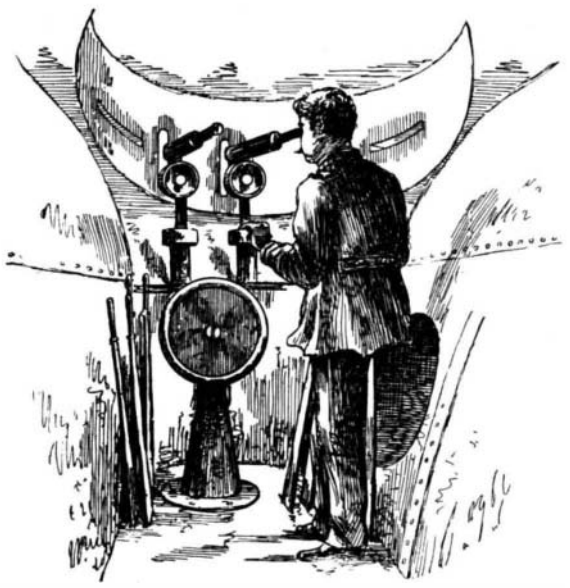
THE FIRST CLASS BATTLESHIP INDIANA.

In our last issue are described in detail the defensive arrangements of the Indiana—her double bottom, side and deck armor, and massive turrets, by means of which she will be able to endure the awful storm of projectiles which will fall upon a modern warship in time of battle. This armor is as thick, and in most cases thicker than that of the best modern battleships of foreign navies, and, moreover, it is of far better quality, having been forged by the famous Harvey process, which was fortunately invented in time to be used on these ships. Judged by her mere power to resist penetration, there is no battleship in the world to-day that could stand attack by such heavy guns, or stand it so long, as the Indiana.

But a battleship is essentially a fighting machine, and her first requirement is that she shall be able to deliver heavy blows, and many of them. Unlike the cruiser, she is not designed on the understanding that she may frequently have to run from a more powerful ship. Her place is always in the thick of the fight; and when the designer has given her sufficient structural and armored protection to enable her to take her place in the first line of battle, his next object is to arm her with as many armor piercing and rapid fire guns as the limits of her displacement will allow. Judged by this double standard, the Indiana is without a rival; for it is a fact, which has never been disputed, that she carries the heaviest armament of any ship afloat to-day. This preponderance of power is due to the eight 8 inch guns which are carried in four turrets flanking the two turrets of the 13 inch guns. They are an entirely novel feature in battleship design, and may be called the chief distinctive feature of this ship. The accepted type of battleship carries usually a main battery of four heavy guns disposed in two turrets, fore and aft, supplemented by a broadside secondary battery of five or six inch guns, the first being capable of piercing armor and the latter being used against the lightly armored or unarmored portions of the enemy. Thus the Camperdown, of the British navy, a ship of the same size as the Indiana, and less effectively protected, carries four 67 ton guns of about the same power as the heavy guns of the American ship, and a secondary battery of six 6 inch guns. Against this the Indiana carries, in addition to her main and secondary batteries, the eight 8-inch armor piercing guns above mentioned — a preponderance of power which would give her the certain victory in a naval duel.

Our illustrations in this number are devoted to the armament of the Indiana, and show the methods of mounting and handling the great guns. This, especially in the case of the 13 inch guns, each of which weighs 67 tons, is a matter calling for great skill in design; and so well has it been carried out, that one man is able to raise or lower these great masses of metal, and swing them through an arc of 270 degrees, by the manipulation of a few small handwheels and levers situated within the sighting station of the turret. The gun itself is mounted in a gun metal seating, to which it is strapped down by the four steel bands shown in the illustration. The seating is arranged to slide, in much the same way as the rest of a lathe upon its bed, upon the upper flanges of a massive steel frame, the forward end of which is hinged to the wall of the turret, the after end being carried by the plunger of a hydraulic ram, by means of which the gun with its carriage is raised or lowered to give the proper elevation. The guns are trained by turning the turret which carries them. This is effected by hydraulic engines located within the shelter of the barbettes, below the turret, operating a pinion, which engages a circular vertical rack bolted to the inside of the turret. To check the recoil of the guns, which represents an initial energy of over 33,000 foot tons, a recoil cylinder is mounted within



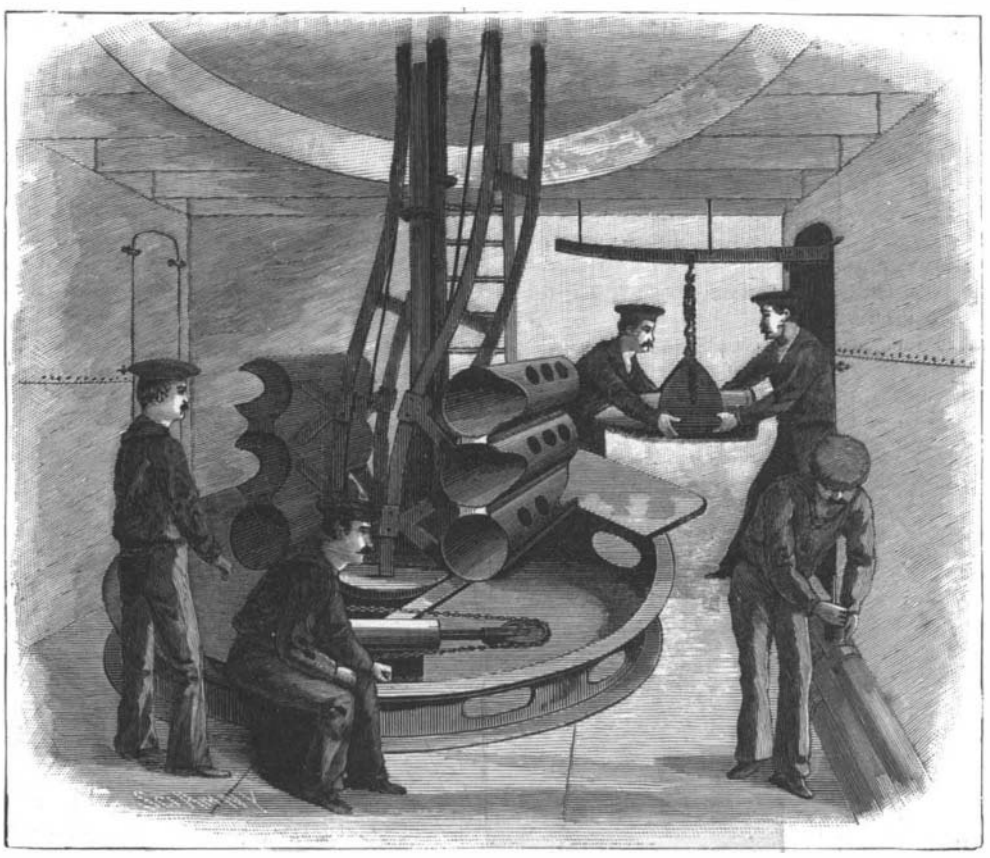
INTERIOR OF SIGHTING HOOD OF 13 INCH GUN TURRETS.

the gun carriage beneath the gun. It is filled with water, and is provided with a relief valve, which is automatically opened on the discharge of the gun. The plunger or piston is attached to the seating of the gun, and as the gun recoils the water is forced out of the cylinder, the brake action being secured by the small size of the discharge valve. After being loaded the gun is run out to the firing position by admitting water under pressure at the back of the piston in the recoil cylinders.

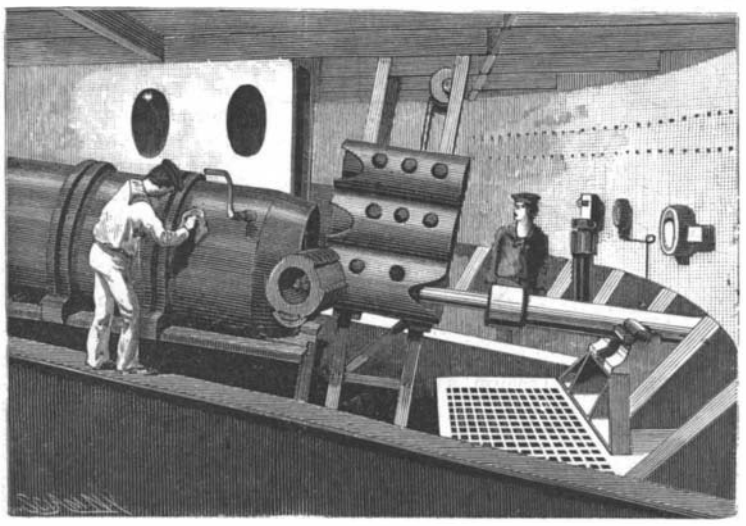
In describing the process of loading and firing a 13 inch gun, it is necessary to descend below the steel protective deck to the "handling room," which is located immediately beneath the turret. It is square in form, and at each corner is a watertight door which leads to the ammunition rooms, where the powder and shell are stored in suitable racks. The charge is transferred to a cradle suspended from an overhead track and run out into the handling room, where it is unloaded into the ammunition hoists, of which there are two, one to each gun. Each hoist consists of a triple cage of three hollow cylinders, the upper two for the powder, which is done up in two sections, and the lower for the shell.

The two sections of powder weigh 550 pounds, and the shell 1,100 pounds. The cage is then run up to the breech of the gun by a hydraulic ram and steel wire ropes and pulleys, the speed of the hoist being six times that of the ram. When the shell is opposite the breech it is rammed into the gun by a telescopic hydraulic rammer, which can be seen pivoted against the turret to the rear of the gun, the rammer being swung back against the turret wall when not in use. The two sections of powder are then rammed in after the shot, the breech plug, which is shown swung to the left clear of the gun, is thrust into the breech and locked, the firing attachment is screwed onto the stud, shown within the plug, and the gun is ready for the gunner to lay and fire. The breech plug and the mechanism for opening and closing it are very ingeniously designed, and will bear a detailed description. To enable the plug to withstand the shock of discharge, which is as great against the plug as it is against the shell, it is provided with a powerful thread and screwed into the breech of the gun. After the thread has been cut in the lathe, three wide channels are cut across it, parallel to the axis of the plug, similar channels being cut across the thread in the breech. When the plug is inserted, it is placed so that the remaining thread on both plug and breech will enter the corresponding channels. After it is driven home the plug is given one-sixth of a turn, thereby bringing the threads into engagement and locking the breech. There is a great variety of breech mechanisms employed in different navies, and some of them are extremely complicated. The system in use on the Indiana is a recent design and a great advance upon previous methods. The three operations of unlocking the plug, withdrawing it upon the swinging tray, and throwing the tray round clear of the breech are performed by one man, by means of a crank shown on the right side of the gun. The first motions of the crank turn a gear which engages a rack on the periphery of the plug and gives it a one-sixth turn, thereby disengaging the threads; the crank shaft then operates a screw, which thrusts the plug out upon the tray; and when this operation is complete another gear is engaged which swings the tray upon its hinges.

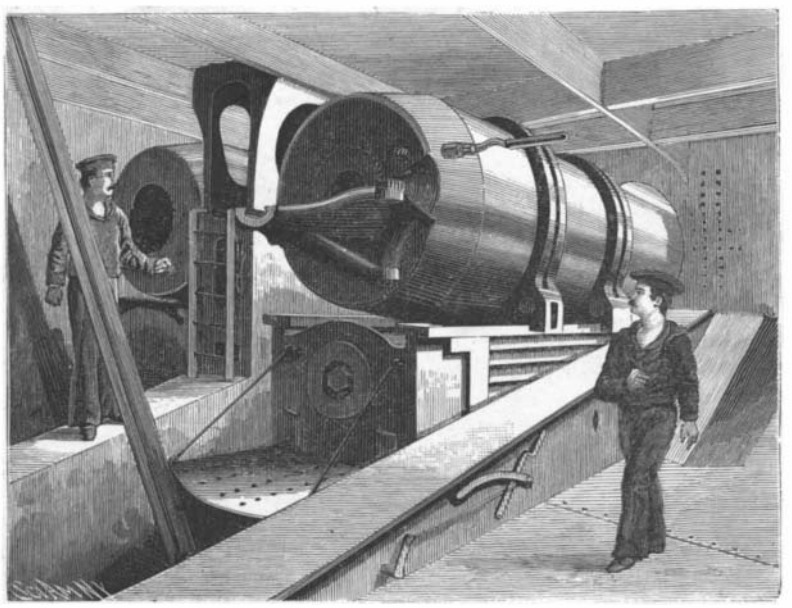
In the illustration showing the breech of the 13 inch guns will be noticed a ladder leading up to a plated, box-like structure. This latter is the position occupied by the officer who lays and fires the guns. The top of the compartment projects above the roof of the turret, and is heavily armored. It is provided with two narrow vertical and horizontal slots at which two sighting telescopes are placed, one for each gun. The axis of each telescope is parallel to the axis of the gun which it represents, and the handwheels which operate the telescopes at the same time serve to work the hydraulic rams for raising and lowering the guns, so that the two



THE BATTLESHIP INDIANA — LOADING THE AMMUNITION HOISTS FOR 13 INCH GUNS.



RAMMING HOME THE CHARGE IN A 13 INCH GUN.



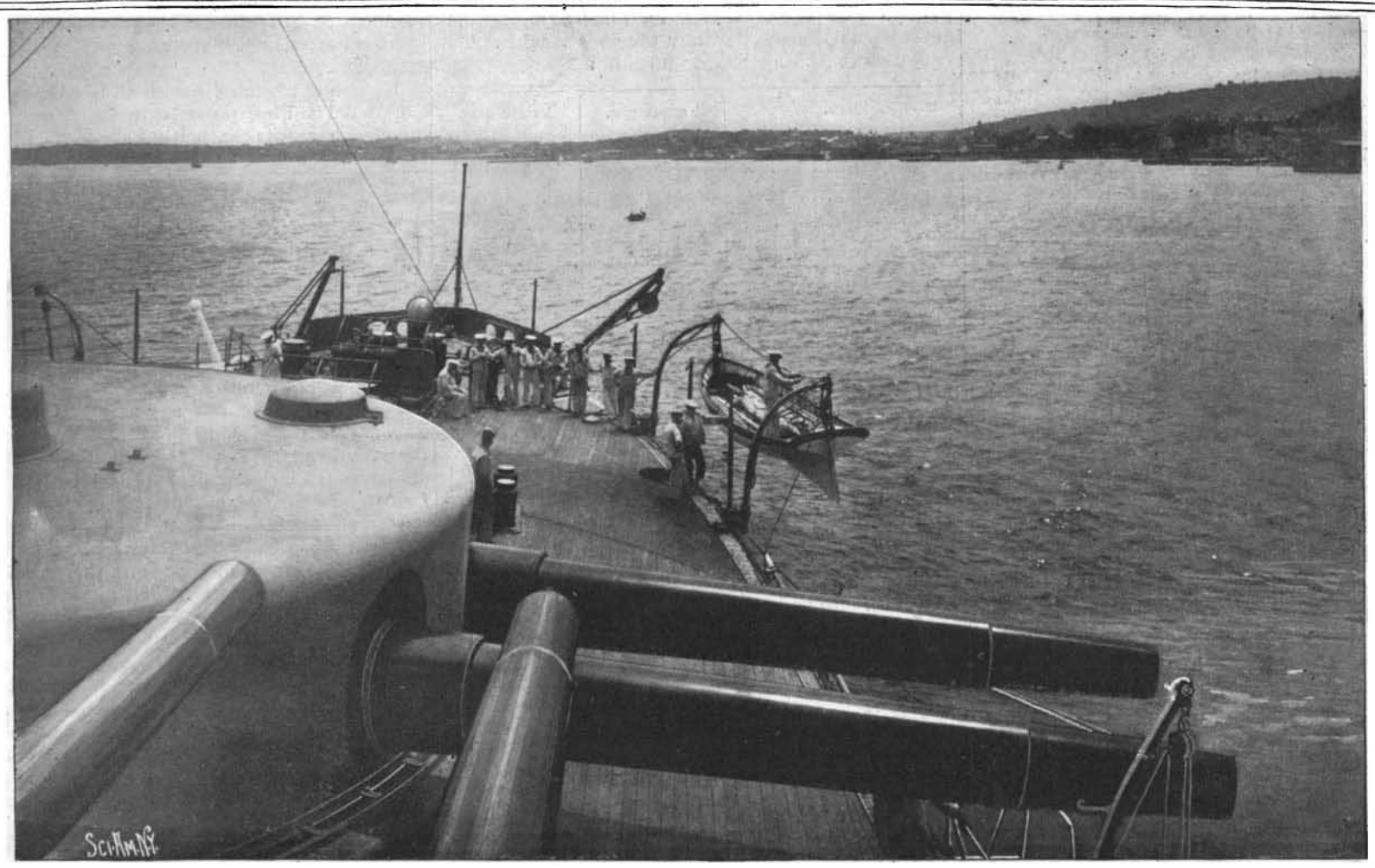
BREECH OF THE 13 INCH GUNS.

SCIENTIFIC AMERICAN

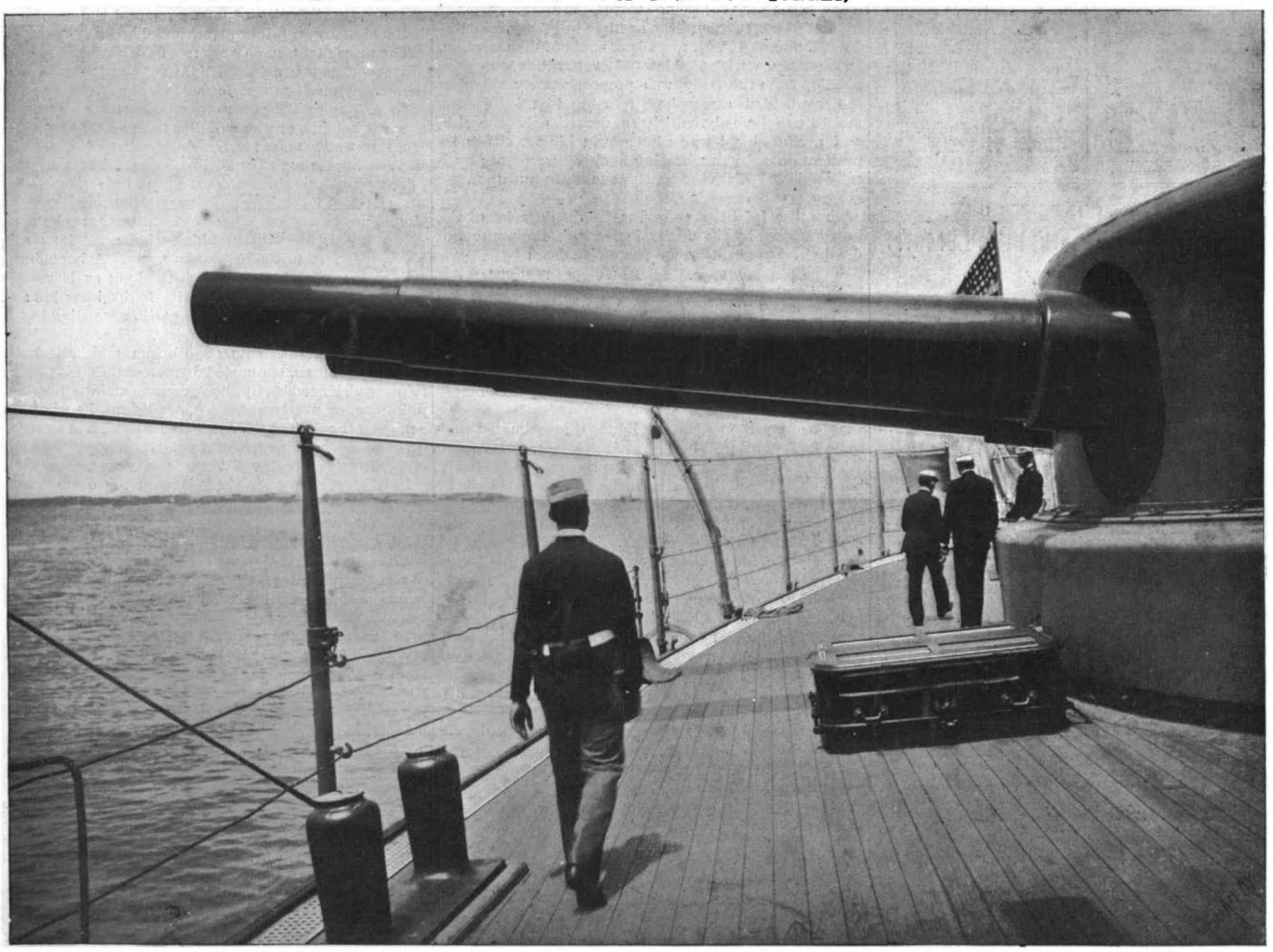
[Entered at the Post Office of New York, N. Y., as Second Class matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

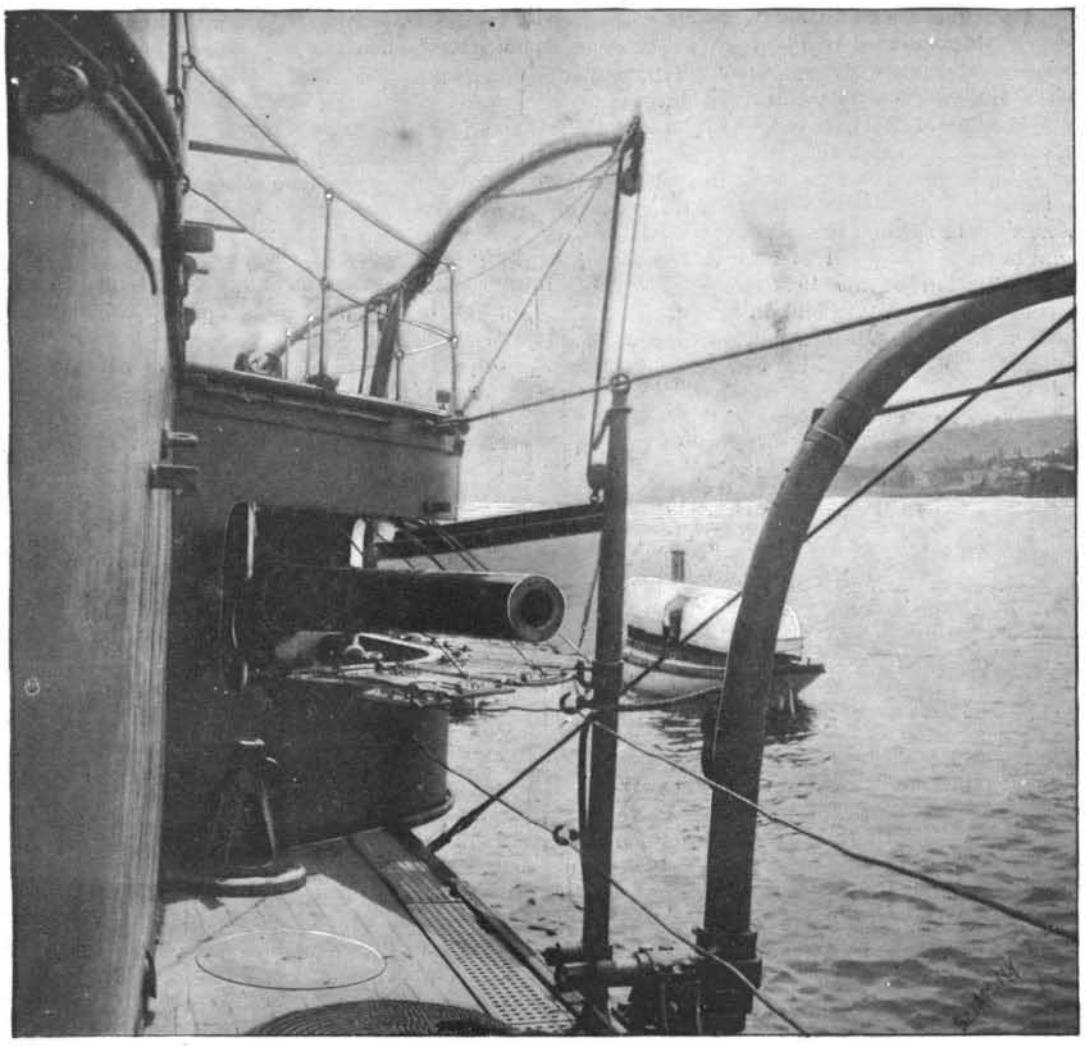
Vol. LXXV.—No. 8. ESTABLISHED 1845. NEW YORK, AUGUST 22, 1896. $3.00 A YEAR WEEKLY.



THE INDIANA—VIEW FROM TOP OF EIGHT INCH GUN TURRET, LOOKING FORWARD.



THE BATTLESHIP INDIANA—THE GREAT THIRTEEN INCH GUNS SWUNG OVER TO STARBOARD.—[See page 172.]



EXTERIOR VIEW OF 6 INCH GUN AND TURRET.

are adjusted simultaneously. The turning gear of the turret is set in motion by means of the vertical wheel shown in front of the gunner. When the sights coincide with the object, the gun is fired by means of an electric button placed conveniently to hand.

Flanking the main turrets are the four 8 inch gun turrets, whose interior arrangements are very similar to those above described. These guns are carried at a great height above water—no less than 26 feet—and they would, therefore, be well out of reach of the heavier seas in stormy weather. This great command is a valuable feature in a sea fight—command in a gun being like length of reach in a boxer. The shell being delivered from so great a height would have a "plunging" effect, and would also be less liable to be deflected by striking the tops of the waves. The four 6 inch guns are mounted below the 8 inch gun turrets, and on the main deck. The training is effected by means of a pinion and a circular rack, laid on the deck, both of which can be seen in the accompanying illustration. The elevation of the gun is accomplished by the worm and pinion, which meshes into a vertical, circular rack, which can be seen attached to the gun.

Our last illustration shows a part of the broadside rapid fire 6 pounder battery and the hinged grated shelves on which the gunners stand, the shelves hanging down vertically when not in use. There are twenty of these effective little guns in all. They fire a 2¼ inch shell which is capable of penetrating over 3 inches of iron at a distance of 1,000 yards, and as each can deliver some twenty shots a minute, it can be seen that a torpedo boat would be roughly handled, and probably disabled, long before she could get near enough to discharge her torpedoes. There are also six 1 pounder guns placed in the tops and on the superstructure. The weight, penetration, etc., of the guns is as follows:

Caliber	13 inch.	8 inch.	6 inch.	6 pounder	1 pounder
Length	40 feet	25⅓ feet	21¼ feet	8 feet	3½ feet
Weight	135,000 lb.	29,300 lb.	13,440 lb.	800 lb.	79 lb.
Perforation of wrgt. iron at muzzle	34·6 in.	20·6 in.	15·6 in.	4·4 in.	2 in.
Velocity at muzzle	2,100 f. s.	2,080 f. s.	2,150 f. s.	1,940 f. s.	1,460 f. s.
Weight of shell	1,100 lb.	250 lb.	100 lb.	6 lb.	1 lb.
Weight of charge	550 lb.	115 lb.	50 lb.	2 lb.	.....

Exposition at Brussels in 1897.

The Department of State has received an invitation, through the Belgian minister, for the participation by the United States in the International Exposition to be held at Brussels, beginning April 24 and closing November 1, 1897, and the Secretary of State, in a letter to the Secretary of the Treasury, has recommended that Congress be asked to appropriate the sum of $35,000 to enable this country to be properly represented by a commission. Attention is called to the fact that the Belgian government participated officially at the Chicago Exposition in the most liberal manner, and the opinion is expressed that the industrial and commercial interests of the United States would be greatly promoted by a creditable exhibit. "Although," it is added, "the great bulk of our exports to Belgium consist of raw products and food supplies, a considerable quantity—between $2,000,000 and $3,000,000 worth—of manufactured goods is purchased annually by that country from the United States, and the fact that, notwithstanding her great industrial development, Belgium imports largely of the finished products of other advanced manufacturing countries such as France and England, encourages the hope that similar lines of goods from the United States may find a much larger sale in Belgian markets. As conducive to that result, a proper representation of this country at the Brussels exhibition is obviously most desirable."

In his note transmitting the invitation, the Belgian minister states that the exposition will be under the patronage of his government, the Province of Brabant, and the city of Brussels. The object of the exposition is "to show the progress of industry, to invite the producers to various competitive contests, and to reward the winners."

There will be fourteen sections, namely, (1) fine arts, (2) social economy, (3) hygiene, (4) life saving, (5) industrial and decorative arts, (6) lighting, heating, and their devices, (7) electricity, traction, (8) military science, (9) manufactures, raw materials, methods of manufacture and their products, (10) sporting articles, (11 athletics and popular games, (12) temporary agricultural and horticultural competitions, (13) practical teaching, female industries, and manual work, (14) commerce, colonies. The divisions of the international competitions will represent a series of special exhibitions each of which will be reserved for objects of the same category. In each of the subdivisions there will be competitive contests relating to the problem the solution of which constitutes a requirement for the group entering each competition. Awards in money will be granted for the solution of the problems.

In addition to these competitions, there will be held by the organization of the foreign sections an exposition at which the different countries may freely exhibit their products.

The government has appropriated for the use of the exposition the park of Cinquantenaire, with its museums and annexes. His majesty the king, desirous on his part to testify his interest in this enterprise, has placed at the disposition of the exposition the royal domain of Tervueren. The productions of the Independent State of the Congo, the games that are the subject of section 11, as well as various other attractions, will be placed on exhibition there.

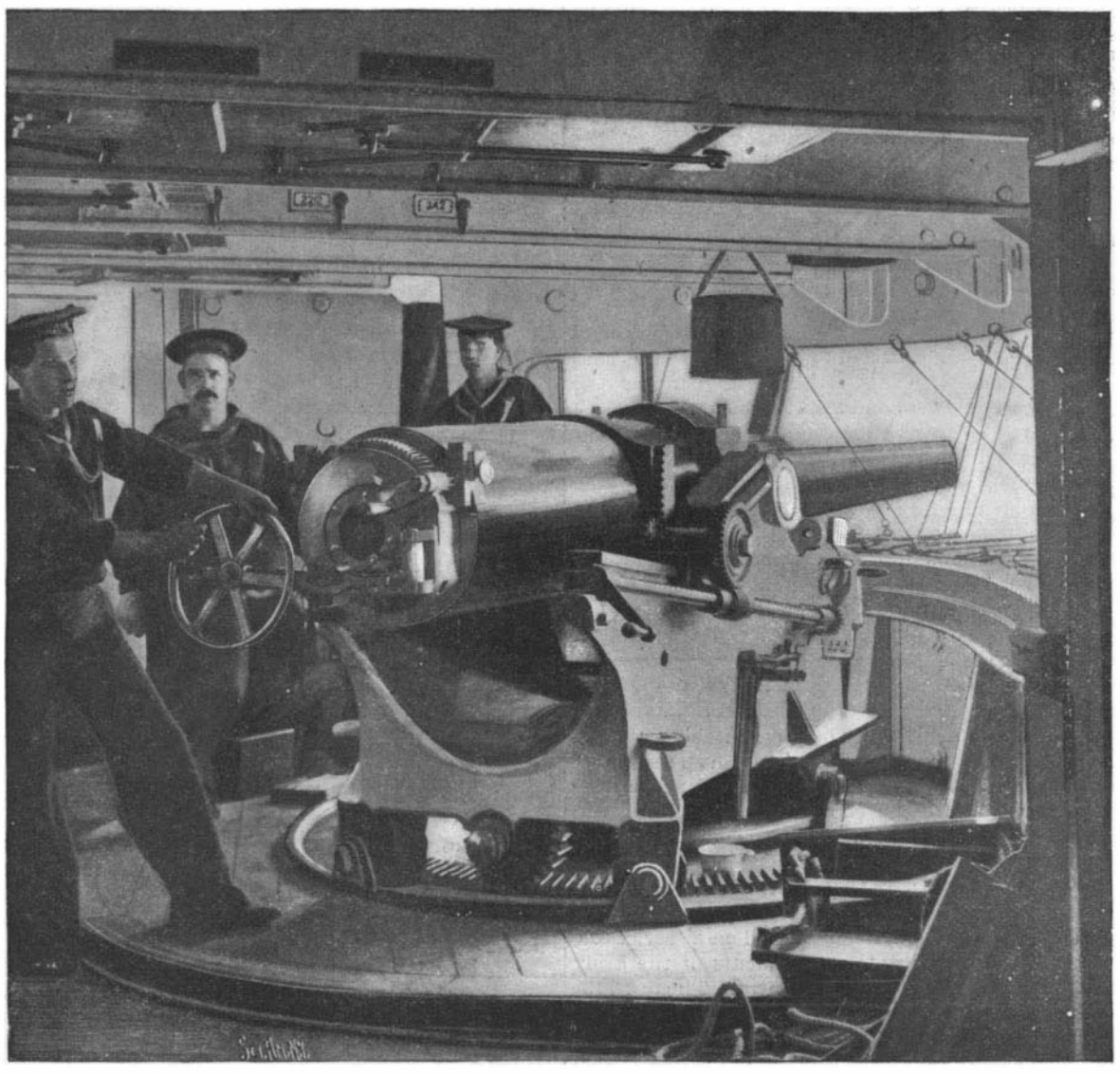
The park of Cinquantenaire will be connected with the royal domain of Tervueren by means of electric cars running through a new avenue, which, from its vast dimensions and picturesque situations, will form one of the most beautiful thoroughfares of the capital.

Lamalou-l'Ancien.

The last issue of the SUPPLEMENT, No. 1076, contains a very interesting account of the thermal baths at Lamalou, in the south of France, and the remarkable results derived from the treatment there of rheumatism, nervous affections, diseases of the spinal marrow, paralysis, and especially locomotor ataxia. The baths, though but little known in this country, are among the oldest in Europe, and to Dr. Belugou, the well-known physician of Paris and Lamalou, we are indebted for the description of the place and its waters.

A Gas Exhibition.

It is announced that a gas exhibition will be held in Madison Square Garden, New York City, probably some time in January, 1897. It is expected that every class of article necessary to the production and utilization of gas will find a place in the gas exhibition. For full particulars, address E. C. Brown, 280 Broadway, New York City.



THE BATTLESHIP INDIANA—TRAINING A 6 INCH GUN.

Science Notes.

Magellan's contrary winds are to be overcome by a fleet of powerful tugboats which a Chilean company will maintain in the Straits.

The total area of land surface of the earth is calculated to be 28·3 per cent, and that of sea as 71·7 of the earth's surface, certain assumptions being made for the unknown polar regions. The ratio of land to water surface is thus 1 : 2·54, by Professor Hermann Wagner, says The Engineer. Other interesting levels are those of the mean height of the land, 700 meters—2,300 feet—above actual sea level; and of the condensation spheroid, i. e., the physical globe if the water were condensed to the density of the rocks of the crust, 1,300 meters—or 4,260 feet—below present sea level.

An interesting series of experiments on the transparency of liquids is described by M. W. Spring in the Bulletin of the Royal Academy of Belgium. The first of M. Spring's papers deals with the colors of the alcohols as compared with water. None of the alcohols observed were colorless when the thickness of fluid was 26 meters; methyl alcohol appeared greenish blue, ethyl alcohol the same, but of a less warm color, and amyl alcohol greenish yellow. The pure blue color observed in water becomes thus modified by the admixture of more and more yellow as we pass from one term of the homologous series of compounds to the next. The absorbing powers of the various liquids for ordinary light were also observed, and it was found that these formed a descending series, the simplest substance, water, offering the greatest resistance to the passage of light seen by the eye. In a second contribution, the same writer discusses the temperature at which the connection currents begin to produce opacity in a column of water of given length. Where the length is 26 meters the smallest difference of temperature that will suffice is about 0·570°, and is comparable with that which doubtless exists in lakes and seas. The author concludes that we have here an explanation of the varied colors so often seen on water. These result from the differences of temperature caused by sunshine, on the one hand, and by the cooling action of wind blowing on the surface, on the other.

Cycle Notes.

A pneumatic tricycle hearse has been built.

One French maker is putting out wheels equipped with wooden spokes, rims, and hubs.

A subscription agent of Business goes over large sections of the country, wheeling from place to place.

A short time ago a race was run in Paris in which no machine was entered which was not at least twenty years old.

In Grand Rapids, Mich., a trailer for the free transportation of passengers' wheels is run once an hour, attached to a trolley car.

A coin controlled bicycle has been devised. Unless the machine is fed with coins commensurate with the time of hiring, the wheel will refuse to turn.

An analysis of two thousand accident policies, on which benefits were paid, showed that only seventy-six were injured in bicycle accidents.

It has been estimated that the expenditure of power necessary to walk five miles would drive a bicycle on an ordinary road twenty-five miles.

Fifty bicycles were impounded in one day in Paris recently because they failed to have the owner's name and residence soldered to them as the law requires.

An agency was recently opened in Venice for the rental of a water cycle. The gondoliers promptly obtained an injunction restraining the parties from placing their cycles in use.

At some of the stations on the Long Island Railroad facilities have been provided for checking the wheels of the suburban residents, so that they can use the bicycle to carry them to and from their homes.

A good wrinkle in putting a handle on a handle bar is to smear a little vaseline around the edge of the inside ferrule, which will effectually prevent the cement from adhering to the ferrule, should any be squeezed out.

Zigzag hill climbing is easier than the straight lift. The cyclist can here learn of the mule. No mule native to a mountainous region takes a straight course up hill with a load, but "weaves" continually from one side of the way to the other.

Although very often but little attention is given to the accurate adjustment of the head, this part stands in need of it as much as any bearing in the machine, and should never be allowed to remain in the slightest degree loose. Not only will a loose head rattle over rough ground, and cause the balls and ball races to wear unevenly, but the risk of a breakage of the steering post or front forks is increased.

The Inventive Age says that the latest invention to facilitate field operations is the typewriter bicycle. This consists of a typewriter mounted on a serviceable wheel, which can follow the movements of the army through an ordinary stretch of country. The operator can take commands and general orders in shorthand and strike off several duplicates on the typewriter, being held erect by portable props. It has been tried in England and worked very satisfactorily.

THE BROOKS PERIODICAL COMET.

WILLIAM R. BROOKS, M.A., F.R.A.S.

The return to visibility, after its seven years' journey around the sun, of the very interesting comet known as the Brooks periodical comet of 1889, is a notable event in astronomical annals.

While sweeping the southeastern heavens on the early morning of July 6, 1889, with the ten inch equatorial telescope, the comet was discovered. It was in Cetus, and in right ascension 23 hours, 44 minutes, 30 seconds; declination south 9° 10′.

Fig. 1 shows the telescopic field in which the comet was discovered. The apparent motion of the comet was from right to left, as we look at the figure, but

Fig. 1.—DISCOVERY TELESCOPIC FIELD BROOKS' PERIODICAL COMET.*

this motion was so slow that it did not move out of the telescopic field of discovery for over a week. The real motion of the comet was nearly in the line of sight, and approaching us and the sun. Hence the comet grew larger and brighter daily. As it came nearer, the main comet was found to be attended by several companions.

In telescopes of moderate aperture two were seen, but in the giant refractor of Mount Hamilton, under the keen vision of Barnard, and in other large telescopes, four of these little attendants were found preceding the parent comet in its sweep through space, as illustrated in Fig. 2. It is on this account sometimes called Brooks' multiple comet.

The mathematicians soon found that the comet was moving in an elliptical orbit, with a period of revolution about the sun of a little over seven years. It is thus a member of our own solar system.

Computing backward, however, they found that it

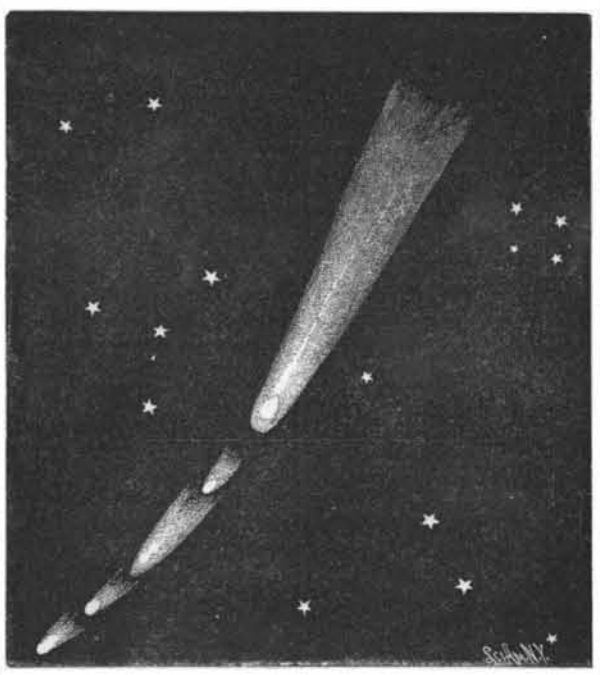


Fig. 2.—BROOKS' PERIODICAL MULTIPLE COMET.†

had not always had this short periodic revolution. It was found by Dr. Chandler that in 1886, or three years previous to the writer's discovery of the comet, it had come into Jupiter's all-powerful attraction, and its orbit and period changed from a previous one of nearly thirty years' duration to its present seven year period.

Nor was this all. It is believed that during this encounter of Jupiter and the comet, the material for the fifth satellite of Jupiter, discovered by Barnard in 1893, was secured—captured from the comet by Jupiter's superior attraction.

* Discovered by Prof. Brooks July 6, 1889.

† Discovered by Wm. R. Brooks July 6, 1896.

I append a short ephemeris of the comet, showing its place in the heavens for the next few weeks.

August.	Right Ascension.	Declination South.
12	22 h. 33 m.	18° 51′
16	22 h. 31 m.	18° 58′
20	22 h. 29 m.	19° 3′
24	22 h. 26 m.	19° 6′
28	22 h. 23 m.	19° 6′
September.		
1	22 h. 20 m.	19° 4′

From these positions the path of the comet may be traced beyond the above dates. The comet is increasing in brightness, reaching perihelion early in November next.

Smith Observatory, Geneva, N. Y., August 7, 1896.

The American Institute Fair.

The American Institute Fair will open at the Madison Square Garden on Monday, September 28, and will close on Thursday, October 29, and during this time there will be shown at the usual popular price of twenty-five cents one of the best exhibitions that the institute has given for a long time. The enterprise of securing the Madison Square Garden has been seconded by the exhibitors, who appreciate that the institute has had no exhibition since 1892. On the main floor, which will be entirely filled by the best class of exhibits, there will be much active machinery, including silk weaving, the making of asbestos cloth, the manufacture of shoes, the making of hand-made paper, an exhibit showing how cigars and cigarettes are made, and motors adapted to boats and other uses, and a horseless carriage as light almost as an ordinary road wagon. There will also be a beautiful display of boats. The bicycle will of course be represented. In the machinery department down stairs there will be ice machines in operation, high-speed and gas engines, printing presses, farming machinery, and novelties always to be seen in the mechanical department. The show of flowers, fruits, and vegetables, beginning October 5 and continuing in the concert hall under the direction of the committee on agriculture, promises to be an especially attractive feature.

The race agent of the American Rules will take charge of the flying of birds from the tower of the garden each day, and will decide upon the awards for number of birds, speed, distance, and will also arrange for the exhibit of homing pigeons during the week ending October 24.

A Machinery Exhibit in China.

The Peking (China) University, an educational institution conducted under the auspices of the American Methodist Episcopal Mission, has recently opened in one of its buildings a museum which it is proposed to devote largely to the exhibition of foreign machinery and mechanical appliances. This museum is visited daily by increasing numbers of people of the better classes, and the authorities would be glad to receive and exhibit working models, photographs, or drawings of machinery and inventions, or specimens thereof, such as plows, ships, firearms, cannon, electric machinery, cars, locomotives, wind mills, looms, printing presses, wagons, engines, etc. Each exhibit which may be presented to them will be marked in Chinese, with the name and address of the maker, together with the description and price, if desired, and a capable translator will explain their use to inquirers.

Correspondence on this subject and articles for exhibition may be sent to the Peking University, Peking, China, or to Mr. Charles H. Taft, treasurer of the Peking University, No. 78 William Street, New York City, and under an arrangement with the I. M. customs will be imported to China free of duty.

Medals or Decorations for Inventors.

An "old SCIENTIFIC AMERICAN reader," writing from Havana, Cuba, suggests that the government, in granting letters patent to an inventor, should at the same time issue to him a distinctive medal, to be worn externally, indicating his membership in the "American Legion of Inventors," who have done so much to promote our wonderful industrial progress. Such a medal, made of silver in the form of a star, to be suspended from a ribbon formed of the national colors, our correspondent suggests, would not only be a highly honorable distinction, but might in many cases be of material benefit to the inventor, acting in a manner as an introduction, and aiding him in efforts to obtain capital to facilitate the introduction of his improvement. Inventors obtaining three or more patents, it is recommended, should have a gold medal; and, for all inventions patented before such a law is passed, it is suggested that the inventors may have the medals issued to them on payment of their cost.

Water Supply for Paris and London.

It is proposed to take 440,000,000 gallons daily to Paris from the lake of Geneva, a distance of about 310 miles. London may have a new supply of fresh water, of equal importance to the Paris supply, from parts of Wales situated at an altitude of 2,790 feet above the sea level, particularly the region from which spring the Towy, Usk, and Wye.