolation ward for contagious maladies, should occasion demand.

Two steam launches, fitted with platforms for the accommodation of the ill or wounded, form a part of the ship's boat complement, and special in and out hoisting apparatus insures the handling of the unfortunates with a minimum disturbance of position. The patient can be moved lying in his cot or hammock, if desired.

The "Relief" is somewhat smaller than the "Solace," being but 328 feet in length and 3,500 tons displacement and one or two knots slower. She is divided in five wards for the accommodation of patients, two on the forward and after portions of the berth deck respectively, two similarly situated on the cabin deck and one forward on the promenade deck, the total berthing capacity being about 300, though this can be considerably extended in an emergency. The surgical ward is aft on the berth deck, and is joined on the starboard side by the operating room, that, as in the "Solace," is tiled with rubber and the bulkheads protected by enamel paint. The illustration exhibits two operating tables, a steam sterilizer immediately to the rear thereof, and the array of trays and shelves and cases for appliances on the right. There is the same completeness as regards resources and appliances of all kinds, even X ray, microscopic, and photographic outfits being provided. As before remarked, the general details, including provisions for light and ventilation, for cold storage, ice manufacture, laundrying and sterilizing, bath and closet accommodation, and transfer of the ill and wounded, are practically identical in the two ships.



OPERATING ROOM ON UNITED STATES AMBULANCE SHIP "SOLACE."

The medical staff of the "Solace" includes four naval surgeons, three naval apothecaries, and thirteen male nurses and attendants; of the "Relief," eight army surgeons and hospital stewards, and sixteen nurses and attendants.

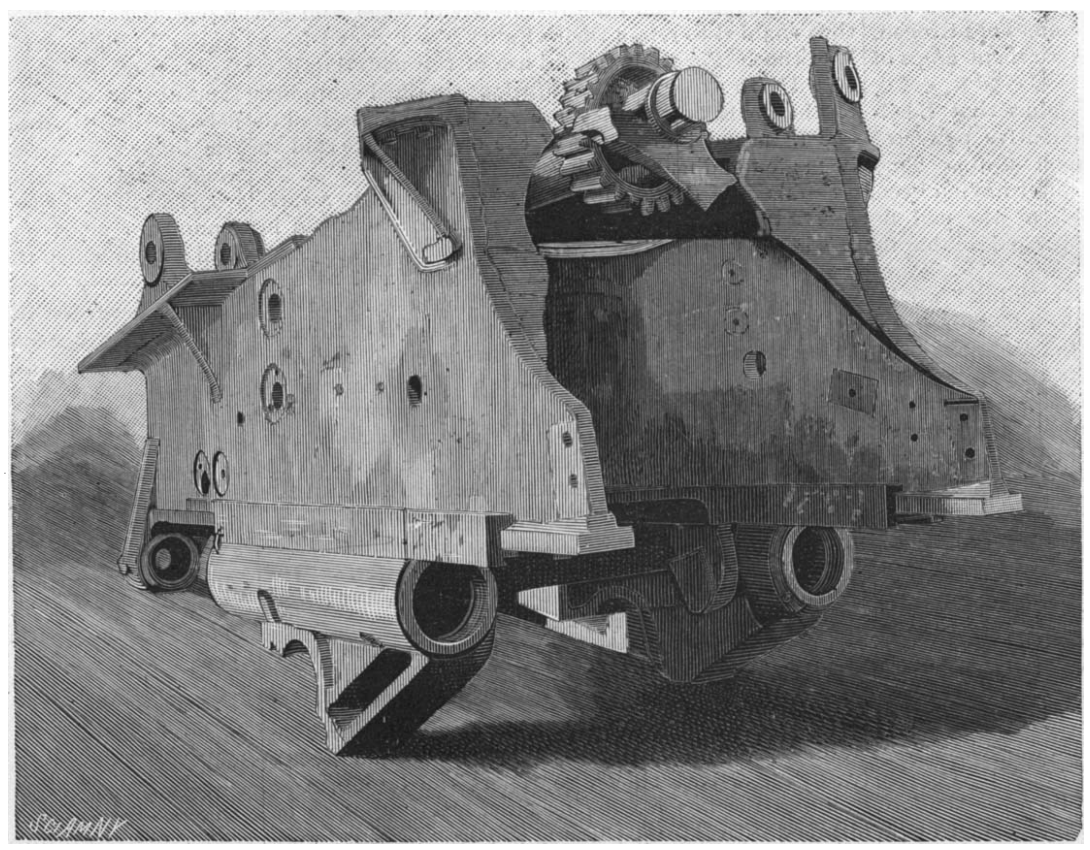
It certainly should be a matter of general pride and congratulation that the United States has thus taken the initiative in inaugurating hospital ships that are true to the title instead of being mere transports, and that insure careful and proper medical treatment for the ill and wounded, and the best of comfort while in transit to their homes or hospital assignments.

A RELIC FROM THE WRECK OF THE "MAINE."

When the gunboat "Yorktown" sets sail from the navy yard at Mare Island, San Francisco, she will carry on her deck a substantial memento of the wreck of the "Maine" in the shape of one of the 6-inch gun carriages that formed a part of the armament of that ill-fated ship.

Among the many objects that were recovered from the "Maine" during the diving operations which were carried on between the date of the explosion and the declaration of war, was the gun carriage for a 6-inch rifle which is shown in the accompanying illustration. It was brought to Norfolk and placed in the scrap heap at the navy yard, the injuries which it had received in the explosion being such as to render it, in the opinion of the ordnance officers, unfit for further use. It was due to the activity of Admiral Dewey that the discarded gun mount received a sudden and unexpected value as a part of our reserve stock of gun material. It will be remembered that in the Manila fight a shell landed on the "Baltimore" and did a considerable amount of mischief, exploding a case of ammunition and disabling a 6-inch gun carriage. It was impossible to supply a new carriage from the reserve stock, as this had been entirely depleted in supplying the auxiliary cruisers. Accordingly orders were given to remove one of the 6-inch carriages from the "Yorktown," which is undergoing repairs at Mare Island, and ship it down to Manila.

Of course, the deficiency on the gunboat had to be at once made good, and the discarded mount from the "Maine" was therefore pressed into service. Fortunately, the only serious damage to the mount was the break which is shown in our engraving, part of the web of the casting at the rear of the gun having been broken away. The broken portion, which has now been repaired with a strong patch, is not directly affected by the shock of discharging the gun, and for practical purposes the "Maine's" gun carriage, which is probably by this time mounted in place on the deck of the "Yorktown," is as serviceable as ever. The "Yorktown" will very shortly be on its way to join the fleet of Admiral Dewey, and it is not unlikely that the "Maine" relic will perform its share in the active operations of the war. As shown in our illustration the gun carriage is lying upside down, and is resting on the trunnion bearing brackets and on the lugs to which the hydraulic recoil piston rods are bolted. The two recoil cylinders are clearly seen, as is also the fracture to which we have above referred. It will be seen that the rear bearing of the shaft which carries the traversing gear wheel has broken away from the gun carriage. The repairs of which we have spoken were made at this point.



SIX-INCH GUN CARRIAGE RECOVERED FROM THE "MAINE" AND NOW MOUNTED ON THE "YORKTOWN."

A Novel Light.

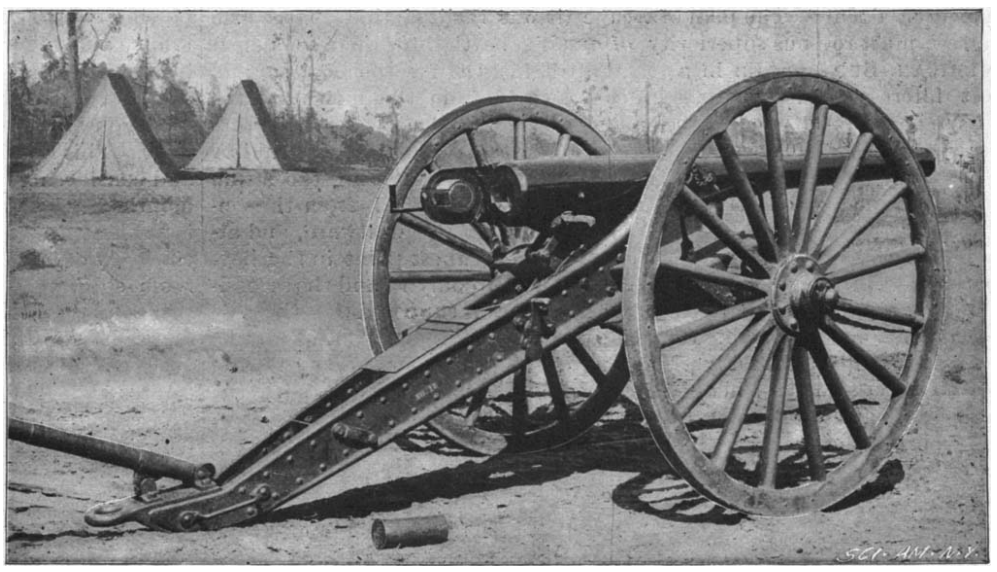
The lighthouse on Armish Rock, in the Hebrides, is about 500 feet from the shore. To avoid having an attendant on the rock, the light is produced on the shore and projected across the water upon a mirror in the lighthouse, the mirror reflecting the light in the desired direction.

PHYSIOLOGISTS say that of all people in middle life at least one-third have one ear in some degree affected by deafness.

THE 3·2-INCH DRIGGS-SEABURY FIELD-GUN.

In the accompanying illustration we show a 3·2-inch field-gun with Driggs-Seabury improved breech-mechanism, mounted on a carriage designed by Colonel Buffington.

The 3·2-inch gun is a favorite field weapon, and is capable of great execution when firing shrapnel against bodies of troops. The gun weighs 805 pounds, is 7·31 feet long and has a bore 25·20 calibers in length. The shell weighs 13·5 pounds and the charge 3·5 pounds. The muzzle velocity is 1,685 feet per second, the muzzle energy 266 foot-tons, and the penetration through steel 3·8 inches. The breech-mechanism, which is shown swung back clear of the breech in the opened position, is of remarkable compactness and simplicity—two most important features in field artillery. Unlike the naval and coast defense guns, which are always within easy reach of a forge, if not of a machine shop, the field-guns usually go into action at a considerable distance from any extensive repair facilities, and their disablement will probably put them out of action indefinitely. It is of the highest importance that their parts should be few, simple, and easily repaired. The breech-mechanism of the gun under consideration is an improved form of the old Driggs-Seabury mechanism, and as may be seen from the cut, it is remarkably compact and free from complication.



3·2-INCH FIELD-GUN ON BUFFINGTON GUN-CARRIAGE.

Weight of shell, 13·5 pounds; powder, 3·5 pounds; muzzle velocity, 1,685 feet per second; muzzle energy, 266 foot-tons; penetration, 3·8 inches steel.

If the reader will refer to the SCIENTIFIC AMERICAN ARMY AND COAST DEFENCE SUPPLEMENT, he will notice in the chapter on rapid-fire guns that there are usually three distinct motions of the breech-block in opening the breech. It is first rotated to unlock the threads, then withdrawn onto a hinged carrier tray or ring, and finally swung clear of the breech to make way for the next operation of loading. The Driggs-Seabury breech-mechanism embodies an improvement which is designed to do away with the second movement, and reduce the operation to two, namely, the rotation of the block and its withdrawal on the hinged tray. In the old three-motion mechanism, it was necessary to withdraw the block onto the hinged tray on a line with the axis of the gun, because the circular path described by the tray prevented the block from being swung to the right or left directly from its seat in the breech-box. In the new type the breech-box is curved to the circle described by the block, and the withdrawal of the block on the axial line of the gun is thereby rendered unnecessary.

The opening and closing lever is hinged at the center of the carrier-plate. The first movement of the lever rotates the block, the rear end of which is threaded into a ring in the carrier-plate. The rotation is accomplished by means of a short lever which is formed at the inner end of the opening lever, where it is hinged to the carrier-plate. The short lever has a ball and socket engagement with the outer end of the breech-block, and as the opening lever is swung across the breech, the breech-block is given one-sixth of a turn. The further motion of the lever causes the breech-block and tray to swing clear of the breech into the position shown in our cut.

The Buffington carriage is constructed of plate steel. To stiffen the axle, it is inclosed between two plates of steel, which are firmly riveted together. The width of the plates is so placed that they take the bending strain of the recoil which would otherwise come upon the axle. The flasks are formed of sheet steel riveted together, and they are so placed as to give great lateral and vertical stiffness to the carriage. The elevation of the gun is accomplished by means of a set of jointed levers known as "lazy tongs," which will be noticed beneath the breech of the gun. The "trail hand-spike," by which the gun is traversed, will be noticed inserted in the trail-piece of the stock where the carriage rests on the ground.

When it is not in use the hand-spike is folded forward against the trail and held in place by a catch. Two gunners can be seated on the axle. Two hundred of these guns are now under construction for the government.

A GROUP OF NAVY PROJECTILES.

The projectiles in use by our navy may be classed as solid shot, shell, and shrapnel. Although some excellent solid shot is still manufactured, such as the Johnson fluid compressed shot, a description of which is given in our COAST DEFENCE SUPPLEMENT, solid shot have given place to shell as the standard projectiles of the navy.

Shell is formed with an interior cavity of considerable dimensions, in which is placed a charge of powder or high explosive. It is provided with a fuse for the ignition of the charge, which is of the percussion or time-fuse type. The former acts at the instant of striking; the latter is set to explode the shell a certain length of time after the shell has left the muzzle of the gun.

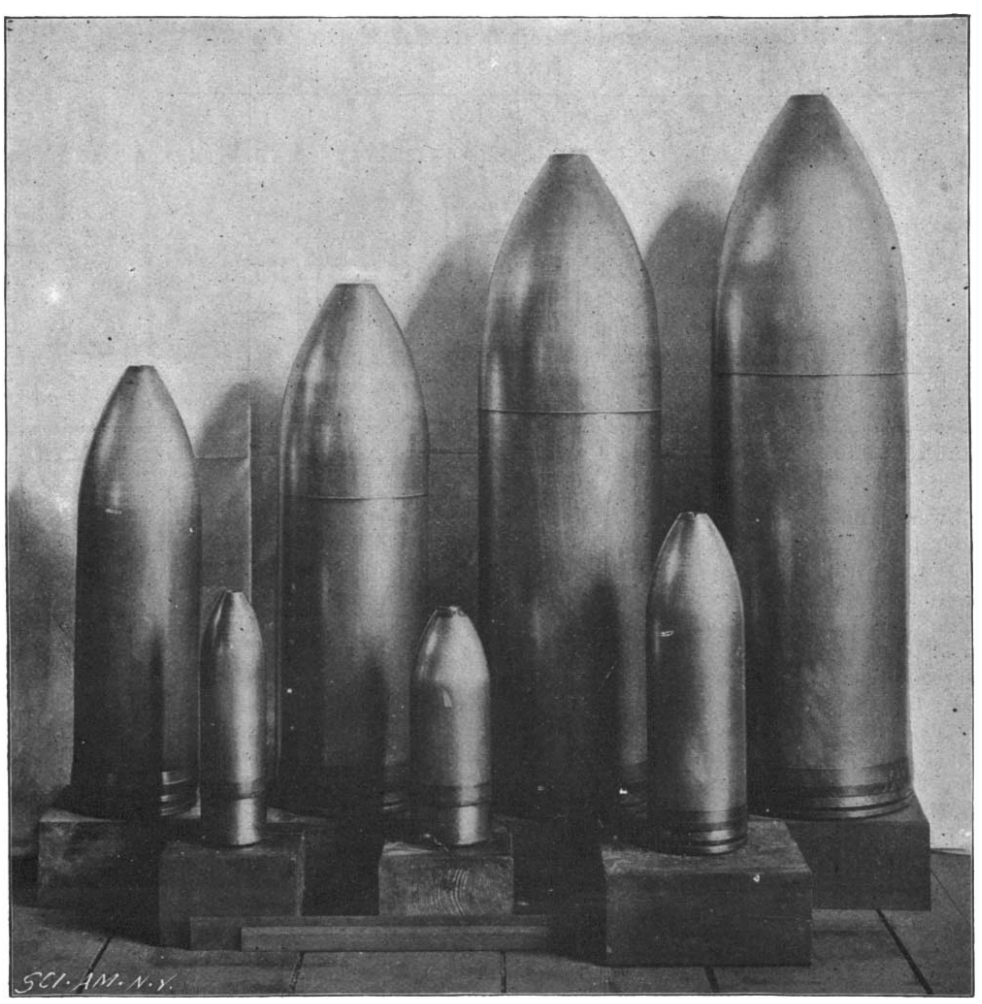
Shrapnel is the modern form of the old case shot, which consisted of a large number of balls put up in a case, or envelope, which merely served to hold them together until they left the muzzle of the gun. In the case of shrapnel the envelope is made sufficiently strong to bear the shock of discharge, and a time-fuse is provided.

The best armor-piercing projectiles are now made of chrome steel, the small admixture of chromium serving to impart to the steel a remarkable amount of toughness. The projectiles are cast, forged, and carefully annealed and tempered, the hardening being confined to the point or nose. The latter is ogival in form, the point being struck with a radius which is two or three times the diameter of the shell. The point has to be sharply pointed to insure its penetration of the hard face of the armor; but if it is made too fine, it will lack the necessary resisting power and will be fractured before it can get through. The best proportion of radius is found to lie between two and three times the diameter.

There are two kinds of armor-piercing projectiles: The first is made solid, or practically so, a small core being formed to give the best results in the forging process; the other type is known as semi-armor-piercing. It is formed hollow with a core of moderate dimensions, large enough to hold an explosive charge that will insure the bursting of the thick walls of the projectile. It is made of chrome steel, and requires in its manufacture to be treated with great care to secure the combined hardness and toughness to enable it to pierce solid armor without fracturing and carry its explosive charge intact into the interior of the ship. When such shell is filled with common powder, the heat engendered by passing through the armor is depended on to explode the shell just within the ship; no fuse is used.

The object at which projectile makers are aiming just now is to make a shell which can carry a charge through the best armor and burst on the inner side of the armor. It is already possible to put solid shot through plate that is as much as one and one-half the diameter of the shot in thickness, and the success of the projectile makers is such as to make it likely that before long a bursting shell can be made to perform the same feat. The Wheeler-Sterling shells are steadily improving in quality, and give promise of equaling the penetration of solid projectiles without breaking up.

It will be evident that penetration of the armor belt by a shell will be vastly more destructive to the ship than penetration by solid shot. The damage wrought by the latter will be confined to its direct path, whereas the zone of destruction of a shell will be almost as extensive, if it is of the larger calibers, as the whole area of the deck on which it strikes. The effects, moreover, will be greatly augmented if a high-explosive bursting charge be substituted for common powder, although the sensitiveness of such charges renders it very difficult to carry them through armor plate and burst them on the inside. Excellent results, however, have been achieved in this direction against armor of moderate thickness.



8-inch 10-inch 12-inch 13-inch
4-inch 5-inch 6-inch

GROUP OF COMMON SHELL AT THE WASHINGTON NAVY YARD.

The group of shells shown in our engraving includes one of each of the sizes used on our warships, from the 4-inch 33-pound shell up to the 13-inch 1,100-pound shell of our largest guns. They are all of the class known as "common shell," and are used against fortifications and earthworks and against the unarmored or lightly armored portions of warships. They are usually formed of cast iron, though sometimes of cast steel, and the interior cavity is large, enabling a big bursting charge to be carried. Unlike the forged chrome steel shell, they are unfit for armor-piercing, not having the necessary strength to carry them through the plates.

The particulars of these shells are given in the following table:

Diameter.	Length.	Bursting Charge.
4-inch.....	1 foot 4 inches.	2 pounds.
5 "	1 " 3 "	3 "
6 "	1 " 9 "	4 "
8 "	2 " 6 "	10 "
10 "	3 " 0 "	22 "
12 "	3 " 8 "	42 "
13 "	4 " 0 "	70 "

It will be noticed that the point of the shell is cut off. It is here that the percussion fuse is inserted. The fuse consists of a hollow threaded brass case, which is screwed into a hole bored through into the interior of the shell. Inside the case is a cylindrical lead plunger, in the center of which is a fulminate and a priming charge. When the gun is fired, the plunger

moves to the rear of the fuse, and at the moment when the shell strikes an obstruction it flies forward, the fulminate striking a small anvil on the fuse cap. This ignites the primer, the flame of which enters the shell and explodes it.

ADMIRAL SAMPSON'S REPORT OF THE SANTIAGO ENGAGEMENT.

Admiral Sampson's report of the naval engagement off the south coast of Cuba is too lengthy a document for insertion in these columns, and we must refer our readers to the SCIENTIFIC AMERICAN SUPPLEMENT, where the text of this most interesting and valuable report is given in full. We have preferred, however, the accompanying set of diagrams, in which the positions of the contending squadrons are shown at four different stages of the battle, and these, together with the following notes of the conflict, will give our readers a very clear conception of the course of this memorable conflict from start to finish.

Before entering into technical details, and by way of preface, we would draw the attention of our readers to the fact that the Admiral's report disposes effectually of the altogether stupid newspaper gossip to the effect that rival jealousies and clashing authority marred the glory of the Santiago victory. From the report of the chief in command down to the report of the captain of the smallest torpedo boat or converted yacht, there is manifest a desire to give the credit of the day's work to the fleet as a whole, and the particular performance of each ship is only considered as part of a prearranged and successfully executed plan. Our sailors have too much pride in the success of the American navy to becloud the hour of victory with petty wranglings as to whether to admiral or commodore, gunner or quartermaster belongs the chief credit of victory.

Besides, as Admiral Cervera aptly remarked on learning that one of his defeated captains had been permitted to retain his sword, "Sailors are always gentlemen." We commend this statement to the consideration of that section of the press which has lately been attempting to prove that this is just what our sailors are not.

It is evident from the report that the blockade was carried out with the greatest diligence and watchfulness. By day our vessels were ranged in semicircles around the harbor mouth at a distance of from four to six miles from the entrance. By night the vessels closed in, three lines being drawn around the entrance as follows: At a distance of one mile, in a semicircle, were three picket launches; at a distance of two miles were three gunboats, the "Vixen" to the westward, the "Suwanee" due south, and the "Dolphin" to the east; and the battleships and cruisers lay outside of these, in the following order from the westward: Armored cruiser "Brooklyn," 9,215 tons, 21·9 knots; second-class battleship "Texas," 6,315 tons, 17·8 knots; first-class battleship "Massachusetts," 10,288 tons, 16·2 knots; seagoing battleship "Iowa," 11,340 tons, 17·1 knots; armored cruiser "New York," 8,200 tons, 21 knots; first-class battleship "Oregon," 10,288 tons, 16·8 knots; first-class battleship "Indiana," 10,288 tons, 15·5 knots. Searchlights were kept playing upon the entrance and the adjoining coasts during the whole night, a system of signals was arranged, and everything possible was done to draw an impregnable blockade about the harbor entrance. After the arrival of Shafter's army, the night blockading distance was reduced to two miles.

It was generally supposed that Cervera would make a dash for the open sea under cover of darkness; but we learn from his own lips that so effective were the precautions of the blockading ships, that he realized the hopelessness of an attempt to break through when the lines were drawn up within two miles of the entrance.

On the morning of the eventful day, the "Massachusetts" had left her station between the "Iowa" and "Texas," and had gone down the coast to Guantanamo for coal, and the flagship "New York" had started in the same direction for Siboney, where Admiral Sampson intended to land, for a conference with General Shafter. These withdrawals, of course, greatly weakened the blockade, and Admiral Cervera determined to make a dash for the open at the hour of general quarters, when the whole ship's crew would be mustered on deck for inspection—the one moment in the whole twenty-four hours when the ships could be "taken aback," as it were.

The plan of escape (it was realized that the enormous superiority of our big battleships rendered defeat certain in a stand-up fight) was for the cruisers and destroyers to steam swiftly from the mouth of the harbor at the moment when the American crews were at quarters, thereby gaining the time which would be consumed in manning the guns, increasing the steam pressure, etc. As each vessel emerged from the entrance it was to turn sharply to the westward, and attempt to break through the weakest point in the line, represented by the cruiser "Brooklyn" and the second-class battleship "Texas." It was supposed that the only ship which could overhaul the Spanish fleet was the "Brooklyn," and orders were given to concentrate upon her the fire of the advancing fleet. With the "Brooklyn" crippled, and the powerful battleships, which would naturally lose much time in getting under weigh, left astern, Cervera expected to make a successful run for Cienfuegos or Havana Harbor.

The plan was well conceived, and had these 20-knot ships been manned by American gunners and engineers, the probability is that two at least, and possibly the whole four, would have got away. As it was, execrable Spanish gunnery and poor Spanish stoking on the one hand, and excellent American marksmanship and good work in the engine room force on the other, notably in the case of the "Oregon," rendered the attempt one of the most pitiable failures recorded in history.

According to Sampson's report, the speed of the cruisers on issuing from the channel was only 8 or 10 knots, and the fastest ship of the four, the "Colon," a vessel which in proper hands should have been good, even with her foul bottom, for 17 or 18 knots, was only able to make an average of 13·7 knots during her run of 48 miles up the coast. Foul bottoms alone do not account for this falling off, and in default of any other explanation, it must be set down to the notorious incapacity of the Spanish as engineers.

High speed as a necessary element in the construction of warships loses none of its value because of the Santiago engagement. This is evident, moreover, from the fact that the "Brooklyn," with only two out of her four engines coupled up, was eventually able to work up to 16 knots an hour and overhaul the fleeing Spaniard, and the "New York," which was also using half her engine power and was 7 miles from the harbor when the chase started, was close up and rapidly gaining when the "Colon" surrendered. The most impressive evidence of the value of speed is afforded by the battleship "Oregon." Built on the Pacific coast at the Union Iron Works, she has always proved to be a very efficient vessel. On her trial she exceeded the contract speed of 15 knots by 1·8 knots, and the fleetness which she then showed has apparently never left her. She steamed rapidly through the fleet, easily passing the "Texas," 17·8 knots, and the "Iowa," 17·1 knots, and under forced draught gradually overhauling the "Colon." As the average speed of the latter was 13·7 knots, it is probable that the average of the "Oregon" for her fifty mile run was fully 14 knots an hour. This is only one knot below her contract speed, and considering the fact that she had been for many months in the water without cleaning her bottom, it is a splendid performance, and speaks volumes for the efficiency of her machinery and engine and boiler room staff.

We draw particular attention to the accompanying diagrams showing the armor protection of the two types of cruiser as represented by the "Colon" and the "Vizcaya." They fully explain the early defeat of the "Vizcaya," "Teresa," and "Oquendo" and the comparatively small damage inflicted on the "Colon." In the three ships destroyed so early in the action, the side armor is all concentrated in a thick belt which only rises two or three feet above the waterline for two-thirds of the ship's length amidships. Above this belt there was nothing but the thin plating of the deck which served merely to set off the percussion fuses of the shells and caused them to burst between decks, slaughtering the men and setting fire to the woodwork. Every shell that was fired, including small 6 and 1-pounders, was effective, and it was the hail of projectiles from these little weapons that drove the Spaniards from the guns and sent the ships hurrying for the shore.

Now the "Colon" has her armor better disposed: Instead of having it all concentrated in a thick, partial belt at the waterline, which, as the battle showed, is but seldom liable to be hit, her armor was spread out in a thinner 6-inch sheet over the whole waterline and over the whole main and broadside battery up to the main deck. This 6 inches of Harvey steel was capable of stopping all but the 8, 12, and 13-inch shells, and rendered her safe against the shells of the secondary batteries. Even when she was struck by large projectiles they often failed to penetrate, the worst damage being done to the unarmored ends.

We have always greatly admired the "Cristobal Colon" and "Dupuy de Lome" (French) type of ship, and we sincerely hope that the value of thinner but more widely distributed armor will not be lost upon our naval constructors.

The wretched gunnery of the Spaniards is shown by the fact that not a single shot was delivered that did any serious injury to our ships, although the fight was at close ranges and they carried 11-inch guns, which were fully capable at these ranges of penetrating our heaviest armor. Not one of the larger shells appears to have reached the mark. Several of our captains in their reports speak of a storm of shells passing by them and generally overhead. It has invariably been the habit of the Spaniards to fire too high, and we doubt if many of the excitable dons ever changed an elevation when once the fight was fairly on.

The "Brooklyn" was hit most frequently of all the ships, as was to have been expected, seeing the attack was concentrated on her at the beginning of the fight and she was under continuous fire altogether for nearly four hours. The accompanying diagram, which is reproduced from the official drawings accompanying the report, will prove of great interest. It shows that the brunt of her fighting took place with the "Colon." The 6-inch and 4·7-inch shot holes could only have been made by this vessel, as she was the only ship that carried guns of these calibers.

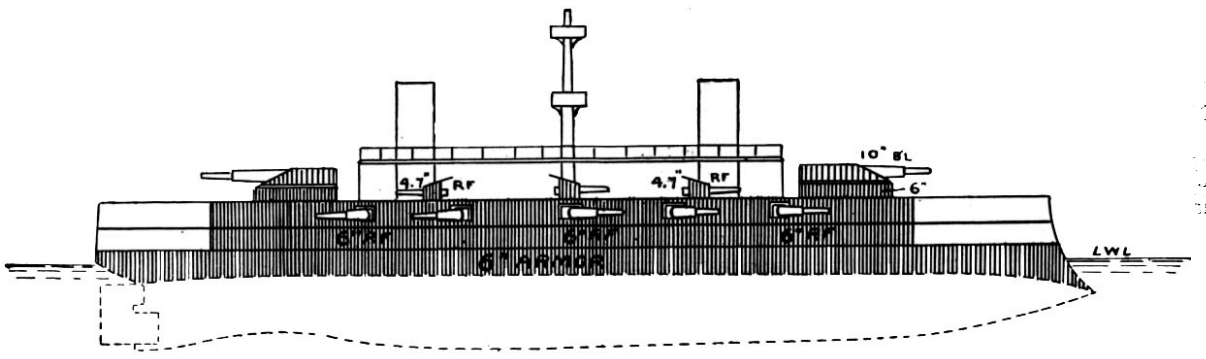
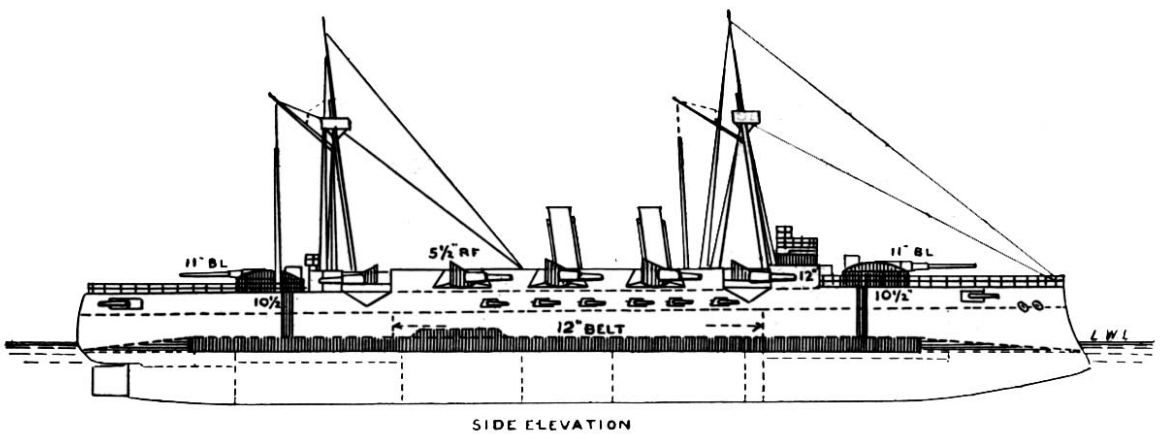


DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISER "CRISTOBAL COLON."



SIDE ELEVATION

DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISERS "VIZCAYA," "MARIA TERESA," AND "OQUENDO."

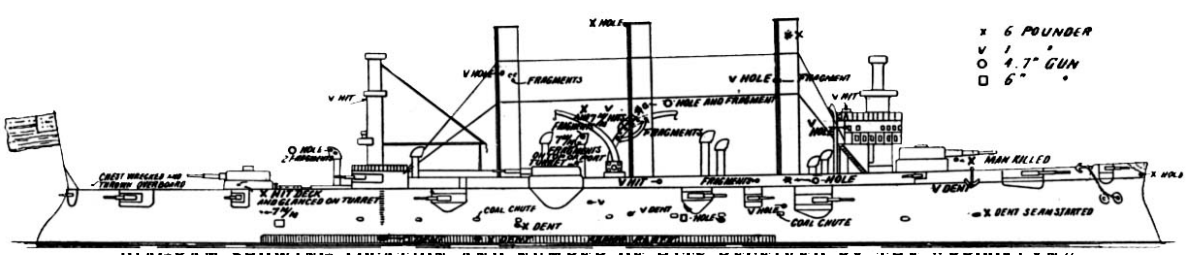


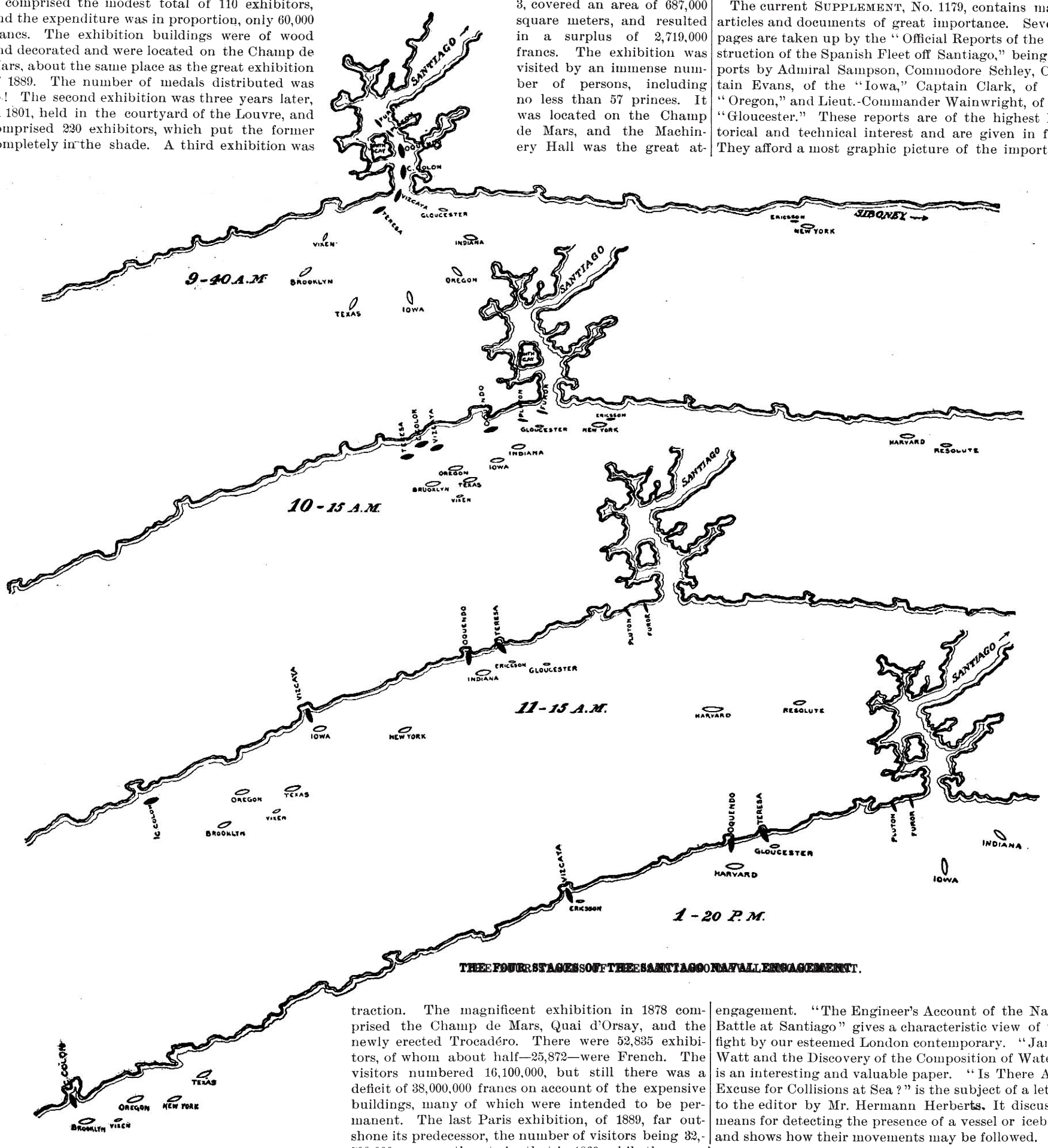
DIAGRAM SHOWING LOCATION AND NUMBER OF HITS RECEIVED BY THE "BROOKLYN" IN THE SANTIAGO ENGAGEMENT.

We cannot close without paying a tribute to the noble qualities displayed by our seamen in the endeavor to save the survivors from the burning and exploding vessels. The work was full of the most serious risk; but the men in the rescue boats never faltered until the last living Spaniard had been taken off. This is one of the brightest features of the whole story, and the terrific fierceness of the onslaught of our ships is only equaled by the splendid heroism with which the work of rescue was carried out.

Paris Exhibitions.

The first Paris exhibition was held in the year 1798; it comprised the modest total of 110 exhibitors, and the expenditure was in proportion, only 60,000 francs. The exhibition buildings were of wood and decorated and were located on the Champ de Mars, about the same place as the great exhibition of 1889. The number of medals distributed was 25! The second exhibition was three years later, in 1801, held in the courtyard of the Louvre, and comprised 230 exhibitors, which put the former completely in the shade. A third exhibition was held the following year on the same spot, the number of exhibitors having risen to 540. Napoleon the Great opened the fourth exhibition, held at the Place des Invalides in the year 1806.

There were 1,422 exhibitors, and several grand fetes were held in connection with it. Number five of Paris exhibitions was held in the year 1819, in the Louvre Palace, the number of exhibitors being 1,622. The sixth was held in 1823, but was not of much importance. Number seven was also held at the Louvre, in 1827, under the reign of Charles X., but, like its predecessor, it was on a more modest scale. The eighth, however, held during the reign of Louis Philippe, at Place de la Concorde, was a great success, the exhibitors numbering 2,447. This figure had increased to 3,381 at the exhibition held in the year 1839 at Champs Elysées, and to 3,960 exhibitors at the one held five years later, also at Champs Elysées, which site also was chosen for the exhibition in 1849. The state grant on that occasion rose to 600,000 francs, and the buildings covered an area of 22,000 square meters. The first world's exhibition proper was opened in the Industrial Palace in the year 1855, when the state grant had risen to 11,500,000 francs and the area covered to 168,000 square meters. There were 23,954 exhibitors, and the number of visitors reached 5,160,000 persons. This exhibition gave an immense impetus to trade and industry. The next was held in 1867, for which 10,000,000 francs were subscribed, and there were 52,000 exhibitors, of whom 16,000 were French. It lasted from April 1 to November 3, covered an area of 687,000 square meters, and resulted in a surplus of 2,719,000 francs. The exhibition was visited by an immense number of persons, including no less than 57 princes. It was located on the Champ de Mars, and the Machinery Hall was the great attraction. The magnificent exhibition in 1878 comprised the Champ de Mars, Quai d'Orsay, and the newly erected Trocadéro. There were 52,835 exhibitors, of whom about half—25,872—were French. The visitors numbered 16,100,000, but still there was a deficit of 38,000,000 francs on account of the expensive buildings, many of which were intended to be permanent. The last Paris exhibition, of 1889, far outshone its predecessor, the number of visitors being 32,500,000, or more than twice that in 1869, while the number of exhibitors had risen to 45,486, of whom 30,122 were French, and no doubt this splendid record will be beaten by the one of 1900.—Engineering.



THREE FOUR STAGES OF THE SANTIAGO NAVAL ENGAGEMENT.

The Scarcity of Tin Ore.

The fact that tin, of all the metals in common use, is only sparingly distributed throughout the world is again called attention to by an Australian geologist, Mr. B. J. Skertchley, who has published a monograph upon the subject. While the known gold fields of the world cover more than 1,500,000 square miles, the tin fields have an area of less than 12,500 square miles. Thus, for every square mile of tin ground there are 132 square miles of gold-bearing country. There are seven tin districts in Europe, producing about 8,300 tons yearly, of which the Cornish mines yield about 8,000 tons. Asia has two tin areas—Hunan, in China, estimated by some of the best authorities to produce 10,000 to 20,000 tons a year, but proved by official figures to yield less than 2,500 tons, and the Straits Settlements and adjacent principalities, yielding 58,000 tons yearly, the richest yield in the world. Africa has no known tin mine; North America no payable mine; South America only one tin area, Bolivia and Peru, yielding less than 4,000 tons a year, and Australasia, the youngest, contributes about 6,000 tons a year.

The Current Supplement.

The current SUPPLEMENT, No. 1179, contains many articles and documents of great importance. Several pages are taken up by the "Official Reports of the Destruction of the Spanish Fleet off Santiago," being reports by Admiral Sampson, Commodore Schley, Captain Evans, of the "Iowa," Captain Clark, of the "Oregon," and Lieut.-Commander Wainwright, of the "Gloucester." These reports are of the highest historical and technical interest and are given in full. They afford a most graphic picture of the important engagement. "The Engineer's Account of the Naval Battle at Santiago" gives a characteristic view of the fight by our esteemed London contemporary. "James Watt and the Discovery of the Composition of Water" is an interesting and valuable paper. "Is There Any Excuse for Collisions at Sea?" is the subject of a letter to the editor by Mr. Hermann Herberts. It discusses means for detecting the presence of a vessel or iceberg and shows how their movements may be followed.

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RECENTLY PATENTED INVENTIONS.

Electrical Appliances.

ELECTRIC RAILROAD.—CLARENCE A. MYERS, Atlantic City, N. J. In this railroad the electrical conductor is safely carried under ground, overhead wires being completely dispensed with. Provision is also made for returning the current to the central station. The invention provides for a track-rail comprising two sections spaced apart and forming opposite walls of a conduit. The tread of one section is below the plane of the other section-tread. In a groove in the under side of a section-tread an insulating material is arranged which supports the electrical conductor.

ELECTRIC STOP-MOTION FOR LOOMS.—ALEJANDRO STEPHENS, Guadalajara, Mex. This invention seeks to provide a means whereby a loom may be automatically stopped as soon as the fillling in the shuttle is exhausted or the shuttle-thread breaks. With the lay and with a stop-lever an electric circuit is connected. This circuit contains an electro-magnet, a swinging armature-lever carried by the lay and adapted to be moved into the path of a projection on the stop-lever when the electro-magnet is energized, a shuttle provided with two eyes at right angles to each other and with a guide-recess between the eyes, contact-plates in the shuttle, and a loose disk in the recess of the shuttle provided with an aperture to receive the thread by which it is supported away from the contact-plates. The circuit is broken so long as the disk is suspended, but when the thread runs out or breaks and the disk drops by its gravity, then the electric circuit is closed as soon as the shuttle passes between the plates. The electro-magnets are then electrified and attract the armature-lever, so that the lay imparts a swinging motion to the stop-lever to stop the loom in the usual manner.

Engineering Improvements.

ROTARY ENGINE.—FRED. E. BRAINERD, Carbondale, Ill. This engine consists principally of a cylinder connected with a motive-agent supply and provided with an exhaust. In the cylinder a piston is mounted to turn and has a number of heads and a series of abutments arranged in pairs. Each pair has its abutments arranged diametrically opposite each other and connected by a spring. The engine is designed to use the steam in small quantities expansively, but with a continuous pressure on the piston-heads.

ROTARY ENGINE.—SUTTON H. DRAPER, Missoula, Mont. In this engine a piston is provided consisting of a sliding head having a cavity in its outer edge containing a friction-roller. This roller consists of two sections having their ends joined by spiral cam-surfaces, the sections being hollowed and having a spring acting to rotate one section upon the other. A steam-supply and two exhaust-ports are located one on each side of the steam-port, the ports being comparatively long and narrow. An exhaust-pipe connection is provided having a yoke, the legs of which are hollow and taper from a long, narrow section at their base to an approximate circular section at their junction; this junction is located above one end of the ports. A steam-pipe connection is provided consisting of a hollow casting also tapering from a long and narrow section at its base to an approximate circular section at its upper end, the taper being from one end and opposite that of the exhaust yoke, whereby it is enabled to lie between the arms of the exhaust yoke.

Mechanical Devices.

BASKET-MACHINE.—WILLIAM JACKSON, Traverse City, Mich. In general, this machine is characterized by having means for forming staples from continuous lengths of wire and for driving these staples. The means by which this is done coact with a work-holder on which the basket is formed and by which the materials of the basket are held during the operation of bending and driving the staples. On the top of a column a drive-shaft is revolubly mounted. With the drive-shaft a plate is connected to be vertically reciprocated thereby. The staple-forming and driving devices are operated by the plate and are connected therewith. A lever has sliding connection with the plate and is rocked by the movement thereof. Means are provided for driving wire-feeding devices from the lever. To a rock-shaft, arms are attached and control the means for driving the wire-feeding devices. The rock-shaft is thrown by a treadle connected with a rod which is in turn connected with a crank on the rock-shaft.

COMBINED MOWING AND RAKING MACHINE.—JOHN MCCALLUM, Chippewa Falls, Wis. To provide a machine which shall simultaneously mow and rake grass, this inventor has devised novel means to attain the desired end. On a tricycle-frame he mounts a rear main transverse axle on which two traction-wheels are fitted. A dirigible front wheel is provided which is controlled by a handle bar. The operator sits on a saddle fastened to the tricycle frame and operates a pedal-shaft with his feet by means of crank-arms and pedals. Two sprocket-gears of different diameters are fixed on the pedal-shaft and two sprocket-gears are fixed to the axle. One of these gears is connected by a spocket-chain with a gear on the pedal-shaft, while a sprocket-gear on the axle is chain-connected with the other gear on the pedal-shaft. A rotatable transverse cutter has a sprocket-gear on its shaft, chain-connected with the remaining sprocket-gear on the axle. The rake is mounted behind the cutter and may be raised or lowered from the saddle by means of a lever acting on a rod to which a link is pivoted, the rake being fastened to the link.

TRUING DEVICE.—GEORGE WAGNER, St. Paul, Minn. To provide an improved truing device which shall be simple and durable in construction, and which shall be of especial service in the truing of bicycle wheels, this inventor employs two threaded spindles longitudinally aligned with each other, and adapted to engage the respective ends of the wheel-hub. Braces are carried on each spindle and strained thereby. These braces have attaching devices at their outer ends to engage the rim of the wheel.

Miscellaneous Inventions.

DUST-PAN.—HAMILTON WEIR, La Porte, Ind. The dust-pan provided by this invention can be made from a single plate of metal struck up and secured in shape without soldering. The blank from which the pan is formed consists of a base-plate having lateral wings to form the sides of the pan. These wings are extended rearwardly to form the sections of the back of the pan, and the rear extension running from the base-plate between the back extensions to form the foot-piece. The blank is provided with connecting tongues and is slotted to receive these tongues, so that the parts may be united without soldering.

NEWSPAPER OR BOOK PROTECTOR.—WILLIAM H. BURLAND, Punta Gorda, Fla. This invention seeks to provide a device which, when applied to a book or a magazine, will protect those portions of the leaves which are ordinarily exposed, and which, when applied to a newspaper, may be made to protect either an end or a side edge, or all the open edges. The inventor extends sundry of the book or newspaper leaves beyond the other leaves at the three free edges of these other leaves, forming projecting margins. These margins are long enough to overlap, and are adapted for sealing engagement, so as to conceal the contents of the book completely.

WAGON STEERING AND DRIVING MECHANISM.—LEIGH WATKINS, Denver, Col. In this invention various improvements are to be found, which enable the axles of one or more wagons to be connected so that the wheels may be used as traction wheels. Various devices have also been provided by which the steering of the wagons may be accomplished in such a manner that the wheels of successive wagons connected together will all follow the same track, The wagon-gearing has axles mounted to swing horizontally. Segment-gears are attached to the axles and extend horizontally toward one another. A horizonal shaft has a gear slidably keyed upon each end and meshing with the segment-gears, and also has a similar segment gear, gear-wheel and shaft upon the outer side of the axle by which two similar wagons may be connected and simultaneously controlled. The wagon-steering device comprises axles mounted to swing horizontally, and connections between adjacent axles upon different wagons consisting of the segment-gears fixed to the axles, longitudinal shafts, gears upon each end of the shafts and meshing with the segment-gears, and hand-controlled means for turning one of the axles.

SEAL-LOCK.—ELVIN H. MORSE, Colorado Springs, Col. The purpose of this invention is to provide a simple, inexpensive self sealing bolt for use on ballot-boxes, hinged doors and the like, which cannot be opened without first breaking the seal and which cannot be picked. The lock and seal comprise a spring-pressed bolt, a keeper-plate adapted to be loosely connected to a hinged lid or the like, and a seal-plate extended at right angles from the keeper-plate and adapted to engage against the outer surface of the lid or like.

GATE.—WILLIAM A. WHITCOMB, Downs, Ill. The gate patented by this inventor is so constructed that it may be opened by persons seated in a vehicle or upon a horse, thus avoiding the necessity of dismounting. To the gate a rod is connected, and to the gate-post a cross-bar is rigidly secured. On the cross-bar a rod is pivoted. On the gate-post a lever swings to which a rod is likewise pivoted. Each rod has a clevis, the clevises being pivoted to each other. A weighted rod is mounted to swing on one clevis and bears against the pivot of the clevises. By pulling upon an operating lever, the gate is opened and closed without descending from the carriage.

GATE.—PROSPER COUPAL, Bourbonnais, Ill. The purpose of this invention is to provide a gate of the sliding type which may be opened or closed from either side by persons on horseback or in vehicles. An arm is pivotally connected with the rear end post of the gate and with the upper portion of a frame. To the arm a latch-bar is pivoted and upon the latch-bar a latch-head is pivoted. A keeper for the latch-bar is carried by the frame. At opposite sides of the frame, pulley-blocks are located. Chains are attached to the latch-head and are carried each through a pulley-block. Other chains are attached to the latch-bar at the rear of the pulley-blocks, the latter chains being likewise carried in opposite directions through the pulley-blocks. By pulling upon a chain, it is possible to disengage the latch-head from the keeper, and by carrying the latch-bar rearward, the gate is made to travel on a track carried by the frame previously mentioned, thus opening it.

SUPPORT FOR FEED-BAGS.—TIMOTHY MULCAHY, New York City. To provide a device adapted for attachment to the forward ends of vehicle shafts or thills, and so arranged that a feed-bag or pail of water may be held within convenient reach of the animal in the shafts, is the purpose of this invention. The support for the feed-bag consists of an arm formed at one end with a socket, the opposite end being flattened in a horizontal plane and formed with a vertical longitudinal slot. A fastening device is provided for securing the socket-end of the arm to the shaft. The holder for the pail or bag is ring-shaped and provided with a projecting lug adapted to extend over the flattened slotted portion of the arm. Means are provided for securing the lug adjustably to the slotted portion of the arm.

PROCESS OF PYRITIC SMELTING AND APPARATUS THEREFOR.—GUSTAF M. WESTMAN, New York City. The purpose of this invention is to provide a new and improved process for treating sulphureted ores containing precious metals so that the metal is taken up by the iron or copper matte, while the zinc and lead sulphurets are converted into oxides at such a temperature as to become volatilized and discharged from the furnace as a gas, together with sulphurous acid. Finally the zinc and lead oxides are precipitated in a condenser, the remaining gases being treated in a lead chamber to form sulphuric acid. The regenerator and hot-air chamber used are connected with a shaft furnace having a side channel communicating with the conductor and extending vertically downward. The mouth is located within the ore-chamber and directly over the rear side of the bottom thereof, which slopes from that point.

SKIRT-PROTECTOR.—AUGUST ALLGOEVER, New York city. To provide a skirt-protector so constructed that its lower portion shall be prevented from straightening out of the desired position, this inventor uses a flat flexible core and a body having an upright portion and a portion folded about the core whereby lateral shoulders are formed at substantially right angles to and upon opposite sides of the body portion. One shoulder is wider than the other, the core being extended into each shoulder. The second shoulder it is, which offsets the flattening out of the protector or binding when rolled up for transportation or storing.

PUZZLE.—NED B. CRARY, Canisteo, N. Y. This puzzle comprises a base having vertical spaced projections and a series of balls connected by ligaments and adapted to pass between certain of the projections. The flexible ligament adds to the difficulty of causing the balls to traverse the desired path. The pins are so spaced that the larger of the movable balls cannot pass between each two but only between a certain two in each row of vertical projections.

SKEIN-HOLDER.—MARY A. ARROWSMITH, Freehold, N. J. This skein-holder comprises radiating figures provided with a clamping or securing mechanism, and having a flexible connecting-web stopping short of the outer ends of the fingers. By means of this device skeins may be readily wound into balls or may be conveniently held while the yarn is being consumed.

ARM-REST.—LEWIS BARR, Dayton, O. This device comprises essentially a frame having feet or arms extending across at each end and a longitudinal guideway within which slides one of two blocks pivoted to each other. Upon the other block slides a plate, which is preferably concaved upwardly and adapted to act as a support for the fore-arm, this plate being provided upon its under surface with a longitudinal guideway engaging the upper of the blocks or slides. This construction thus permits universal movement in any direction within its limit.

SLING-TRIP.—EMA CANCIENNE, Albemarle, La. This sling-trip comprises a handled bar, pairs of loops mounted to turn at the ends of the bar, hooks fixed on the bar between the members of the loops to hold them against lateral movement on the bar, and chains, of which one is permanently connected at one end to the loops and the other adapted to be hooked at one end to the hooks so that upon turning the bar the hooks release their chain.

SASH-FASTENER.—GEORGE FELTHAM, Waycross, Ga. The object of this invention is to provide a sash and fastener arranged to exclude dust and the like from a room, and to lock both sashes securely in any desired position without danger of the fastener being unlocked or opened from the outside. The fastener comprises a casing adapted to be secured to the lower sash, a laterally-movable bar in the casing, a pivoted head on the outer end of the bar and adapted to engage the upper sash, and a spring for holding the head in position when not in use.

WINDOW-GUARD.—JOHN L. SCHARFF, Reading, Pa. In this invention a device is provided which may be secured between the vertical portions of window-frames and at the outer side of a window, so that persons cleaning the window may be supported and prevented from falling. To a post a bridle is attached. A hook member has connection with the bridle by means of a loop therein. A lock slides on the hook member and has an elongated eye through which the loop of the bridle is passed. Two posts are employed, and being flexibly joined by lines and held by the bridles, combine great strength and convenience of adjustment.

CURTAIN-HOLDER.—ULYSSES S. PARISH and FLAVEL A. RUDOLPH, Carmi, Ill. According to this invention, a support is slidably mounted on a vertically extending supported rod. A spring-pressed locking-catch is pivotally mounted on the support and engages with the rod to lock the support at various positions on the rod. A cord is attached to the catch and serves to move it against its spring and to permit the vertical movement of the support. On the support a frame is carried from which the curtain is hung. With this device a curtain is prevented from moving sidewise, especially so when the curtain is narrow and does not overlap the sides of the window-frame.

COMBINED MATCH-BOX AND LIGHTER.—CHARLES WILSON, Newport, Ky. In this invention, an outer casing is provided with an apron at its lower end and with a slot in one side for the introduction of a match. The casing has an opening at or near the center of the front wall for the material to be lighted. An inner casing of asbestos is provided, which at the back and sides, forms a series of pockets with the back and sides of the outer casing. The inner casing forms a chamber communicating with the slot in the side of the outer casing and the openings in the front wall thereof. When a cigar is to be lighted, an end of the cigar is introduced within the chamber and a match is passed through the slots and struck on the interior roughened surface of the inner casing. The flame being protected, the cigar or pipe can be thoroughly lighted.

HEATING-DRUM.—CLAYTON M. RICHARDSON, Toronto, Canada. To provide a device capable of being used in the same compartment with a stove, this inventor has patented a drum which is so constructed that it may be large or small as desired. The device comprises a series of compartments, one above the other, and connected together. The compartments are subdivided by vertical partitions, with the exception of the lower compartment. Air-pipes extend through the lower compartment and through the next compartment above, and have their outlets between compartments so as to discharge heated air under the bottom of the compartments.

ELASTIC TIRE AND RIM FOR WHEELS.—ARTHUR C. MOORE and GEORGE RODWELL, London, Eng. This elastic rim for wheels, it is claimed, possesses the qualities of lightness, elasticity and strength, and consists essentially in the combination with a jointless inner rim of approximately U section with outwardly directed flanges, of an outer rim constructed of two annular members, together forming an outer annular member of approximately U section, with inwardly directed flanges adapted to embrace the sides or flanges of the inner rim, and of an intermediate pneumatic chamber whereby the required resiliency is obtained without liability of puncturing, the air-chamber being wholly inclosed and protected by the outer member of the metallic rim.

Designs.

TIP FOR HAY-FORKS.—GEORGE F. CAREY, New York city. The tip designed by this inventor has an upper cylindrical portion which extends with its sides on parallel lines for a considerable distance compared with the length of the tip and unites with the converging lines, which extend on straight lines, forming a tapering portion brought to a sharp point, the entire surface of the tip being smooth and presenting a cavity at the free end of its cylindrical portion.

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Notes & Queries

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References to former articles or answers should give date of paper and page or number of question.
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(7470) H. C. asks how many cubic feet of air a person breathes per minute and in how small a space that amount of air can be confined, or in how small a space can enough air be confined to last a man ten or twelve hours, and how much would that amount of air weigh? A. An average man or woman requires not less than 3,600 cubic feet of fresh air per hour, continuously supplied during that period, when asleep or in repose; about 4,950 cubic feet per hour when engaged in light work; 10,000 cubic feet per hour if engaged in heavy work—this exclusive of the air consumed by lights and heating appliances. Neither is this applicable to all individuals, since some require more than others, depending upon lung area and expansion. In close rooms, 6,000 cubic feet of air per hour (100 feet per minute) is generally required, allowing for lights and heat, stoves, etc. A single candle, to give its full light, requires 100 cubic feet of air per hour. In sickness these figures should be increased at least one-third. Air cannot be confined for purposes of respiration, for it is contaminated with carbonic oxide with every expiration. Certain air storage tanks, which may be utilized for a brief period by divers, provide for air expansion, but the expiration is not into the tank, but outside thereof; consequently, if the air were not compressed, it would not serve the purpose of respiration, as there would be no expansion. Your final query is answered by the foregoing. To place any individual in a perfectly airtight room would be to insure his or her death by asphyxiation, if therein long enough; in time all the vital constituents of the air would be consumed and replaced by deadly carbonic oxide. Proper ventilation is the first essential of proper respiration. Air presents different weights at different temperatures and elevations.

(7471) C. S. B. says: Can you furnish, through your Notes and Queries in the SCIENTIFIC AMERICAN, a receipt for making a salad dressing of the mayonnaise variety, but having keeping qualities that will render it suitable to be put up in bottles, and kept as a stock article?

A. Powdered turmeric	1	oz.
Powdered tragacanth	1	"
Olive oil	8	"
Eggs	8	"
Water	5¾	pts.
Ground mustard	1½	oz.
Salt	8	"
Acetic acid (glacial)	2	"
Tincture of capsicum (Or according to taste.)	½	"
Sugar	1	lb.

Mix the first three ingredients in a mortar capable of holding one gallon, then add the eggs, which have been whipped previously, and incorporate thoroughly until an

(*Continued on page 93*)