THE

ENGINEERING

AND

MINING JOURNAL.

VOLUME XXXIX.

JANUARY TO JUNE, 1885.

SCIENTIFIC PUBLISHING COMPANY,

No. 27 PARK PLACE,

NEW YORK.

MAN'S PATENT AUTOMATIC CUT-OFF VALVE.

It is now many years since the mechanical world was astir through the introduction of the Corliss cut-off valve, which, modified and improved, has maintained its position as a first-class cut-off valve actuated by "trip" motion. It marked an era in the construction and economy of the steam-engine, through the application of a principle that would indeed seem difficult to improve upon; but we lay before our readers drawings and description of a new cut-off valve, the invention of Mr. James H. Man, of Denver. Colo., that is actuated on an entirely new principle, and which, through various and severe tests, has proved itself to possess advantages beyond the expectations of its inventor and advocates.

To describe the principle of its action, we can not do better than quote from the preamble to the patent specification No. 308,181, dated November 18th, 1884, which runs thus:

"When steam (or gas) at any pressure passes through an orifice into any lower pressure, its velocity is due to and varies approximately as the square root of the difference of pressures. When this difference is small, if then the orifice be that of a valve free to close, but kept open by its own weight or a spring, it is evident the valve will not remain open, when the difference of pressures on either side of itself produces a force greater than that tending to keep it open. The valve is in equilibrium when these forces are equal and opposite, and the velocity of the steam at the moment of equilibrium is therefore definable.

"By introducing such a valve between the slide-case and the cylinder, so that the velocity of the steam shall just produce equilibrium about the valve at the moment of maximum piston speed, the valve will close and give an instantaneous cut-off at about half-stroke. To effect the cut-off earlier than half-stroke, the phenomenon of equilibrium has merely to take place at some previous moment, which may be accomplished, 1st, by an increase in the speed of the engine; 2d, a decrease in the area of the valve; and 3d, a decrease in the load on the valve.

"From a study of the first of these causes, it appears the valve, when once adjusted, should be an automatic regulator of speed, and this is actually the case to a certain extent; but in practice it will be found necessary to adopt one of the other causes.

"Locomotive, marine, and other engines that require regulation of power at varying speeds can be fitted with mechanism by which the area of the valve or the load on it can be altered at pleasure, and so vary the point of cut-off to suit circumstances. In other engines requiring regulation of speed, any governor can be applied to actuate the cut-off valve or its load."

The particular design of valve preferred is shown in section in the accompanying cut. It is constructed on the differential principle, for the double purpose of increasing the area for the passage of steam and decreasing the weight of the valve. It is simply a hollow bobbin of steel or other suitable material, that slides on a tube arranged so that the steam for the supply of the upper seating passes through the valve itself. This week we illustrate a horizontal engine with sectional views, showing its application to a pair of vertical balanced piston-valves, arranged and driven in a somewhat novel manner, and for which application has been filed for letters patent. The principle is, however, precisely the same, whether the application be to flat or cylindrical valves, working either horizontally or vertically, namely, the steam, in passing toward the cylinder, passes through the top and bottom seatings of the valve; and if the area presented for the passage of the steam be not large enough for the maintenance of initial pressure within the cylinder, the steam will become throttled at some point in the stroke. In other words, there will be a slightly reduced pressure within the valve chamber, the excess of external pressure tending to raise the valve.

It will thus be seen, if the weight of the valve on its effective area (the difference between the areas of its two disks) represents a pressure downward less than the excess of external pressure upward, the valve will be closed by the steam at a velocity approximately equal to the influx of steam, thus producing an instantaneous cut-off.

The exact point of cut-off is determined solely by the position of the valve (the amount of opening) in relation to the speed of the engine, and it is merely necessary to raise or lower the stop on which the valve rests (normally) to effect earlier or later cut-offs.

We shall also give at some future date its application to that class of engines known as the single-acting trunk piston engine. It is, however, equally applicable to beam-engines or inverted cylinder-engines. The principle is applicable to a valve of any design.

The use of a piston-valve and eccentric with an independent cut-off that requires no mechanism for its action will present to the engineer points for careful study that will soon convince him that they are a simple and good means for obtaining the conditions necessary for the successful working of an economical high-speed engine. By means of a piston-valve, the lead, the exhaust, and the amount of compression can be adjusted to suit the exigencies of any particular engine without considering the point of cut-off of the main valve.

By a correct proportioning of ports and port-openings, we can arrive at the finest possible admission and back-pressure lines, and at the same time, by the intantaneous action of the cut-off valve, we have a perfect cut-off and expansion line. Further than this, whereas Professor Thurston, in his recent treatise on *Stationary Steam-Engines*, has recorded "the reintroduction of the positive motion classes of valve gear and expansion gear" for high-speed engines, to which the "drop cut-off" was no longer applicable, we are now recording exactly the reverse, namely, the introduction of a non-positive and automatic cut-off valve that is applicable to low, but especially to high-speed engines.

The Hendey & Meyer Engineering Company of Denver, Colo., has taken up the manufacture of these engines, one of which is now successfully running its works. It is a horizontal 10-inch by 15-inch, making 225 revolutions a minute, from which the indicator cards appended were taken.

Twenty-four Hour Dials.—European horologists have begun to place on watches, etc., the hour-hands of which make two circuits in twenty-four hours, dials with figures so arranged from 1 to 24 that those for the day hours are shown on an inside circle and those for the night hours on an outside circle, after the manner first popularly introduced in this country.

PUMPING MACHINERY.—II.*

By E. D. Leavitt, Jr., Cambridgeport, Mass.

MINE PUMPING MACHINERY.

One of the earliest steam-engines, of any size, introduced into America, was erected about the year 1763, at the Schuylkill copper mine, situated on the Passaic River, in New Jersey. All its principal parts were imported from England; and a Mr. Hornblower (the son, it is believed, of the well-known engineer of that name) came to this country for the purpose of putting up and running this engine.

At the time when the manufacture of the engines for the Philadelphia Water-Works was commenced, and as late as the year 1803, we find five engines, in addition to the one above mentioned, noticed as being used in this country: two at the Philadelphia Water-Works; one just about being started at the Manhattan Water-Works, New York; one in Boston; and one in Roosevelt's saw-mill, New York; also a small one, used by Oliver Evans to grind plaster of Paris, in Philadelphia. Thus, at the period spoken of, out of 7 steam-engines known to be in America, 4 were pumping-engines.

In the coal regions of Pennsylvania, a simple, high-pressure, single-acting Bull engine has been extensively adopted; the dimensions usually run from 36 inches to 80 inches diameter, and a very common stroke is 10 feet. At the Empire shaft, in the Schuylkill coal region, there is a very fine pair of these engines, with 80-inch cylinders, working 24-inch pumps. The stroke of both steam-pistons and pumps is 10 feet. These Bull engines are placed either vertically or on an incline, as is most convenient for the workings. The water-valves are made either double, triple, or four beat, according as the pumps are large or small; and the beats are usually flat, and faced with leather. Many flap-valves are also in use. These are frequently arranged on conical seats, and work very well. The Bull engines, from their strength and simplicity, give very little trouble, working year after year with astonishing freedom from accident and slight cost of repair. No attempt is made to economize fuel, which consists mainly of culm, which would otherwise be wasted. Of late, direct-acting steam-pumps placed under ground have found much favor with mine operators, on account of their portability and small first cost. They usually range in size from 8-inch steam and 5-inch water cylinders by 12-inch stroke, to 30-inch steam and 14-inch water cylinders by 36-inch stroke. Great numbers of these pumps are in use all over the United States.

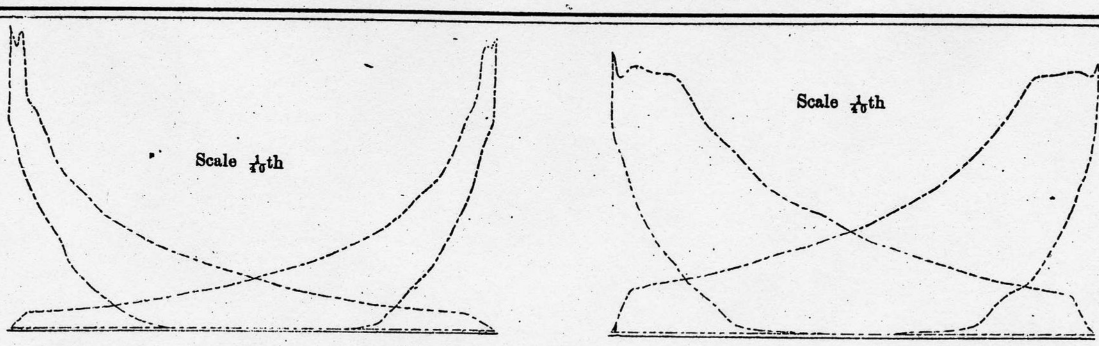
A pumping-engine that is remarkable for its size and peculiarities of construction is located at the Lehigh zinc mine, at Friedensburg, Pa. It was designed by Mr. John West, the company's engineer, and built by Merrick & Sons, of the Southwark Foundry, Philadelphia. It is a beam and fly-wheel engine, the steam-cylinder being 110 inches in diameter, with a stroke of 10 feet. There are two beams on the same main center, from the outer end of which a double line of bucket-and-plunger pumps is operated. The crank-shaft is underneath the steam-cylinder; and there are two fly-wheels, one on each end of said shaft, the crank-pins being fast in the hubs of the same. There are two connecting-rods, which are attached one to each end of an end beam-pin 28 inches in diameter. The main center and crank-shafts are also 28 inches in diameter; each of the two plunger-holes is 24 inches by 30 inches in section; and all the working parts are in proportion to those heretofore mentioned.

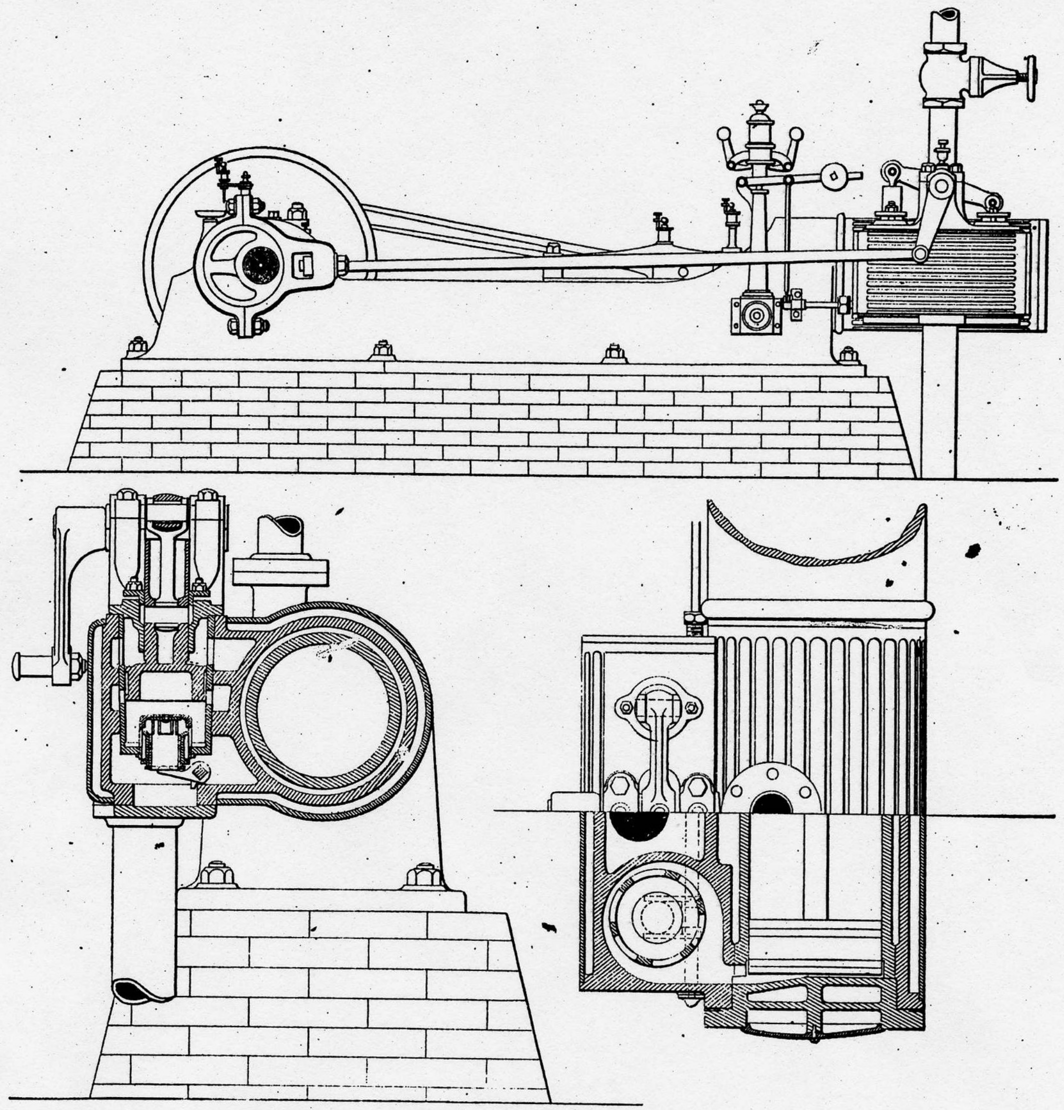
Perhaps no mining district has ever had to contend against greater difficulties in pumping than have faced the engineers at the celebrated Comstock lode, Virginia City, Nev. The mines are of great depth, in some instances 3300 feet; and the water is hot, rising to 160 degrees Fahr. The machinery collected at this location is of great variety and magnitude. There are many Davey engines, both horizontal and vertical. The Union and Yellow Jacket shafts have compound fly-wheel engines of very great power; the former having a beam, and the latter being horizontal, with cylinders placed side by side, and pistons connected to a massive cross-head, from the ends of which connecting-rods lead to crank-pins located in the hubs of the fly-wheels, which are overhung upon the ends of the main-shaft. From the center of the cross-head, a link runs to the main pump-bob, which operates a double line of 16-inch pumps, 10-foot stroke. The steam-stroke is 12 feet. Depth of shaft, 3300 feet.

The pumping machinery used in the iron and copper districts of Michigan usually consists of Cornish plunger-pumps, which are operated by geared engines; the latter making from 3 to 16 strokes to one of the pump's.

The largest plant of this type yet erected is that of the Calumet & Hecla copper mine, at Calumet, Mich. There are two lines of pumps, varying in diameter from 7 inches to 14 inches, and with an adjustable stroke varying from 3 feet to 9 feet. The object of the adjustable stroke is to diminish the capacity of the pumps in the dry season. Each line of pumps is driven from a crank placed on a steel spur-wheel shaft 15 inches in diameter, making 10 revolutions per minute. The mortise spur-wheels have a diameter of 22¼ feet at the pitch line, with two rows of teeth, each 15 inches face. The pitch is 4·72 inches. Engaging with the mortisewheels are pinions of gun-iron 4 feet 6 inches in diameter, placed on steel shafts 12 inches in diameter, and making 50 revolutions a minute. The 12-inch pinion-shafts are driven through mortise-wheels 12 feet in diameter, and 24 inches face, by pinions 3 feet 9 inches diameter, which make 160 revolutions a minute. The pinion-shafts are driven through a wire-rope transmission from an engine located 500 feet distant. The rope-wheels are 15 feet in diameter, and make 160 revolutions a minute. The engine is 4700 horse-power, and, in addition to driving the pumping machinery, does the hoisting and air-compressing for the Calumet mine. In the same building with the mine pump-gearing, is a duplicate arrangement for operating the man-engines. In order to operate the mine-pumps and man-engine for the Hecla mine, it was necessary to use rock-shafts, which are made of gun-iron, and hollow; they are 32 inches in diameter outside, with 4¼ inches thickness of metal. The pump rock-shaft is 39 feet 4¼ inches long over all, in two sections, and weighs 40 tons. There are rockers placed on each end of this shaft, one of which is connected with a crank on the mortise-wheel shaft, and the other with the surface-rods that work the pump-bobs.

* A paper read at the Montreal Meeting of the British Association.





MAN'S PATENT AUTOMATIC CUF-OFF VALVE.

These rods are of Norway pine, 12 inches by 12 inches in section, and 1000 feet long. There are two bobs, one above the other, with axes at right angles, each weighing about 25 tons. The connection from the upper bob to the lower has hemispherical pins and brasses to accommodate vibrations in right-angled planes. The slope of the main pump is 39 degrees, and the machinery has been designed to raise water from 4000 feet depth. The pumps are of the usual Cornish plunger-type, with flap-valves. There is an auxiliary engine of the Porter-Allen type, for driving the pumps and man-engines when the main engine is not working. It makes 160 revolutions a minute, the same as the rope-wheels. The seeming complication of this arrangement is due to the fact that it had to be adapted to existing works, for increased depths, and put in without interfering with the daily operation of the mine.

The Calumet & Hecla Mining Company has also an extensive pumping plant at its stamp-mills, which are located on the shore of Torch Lake, about 4¼ miles from the mine. There are located here 3 pumping-engines; two of which have a capacity of 20,000,000 gallons a day, and the third 10,000,000 gallons a day. The water is elevated between 50 and 60 feet, and is used for treating the stamped rock. Two of the engines are of the inverted compound beam and fly-wheel type; and the third is a geared pump, which has a horizontal double-acting plunger, 36 inches in diameter by 6-foot stroke, driven from the crank of a spur-wheel shaft.

The spur-wheel is 12 feet diameter, 24 inches face, and contains 96 teeth. The pinion engaging with it has 27 teeth, and is fast on the fly-wheel shaft of a Brown horizontal engine, having a cylinder 18 inches in diameter, and stroke of 4 feet. The steam pressure used is 110 pounds per square inch; and the engine has a Buckley condenser. The pump-valves are annular, of brass, faced with rubber, and closed by brass spiral springs. Their external diameter is 6 inches, and the lift is confined to ½ inch. There are 91 suction and 91 delivery valves at each end of the pump. The maximum speed of this pump is 26 double strokes a minute.

The largest of the compound engines is named Ontario, and has a vertical low-pressure cylinder 36 inches in diameter, and an inclined high-pressure cylinder 17¼ inches in diameter; the stroke of both being 5 feet. These are inverted over a beam, or rocker; and the pistons are connected to opposite ends of the same.

The beam attachment of the main connecting-rod is made to a pin located above and midway between the pins for piston connections.

MAN'S AUTOMATIC CUT-OFF VALVE APPLIED TO SINGLE-ACTING TRUNK PISTON ENGINES.

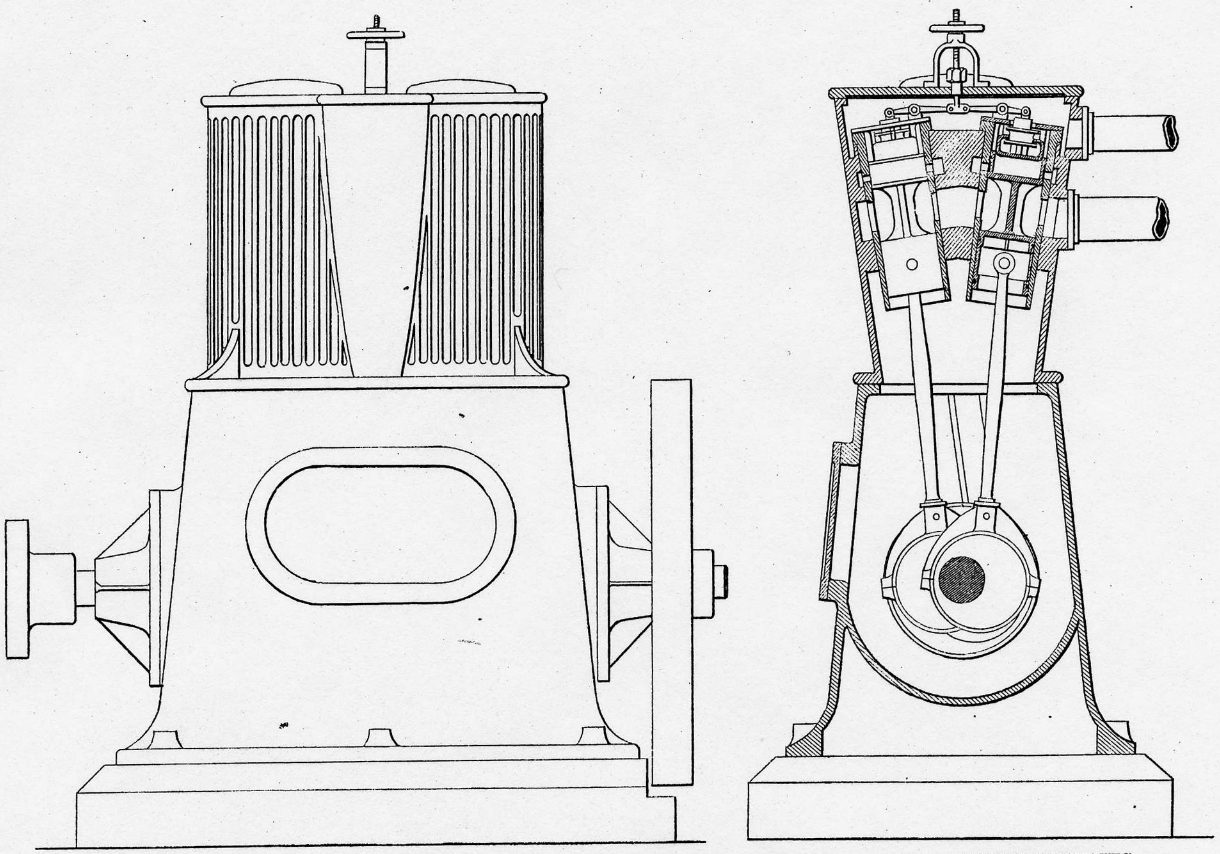
In our last issue, we gave cuts and description of a horizontal engine fitted with this new cut-off valve, as made by the Hendey & Meyer Engineering Company, of Denver, Colo. This week, we show its application to that class known as the single-acting trunk piston engine. It is, however, equally applicable to beam and inverted cylinder engines.

The engine has two single-acting cylinders with trunk pistons attached directly to two cranks set opposite each other, and between the cylinders are two valve-chambers placed at a slight angle to the vertical line, and arranged one for each cylinder, with piston-valves actuated by separate eccentrics. It will thus be seen that the action is precisely the same as with the horizontal type, the only difference in the arrangement being that the patent valves are placed above the main valves instead of below, the steam for the lower seating being supplied from above through the valve itself.

This type of engine appears to be specially applicable for direct attachment to centrifugal pumps and dynamos for high speeds, and it is thus represented in the cuts, having an arrangement for the regulation of the cut-off by hand; but for automatic regulation of speed, a governor can be applied, if desired.

There seems to be no limit to the speed at which this engine may be run. The working parts are always kept one way by the pressure of the steam, so that there is no possibility of "knocking."

The advantages of this cut-off were fully set forth in our previous article, to which we refer our readers. We consider this to be an important and valuable invention in connection with the steam-engine.



MAN'S AUTOMATIC CUT-OFF VALVE APPLIED TO SINGLE-ACTING TRUNK PISTON ENGINES.

Bessemer Steel Statistics.—We have progressed sufficiently far in the collection of Bessemer steel statistics, says the *Bulletin* of the Iron and Steel Association, to ascertain that the production of Bessemer steel ingots last year was only about 116,000 net tons under that of 1883, when 1,654,627 net tons were produced, and the production of Bessemer steel rails was only about 170,000 net tons less than in 1883, when 1,286,554 tons were rolled.

Austrian Middlemen at Odds with Political Economy.—Austrian railroad men have a system of co-operative stores, where they can supply themselves with food and other necessaries of life at considerably less than the ordinary retail prices. This does not please the regular shopkeepers, who, at a recent meeting, resolved to memorialize the government, asking that a law should be passed limiting the proportion of goods that a man should be allowed to purchase in this way to, say, one third of his salary. Shopkeepers, at this rate, will have to go to real work, for it is hardly likely the government will interfere in such a matter.

ANCIENT AND MODERN ENGINEERING AND ARCHITECTURE.*

Dr. R. Wood Brown.

The remark, "there is nothing new under the sun," is more axiomatic than the casual reader believes. We think this is a progressive age and that our generation stands pre-eminent in civilization—is the highest known. This is so, but to state that we, in this age, are immeasurably superior to the ancients is, we think, incorrect. Our aim is not to prove our century inferior to the past ones; rather, it is to present historical facts that will indicate that modern architectural and engineering works are merely reproductions of those of the ancients, though sometimes larger and more speedily erected, owing to better facilities.

The works of long ago compare very favorably with those of the present, and in some instances excel any thing of our own time. Hardening copper for tools is one of the lost arts; we can not manufacture the Damascus blade, nor do we know by what means the pyramids were erected. There are very few (if any) streets like one in Cordova founded 152 B.C. It was perfectly straight, ten miles long, and illuminated by public lamps. Paris, which is said to be the best lighted city in the world, can not surpass this wonderful street. Cordova was not without rivals. Granada, founded before Augustus; Seville in its prime 590 B.C.; Toledo taken by Maximus Flavius 193 B.C., vied with Cordova with its 200,000 houses and 1,000,000 inhabitants. This city of Cordova may not be a fair comparison, as its decay began when conquered by Ferdinand III. of Castile in A.D. 1236. Modern cities surpass the ancient in number rather than in magnificence.

A slight acquaintance with archæology is sufficient to show us that the statue of Liberty Enlightening the World is a duplicate in principle of the Colossus of Rhodes. The former is to be erected upon Bedloe's Island in New York Harbor, in honor of fraternity between France and the United States. It is of copper, and the ascent to the head is made by inner staircases. The right arm is extended, grasping a torch that will illumine the harbor by electricity. The total hight is 328 feet 11 inches, pedestal 177 feet 9 inches, leaving 151 feet 2 inches for the statue. This work of art was fabricated in France under the supervision of its projector, Bartholdi, who, in all probability, took his idea from the Colossus of Rhodes, which was also erected upon an island, Rhodes, in the Mediterranean Sea, twenty miles from Lycia, on the south coast of Asia. This Colossus was of brass, and erected 300 B.C. in honor of Apollo. Historians tell us that the hight was 125 feet, "with legs distended on two moles that formed the entrance of the harbor," said moles supposed to have been twenty feet apart, and ships sailed under the body on entering the port. The statue was hollow, and the legs were lined with large stones to counterbalance the weight. This Colossus was the workmanship of Chares, a pupil of Lysippus, a celebrated sculptor of Greece. The Colossus of Rhodes was thrown down by an earthquake sixty years after erection. The brass made 900 camel-loads, or 720,000 pounds.

The Washington Monument is considered a grand work, but the work

* From the *Kansas City Review of Science and Industry*, February, 1885.