

Scientific American.

ESTABLISHED 1845

MUNN & CO., EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

(Established 1845.)

One copy, one year, for the U. S., Canada or Mexico.....\$3.00
 One copy, six months, for the U. S., Canada or Mexico..... 1.50
 One copy, one year, to any foreign country, postage prepaid, £0 10s. 5d. 4.00
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 MUNN & CO., 361 Broadway, corner Franklin Street, New York.

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(Established 1876)

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 MUNN & CO., Publishers, 361 Broadway, New York.

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

NEW YORK, SATURDAY, MAY 28, 1898.

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THE WEAK POINT IN OUR NAVY.

There is much food for thought on the part of our Board of Naval Strategy as it watches the game of hide and seek which is being played between Admiral Sampson's powerful, slow-moving battleships and the elusive fleet of armored cruisers under Admiral Cervera. The fleet that crept slowly along the northern coasts of Cuba and Hayti, its speed restricted by an inexorable law to the speed and coal capacity of its harbor defense monitors, was the embodiment, as far as guns and armor go, of the very highest powers of attack and defense. But with a trial speed of 10.5 knots, a probable sea speed of 7 or 8 knots, and a very limited coal capacity, the monitors had to be taken in tow at a 5 knot gait, to insure their reaching the objective point with a reserve of fuel in their bunkers. While our squadron was approaching from the westward, the less powerful but swifter fleet of Spain was speeding at a 12 knot gait to the eastward, and was able to reach its objective and prearranged coaling rendezvous in the Caribbean Sea, fill its bunkers, and make its next move on the checkerboard unmolested. With its advantage of 8 or 10 knots over Sampson's squadron of battleships and monitors and of 3 or 4 knots over the "Flying Squadron," coupled with its steaming radius of 7,000 to 10,000 knots, the armored cruisers were now free to make any one of several diversions in favor of the beleaguered island of Cuba. They might run to Porto Rico and take up a strong position under the guns of the fort; they might sweep in a wide circle to the eastward of the islands and menace our Atlantic coasts; or they were free to remain off the Venezuelan coast, drawing our fleets to the southward, and then speed swiftly to the northeast to effect a junction with a possible second Spanish squadron in the shelter of San Juan Harbor.

The present situation teaches a lesson. It proves the usefulness of speed as an offset against mere defensive power, and the inestimable value of speed and offensive power when combined in a fleet composed of identical armored vessels. Although the Spanish cruisers are not capable of contending with our battleships and are certain to be sunk if they attempt it, they would be more than a match for our two armored cruisers the "Brooklyn" and "New York," which are our only armored ships having sufficient speed to hunt them down, and it would certainly go hard with our unarmored and scattered scouting and patrol fleet if Cervera should run to the eastward around the Sampson and Schley squadrons and make a raid up the Atlantic seaboard.

The Spanish fleet in its relation to our blockade of Cuba is what naval strategists call a "fleet in being," that is to say, a fleet which, while it is inferior in strength to the enemy, is in such a condition that it is a constant menace to his operations, and as long as it exists obliges him materially to defer, modify or abandon his predetermined plan of campaign. That the Cape Verde fleet is a "fleet in being" is proved by the fact that its sudden appearance in the West Indies obliged us to postpone, as was advocated long ago in these columns, the intended invasion of Cuba.

It may be asked, Why should we not combine with the "Brooklyn" and "New York" the fast cruisers "Minneapolis," 23 knots; "Columbia," 22.8 knots; "New Orleans," which it now appears is credited with 22½ knots; and "San Francisco," 20 knots; and run down the Spanish fleet? The reply is, as we have already suggested, that these four ships were never designed to stand up against 11-inch armor-piercing guns. If well placed, a single shell from these guns, weighing nearly 600 pounds and filled with high explosives, would be sufficient to put them out of action, even if it did not send them to the bottom. The answer to an 11-inch gun is an 11-inch gun or one of equal penetration, and not the 6-inch and 4-inch guns carried on these vessels; the answer to 12-inch belts is a 12-inch belt or its equivalent, and if to this combination of guns and armor the enemy's ships add the feature of high speed, we must match it with high speed.

It is this trinity of elements that makes up the armored cruiser, and it is just because Spain happens to have and we happen to be without any members of this type that, in spite of our naval superiority, we may be unable to strike the decisive blow by getting rid of the "fleet in being" for some time to come. It is, of course, possible that, before these lines are published, the Spanish admiral may have elected to give battle, or, by skillful strategy upon the part of our fleets, have been so hemmed in as to be forced to fight.

Whatever may be the issue, the situation has already proved that our lack of armored cruisers presents a weak point in the make-up of our navy; one that has already caused us not a little apprehension as to our ability to maintain the blockade, and that may result in the naval campaign being drawn out to an unexpected length. The composition of our navy was determined with a view to coast defense and in agreement with a national policy into which never entered the thought of blockading islands and hunting down hostile armored fleets upon the high seas. We can do nothing to remedy the matter as it stands; but it is in our power to provide against the future by the immediate authorization of several armored cruisers in a supplementary naval appropriation bill.

AIR MOTORS FOR STREET RAILWAY TRACTION.

An important street railway plant, whose operation will be watched with considerable interest, is about to be installed in this city on a portion of the lines of the Metropolitan Street Railway Company. It will be remembered that a few miles of this company's extensive lines have been operated for some time by compressed air motors, which are of the compound type and built under the Hoadley patents. On another stretch of road in this city the Hardie compressed air motor has been in successful operation. The distinctive feature of the Hardie motor is the use of a tank of hot water to heat the compressed air before it is used in the cylinders. A fully illustrated description of this machine will be found in the SCIENTIFIC AMERICAN for August 15, 1896, where it is shown in service on the lines of the Third Avenue Railway Company, New York; another motor of the same type built for the elevated roads was illustrated in the SCIENTIFIC AMERICAN of January 30, 1897.

The new plant will include a power house on the property of the Metropolitan Company in West Twenty-third Street opposite the Pennsylvania terminal, and in addition to the power house the contract calls for the equipment of twenty cars with compressed air. The air compressor will be of the Ingersoll-Sergeant four-stage single-acting type, provided with intercoolers between each pair of cylinders and a final cooler after the fourth-stage cylinder. The air cylinders will be vertical and will be set under a vertical cross-compound Allis engine.

It is interesting to note that the American Air Power Company, to whom the contract has been let, was formed by a combination of the Hoadley-Knight and Hardie Companies. The new plant and equipment will embody the experience gained by the two experimental lines to which reference has been made above, and as both of these tests have shown satisfactory results, it is safe to say that the new Twenty-eighth and Twenty-ninth Streets equipment will represent the very latest advance in compressed air traction. The Metropolitan Street Railway Company has now in operation four different systems: the cable, underground trolley, compressed air and the horse car. The probabilities are that of these four, two only will survive—the underground trolley and compressed air: the former being used on what might be called the trunk lines running north and south on Manhattan Island, and the compressed air motors working the crosstown branches.

LAUNCH OF THE BATTLESHIP "ALABAMA."

The first-class battleship "Alabama" was successfully launched at the Cramps' shipyard on May 18 in the presence of less than one hundred invited guests. The work of cutting away the blocks that held the ship in place was commenced at half past twelve, and the "Alabama" took the water in less than half an hour.

We have so recently described this vessel (see SPECIAL NAVY SUPPLEMENT) that it will be sufficient to recapitulate the leading features of her design, which are as follows: Length on load water line, 368 feet; beam, 72 feet 5 inches; mean draught, 23 feet 6 inches; displacement, 11,525 tons. Her maximum coal supply will be 1,200 tons, and she will be driven at a speed of 16 knots by twin vertical triple expansion engines of 10,000 horse power. This result will be obtained under a moderate forced draught. She will carry a complement of 489.

The armor will be of the latest Harveyized nickel steel and will be more complete than in any ship of our navy. The belt will be 16½ inches thick amidships, tapering toward the ends. Above this will be a wall of 5½ and 6-inch armor protecting the rapid-fire battery. The main battery of four 13-inch guns will be placed in 15-inch turrets above 17-inch barbettes, and the rapid-fire battery of fourteen 6-inch guns will be sheltered behind six inches of steel. The secondary rapid-fire battery will consist of sixteen 6-pounders, four 1-pounders and one Colt. The maximum concentration of fire dead ahead will be two 13-inch and two 6-inch guns; astern it will be the same, and on the broadside the concentration will be four 13-inch and seven 6-inch.

Our readers who are familiar with the details of our earlier battleships will notice that the 8-inch gun which forms such a conspicuous feature in the "Indiana," "Iowa" and "Kentucky" types has disappeared altogether in the "Alabama." This is in accordance with the latest theory or fashion in battleship design, which is to have only three main types of guns: the armor-piercers, generally not less than 12-inch; the rapid-fire battery, of not less than 5-inch caliber; and the secondary rapid-fire battery, of 6 and 1-pounders. The first type is for the penetration of the belt armor and demolishing of the barbettes and turrets, the second type is intended for wrecking the lighter armor, 8 inches or less in thickness, and the "pounder" guns are for the destruction of torpedo boats and the attack of unprotected gun positions. The 8-inch gun has been thrown out because it is heavier than necessary for the attack of light armor and not powerful enough to penetrate belts and barbettes, except at close range.

The long caliber 6-inch rapid-firer can pierce almost as thick armor at the shorter ranges as the 8-inch, and its rapidity of fire is four or five times as great.

Although the "Alabama" is afloat, she will not be commissioned for eighteen months, unless the work is pushed along much faster than is usual on our battle-ships. If there is no delay waiting for armor, guns, etc., this fine vessel might be in the fighting line by the summer of 1899.

THE HEAVENS IN JUNE.

BY GARRETT P. SERVISS.

At 9 P. M. in the middle of June the great star Arcturus is overhead. Even for those who know and care but little about astronomy it is worth while to look carefully at Arcturus, because Arcturus is the very mightiest sun that the heavens are known to contain. Its distance is about a thousand millions of millions of miles, or more than ten million times the distance of our own sun. Since the intensity of light decreases as the square of the distance increases, it is easy to show that if we were as near to Arcturus as we are to the sun, the earth would be vaporized by the blast of unimaginable heat which would smite it, for Arcturus must exceed the sun in light and heat giving power in the ratio of six thousand to one! As to the actual size of Arcturus, it is not improbable that its globe would more than fill the entire space that is belted by the orbit of the planet Mercury! Not to know Arcturus, then, is to be unacquainted with the most stupendous physical phenomenon within the range of human vision.

An easy way to make certain of the identification of Arcturus is this: Look for the Great Dipper, which will be found between the pole and the zenith, with its handle upward. Follow with the eye the bending line of the handle, beginning at the bowl, and continue it, beyond the last star in the end, to a distance about equal to the entire length of the Dipper, and thus the eye will be led to a bright yellowish star, which is Arcturus. Far southward shines the white star Spica, in Virgo, and farther west the planet Jupiter, the three—Arcturus, Spica and Jupiter—marking the corners of a large triangle.

Northeast of Arcturus will be seen the beautiful circlet of the Northern Crown, and half way between the Crown and the horizon, the brilliant Vega will catch the eye. This star ranks next to Arcturus among the recognized giants of starry space. Its distance is more than five hundred millions of millions of miles, and in light-giving power it probably exceeds the sun about two thousand times! Those who have telescopes may enjoy an exceedingly beautiful contrast of color by looking alternately at Arcturus and Vega.

THE PLANETS.

Mercury is a morning star, visible to early risers at the beginning of the month, but lost in the rays of the sun at the end. It passes from Aries into Gemini, to become an evening star in July.

Venus is beginning to overmatch Jupiter in splendor as an evening star. At the opening of June she is in Gemini and at the close in Cancer. With a telescope she appears in the form of a gibbous moon, more than eight-tenths of her disk being illuminated. Venus is a kind of mirror to the earth. Being very nearly of the same size as our planet, she presents an appearance similar to that which the earth would present if we could look at it from a corresponding point of view. But when, as will happen in December, Venus comes between the sun and the earth, her inhabitants will behold a planetary spectacle more magnificent than any ever presented to our eyes; for then the earth will be seen in their midnight sky, in the phase of a full moon, with all its continents, and oceans, and streaming storm clouds plainly visible to their telescopes; and accompanied by its ever faithful attendant the moon, which itself will appear as a planet of no mean size. Its cloudless condition, in contrast with the earth, would instantly arrest the attention of an astronomer on Venus.

Mars in these warlike days sulks in his tent. He is far off and faint in the morning sky, passing during the month from Pisces into Aries.

But while the celestial god of war thus apparently neglects his interests on the earth, the great master planet Jupiter occupies a commanding place, crossing the meridian early in the evening and remaining conspicuous during the first half of the night. Jupiter has developed a remarkable series of dark elliptical spots in his north tropical zone during the past two years, and at present these spots appear to be increasing in number. Three of them are being carefully studied by observers of Jupiter, and their velocity of motion is said to be greater than that of spots which were seen in the same latitude three or four years ago. The commotion of Jupiter's surface markings is always a fascinating thing to watch. Tremendous changes are evidently going on there, but the clew to their nature is yet lacking. Jupiter is in the western part of Virgo, moving slowly toward the southeast.

Saturn, near the northern edge of Scorpio, rises about 7 o'clock in the evening on the 1st of June, and crosses the meridian about midnight, having been in

opposition to the sun on May 30th. Its north pole and the northern side of its rings are presented toward the earth. Its most conspicuous satellite, Titan, will be seen at eastern elongation on June 8, at western elongation on June 16, and at eastern elongation again on June 24.

Uranus remains in Scorpio, and during the month retreats slowly westward from the neighborhood of the double star Beta.

Neptune is in Taurus, and in conjunction with the sun on the morning of the 13th.

THE MOON.

The moon is full on June 4; at last quarter on June 11; new on June 18, and at first quarter on June 26. It is nearest to the earth on the 19th and farthest from the earth on the 4th. Greatest libration east, June 27; greatest libration west, June 11.

The lunar conjunctions with the planets occur as follows: Uranus, the 3d; Saturn, the 4th; Mars, the 14th; Mercury, the 17th; Neptune, the 19th; Venus, the 21st; Jupiter, the 26th.

On the morning of June 21, about 5 o'clock, Eastern standard time, the sun enters the sign Libra and the astronomical summer begins. Eleven days later the earth will be at the cooler extremity of its orbit, or in aphelion, a fact which those who find comfort in the reflection that things might, at any time, be worse than they are, will do well to recollect when July rolls in its tide of heat.

SAN JUAN'S BOMBARDMENT.

In our last week's issue we referred to the bombardment of the fortifications of San Juan, the capital of Porto Rico, on May 12. At that time only meager details of the engagement were available. Now, however, full particulars of the battle have been published. As will be seen by our plan of the harbor of San Juan, the reef on which the city is built is practically an island separated from the mainland by a tidal ditch. The whole sea front of the island is precipitous, especially so at the western point, where rocks frown above the entrance to the bay within. At this spot stands the old stone fort called Morro Castle, with its thick walls and tiers of guns. It was in the time of smooth-bore guns practically impregnable. Having fears of buccaneers in the old days, the Spaniards erected a defense line running along the shore front for three-quarters of a mile, where they built another big castle. The defense line was carried all the way around the inner front of the island or peninsula, and within this area they built the town.

When the fleet approached the lighthouse tower, 171 feet above the sea, it did not show any light, indicating that the people of the town were expecting trouble. The "Detroit" with the tug "Wampatuck" slowly led the way in. The torpedo boat "Porter" ran off to the east a half mile or so from the line of the squadron and stopped within a mile of the shore. On arriving within 1,400 yards of Morro Castle the "Detroit" turned west and steamed slowly along the beach for a quarter of a mile, while the "Wampatuck" with her flag of truce drifted on, followed by the "Iowa," the "Indiana," "New York," "Amphitrite" and "Terror." It was at five o'clock that the "Detroit" turned east, and at that moment a signal fluttered on the "Iowa" which called for the hoisting of the American ensign on every ship. For six minutes the flags floated in peace, and then some Spanish officer having no regard for the flag of truce opened fire on the "Wampatuck" and sent her skurrying away out of range. Admiral Sampson told Captain Evans that the fire might be returned. The forward turret of the "Iowa" was turned so that the long 12-inch rifles were headed at the yellowish walls of the old castle, and at 5:15 o'clock the word "fire" was given, and the huge projectiles were hurled at the point whence the guns had been firing at the flag of truce. The aim was so good that no further shots were fired from that part of Morro during the remainder of the engagement. The 8-inch guns then took part, and the "Detroit" followed with her 5-inch guns. Then came the "Indiana" with her 13-inch rifles which took the place of the flagship, which was steaming slowly out to sea, her 8-inch guns also firing. The fleet was now steaming slowly in a circle.

In the meantime the soldiers in all the forts had begun to fire on the squadron, but it was a useless task, for the shots from the old smooth-bore guns did not reach the vessels. At first the fire was so feeble that it is thought that the artillerymen were enjoying a peaceful rest when they were rudely awakened by the roar of the big guns. At Santo Domingo barracks there was a battery with at least four modern rifles of 8 or 10-inch caliber and other batteries appeared to be equipped with modern guns. These opened on the fleet soon after the first gun was fired from Morro, but not since modern rifles with gun sights were invented has any one seen such shots as from these crest batteries. Shot after shot, mounting into hundreds, were fired, but hit nothing, every shot flying far above and beyond the great targets. Even the unarmored "Detroit," which lay perhaps 1,200 yards from the nearest battery, remained wholly un-

touched. The Spaniards did not neglect the "Porter," and she would have been an easy prey if they could have hit her, but their efforts were futile. The marksmanship of the American squadron on the first round was not, on the whole, quite worthy of the record made at the targets. The majority of the shots hit Morro, but three or four at least fell so far short as to strike the water, but the first round of the squadron in its elliptical course cured that completely. The Spaniards, as the "Iowa" came down on them for the second round, worked their guns with increased frenzy and their aim was worse and worse, until the "Iowa" reached the turning point and once more began firing with her 12-inch rifles, the "Indiana" following. The Americans now had perfect range and were as cool as at target practice, while the Spaniards shot wilder and wilder and at last fled. The first shot which seemed to reach the city struck the huge barracks just east of Morro. A cloud of yellow brickdust rose high in the air, obscuring the building, and the flames and smoke of a conflagration appeared. Within ten minutes a half dozen other shots had fallen elsewhere in the town, and by the time the "New York" turned out to sea again seven different fires were seen in different parts of the city.

The forts nearest Morro were wholly obscured by the smoke of the shells. The forts replied with an occasional gun, and most of the Spanish at this time had fled to the bombproofs. The guns at the east of the city, however, continued to work steadily because they had received little attention from the ships. The "Detroit" now turned to the west, and running close under the guns of Morro, attacked a new earthwork built on an island on the west side of the channel. There were a couple of modern 8-inch guns there, but the little vessel forced the gunners to retire. Both the "Montgomery" and the "Porter" were ordered out of range, but a casual observer would say there were no cases on record during the cruise where orders were obeyed with such deliberation.

Three circuits were made. The first gun, as has been said, was fired at the forts at 5:15 A. M., and at 7:20 A. M. the "Iowa" opened fire for the third and last time. Before her guns were fired a big breach was plainly visible in the curtain wall of Morro, and from that time on, nothing of the fort could be seen because of the smoke and dust. The "Indiana" began the last round at 7:26 o'clock, the "New York" at 7:30, the "Amphitrite" at 7:40 and the "Terror" at 7:56.

The big fort east of the city near the Tierra gate was hit as the "Iowa" turned away, firing her last shot. Five guns had been worked steadily from within the fort, but only two were fired after that and they quit soon after the "New York" got a broadside on the city, but they opened again after she pulled out and then one shot from the hill battery just east of Morro was fired. It struck against the iron stanchions used for hoisting the boats to and from the superstructure of the "New York" and burst.

The boat was knocked to pieces, and a fragment of the shell struck Frank Widemark, seaman, and he was killed; three or four others were injured. A 10-inch shell struck a gallows frame on the "Iowa" and burst at about the same time, hurling fragments in all directions; three men were injured. Both these shots were plainly accidental because they came on board at long range and because the following shots fell as wide as usual of the ships. As the squadron drew off, the "Terror" lingered behind, firing at five minute intervals, until 8:05 o'clock, when the last shots from the fleet were sent. The hill battery kept wasting its ammunition until 8:29.

The admiral and all the officers, save only those stationed under cover, fought on the bridge and upon the decks. Admiral Sampson went from point to point on the bridge or deck as the exigencies of the smoke made it convenient. Though the battle may be considered as an unimportant incident of the war, like the bombardment at Matanzas, it certainly proved the lack of training of the Spanish and demonstrated the skill and ability of the Americans. The destruction in the town was not great, but nearly all of the big guns were dismounted.

STATE COLLEGE OF FORESTRY.

A conference has been held at Albany to decide upon the location of 30,000 acres of land to be purchased by the State for the establishment of a college of forestry under the authorization of an act of the last legislature. Dr. Fernow, director of the new State College of Forestry at Cornell University, who was formerly chief of the Forestry Division of the Department of Agriculture at Washington, formulated the conditions which the Cornell authorities had decided necessary for land for the purpose of the new college, and a canvass was made of the available property in the Adirondack woods which is on the market. This developed that there were not more than three or four tracts available, which it is believed the State could readily secure. These tracts are in Hamilton and Franklin Counties, and it is held that they could be purchased at less than \$6 an acre. No particular plot of ground has been decided upon as yet.