THE NEW UNITED STATES CRUISERS.

(*Continued from first page.*)

partments having a length of 136 feet. This space will have a double bottom 3½ feet deep, divided into fourteen water-tight cells. A steel deck 1½ inches thick will cover the machinery.

These compartments will be divided on each side by vertical longitudinal bulkheads, and the space between them and the sides of the boat will be filled with coal. From the water line to 8 feet above it this coal armor will be 9 feet thick, and aft will have a thickness of 5 feet from the water line to 14 feet below it. When the doors are shut, the coal bunkers and the pockets in the boiler rooms form thirty-four water-tight compartments. The deck covering the machinery compartments will afford protection by preventing the access of shot and water to the main compartments, but it is not expected to resist a 6-inch shot even at inclinations of from six to eight degrees; entering shot would in all likelihood explode in the coal without doing injury to the machinery.

The magazine rooms will be in the hold amidships, before and abaft the machinery space. The deck above them will be covered by a protecting plating three-quarters of an inch thick. All hatches through it are to have water-tight covers, and coffer dams reaching to the berth deck will surround the magazine hatches. Other divisions in the hold by bulkheads of steel and the shaft alley bulkheads, together with those already noted, divide the vessel into eighty-five water-tight compartments.

A system of drainage has been adopted by which the combined power of the steam and circulating pumps, having a capacity of 2,500 tons per hour, can be concentrated on any main compartment. In addition to this there will be six continuous acting hand pumps on the berth deck, having independent suctions to each main compartment, and each compartment of the double bottom; they deliver either directly overboard or into the fire main, which will extend about three-fourths of the length of the vessel amidships on the berth deck, with stand pipes to gun and spar decks.

The outside plating of the vessel will be nine-sixteenths of an inch thick, will weigh twenty-three pounds per square foot, and there will be a double plate at the water line from the stem to within 70 feet of the stern. The stem and stern posts are to be of hammered steel. The water-tight inner bottom will be plating 10 and 12½ pounds per foot. The berth deck will have a protective plating over the engine and boilers for 136 feet. The bow of the vessel will be strengthened for ramming.

The rudder and steering gear will be below water line. A fighting hand wheel and steam steering engine will be placed on the water-tight flat, to which communication can be had by telegraph from the bridges. In addition there will be a hand steering wheel on the spar deck and a steam steering wheel in the pilot house.

The vessel will be bark rigged, with an area of plain sail of 14,880 square feet. The coal bunker capacity will be 940 tons, while 300 tons additional can be stored away on the berth deck. This will enable the Chicago to steam 3,000 miles at 15 knots, or 6,000 miles at 10 or 11 knots per hour. The vessel will be ventilated by an exhaust system.

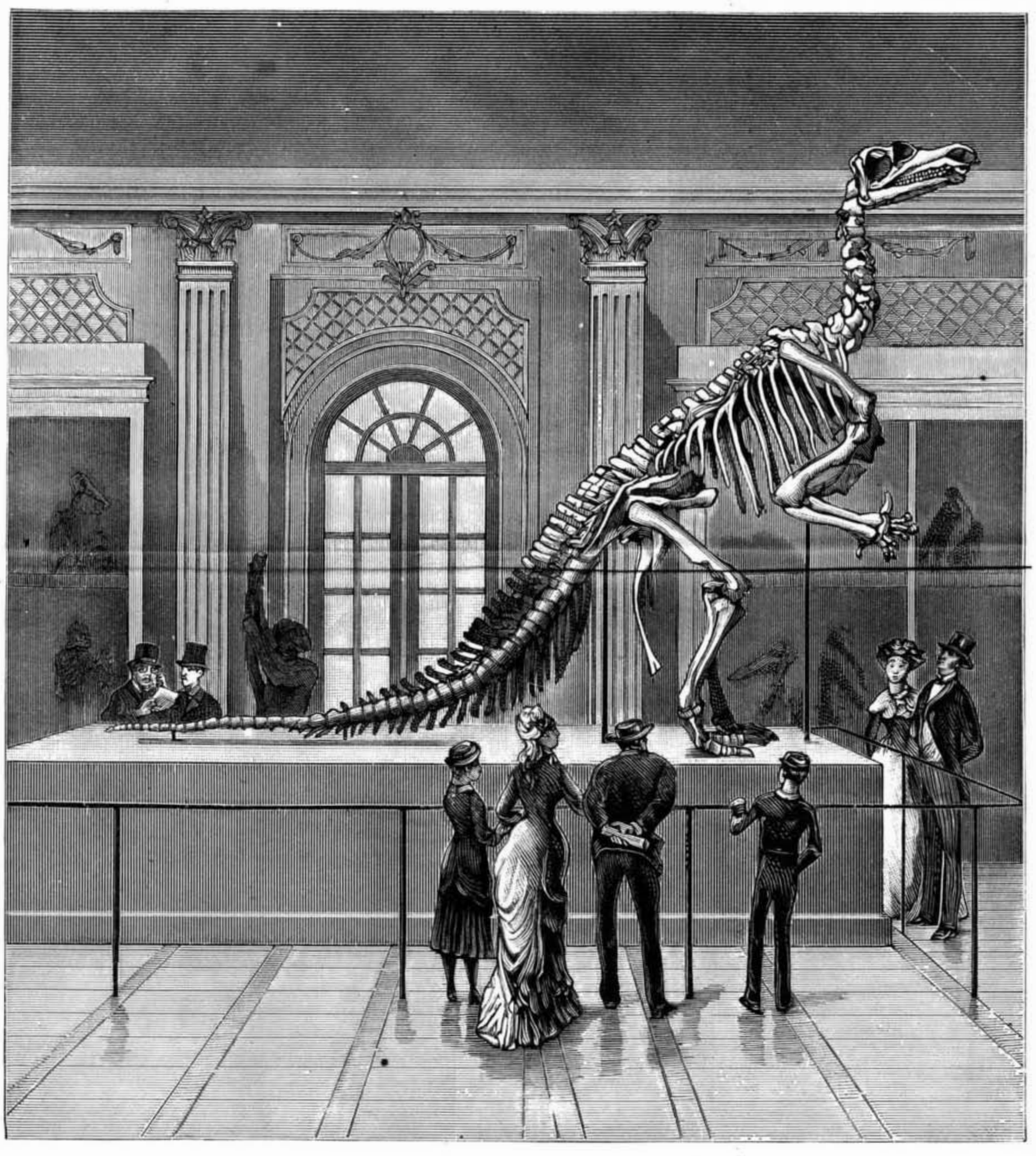
There will be twin screws operated by two pairs of two cylinder compound overhead beam engines, each of which will be placed in a separate water-tight compartment 22 feet long, and inclosed by a deck for protection. The high and low pressure cylinders will be situated side by side, are vertical, 8 feet apart, and 2 feet 1 inch and 3 feet 5 inches respectively from the midship line. The diameters of the cylinders will be 45 and 78 inches, and the stroke 52 inches. Each cylinder will be steam jacketed, and fitted with two double ported main slide valves, actuated by eccentrics through arms and rock shafts, each furnished with a steam cylinder and piston to balance the weight of the valves. The cut-off valves will be adjustable between the limits of one-eighth and five-eighths of the stroke. The exhaust steam from the high pressure cylinder will pass directly to the low pressure steam chests; suitable pipes will exhaust the steam into the condenser and atmosphere. The condensers will be furnished with tinned brass tubes having a cooling surface of 5,000 square feet each. Beside each condenser will be placed an independent, double-acting, combined air and circulating pump. Worked from the crosshead of each pump piston will be two double-acting feed pumps 5 inches in diameter.

There will be fourteen horizontal return tubular boilers, constructed of steel, and capable of carrying a pressure of 100 pounds. They will be placed in two separate water-tight compartments. The fire rooms will run fore and aft, and will be 10 feet wide. Each boiler will be 9 feet in external diameter and 9 feet 10 inches in length on the bottom, and will be set inclining from front to back, over a single furnace. Each furnace will have about 57⅓ square feet of grate surface, or an aggregate of 802 square feet in all the boilers. The shells will be five-eighths of an inch thick, and the heads three-quarters and five-eighths. The tubes will be lap-welded iron. In each smoke pipe, concentric with it, there will be a steam drum 9 feet in diameter and 9 feet long, with a shell seven-eighths of an inch thick; this will have eight 18-inch and four 15-inch lap-welded flues passing through it. The fire rooms will be air-tight, and each will be provided with two large blowers.

The battery of the Chicago will consist of four 8 inch high powered breech loaders, weighing 12 tons each, mounted on the flush spar deck in projecting half turrets, the center of the trunnions being 20¼ feet above water. The turrets will be unarmored and the men will be protected only by shields on the guns. Six 6-inch B. L. R., weighing 4 tons each, will be mounted broadside on the gun deck, which will also be arranged for two additional 6-inch guns if found desirable. One 6-inch will be mounted in a recessed gun deck port on each bow. Two 5-inch guns will be placed in recessed ports abaft the captain's cabin. The 8-inch projectile weighs 250 pounds; the 6-inch 100 pounds, and the 5-inch 60 pounds. In addition there will be four 47 mm. and two 37 mm. Hotchkiss revolving cannons, mounted in fixed bullet proof towers.

The contract price for the hull and fittings of the Chicago, exclusive of the masts, spars, rigging, sails, etc., is $889,000.

EXPERTS in chemistry have estimated that the cost of London's winter smoke and fog is $25,000,000 annually; that is to say, constituents of coal to this value escape unconsumed, and assist in forming the sooty vapor.



THE GREAT IGUANODON AT THE BRUSSELS MUSEUM.

THE BERNISSART IGUANODONS.

The animal whose skeleton is represented in our engraving is, at a first glance, surprising by reason of its colossal size and its resemblance to the giant kangaroo. Like the latter, it has an enormous tail, very long hind legs, and very short fore ones. It seems as if it ought to be placed near that marsupial; but paleontologists, rightly setting aside all vulgar ideas, make it out a reptile. A reptile! A biped like man and like birds, capable of seizing his aggressor between his arms! It must be avowed that reptiles have changed much during the long route that they have traversed since geological times up to our own.

Surely, had any one in former times had any idea in regard to paleontology, and had any one suspected the existence of these forms so carefully preserved in the terrestrial crust, and so different from those of to-day, naturalists would have perhaps been embarrassed, but they most certainly would not have given the name of crawling animals to the interesting class in which are arranged, among others, the *Iguanodon*, a walking animal, the *Pterodactyl*, provided with wings, and the *Ichthyosaurus*, a swimmer which could only live in the bosom of the sea. And, what is worthy of remark, in secondary times, when these surprising beings were in their glory, reptiles seemed to outline, in a vague and colossal way, the principal types of those vertebrates which were destined to reign over the world, each in his time—the fish, the bird, and the mammal.

Two years ago, I myself saw iguanodons in the course of preparation at the Brussels Museum. The bones of two individuals of these sufficed to fill a very large hall. One of them measured 10 meters in length, and the other 14. They had been found in 1878 at Bernissart, a locality situated between Mons and Tournai, very famous for its coal mines. It must not be thought, however, that these reptiles belonged to the coal epoch, for their remains lie buried in the lower Cretaceous strata (Wealden), known by miners as "dead lands," and which must be traversed to a depth of 300 to 400 meters before coal is reached.

Mr. Fages saw the first bones, Mr. Van Beneden determined the species, and Mr. Depauw, superintendent of the museum workshops, took upon himself the difficult task of working this rich vein of fossils. For this purpose he adopted the life of a miner and pursued his labors for three years at a depth varying from 322 to 356 meters. He was fortunate enough to exhume twenty-two iguanodons, fifteen of which are now mounted. He attained this result by inventing ingenious processes of solidifying the bones, which, being impregnated with pyrites, would otherwise have crumbled away upon contact with the air.

The following are, according to Mr. Dollo, who has made a very profound study of the *Iguanodon Bernissartensis*, a few details in regard to the structure of the gigantic reptile. It belongs to the sub-class of Dinosaurians and to the order Ornithopeda. The individual described by the learned Belgian is 9·5 m. from the end of the nose to the extremity of the tail, and, when standing upright upon its hind legs, rises 4·36 m. above the level of the earth. Its head is relatively small, and much compressed in the direction of the bilateral diameter. The nostrils are spacious, and apparently partitioned in their anterior region. The orbits are of medium size, and are elongated in the direction of the vertical. The temporal fossa is limited above and beneath by a bony arc—an arrangement that is no longer met with except in a single lizard of our own time (*Hatteria*). As in our present reptiles, the teeth, ninety-two in number, replaced one another indefinitely; that is to say, as soon as one was worn out another succeeded it.

The neck is moderately long, and contains ten vertebræ, each of which, excepting the first, bears a pair of small ribs. It must have been very flexible. The trunk consists of 24 vertebræ strongly united by ossified ligaments. The vertebræ, 1 to 17, each bears a pair of strong ribs. The six last vertebræ of the trunk are soldered so as to form the sacrum, to which is attached the pelvis.

The tail is a little longer than the rest of the body; it is 5 meters in length and contains 51 vertebræ. It is compressed laterally, and reminds us of that of the crocodile. The scapular bones are four in number—two scapulæ and two coracoides.

The fore legs are shorter than the hind ones, and are massive and powerful. Each of them terminates in a five-fingered hand. The first finger, or thumb, is transformed into an enormous spur, which, when covered with horn, must have proved a terrible weapon.

The pelvis contains six bones, to wit: two ilias, two pubes and post-pubes, and two ischia. These latter are remarkable for their elongated form, and, like the other parts of the pelvis, remind us of those of birds. The hind limbs, which, as we have said, are larger and longer than the fore ones, terminate in four fingers.

Several scientists, Mr. Dollo among them, think they have observed traces of webbed feet in the impressions left by the iguanodon in the Wealden formation. Everything, in fact, leads to the belief that these dinosaurs were aquatic in their habits. They must have lived in the midst of swamps and upon the margins of rivers whose waters served them as a place of refuge.

It was Cuvier who, in 1822, determined the first bony remains of the iguanodon. Gedeon Mantell, the author of the discovery, and the one who gave his name to the species, which is smaller than and very different from *I. Bernissartensis*, submitted the teeth to the examination of the illustrious naturalist, and the latter unhesitatingly assigned them to a great herbivorous animal; and he was not deceived, for the diet of the iguanodon was exclusively a vegetable one.

These animals of geological times divided their food with the horny beak in which their jaws ended, and triturated it in the back of the mouth by means of numerous teeth. They thus fattened themselves, and became a prey, notwithstanding their size, to certain great carnivora—for example, to such other dinosaurs (*Megalosaurus*) as were provided with sharp teeth and claws.—*S. Meunier, in La Nature.*

The Electric Light as a Fish Hook.

The United States fish steamer Albatross is fitted with electric lights, and during a recent cruise the experiment was tried of lowering one of them into the sea. Engineer G. W. Baird gives in *Science* the following description of the trial:

Fishermen in nearly all parts of the world use a light in their boats when fishing at night, to attract fishes into their nets; and it is a common thing for flying-fish to come on board ship at night, if a light be advantageously placed to attract them.

Until incandescent lamps were invented, there were no convenient means of sustaining a light beneath the surface of the water, and there is consequently opened up to us an unexplored field in fishing.

Just what service our submarine lamps will be, we are as yet unable to say; but, with the small lamp which we use from one to ten feet below the surface, amphipods in great numbers, silver-sides, young bluefish, young lobster, squid, and flying-fish have been induced into the nets, and dolphins have approached it; but whether the dolphins were attracted by the light, or were pursuing the squid, Professor Benedict, the naturalist of the ship, was unable to say. Squid are especially susceptible to the influence of light. I am informed by the very eminent authority of Professor Verrill, of Yale College, that a heavy sea, breaking upon a lee shore when the full moon is casting its rays across the land into the sea, will throw hundreds of squid upon the beach in a single night; an evidence of their moving in the direction of the light until caught in the spray and hurled upon the shore.

To succeed in producing the light at considerable depths has been by no means easy.

The Edison Company first prepared a lantern of two thicknesses of glass, hemispherical in form, with its flat side tightly joined to a bronze disk, on which were placed three sixteen-candle power B lamps in multiple arc. At a moderate depth it burned beautifully; but at about a hundred and fifty feet the packing leaked, and, the sea water entering, short-circuited, and the lamp was extinguished by the destruction of the cut-out plug. A similar lamp was then tried with improved packing; but its glass walls were crushed by the pressure of the water, and it was extinguished.

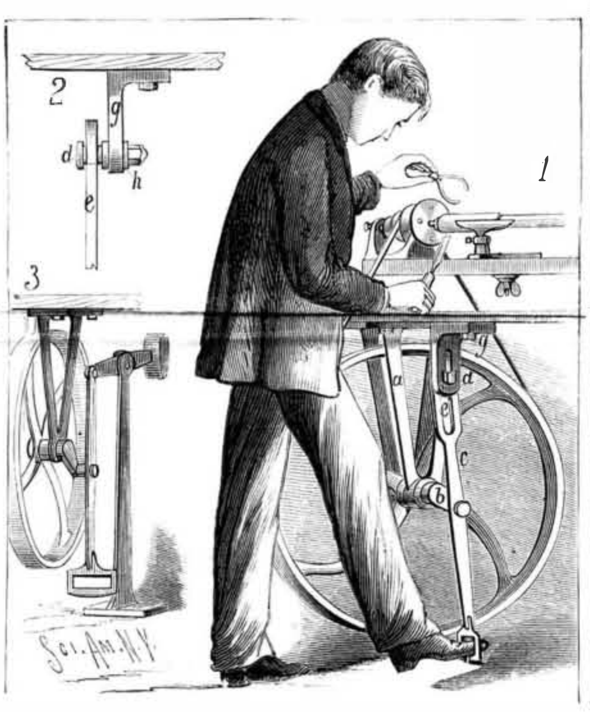
The next essay was with a single Edison lamp, its glass vessel being cylindrical in form, with hemispherical end, to give it strength; its thin platinum wires extending through one end without any external attachment. To these delicate wires I succeeded in soldering the copper wires of the cable, but broke (or cut) off one of the platinum wires at the point where it enters the glass, while putting on the insulation. When it is remembered that a hundred fathoms depth of water brings a pressure of over two hundred and fifty pounds per square inch on the lamp, it will be understood that great care was required in every procedure.

Our next attempt was with a single Edison lamp exactly the same as the last. I succeeded in soldering and insulating the joints perfectly; but the pressure of the water upon the insulation cut the delicate platinum wire on the glass before it had reached a hundred feet in depth.

The Edison Company then produced a lamp in which the platinum wires were soldered to copper wires in a glass cavity, and filled in with resin, so that copper wires, about No. 30 in size, projected from the lamp for our attachment. I coiled the copper wires spirally, and soldered their ends to the ends of the heavy wires of the cable, separating them by a small block of pine wood; this gave some freedom of motion without danger of cutting or breaking the wires. A paper mould was placed round the joint, and filled with warm "gulloot." When this had cooled, it was wrapped with insulation tape and served tightly with twine. This was again covered with gulloot, then tape, and finally with melted gutta-percha; and, when the gutta-percha had cooled, its entire surface was seared over with a hot iron, to make sure of filling any cracks or holes it might contain. The lamp was then lowered into the sea, about seven hundred and fifty feet of cable being paid out, without any indication of failure. To ascertain if the lamp was lighted at all times, we substituted a lamp for the cut-out plug in the deep sea circuit. This brought both lamps in the same circuit, which caused them to glow at about a cherry red instead of a white light; and had any accident happened to break the lamp in the water, or to cause a leak, our upper lamp would have immediately sprung into incandescent whiteness.

FOOT POWER.

This invention is for an improved device for turning the drive wheel of a lathe or any other machine operated by foot power, and is especially adapted to run a watchmaker's or jeweler's lathe. In Fig. 1, which is a perspective view of the device, *c* is a stirrup lever connected with the crank, *b*, of the driving wheel. At the lower end of the lever is the stirrup and at its upper end is a slot, *e*, adapted to receive the bolt, *d*, on which the lever has a vertical motion. A hanger, *g*, attached to the underside of the bench, has a slot in which the bolt, *d*, may be adjusted. The drive wheel is of the ordinary construction and may be adapted for either



DAVIS' FOOT POWER.

a flat or round belt. It is supported on its axle in bearings in the hanger, *a*, which may be bolted to the underside of the bench or to the floor. The stirrup lever has a vertical swinging motion similar to the motion of the foot in walking, thus overcoming the jar to the body experienced in the use of the ordinary forms of treadles. At whatever point the drive wheel may stop it can be readily started by either pressing upon, lifting, pushing, or pulling on the stirrup with the foot. When there is work of drilling or turning requiring more than ordinary power, the bolt, *d*, may be shifted so as to obtain the necessary increase. Fig. 2 is a front elevation of the device. In the modified form, Fig. 3, the beam has a weight on one end for the purpose of counterbalancing the weight of the stirrup rod. In Fig. 1, the rim of the wheel is loaded in casting, opposite the crank pin, for the same purpose, causing the wheel to be evenly balanced and free from jar and to have the regular motion essential to fine work.

This invention has been recently patented by Mr. George Davis, of 1207 Main St., Richmond, Virginia.

Machine Shell Guns.

The *Journal of the Royal United Service Institution* contains the paper on machine guns, by Captain Lord Charles W. D. Beresford, R. N., which was read before the Institute on the 15th of June last. His chief purpose seems to be to show the necessity of providing shell machine guns for the British navy, which thus far is not provided with a single one, its equipment in hand, or contracted for, consisting of 565 Nordenfelt machine guns of 1 inch caliber, throwing a solid steel bullet, 142 Gatlings and 350 Gardiner machine guns, 45 inch rifle caliber, throwing lead bullets. In all classes of vessels the French are better gunned, as not only have they the enormous advantage of breech loaders, but their guns are vastly superior to the English in penetration and rapidity of fire per weight of gun; while to add to the advantages named, the French have mounted in their fleet between 600 and 700 Hotchkiss machine guns, throwing 1 pound shell at the rate of fifteen to twenty a minute. Most of these guns were mounted in position in their fleet before the English had any sort of machine gun whatever, and some were bought as far back as 1875, or three years before the English had any. "It is needless," says Captain Beresford, "to point out the superiority that a machine gun throwing shells would have over the machine gun which only throws bullets, excepting in the case of resisting torpedo-boat attack, when the bullet gun is better. The proportion of machine guns between the two fleets, in another two years, may be about two to one in favor of the French, if the present relative rate of progress is kept up, as they determined two years ago to double the complement of Hotchkiss shell guns to each of their ships. All the French small craft have two or more machine shell guns, whereas the English small craft last year had no machine guns of any description whatever. The French small craft are, however, so vastly superior to ours in fighting capabilities that there could be no doubt as to which would win an action, if two ships of similar tonnage were engaged."

The rain of machine gun shells, as he further shows, will do more to demoralize a ship's company than a few heavy shot or shell striking, passing through, or shrieking over a ship. The French, also, go upon the principle of exposing their machine guns, with a view to getting an all-round and continuous fire; whereas the English prefer protecting the men and guns, and consequently the guns will only bear on a certain small arc. The French give it as their opinion, founded upon actual practice, that the proportion of hits between a barbette and a broadside ship, coming into range, passing at 60 yards, and going on out of range, is three to one in favor of the barbette. Captain Beresford advocates a 2 pound shell gun, and gives it as his opinion that the gun should be a single-barreled gun, so as to be light and easily moved and shifted as wanted; it should have, as far as is possible, an all-round fire, with, perhaps, an umbrella-shaped screen over the men, to keep bullets and shell splinters clear of them, and from under which they can see the enemy from any point of the compass. Men that are hidden won't fight; they must see what is going on to work well, and more particularly with these guns, if they are to be thoroughly effective. Lastly, it is imperative that the man who sights the gun should be able to fire it, as the eye and hand must work together. The 2 pound shell gun is the best sized machine shell gun, as it does not recoil even when on its landing carriage, and it has better penetration than the 2½ pr., and equally good penetration with the 4 pr. tried at Portsmouth, with lower initial velocity, both of which guns are considerably heavier. It penetrated at the Portsmouth trials 2½ inch iron at 300 yards, and can therefore be relied upon to penetrate unarmored vessels, gun ports, etc., at any angle or range for which it is likely to be required.

The French have given orders to rapidly increase the complement of Hotchkiss shell guns they possess, as they find they are not suitable against torpedo boat attack unless used in large numbers, although they are at the same time trying heavier shell guns of other patterns.

Captain Beresford describes the new Gatling system of feeding as perfect, while he thinks the revolving system and its weight objectionable. He states that the Gatlings have been very serviceable to the British navy. At Alexandria they "came in very usefully for the landing, clearing the town of riot, and restoring order. It was openly stated by Arabi's officers and men that nothing would induce them to face machines that 'pumped lead,' which referred to the Gatling, with which Captain Fisher held the lines with 370 men during four anxious days and nights. Such was the terror inspired by these guns when used for clearing the streets, that although there was an army of over 9,000 men within a short distance, they would not face the small party of 370 men, who held the lines with the Gatling guns."

Combination Tag and Envelope.

This consists of an envelope made of stout paper, open at one end and provided with a flap long enough to reach to the closed end when folded down. The bill is inclosed in the envelope, the address is written upon the face or under side of the flap, and the tag tied to the package by a cord passing through two eyelets—one in the free end of the flap and one in the closed end of the envelope. Although this combination tag and envelope has been in use but a short time, it has given satisfaction to shippers, and proved to be economical.

It was patented in the United States and Canada by Mr. Joseph T. Dunham, and is now being manufactured by Jos. T. Dunham & Co., Pier 24, North River, New York city.

"HUMAN labor," says Dr. Zellner, of Ashville, Ala., "is the most costly factor that enters into the production of cotton, and every consistent means should be adopted to dispense with it." And then the doctor, who has the reputation of having raised some of the finest samples ever grown in the South, describes how, by planting at proper distances, in checks five by three feet apart, one-half of the after labor of cultivating may be saved. About the same amount of plow work is said to be necessary, but not more than one-fourth as much work with the hoe as is required by cotton in drills.