two 45-ton coal cars loaded during a heavy snow storm, the shoes taking current from the rail when covered with snow and ice to the depth of several inches. In adapting the motors for service with the systems, the mechanism was practically unchanged, a few alterations being made to the air compressors and the contact shoes connected as shown in the illustrations.

Both the sectional and third-rail installations were completed under the supervision of Mr. John McLeod Murphy, inventor of the sectional method and chief engineer of the Murphy Safety Third Rail Company.

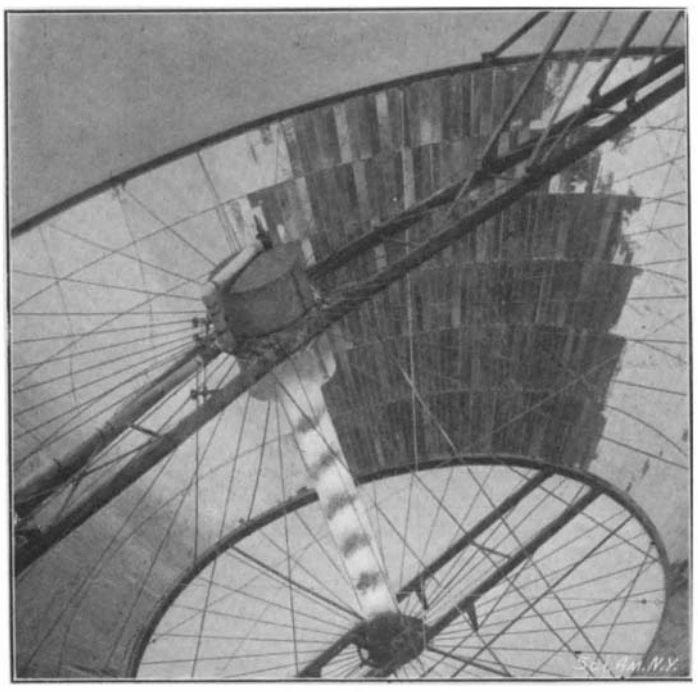
SOLAR MOTORS

BY CHARLES F. HOLDER.

For many years the attention of inventors has been directed to the question of utilizing the direct rays of the sun as a substitute for coal, wood, or other fuel; large burning glasses or reflectors being the general form of the various machines. Especially in France have these been seen. A so-called "burning mirror," made by a Frenchman named Villette, was four feet in diameter, and produced so intense a heat that, according to the report, it melted cast iron in sixteen seconds. The heat resulting from the sun's rays is remarkable. An Englishman, one Parker, years ago built a lens about three feet in diameter, which melted a cube of cast iron in three seconds, and granite was fused in one minute. This result was produced from a concentrating surface of seven square feet; which suggests that if the reflector could be made so that the field of concentration would be a square mile the iron would melt in less than a millionth of a second, suggesting the possibilities in this direction with enormous reflectors, or groups of small ones.

It was for a long time difficult to build a concave mirror of very large size, but this was finally overcome by having the surface of the concave mirror covered with small pieces of glass, or mirrors, each of which is so placed that the light or reflection from each side is thrown upon the same spot, the sum total, or the amount of heat centralized, being equivalent to the amount reflected by each glass, multiplied by the number of mirrors. In Europe the early solar glasses were generally of two kinds; that is, the heat was concentrated in two ways—by reflection from polished concave mirrors and by refraction through a convex lens. The earliest use, centuries ago, of such a contrivance was theoretically to dazzle or blind an enemy, metal disks being employed; but nearly all such devices failed to be of any practical value and fell into the category of "curiosities." The story of Archimedes will be remembered in this connection. Twenty years before Christ it is alleged he set fire to the enemy's ships by using an enormous sun glass. Sir William Herschel experimented with the sun's heat in Africa; and Captain Ericsson has made a number of studies in this direction and exhibited a solar motor in New York in 1884.

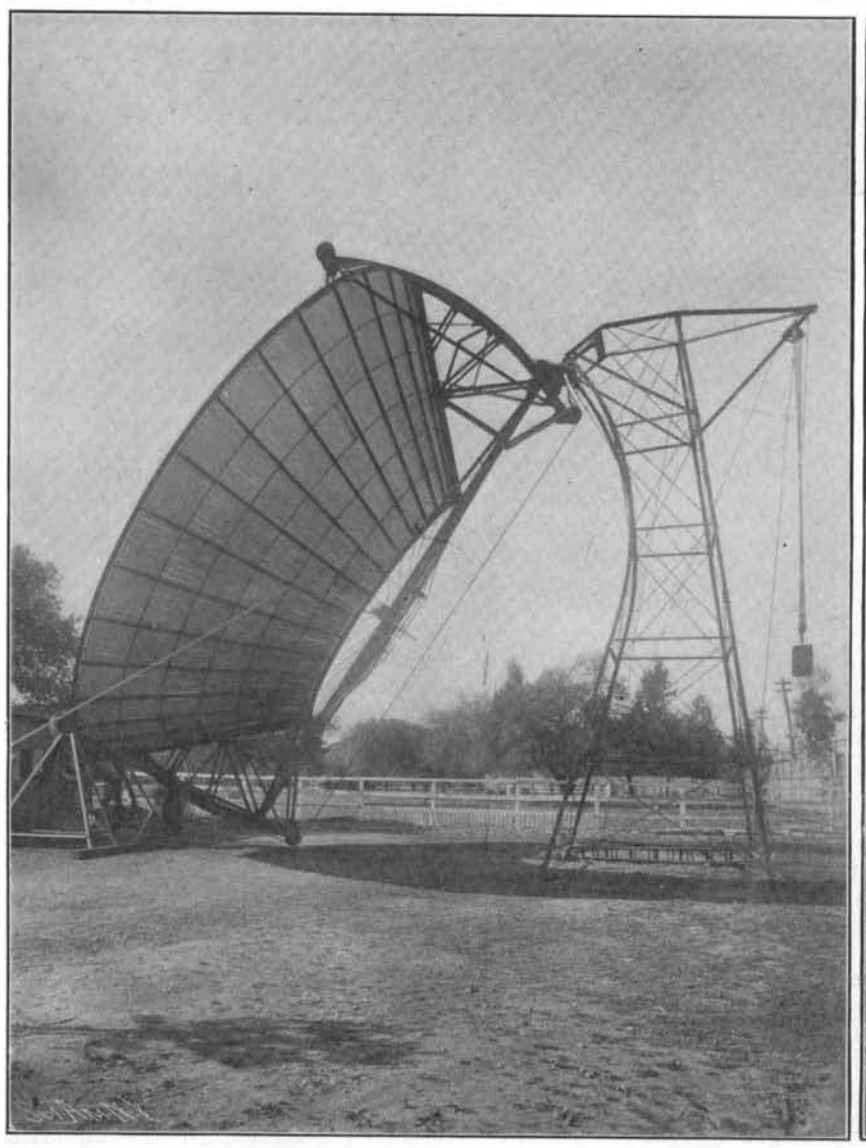
In Western America within the past twenty years it has been found that there are regions where it is especially desirable to obtain a motor which can be run practically without fuel. Such a region is the Californian desert, where vast mining interests have sprung up, and in arid sections where irrigation is necessary, and even in the richest portions of fertile California in connection with the question of irrigation. On the desert the sun shines almost continuously, and in Southern California the percentage of sunshine to cloud is remarkable. These conditions have called attention to the possibility of a practical sun motor, and it is interesting to note that in South Pasadena, California, such a machine has been set up and is successfully accomplishing the work for which it was made—an automatic engine running by the heat of the sun. This machine is exhibited at the Ostrich Farm, and has attracted the attention of a vast number of people, especially as Southern California is now thronged wtih tourists. In appearance the motor resembles a huge disk of glass, and at a distance might well be taken for a windmill of some kind; but the disk is a reflector thirty-three feet six inches in diameter on top, and fifteen feet on the bottom. The inner surface is made up of seventeen hundred and eighty-eight small mirrors, all arranged so that they concentrate the sun upon the central or focal point.



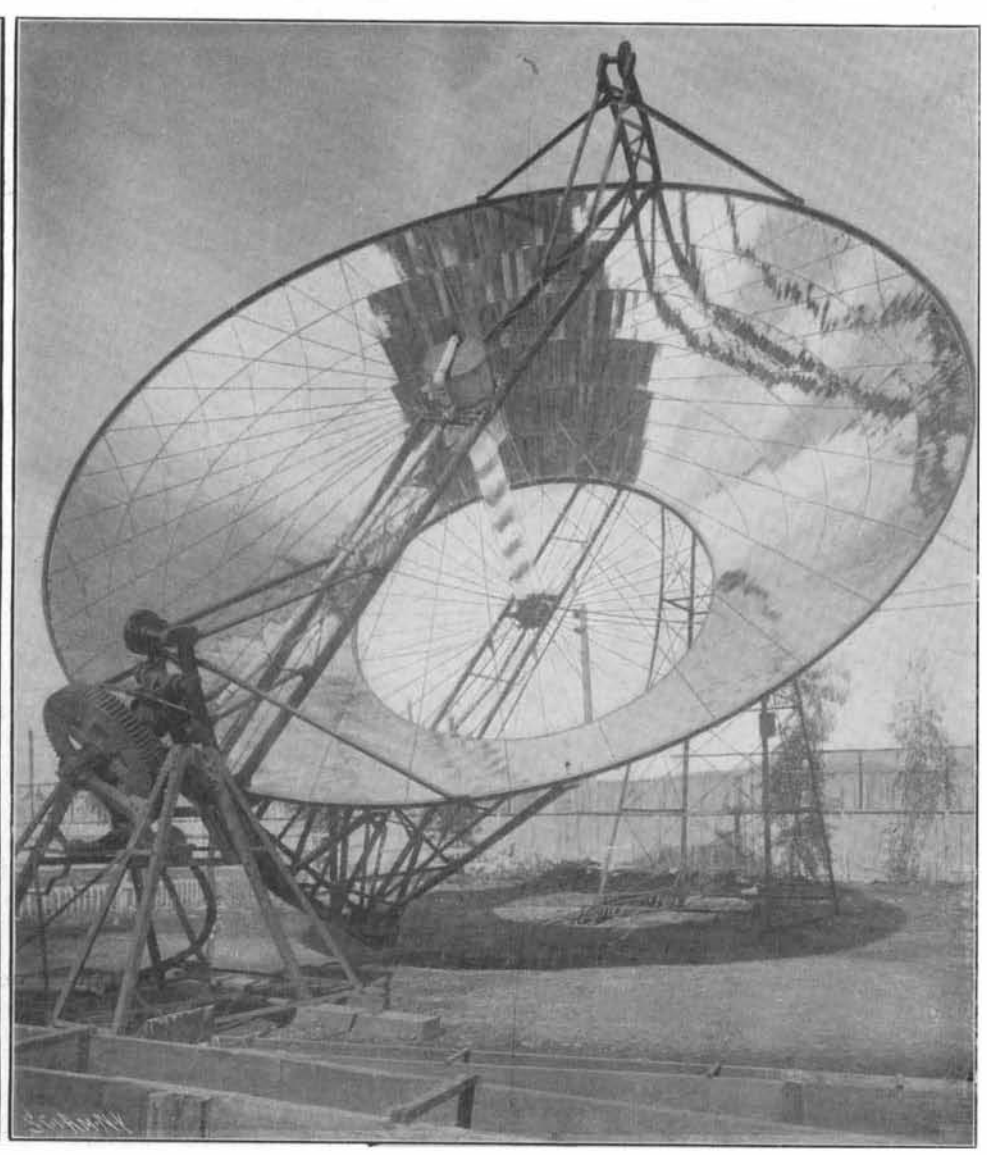
BOILER AND CONNECTIONS.

Here, as shown in the accompanying illustrations, is suspended the boiler, which is thirteen feet six inches in length, and holds one hundred gallons of water, leaving eight cubic feet for steam. At the time of the writer's visit to the farm the motor was the subject of no little comment, and the attendant stated, confidentially, that some of the questions asked were remarkable. One man assumed that it had something to do with the incubation of the ostrich eggs; and many asked what made it go, being unable to understand or appreciate the idea. The motor is attractive in appearance; built lightly, supported by seeming delicate shafts, though in reality strong enough to resist a wind pressure of one hundred miles an hour. The reflector must face the sun exactly, and as heavy as it is, weighing tons, it can be easily moved. It stands, after the fashion of the telescope, upon an equatorial mounting, the axis being north and south; the reflector follows the sun, regulated by a clock, the work being automatic, as, in fact, is everything about it. The true focus is shown by an indicator, and in about an hour after it is adjusted the boiler is seen to have attained a white heat and the steam gage registers one hundred and fifty pounds. The steam is carried from the suspended boiler to the engine in a flexible phosphor-bronze tube and returns again from the condenser to the boiler in the form of water, so that the boiler is kept automatically full. The engine is oiled automatically, and when the disk is once turned, facing the sun, it runs all day as independent of an engineer as does a windmill.

The amount of heat concentrated in the boiler by the seventeen hundred and odd mirrors cannot be realized, as nothing can be seen but a small cloud of escaping steam; but should a man climb upon the disk and cross it he would literally be burned to a crisp in a few seconds. Copper is melted in a short time here, and a pole of wood thrust into the magic circle flames up like a match. That the motor is a success is seen by the work it is doing—pumping water from a well, illustrating the possibilities of cheap irri-



SIDE VIEW, SHOWING THE FIXED SUPPORTS AND MOUNTING OF REFLECTOR.



FRONT VIEW, SHOWING THE SUN'S RAYS CONCENTRATED ON THE BOILER, AND GEARING FOR REVOLVING THE REFLECTOR.

A SOLAR MOTOR AT WORK AT LOS ANGELES, CAL.—15 HORSE POWER, STEAM AT 150 POUNDS PRESSURE.

gation, and lifting fourteen hundred gallons per minute —equal to one hundred and fifty-five miner's inches. Up to the present time the motor has produced results equal to about ten horse power, but fifteen is claimed for it.

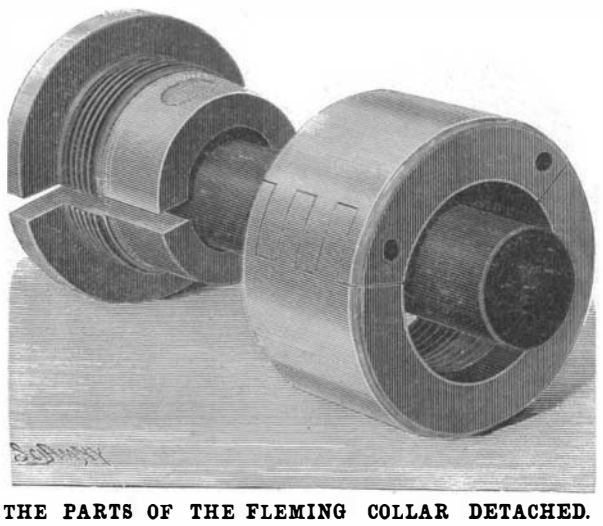
The motor is the result of a number of experiments by a band of Boston capitalists. One of the first productions was a silver reflector, which cost many thousands of dollars, but was abandoned. The next was modeled after the Ericsson machine of 1884; but it was a failure. A third was erected at Longwood, proving also a failure. A fourth attempt was made, this time in Denver, which was fairly successful, doing one-half the work of the Pasadena model. Finally the latter was produced and found to be a success. A duplicate, perhaps improved, will be erected at the Pan-American Exhibition. Dwellers in the East, where rain falls every few days throughout the year, cannot realize what such a perfected motor means to the West, where arid lands await but the flow of water to blossom as the rose. In such regions—and they represent millions of square miles—fuel is usually very scarce, often being so important a factor that the question of it determines the success or failure of the work. This is essentially true of the Californian desert and vast regions in Colorado, Utah, and surrounding States and Territories. Mines and pumping plants are often far from railroads, and in sections where no fuel is in sight, wood and coal being hauled from long distances. In such locations the solar motor is a boon. The skies are comparatively free of clouds, and the machine can begin work an hour after sunrise, possibly earlier, and continue until half an hour before sunset. It is possible that with cheaper methods of storing electricity sufficient power may be stored during the day to run the engine at night, or during the absence of the sun. Inventors are already experimenting upon methods of increasing the effectiveness of the motors, and probably larger ones, and groups of them, will be seen in the near future.

No invention of modern times has given such an impetus to the development of arid lands as the solar motor, and it has been visited by many interested in the question. The development of Lower California has been seriously impeded by the lack of fuel; the country being dry and barren in localities where rich mines are known to exist. The country is cloudless for months—in every sense the land for the solar motor, as water underlies the surface almost everywhere, and when pumped up and sent out upon the soil the region, which was formerly a desert, can be made fertile and literally to blossom as the rose.

THE FLEMING SAFETY COLLAR FOR SHAFTS.

Many of the accidents which occur in machine-shops and factories are due to the old-fashioned projecting set-screw by which collars are usually held on shafts. These set-screws have been condemned by factory inspectors, and even prohibited by law, for which reason they have often been countersunk, thus weakening the collar. Moreover, the collar is held in place only by bearing of the set-screw on the shaft. If the bearing-point slip, the collar moves from its place, thereby deranging the shafting and causing belts to slide from their pulleys.

These difficulties have been very simply and effectively overcome in the Fleming safety-collar, to which our attention has been called by Mr. W. H. Davis, P. O.

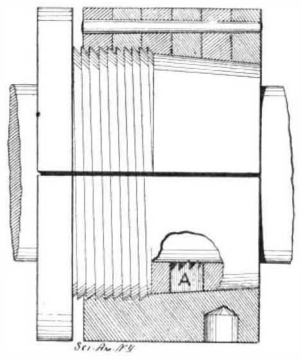


THE PARTS OF THE FLEMING COLLAR DETACHED.

Box 305, Montreal, Canada, and in which the set-screw is entirely abandoned. The Fleming collar comprises essentially four pieces — two symmetrical, tapering, threaded and flanged semi-cylinders, which embrace the shaft, a threaded locking-ring which binds the semi-cylinders firmly to the shaft, and a toothed gripping-key, *A*, received by an opening in one of the semi-cylinders and forced into engagement with the shaft by the locking-ring.

The merits of this arrangement are obvious. The set-screw is entirely dispensed with; the members can be taken from the shaft without removing any other part of the machinery; the collar is held to the shaft, not at one point alone, but through its entire length and internal circumference.

The fact that the collar can be applied to a shaft

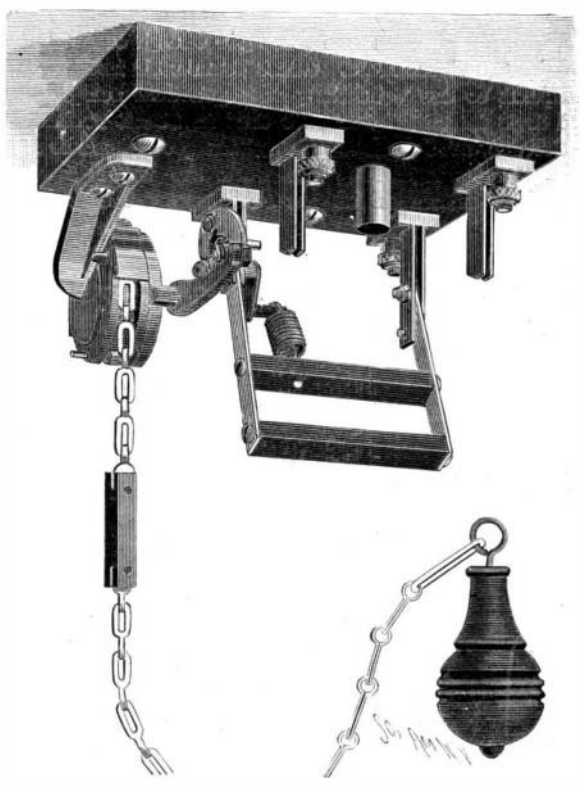


PARTIAL SECTION OF THE COLLAR.

without removing any machinery is in itself a significant feature. In all collars now used, the machinery on the end of the shaft must be taken off before the collar can be slipped on. The time, labor, and expense thus involved are items which are by no means small. Moreover, the cost of manufacture is no more than that of any collar now in use.

AN EFFICIENT SINGLE-PULL CEILING-SWITCH.

From the electrician's standpoint it cannot be denied that the ceiling-switch has merits which commend it to every consumer of electricity. It can be placed exactly where it is needed, and it dispenses with the wires which ordinarily run down to a suitable point on a wall. But these obvious merits have been more than offset by the mechanical defects which are unfortunately too often found in ceiling-switches. The two unsightly cords which form a part of most switches of this type cannot be manipulated with that ease which should be one of the distinguishing features of every electrical appliance. Our attention has been drawn to a novel switch made by J. Jones and Son, of



THE JONES SINGLE-PULL CEILING-SWITCH.

64 Cortlandt Street, Manhattan, New York city, which so far improves upon most ceiling-switches that the difficulties usually presented have been overcome.

The improved switch is a single-pull switch. By drawing downward on a single chain or cord, the circuit is opened or closed. Mechanically considered, the switch consists of a bed-plate screwed to the ceiling, which bed-plate carries the fixed contact-points and the switch-arms or blades, one of which is loosely pivoted and the other mounted on a rock-shaft. The rock-shaft carries a rock-arm and a crank, both of which have partial rotation in opposite directions. The crank is connected by a coiled spring with a cross-piece extending between the two switch-arms. The rock-arm is pivotally connected by means of a link with a crank-pin on a disk actuated by a spring-drum, to which a pull-chain is attached.

A pull upon the chain first winds the spring of the drum, then turns the disks and with it the crank-pin, through one-half a revolution As the crank-pin turns, the link is thrown forward, thereby swinging the rock-arm and the crank on the rock-shaft in opposite directions. As a result of this movement, the end of the rock-arm is made to engage an elbow-lever which assists in swinging the switch-arm out, and the crank is made to extend the spring by which it is connected with the cross-piece uniting the switch-arms. The switch-arms partially swung by the elbow-lever and by the strain on the coiled spring, are automatically carried entirely away from the contacts by the action of the extended coil-spring. This movement of breaking the circuit is effected with the utmost rapidity. When the pull-chain is released the drum is carried back by its spring without in any way disturbing the disk or the remaining parts.

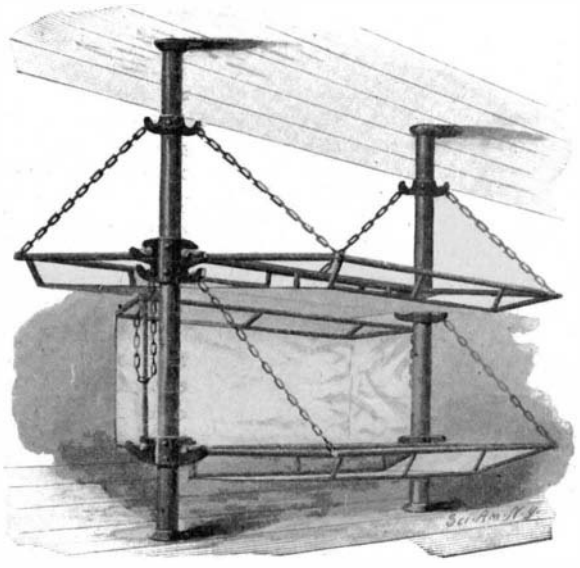
In order to close the circuit it is necessary merely to pull the chain again. The disk is then made to rotate through the remaining half of its revolution, thereby throwing the rock-arm and crank back to their initial positions, rocking the shaft, and extending the coiled spring. When the crank to which the coiled spring is secured passes the vertical the switch is automatically closed by the action of the extended spring. In both making and breaking the circuit the switch-arms are first partially swung and are then automatically actuated by the coiled spring.

A careful examination of the device convinces us that it is both quick and efficient in its operation.

A FOLDING BUNK FOR CARS AND SHIPS.

In emigrant or transport ships and cars it is often necessary to erect a large number of separate bunks, so arranged that they may be easily removed. A bunk of this type has been devised by John P. Lein, a New York inventor.

On two uprights or supports holders are carried having a slot with an upwardly-extended portion. Above the holders each of the supports carries hooks. The



A FOLDABLE AND REMOVABLE BUNK.

bunk itself is provided with contracted necks, which are received by the upwardly-extending slots. Chains attached to the outer side of the bunk are hung on the hooks to support the bunk.

In order to fit out a ship it is necessary merely to erect the uprights, insert the bunk-necks in the slots of the holders, and hook the chains in place. When not in use the bunk can be folded simply by turning it in the holders so that the link of each chain nearest the outer edge will engage the hook. The entire bunk can be readily removed whenever desired.

The Current Supplement.

The current Supplement, No. 1315, has many interesting articles. "The Evolution of the Adobe" is by C. F. Holder, and is accompanied by several illustrations. "Cameos" is by Cyril Davenport, F.S.A. "Optics of Trichromatic Photography" is continued. "Dock Equipment for the Rapid Handling of Coal and Ore on the Great American Lakes," by Arthur C. Johnston, is accompanied by many illustrations. Several articles in this issue are devoted to the consideration of modern commerce. "Women Astronomers" is by J. E. Gore. "Progress of Agriculture in the United States" is by George K. Holmes, and is a valuable article. "Britain's Leaning Towers" describes two curious examples. The recent Berliner patent decision is carefully digested. "Excavations at Carthage" describes some important discoveries. "Constellation Figures as Creek Coins" is by Robert Brown, Jr., and is a curious study in numismatics.

Contents.

(Illustrated articles are marked with an asterisk.)