TWO INSECT SAMSONS.

BY JAMES WEIR, JR.

When Samson stood between the pillars of the temple of Dagon and "bowed himself," thereby occasioning the mighty pile to fall in ruins upon his head, as well as upon the heads of a multitude of his enemies, he evinced extraordinary and super-normal strength; yet it was my good fortune recently to witness exploits of great strength, by the side of which the captive Hebrew's avenging blow pales almost into utter insignificance. When I declare that the actors in these feats were two lowly "pinching bugs," I am afraid that some of my readers will declare that I am drawing on my imagination. And yet, that which I am about to relate can easily be verified by anyone who will take the trouble to investigate and to experiment.

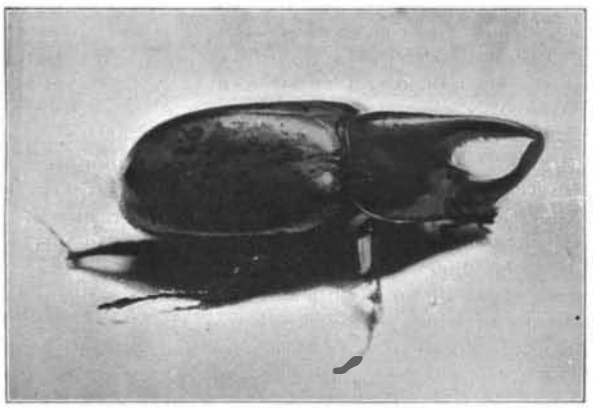
Last summer I went to a "cake walk" which was given at night in the city park. I had secured a good viewpoint and was enjoying the amusing antics of a couple of cake walkers when I felt something alight on the collar of my outing shirt. The entertainment was in the open air, the walking course being one of the footpaths of the park, which was brilliantly illuminated. I had noticed many moths and beetles flying about the lights; so knew at once that my visitor was a "bug" of some kind. I put up my hand and seized it, when, suddenly, a spasm of pain darted from my finger tips to my shoulder. In my agony and surprise I emitted a yell which occasioned the two cake walkers to execute several steps not down in their repertory. On examination, I found that I had got the tip of my middle finger between the mandibles of the largest stag beetle (Lucanus elephas) that I had ever seen. His mandibles were carefully pried apart by a friend and my finger released. It can be seen in the photograph what formidable weapons they are, though the beetle is here considerably reduced, it being, in life, 2¼ inches long and ⅝ of an inch broad. He is much more noticeable with his branching, staglike "horns" (which are not horns, but mandibles), broad, flattened, elephantlike head, and sturdy, polished legs and back, than the smaller female, whose mandibles are not branched and whose form is not so robust and formidable looking.

Unlike most of his congeners, the flight of Lucanus is almost without sound. I did not notice my visitor until I felt him on my collar. As soon as this beetle thinks that it is in danger of an attack from any source, it will hold its head erect and widely open its mandibles. Along the inner margins of the latter the horny skin is exceedingly sensitive. As soon as it feels anything between them, it closes them with considerable force and power, as I can testify from sad experience.

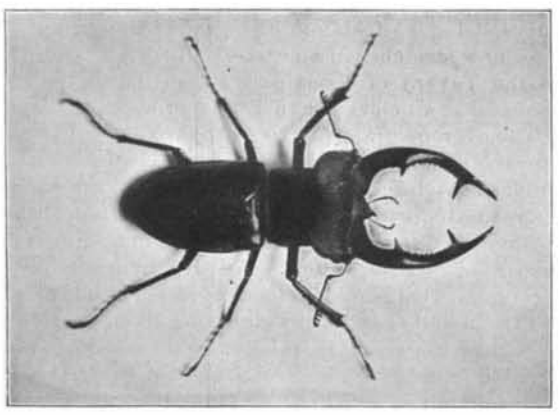
While holding this beetle in my hand, I was greatly struck with the extraordinary strength of his legs. When I closed my fingers upon him, taking care that none of them came between his sharp and ever ready "nippers," he seemed to plow his way through the hollow of my fist without the slightest difficulty. Procuring a little tin wagon which weighed exactly two ounces (960 grains apothecary's weight), I fastened him to it with a quick-drying glue and two pieces of thread. He weighed only 31 grains, yet he walked away, drawing the little wagon, as though he were free and untrammeled. I then placed half an ounce of bird shot in the wagon; he seemed to recognize this additional weight, yet pulled it along without difficulty. I added another half ounce. This seemed to be the limit of his load, for he could barely move the wagon, though move it he did for one inch. Just think of it! Here is a creature weighing only 31 grains which pulled 1,440 grains one inch, measured distance. Do you not think that his feat ranks with, if it does not surpass, that of the famous Samson? I do.

I confined all of his legs save one, which I attached to a very delicate dynamometer. This leg was fully extended and the animal was then irritated. It pulled down, as shown by the dynamometer, 249 grains. A man weighing 240 pounds would have to lift very near 2,000 pounds—one ton—with one hand or one leg in order to equal the performance of this beetle.

The rhinoceros beetle (Dynastes tityrus), the second insect Samson to which I invite attention, differs from the first in many respects. Lucanus is jet black, with wing cases and legs highly polished; it is slender, and sometimes very quick in its movements. Dynastes, on the contrary, is yellowish gray in color, with wing cases splotched with black; its body is heavy and solid looking, and its movements are always slow and sedate. Unlike those of the stag beetle, the horns on the head and prothorax of the rhinoceros beetle are true horns, and not mandibles. If the photograph of Dynastes be closely observed, it will be seen that the top horn springs from the back of the creature's neck, as it were, while the lower horn grows from the back of its head. These horns are fixed and immovable and can only be made to approximate by movements of the beetle's head. Near the base of the upper horn are two short, thornlike spines, one on each side. The female Dynastes is without horns, and is otherwise very different from the individual in the picture. The photograph is life size, and, since it is a very good one indeed, an accurate idea of the appearance of this mammoth beetle can easily be obtained from a study of it.



AN INSECT SAMSON—DYNASTES TITYRUS (RHINOCEROS BEETLE).



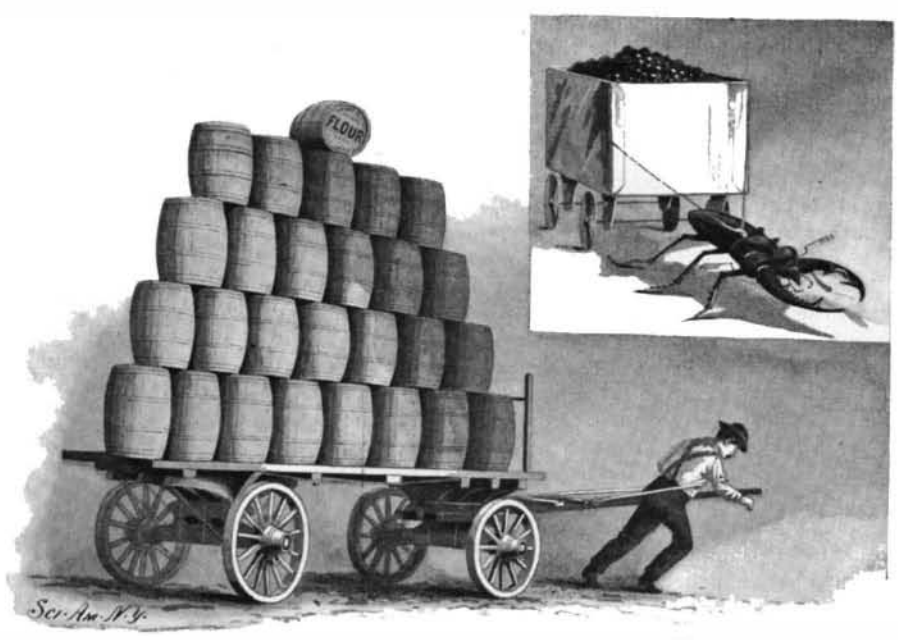
AN INSECT SAMSON—LUCANUS ELEPHAS (STAG BEETLE).

The set (or sets) of muscles governing the action of the mandibles of L. elephas is very highly developed and is exceedingly strong. Especially is this true of the tendinous attachments of the muscles themselves, which seem part and parcel of the mandibles, so closely and intimately are they welded to them.

The anatomical appearance of these structures indicates great strength. This appearance is reality, for relatively the elephant beetle has more power in its "jaws" than the most ferocious bulldog that ever gripped a bone. Furthermore, this insect has all the "staying" qualities of its canine prototype; for, once having seized an object between its powerful pincers, its head may almost be torn from its body before it will relax its grasp.

I held this beetle between thumb and forefinger of my right hand, and then brought the tip of my left thumb between its mandibles. These closed at once on the hard and calloused skin, the tips piercing through and through and meeting beneath the surface. By exerting no little force, during the exhibition of which the cervical attachments underwent considerable strain, the mandibles were dragged through the skin. Not till then did the creature separate them.

These members are powerful weapons of offense and defense, and one should carefully avoid them when examining this insect Samson.



RELATIVE STRENGTH OF MAN AND BEETLE.

The larva or grub of Dynastes is the largest of all the beetle grubs. The individual I have is very near two years old and will pupate during next winter. It will emerge a fully developed rhinoceros beetle about next May or June. When this grub is first hatched out, it is quite active, boring and eating its way through wood that is just beginning to decay. As it grows older, it becomes sluggish and seeks wood that is softer and more decayed; finally, just before it pupates, it seeks the rotten dust and broken up detritus of the cavity and there undergoes further metamorphosis. The grub was reared from the egg.

This giant among beetles is remarkably strong. After fastening it to the tin cart mentioned elsewhere in this paper, I placed in the little vehicle one ounce of bird shot. The beetle pulled this along without difficulty. I then placed a half ounce more of shot in the cart. This seemed to bring out the strength of the insect, for it bent to its work and clearly showed that it felt the additional weight very materially. Again I added a half ounce of shot. This seemed at first to bring the load to a weight beyond the creature's strength, but when I goaded it with an electric needle, it "bowed itself," even as Samson did between the pillars of Dagon, and pulled this, to it, enormous weight of one thousand nine hundred and twenty grains, a measured distance of two inches! The beetle weighed only one hundred and eight grains; consequently, it moved a weight eighteen times greater than its own. To equal this feat I would be compelled to drag a wagon and load which together weighed four thousand five hundred pounds! When we take into consideration that two thousand pounds is a heavy load for two strong draught horses, we can appreciate all the more what a wonderful exploit this was. This beetle showed a dynamometric strength of three hundred and ten grains for one of its fore legs.

In order to further test this insect's strength, I gently placed on its back a common paving brick weighing some four or five pounds. The beetle moved this brick perceptibly to and fro. If a man were to be subjected to a like experiment, the brick being as large in proportion to him as it was to the beetle, he would be crushed into a shapeless mass.

THE UNITED STATES ARMORED CRUISER "BROOKLYN"

Until the story of the naval engagement off Santiago has been written by some naval expert who was present at the fight, and written with a view to giving the facts which are of the greatest technical value, we shall be in ignorance as to which of the American ships bore the brunt of the fight. By one eyewitness the "Iowa" is reported to have been the chief object of attack, and another witness reports that on account of her superior speed the "Brooklyn" was singled out by the Spanish cruisers, and an attempt made to disable her. The fact (if fact it be) that she was hit forty times seems to substantiate the latter statement; moreover, it would be natural for the cruisers, whose sole effort seems to have been to escape, to aim at disabling the speediest ship of the enemy, and the only one that was capable of overhauling them provided she was not disabled.

The "Brooklyn" is the most modern of the large cruisers of our navy. She was modeled on the lines of the "New York," but exceeds her in size, speed, coal endurance and the power of her batteries. Both of the ships are of the armored cruiser type, and they constitute the sole representatives of this type in our navy.

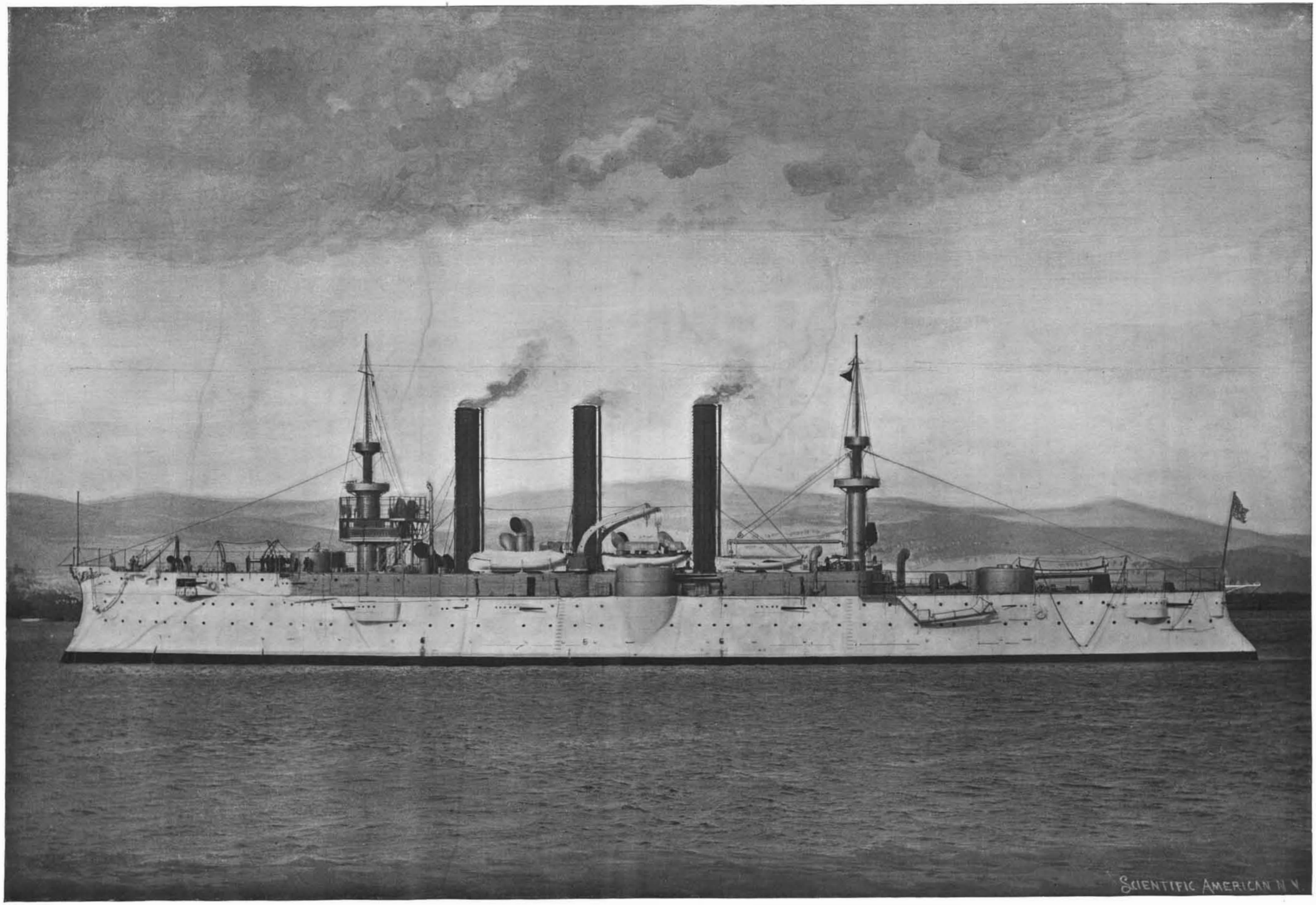
The dimensions of these two vessels are given below.

Both ships have three funnels, and with their lofty freeboard present a commanding appearance. The "Brooklyn's" funnels are abnormally lofty, their extreme height being intended to serve the purpose of forced draught.

The forward pair of 8-inch guns in the "Brooklyn" are carried upon a raised forecastle deck, and the great height of the deck above the waterline gives the ship a peculiar contour from which she is easily recognized.

She was built by the William Cramp and Sons' Ship and Engine Building Company, of Philadelphia, Penn., from government designs, the contract price being $2,986,000. of which it was estimated that the machinery would cost $986,000, the remainder being for hull and fittings. Proposals for the construction of this cruiser were issued on September

	Length.	Beam.	Draught.	Displacement.	Horse Power.	Speed.
	Ft. In.	Ft. In.	Ft. In.			Knots.
"Brooklyn"	400 6	64 8¼	24	9,215	18,769	21·91
"New York"	390 6½	64 10	23 3½	8,200	17,401	21



UNITED STATES ARMORED CRUISER "BROOKLYN."

DISPLACEMENT, 9,215 tons. SPEED, 21·9 knots. MAXIMUM COAL SUPPLY, 1,461 tons. COMPLEMENT, 516. ARMOR: Belt, 8 in.; barbettes, 8 in.; turrets, 5½ in. GUNS: Main battery, eight 8-in., twelve 5 in. rapid-fire; secondary battery, twelve 6-pdrs, four 1-pdrs., four Colts, two field guns. TORPEDO TUBES, four. AUTHORIZED 1892.

28, 1892, bids were opened on December 15, 1892, and the contract awarded on February 11, 1893. The contract requirement as to speed was that the vessel should maintain a speed of 20 knots for four consecutive hours on a displacement of 8,150 tons and with an air pressure in the fire rooms not exceeding 2½ inches, it having been further stipulated that a premium of $50,000 should be paid to the contractors for every quarter knot made in excess of this requirement, and that a penalty of $50,000 should be exacted from them for every quarter knot deficiency.

By the successful completion of the speed trials on August 27, 1896, the builders received a premium of $350,000.

The hull is built of mild steel, which, like everything else in the vessel, is of domestic manufacture.

It is divided into 242 water-tight compartments. There is a double bottom, 3 feet 6 inches deep amidships, divided into 13 water-tight compartments, and extending from frame No. 22 to frame No. 82 and about 29 feet outboard. There is a cofferdam on each side, 3 feet 6 inches wide, extending the whole length of the ship between the protective and berth decks. This cofferdam is filled with cellulose at a density of 7·5 per cubic foot. The transverse and wing bunker bulkheads are carried through the cofferdams and divide them into water-tight compartments.

Length between perpendiculars, feet and inches	400-6
on L. W. L., feet and inches	400-6
over all (including rudder), feet and inches	402-7½
Beam, extreme, and at L. W. L., feet and inches	64-8¼
Ratio of length to beam	6 to 1
Depth in hold from top of main deck beams to top of floor, feet and inches	33-10-3/16
Draught, forward and aft, seagoing trim, feet	24
Displacement, seagoing trim (load draught), tons	9,271
per inch, at L. W. L., tons	41·19

The protective deck armor over the machinery space consists of two courses of 1½-inch steel plates. Forward and aft of this, the total thickness of the two plates is not less than 2½ inches. The protective deck extends the whole length of the ship. Glacis plates, 3 inches thick, are fitted around the engine hatch.

The side armor is 3 inches thick, and extends from 4 feet above to 4 feet below the 24-foot water line for a length of about 192 feet opposite the engine and boiler spaces. The barbette armor of 8-inch turrets is 8 inches thick, with a thickness of 4 inches where not exposed. The turret armor is 5½ inches thick, secured to a backing plate of 20 pounds per square foot. The side armor, turret armor, and barbettes are of Harveyized nickel steel.

The armor of the 5-inch gun sponsons is 4 inches thick, and the splinter bulkheads, 1½ inches thick. The secondary battery protection is 2 inches thick.

The conning tower and shield are of forged steel, 7½ inches thick; from the center of the conning tower an armor tube, 5 inches thick and 12 inches in internal diameter, runs down into the forward handling room.

ARMAMENT.

There are eight 8-inch guns mounted in pairs in four turrets. The guns in the forward and after turrets have an angle of fire of 290°, or 145° on each side of the bow and stern.

The midship guns have an angle of fire of 180° from right ahead to right astern. There are twelve 5-inch rapid-fire guns mounted in sponsons on the gun deck. There are, in addition, twelve 6-pounders, four 1-pounders, and four machine guns. The 1-pounders and machine guns are mounted on the rails and in the tops.

The ammunition is supplied by electric hoists, ten in number. There are four above-water torpedo tubes, two on each side, for firing Whitehead torpedoes. The air compressors are of the Rand Drill Company's three-stage type, and, together with the accumulators, are situated in the forward and after handling rooms.

The ship is driven by four vertical, direct-acting, three-cylinder, triple-expansion engines, placed one in each of four separate watertight compartments, connected by five watertight doors.

There are two engines on each shaft and, in place of the disconnecting coupling fitted on the "New York," there are four taper coupling bolts, the coupling being of the ordinary disk kind.

The I. P. and L. P. cylinders are fitted with steam jackets. The valves are of the single ported, piston type, made of cast iron, one for the high pressure and two each for the intermediate and low pressure cylinders. The low pressure valves are balanced by making the upper ends 1½ inches larger in diameter than the lower, the live steam being between the ends. The other valves are fitted with balancing pistons, connected above with the condensers. The valve gear is of the double bar Stephenson link type. The cut-off can be varied from about 5 to 7 of the stroke by means of a slot in the reversing arm.

Reversing is effected by a Cramps' steam reversing gear, which consists of a steam lift secured to one of the engine frames, and connected to an arm on the reversing shaft. The lifting piston is operated by a piston valve which is controlled by a floating lever, receiving motion at one end from the hand lever, and a reverse motion at the other from a pin on the crosshead, so that the piston moves and stops with the hand.

Each engine is fitted with a disk stop valve, having a screw stem and a balancing piston, and a butterfly throttle. The former is 12⅜ and the latter 14 inches in diameter. The main pistons are of cast steel, dished, and fitted with two packing rings, each ⅝ inch wide and ¾ inch deep, and the followers are grooved.

The engine frames are of the inverted Y type, of cast steel, two for each cylinder; each frame is made in two sections which are bolted together in the vertical plane. Cast on the inside of each frame are ribs and facings to which the cast iron crosshead guides are bolted. The space between the frame and the guide is used for water circulation. The bed plates are of cast steel of I section, each in three sections, bolted together. The bed plates of forward engines are fitted like a pillow block and its wedge, so that the forward shaft may be adjusted to the after engine shaft whenever the bearings wear down.

Shafting and Bearings.—The crank, thrust and forward sections of the propeller shafts are of forged steel; the after sections of the propeller shafts are of nickel steel. The crank shaft of each engine is in three sections, the cranks being bolted to each other at angles of 120°, and the sequence for ahead motion being H. P., I. P., and L. P. The two engines on each shaft are coupled with the H. P. cranks opposite each other. The after couplings of the L. P. crank shafts are of the same dimensions as those of the after engines. The couplings are fitted with tapered, headless bolts, and split pins over the nuts. There is no shaft alley, the thrust shaft coupling direct to the after section of crank shaft of the after engine.

Where the propeller shafts pass through the couplings forward and the propellers aft, the 11-inch hole is reduced to 4 inches in diameter.

Main Condensers.—The main condensers, one for each engine, are made of cast brass, each in five sections, including the water chests. The water circulates through tubes. Brass baffle plates are fitted to direct the steam over the tubes, and plates are provided for supporting the tubes and also to act as baffle plates. The tube sheets are made of rolled brass, 1 inch thick. The tubes are packed with cotton tape set up by screw glands, and are spaced 15/16 inch between centers.

Main Air Pumps.—There is one double, vertical, single acting Blake air pump for each main engine, fitted with the Blake valve gear. Both pumps on one side are connected to both condensers on the same side with intervening straightway valves, and exhaust into either the condensers or the I. P. or L. P. valve chests.

These air pumps are of the same style as fitted on the "New York," "Columbia," "Minneapolis," and other ships, and their successful working has been described in previous reports of trials.

Main Circulating Pumps.—There is a centrifugal, double inlet circulating pump for each condenser, arranged to draw either from the sea, from the bilge of its engine room, or from the main drainage pipe. The sea and bilge injection valves are fitted with a safety lock, so that both cannot be open at the same time.

Screw Propellers.—The propellers are of manganese bronze, and are three-bladed, true screws. The blades are bent back and are adjustable from a pitch of 19 feet 6 inches to 22 feet 3 inches. The hubs are spherical and fitted with conical tail pieces. The starboard propeller is right, and the port one left handed.

Steam is supplied from five double ended and two single ended steel boilers, all 16 feet 3 inches in diameter. Four of the double ended boilers are 18 feet, and the fifth, 19 feet 11½ inches in length. The single ended boilers are both 9 feet 5 inches long.

The working pressure of all boilers is 160 pounds per square inch. There are four Fox's corrugated furnaces in each end of each double ended boiler and four in each single ended boiler.

The boilers are all below the protective deck and placed in three watertight compartments, separated by two athwartship bulkheads. Two double ended boilers are placed in the forward, and two in the after compartment. In the middle compartment, the larger double ended boiler is on the port side, and the two single ended, placed back to back, are on the starboard side.

The longitudinal shell seams of the boilers are treble riveted with double butt straps. Joints of boiler heads and shell seams are double riveted, and the other circumferential seams are lapped and treble riveted. The front and back heads of all boilers are curved at the top; the radius for the double ended boilers being 3 feet 10 inches, and for the single ended boilers, 3 feet 2 inches. The boiler tubes are of charcoal iron, lapwelded and drawn.

The furnaces are fitted with Cone's patent cast iron shaking grates. There are 8 grate bars in each furnace of the main boilers, each bar extending the whole length of the furnace. They rock on lugs on the front and back bearers and on projections on the middle bearers, and can be easily renewed without hauling fires.

The boilers are fitted with a steam circulating apparatus, and the internal feed pipes are arranged to distribute the feed water throughout the boilers.

The figures of heating surface are as follows:

Heating surface, tube, square feet	28,332
furnaces and combustion chambers, square feet	5,100
total, square feet	33,432
Grate surface, square feet	1,016·2
Area through tubes, square feet	155 86
Ratio, total H. S. to G. S.	32·9 to 1
area through tubes to G. S.	0·153 to 1
total area of smoke pipes	1·26 to 1

Forced Draught.—The closed fire room system is used, there being in each fire room two Sturtevant blowers, each driven by a double engine. The diameter of the steam cylinders is 5 inches and the stroke is 4 inches. The diameter of the fan is 60 inches and its width 18 inches.

Feed Pumps.—There are three main and four auxiliary Blake feed pumps in the fire rooms. Both the main and auxiliary feed pumps are so connected that any pump will supply any boiler, but there is no connection between the main and auxiliary systems. There are also independent connections with the feed tanks.

Turning Engines.—In each engine room there is a double cylinder vertical, simple engine, with cylinders 7 inches in diameter and a stroke of 7 inches, secured to the engine frame, for turning the main engines. It operates on a worm wheel on the line shaft through bevel gears and a worm. The worm is made to slide on a feather key, and is held in place by a collar below and a removable key above it. A double pawl ratchet is fitted to the shaft of this engine for turning by hand.

Turret Turning Engines.—The forward and starboard turrets are turned by electricity, the port and after turrets, by steam. The steam turning engines are double vertical engines, with cylinders 8 inches in diameter and a stroke of 7 inches. They are capable of turning the turret at the rate of one revolution per minute with the guns run out and the vessel heeled 10°, with a steam pressure of 100 pounds per square inch. At a recent trial, the steam gear worked slightly better than the electric gear, but the result of the rivalry between the steam turned turrets and electrically turned turrets has no doubt been beneficial, as the present steam gear is believed to work much better than any steam turning gear that has been used in our service.

The steam gear is worked by a lever in the sighting hood; this lever, by appropriate mechanism inside of the ammunition tube, moves a change valve on the engine. The "follow up" gear has been abandoned, and the automatic stop, which is necessary to prevent the turret going too far, is provided by cams which are fastened to the bottom of the revolving turret tube. As the turret nears its extreme position, the cams are brought to against a fixed arm connected to the valve gear. These cams close the valve gradually, and the turret will stop at the same point, regardless of the speed of rotation.

All ammunition hoists are electrical.

OFFICIAL SPEED TRIAL.

The official speed trial took place on Thursday, August 27, 1896, on the measured course off the New England coast, between Cape Ann and Cape Porpoise. The weather was fine and the sea smooth, making the conditions most favorable. The first run over the course was made in 1 hour, 54 minutes, and 42·52 seconds. The turn, made without change in the speed of the engines, occupied 20 minutes and 53·85 seconds. The return was made in 1 hour, 52 minutes and 26·34 seconds. A tidal correction applied to the 83-mile course reduced the latter to 82·953 nautical miles.

The machinery worked smoothly and without water on any journal, except that circulating through the bearings. Indicator diagrams were taken every half hour from each main cylinder, and once an hour from the main air and circulating pumps. No difficulty was found in keeping the steam pressure up to the desired point without running the blowers at too high a speed. The ease with which the steam pressure was maintained was no doubt due, in a great measure, to the high smoke pipes. All boilers were in use and under forced draught. The coal used was Pocahontas of good quality.

DATA OF TRIAL.

Draught at beginning of trial, forward, feet and inches	21-6	
aft, feet and inches	22-3	
mean, feet and inches	21-10½	
Displacement at above draught, tons	8,150	
Average speed, knots	21·9117	
	Starboard.	Port.
Revolutions per minute, main engines	136·2	134·9
mean of both engines	136·55	
Piston speed, feet, per minute	953·4	958·3
Steam pressure, boilers, per gage	158·3	
engines, per gage	158·5	157·4
Vacuum in condensers, inches of mercury	25·5	24·9
Opening of throttle	Wide.	
Cut-off in decimals of stroke from beginning, H. P.	0·74	0·74
I. P. and L. P.	0·70	0·70

The total indicated horse power for all four engines was 18,248. We are indebted for many of our particulars to the builders, William Cramp & Sons, and to **Passed Assistant Engineer W. C. Herbert, U.S.N.**