belts. At the forward and after ends of the citadel formed by this armored structure circular barbettes of 16 inch armor are established, with rotating turrets, each turret carrying two guns with axes parallel. The turrets are of 14 inch armor.

This describes the heavy armor of the ship. Above the water line belt a second citadel of 4 inch armor is built, extending 100 feet fore and aft along the sides and with diagonal segments running to the main barbettes. At each of the four corners of this citadel is a barbette of 8 inch armor, with a revolving turret of 5½ inch armor.

The ship is fought from a conning tower of 7½ inch armor, 8 feet in diameter, and with 7 feet 4 inches head room.

The four breechloading rifles in the main turrets are of 12 inches caliber, and the four upper turrets are armed with eight breechloading rifles of 8 inch caliber, two to a turret. The 12 inch guns in the forward turret and the 8 inch guns in the upper turrets are on the same level, their axes being 25 feet above the mean water line. The axes of the 12 inch guns in the after turret are 18 feet above the water line. This somewhat peculiar distribution can be followed out in our cut showing the completed ship at sea.

The sponsons are to carry 4 inch rifles, of which size of gun there are to be six, and twenty-two rapid firing and machine guns are provided for, to be distributed about the ship and on the fighting mast.

The fighting mast has three tops, and, as shown in the cut, is to be a very prominent feature of the ship. There are also bow and stern torpedo tubes and two tubes on each side.

The engines are of vertical inverted three cylinder type, triple expansion, and developing 11,000 horse power at 112 revolutions of her twin screws. There is a coal carrying capacity of 3,000 tons, giving a radius of action of 16,000 miles at a speed of 10 knots.

As additional protection, the Iowa has deflective steel decks and cellulose packing back of her plating. The armor is all Harveyized steel. Samples were subjected to very severe tests before acceptance, and in our issue of November 9, 1895, we described and illustrated some most interesting ballistic tests conducted at Indian Head proving ground, where a plate, representing the Iowa's armor, was attacked by 10, 12, and 13 inch guns, the largest caliber projectile being the only one which succeeded in penetrating the plate.

One feature of the occasion was the lavish hospitality of the builders of the ship—the Cramp company. In addition to the reception on the special trains, they entertained at a lunch in their establishment no less than 1,300 invited guests. The interest of the occasion is better appreciated when the distance traveled by the guests and their high position in the political and scientific world is realized.

In the stream off the yard lay the ship Massachusetts, and her steam siren sounded as the Iowa went down the ways. It will be many months before the ship can be made ready for commission, and some two years will elapse before the launch of another ship of her type and power. The launch may be ranked as one of the most important that ever took place in this country.

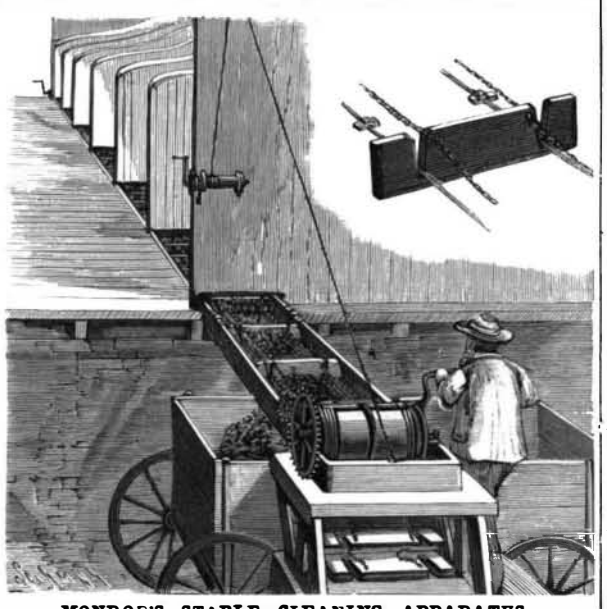
Trolley Road in Japan.

An electric trolley road established at Kioto, Japan, is described and illustrated in L'Energie Electrique. The road has been built by the Thomson-Houston Company, and the current is taken from a central station, which supplies power to a number of silk mills as well as the electric lighting of Kioto. The source of power is a canal from Lake Biwa, which is also used for navigation and irrigation purposes. There are 20 Pelton wheels of about 120 horse power working 12 dynamos, arrangements being made for the employment of alternating currents of from 1,000 to 2,000 volts, and a three-phase system at 2,000 volts, as well as a 500 volt continuous current, the total output being at present about 1,200 kilowatts. One curious feature is an inclined plane 700 meters long, with a fall of 7 per cent, which is used for transporting barges from the canal to the River Ujigawa, and vice versa. This is worked by a cable driven by a 50 horse power Thomson-Houston motor. The electric road is 18 kilometers (11¼ miles) long, and is worked with 26 cars fitted with Thomson motors. It is stated that the results on this road have been so encouraging that the municipalities of Tokio, Yokohama, and Osaka have decided on adopting similar lines.

IT is almost an axiom of the legal profession that the law is clear and certain, and the judges know the law. It is one of the first principles of Blackstone that "the law cannot make a mistake." And yet one of the most eminent of English judges, Lord Mansfield, once said, in deciding a case, "as to the certainty of the law, it would be very hard upon the profession if the law was so certain that everybody knew it. The misfortune is that it is so uncertain that it costs much money to know what it is, even in the court of last resort."

A STABLE CLEANING APPARATUS.

For expeditiously removing manure, etc., from stables, the apparatus shown in the accompanying illustration has been invented and patented by Clarence A. Monroe, Loveland, Col. Sunk in the floor at the rear of the stalls is a trough or trench whose ends extend through opposite openings in the walls of the stable, there being at one end brackets in which is journaled a roller or drum, while at the other end the trough has a hinged section, with open bottom, there



MONROE'S STABLE CLEANING APPARATUS.

being journaled at the outer end of this section another drum. On the drum shaft is a gear wheel meshing with a pinion on a shaft provided with a crank handle, whereby the drum may be rotated. From the outer end of the hinged section a cord or rope extends diagonally up over a sheave on the side wall, and thence down over a roller or windlass, whereby the hinged section may be raised to a vertical position or let down over a wagon in a driveway at the side of the stable, as shown in the illustration. Wire ropes are secured at opposite ends to the respective drums, and on these wire ropes are spaced stops adapted to engage the rear sides of flights, as shown in the small figure, the flights being drawn along in an inclined position in the trenches by the cables. As the flights are drawn over the open bottom of the hinged section they are supported by guide rods, but they become disengaged and fall into a chamber at the forward end of the open bottom of the hinged section.

The flights are connected by chains or flexible connections, and are adapted to be drawn backward through the trench, by means of a handle on the rear drum, the flights being held in vertical position by slides adjacent to the rear drum. When the flights are drawn forward the manure is carried out and delivered into a wagon or other receptacle, the flights being then carried back to their original position by rotating the drum at the rear of the trench.

A CAKE BAKED IN A HAT.

Borrowing a hat, breaking some eggs in it, and taking out a cake is a trick which, although old, is worthy of explanation, and the more so in that the process that we are going to describe has the advantage of being able to be employed anywhere and of producing a complete illusion.

Before beginning the experiment, take three eggs, and, having blown

Fig. 1.

Fig. 2.

two of them, close the apertures with white wax. Place the three eggs upon a plate.

Within the left hand side of your waistcoat place a flat cake, and then make your appearance before the spectators.

Having borrowed a hat, place it upon the table, and, after secretly introducing the cake into it (Fig. 1), take an empty egg, crack the shell upon the edge of the plate, and, inserting your hands in the hat, make believe empty the contents of the egg into the latter (Fig. 2).

In order that the means employed may not occur to any one, take the perfect egg and let it fall upon the plate so that it will break and its contents flow out. Then take the remaining egg and operate as with the first. All you have to do then is to pass the hat back and forth a few times over the flame of a candle in order to cook the mass and then to serve the cake.—Magasin Pittoresque.

Science Notes.

Modern Medicine states that an examination of the dust of railroad cars has been made in Germany under the direction of the Imperial Board of Health. The investigations showed that in fourth-class cars there were more than 12,000 germs per meter, and in first-class cars one-fifth this number. Animals were inoculated with the dust from the cars. Some died of tuberculosis, showing the presence of this germ with the other microbes.

In notes presented before the Paris Academy of Sciences, L. B. Gustave le Bon claims that he has proved by photographic effects that ordinary lamp light and gas light are transmitted through opaque bodies, and states that the body might be a sheet of copper one-thirtieth of an inch in thickness. His experiments have been questioned, says Science, by M. Niewenglowski, who states that he has obtained the same effects in complete darkness, and attributes them to luminous energy stored up in the plates.

An imperial ordinance was promulgated in Japan on December 28, 1895, establishing a new standard time, as follows: (1) The standard time of the empire hitherto in use shall henceforth be called the central standard time. (2) The time of the meridian of 120° east longitude shall be the standard time of Taiwan (Formosa), Hoko group (the Pescadores), and Taeyama and Miyako groups, and shall be called the western standard time. (3) This ordinance shall come into effect on January 1 of the twenty-ninth year of Meiji (1896).

Portugal is about to celebrate a quadricentenary of its own. At the request of the Geographical Society at Lisbon, the government has determined to celebrate the four hundredth anniversary of the expedition which set out on July 8, 1497, under the command of Vasco da Gama, for the discovery of a route to India around the Cape of Good Hope. The details of the celebration have not been decided upon as yet, but it is expected that special expositions will be opened at Lisbon and that scientific congresses will also be held.

Cryostase is the name of a new substance discovered by a German chemist. It is a remarkable compound substance and has some curious properties, among which is that of solidifying under the influence of heat and again becoming liquid at temperatures below the freezing point. It is the only substance which possesses the property of liquefying when cold and becoming solidified when hot; for although some substances like albumen harden at a slightly high temperature, they cannot be brought back to a liquid state even under the influence of a very low temperature. Full details of the composition are lacking. It is said to be made by mixing equal parts of phenol, camphor, and saponine, to which is added a rather smaller quantity of turpentine.

The Albert medal of the Society of Arts was presented by His Royal Highness the Prince of Wales to Sir Lowthian Bell, Bart., F.R.S., on February 26, in recognition of the services he had rendered to arts, manufactures, and commerce by his metallurgical researches and the resulting development of the iron and steel industries.

The Conseil Supérieur de l'Instruction Publique, of France, has issued a decree which removes the restrictions imposed on American and other foreign students in French universities and gives them a status similar to that accorded them by the German universities. The memorial addressed to the Conseil by Prof. H. J. Furber, of the University of Chicago, called attention to the fact that there were only thirty students at the Sorbonne, while there were two hundred at the University of Berlin. The conditions will now probably be completely changed by the new decree.

By the use of the electric furnace, G. de Chalmot has obtained crystals of copper and silver silicides, which always contain, however, as an impurity, some calcium.

The Russian National Health Society is making great efforts to have the Jenner Centenary celebration, which is due to be held in May, a great success. An exhibition of relics of Jenner and of books, pamphlets, prints, instruments, and all objects relating to vaccination or to Jenner, will be held. Four prizes and a gold medal are offered for the best work on vaccination.

Acetylene gas is now proposed for various special uses. Among these are hospital work, especially for oculists, aurists, throat operations, and the like. The microscopist and photographer are said to find it of value, and for all special cases of difficult illumination it may be used to advantage. One suggestion is to provide signalmen with compressed gas in small cylinders, to be used for long and short flash Morse signals. Its use for bicycles, the gas being stored in the handle bars or tubular frames, must not be overlooked.

Acetylene Standard for Photometry.

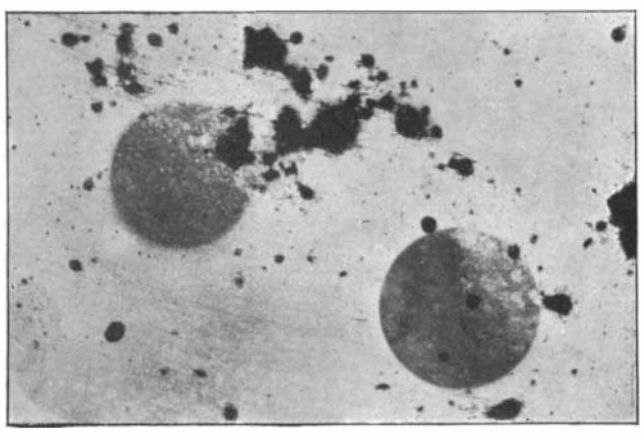
The practical advantages of flames as standards of light have led to their almost exclusive employment for this purpose at the present day. A gas of constant chemical composition, burning under defined conditions, must admittedly form a useful accessory standard. Acetylene, the importance of which has been shown in a masterly study of it by M. Berthelot, appears to be well adapted for the purpose. M. Moissan has found the means of readily preparing the gas in a pure state by the action of water on calcium carbide, which is easily manufactured in the electric furnace. If acetylene is consumed under slight pressure in a burner which gives a broad, shallow flame, the latter is quite steady, very bright, remarkably white, and, for a fairly large surface, of practically uniform luminosity. By placing in front of the flame a screen with an opening of fixed dimensions, which can be varied for particular cases, a source of light well fitted for ordinary photometrical observations is obtained.

These principles were enunciated last year at a meeting of the Société Francaise de Physique, and M. Charpentier (for whose valuable assistance my thanks are due) has constructed for me a standard lamp embodying them, and easily used. The acetylene, issuing from a small conical orifice, draws in the required air, and then passes through a narrow aperture into a tube in which mixing occurs. This tube ends in a steatite batswing burner, like those employed for illuminating gas. Either the whole or a clearly defined portion of the flame may be used. In the model employed, the flame is inclosed in a small chamber, one of the sides of which is provided with an iris diaphragm, enabling any desired number of candles to be secured. Another side is made to accommodate plates with previously calibrated apertures. The whole flame corresponds to more than 100 candles, under a pressure of 0·30 meter of water, and a consumption of 58 liters (2·049 cubic feet) per hour. The illuminating power of acetylene is therefore more than twenty times that of coal gas burnt in a Bengal burner, which gives 1 carcel (9 6 candles) per 105 liters (3·708 cubic feet), and at least six times that of coal gas consumed in a Welsbach burner, which gives one carcel per 30 liters (1·059 cubic feet). Moreover, spectrophotometry shows that for the whole length of the spectrum, from C to F, the light from acetylene differs little from that of platinum in a state of fusion. The latter is employed as the absolute unit, and it is so related to the candle that this is defined as one-twentieth of that unit. Photography, which offers the best means of studying rays of small wave length, shows that in the flame of acetylene there is an actinic intensity, which should prove of most valuable service.—M. Violle in Comptes Rendus.

RADIOGRAPHY.

In the March number of the Red and Blue, of the University of Pennsylvania, is given an account of Roentgen photography and some experiments made at the university in the same direction by Dr. Arthur W. Goodspeed, assistant professor of physics. These experiments were successful repetitions of the experiments of Roentgen and others, together with original work; but the item of greatest interest was contained in the last clause of the article referred to, which we produce, together with cut of the first shadow picture, for which we are indebted to the magazine above mentioned.

In the year 1890, Mr. Jennings, of Philadelphia, had associated himself with Dr. Goodspeed in experiments on spark photography. One evening, the 22d of February, 1890, at the close of work, with the table still littered by plate holders and apparatus, Dr. Goodspeed brought out the Crookes tubes for Mr. Jennings' amusement. Next day that gentleman wrote that he had had a curious failure among his plates—a negative spotted by two disks; but since no one could explain the phenomenon, comparatively uninteresting as it was, the plate was thrown aside and forgotten. Six years later after the discovery of the Roentgen rays, it was recalled to mind and recovered. A duplicate was prepared under exactly the same circumstances; both plates exhibited the same indications of genuineness—the sharp line at one edge of the disk, the dull line of shadow at the farther edge. These photographs the Red and Blue has the honor of presenting for the first time. It was in a lecture on the evening of University Day that Dr. Goodspeed told the story, and concluded thus: "We can claim no merit for the discovery—for no discovery was made. All we ask is that you remember, gentlemen, that six years ago, day for day, the first picture in the world by cathodic ray was taken in the Physical Laboratory of the University of Pennsylvania."



THE FIRST SHADOW PICTURE IN THE WORLD.
Taken by accident at the University of Pennsylvania, February 22, 1890.

DR. CHANTEMESSE, of Paris, has it is said discovered an anti-typhoid serum, with which he has experimented on three patients. After the first hypodermic injection they passed through the ordinary stages of the disease and became convalescent.

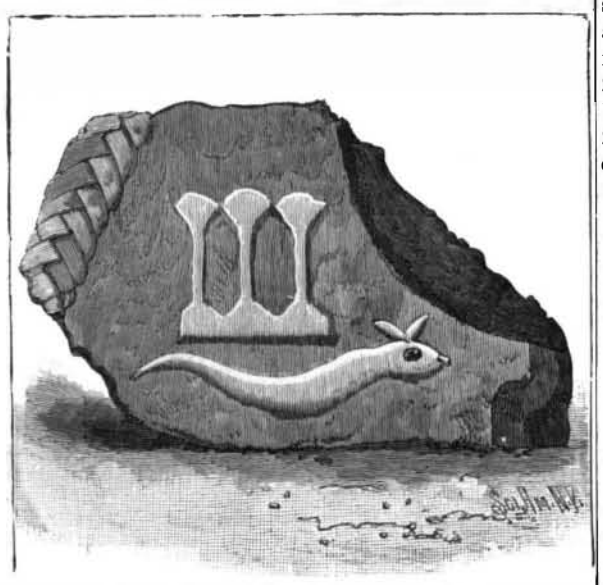
AN INTERESTING ARCHÆOLOGICAL DISCOVERY.

We have received the following letter from Mr. George E. Raum, late of San Francisco:

Cairo, Egypt, February. 29, 1896.

To the Editor of the SCIENTIFIC AMERICAN:

Dear Sir: I inclose a rough sketch of a portion of the rock crown of the Sphinx found by me. This portion of the stone crown or diadem of the Sphinx was found at the bottom of the temple, between its forepaws, on February 26, 1896. Originally this stone crown was in all probability ten feet broad and as high



CAP OR DIADEM OF THE SPHINX.

again, with a stone stem seven feet long, which fitted into the perpendicular hole in its head, to hold it on. We now know how the Sphinx originally looked.

Yours truly, GEORGE E. RAUM.

This discovery of Col. Raum is of great interest, though the statement of the find has been received with incredulity in some quarters. The arguments of the gentlemen who are inclined to disbelieve in the authenticity of the stone found are not convincing, being principally based on the fact that the temple has been excavated by several modern explorers—Caviglia, Mariette, and M. Maspero. Again, others state that "it is not usual to hear of holes 'drilled' by the ancients in their monuments," but the Egyptians worked hard stones with bronze saws set with corundum or diamonds, and for tubular drilling they had tools like our modern diamond rock drills (see Engineering, xxxvii, page 282). Another point which has been made is that there are three lotus columns on the cap. This is more reasonable criticism and may possibly be satisfactorily explained. The fallibility of Egyptologists is well known, but until some really convincing proof is brought forward, it is probably safe to believe that the marked stone found by Mr. Raum is the cap or diadem of the Sphinx.

The Egyptian Sphinx was usually an emblematic figure representative of a king, and may be considered, when with the head of a man and the body of a lion, as the union of intellect and physical force. The Great Sphinx lies about 1,800 feet southeast of the Great Pyramid of Gizeh. It is a recumbent androsphinx, or man-headed lion, hewn out of a natural eminence in the solid rock. Owing to certain defects in the rock, these faults were remedied by a partial stone casing, the legs being likewise added. The addition of these pieces militates against the argument that the cap so recently found could not have belonged to the Sphinx, as it did not form a part of the solid rock. An excellent idea of this hoary monument of antiquity may be obtained from the engraving in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 864. The Sphinx has been variously measured. The figures given by Mr. E. L. Wilson are length, 155 feet; height from the base, 63 feet. Between the paws is a temple (?) which speedily fills up with sand after being excavated. It is considered that the Sphinx is older than the Great Pyramid. Various interpretations have been given to this boldly sculptured figure which rises out of the waste of sands. Cambyses mutilated the face of the Sphinx, and it may have been at this time that it lost its cap.

The brow of the Sphinx is nearly 14 feet broad; so the cap, which is 4 feet 6 inches long at the bottom, probably only formed the tip of the cap, as stated by Mr. Raum. Col. Raum obtained permission to excavate in and around the Pyramids and Sphinx from the Egyptian government. He came upon the cap at a depth of fourteen or fifteen feet below the surface in the temple (?) between the forepaws. The stone is painted red in the decorations, as was in order, as the countenance of the Sphinx was originally of a reddish hue. The cap is irregular in shape, measuring 2 feet 2 inches at the top and 4 feet 6 inches at the bottom; on the left side, from top to bottom, it measures 2 feet 8 inches. The left side has a conventional decoration. In the center are three lotus columns and a fish, on the right side is a portion of the sun's disk. The wonderful discoveries conducted by Mr. L. De Morgan, at Dahshur, Egypt, are described in the current issue of the SUPPLEMENT. The tomb of Queen Khnemit was unearthed by the discoverer and a beautiful golden crown and other ornaments of elaborate workmanship were found.

Fire from Steam Pipes.

The burning of the Warren (R. I.) cotton mill having been attributed to the carbonizing of the wooden lagging on the cylinder of the large quadruple expansion engine, again brings up the possibility of wooden coverings to steam pipes taking fire without the presence of a spark to start the combustion, and some recent investigations by the Boston Manufacturers' Mutual Fire Insurance Company are of considerable interest. In a report of these investigations, appearing in the Providence Journal, several instances are given where wood coverings, although separated from steam pipes by several thicknesses of hair felt and other coverings, became badly charred and in several instances actually took fire.

Mr. Edward Atkinson, president of the company, says that it is sometimes held that this finely carbonized wood will not ignite from any cause except actual contact by spark or flame from an outside source. In proof that charcoal in a porous condition will ignite from the sudden influx of fresh air, he cited an example in his own experience.

Having had occasion to test heat-retarding substances on his own behalf, he once obtained some sections of prepared wood pulp in slabs of 1½ inches in thickness and of a very porous quality, which are made use of in the construction of refrigerators. His purpose was to determine whether or not such slabs could be used to prevent the escape of heat from a lamp oven. He therefore raised the heat of the inner oven, which is a tight inner iron box one inch distant on all sides from an outer case made of vulcanized and very solid wood pulp, to a little under 400 degrees. In the center of that inner oven, isolated from any metallic contact with the wall, was placed one of these slabs and there left subject to heat at less than 400 degrees for about one hour. He then removed the front of the outer oven and opened the door of the inner oven, letting a very quick and large supply of fresh air into the chamber, in which the oxygen had probably been in part exhausted by subjection to the hour's heat. The slab of wood pulp had turned from pure white to dense black, having been converted into very porous charcoal. In less than a minute after the fresh air was let in it took fire and burned to ashes. He repeated the experiment with the same result. Four hundred degrees Fahrenheit will be developed by a pressure of steam of 238 pounds per square inch, but the same carbonization ensues by lapse of time even at boiling heat, or 212 degrees, as has been proved.—The Engineering Record.

Life of a Cannon.

La Nature contains a short note in which the horse power of a cannon is calculated. An Italian cannon of 100 tons with a charge of 550 lb. of powder and a shot weighing about 2,000 lb., will give an initial velocity of 523 meters per second; the length of time during which the powder acts is less than one-hundredth of a second, from which it follows that the horse power developed is about 17,000,000. The writer adds that after about 100 shots the cannon is put out of service and its total active life is, therefore, only one second! In large modern cannon the horse power runs as high as 24,000,000. If the writer had carried out these calculations still farther, he would have found that, after all, this 24,000,000 horse power does not represent a large amount of energy, as it would be just sufficient to run 31 incandescent lamps for only one day.

PROFS. AYRTON and Medley find that incandescent lamps appear to increase in effectiveness during the first 80 or 100 hours of use, after which the light slowly fails.