

THE EDISON X RAY EXPERIMENTS, APPARATUS AND FLUOROSCOPE.

The laboratory of Thomas Alva Edison has been the scene of active work during the present period of interest in the Roentgen discovery. Mr. Edison early began his investigations on the subject, feeling that he needed but one or two weeks to determine the controlling factors of success. As guide he had Roentgen's original paper, and his path seemed short and clear. Now, after two months' active work, his goal is reached, and he has succeeded in devising a simple apparatus by means of which the skeleton of the limbs may be observed as in a photograph.

His work has taken two principal directions: one the perfecting of the Crookes tube; the other the production of an apparatus, the fluoroscope, for enabling the X ray phenomena to be observed directly without the intermediation of photography. After endless trials with different glasses, shapes, and sizes of Crookes tubes and disposition of electrodes, he has adopted as final shape an ellipsoidal tube about five inches long, shown in Fig. 1. At each end are internal disk electrodes of aluminum slightly inclined to each other. The outside of the tube ends are coated with metallic caps, forming external electrodes. Of the effect of such a tube, about 60 per cent is due to the internal electrodes and about 40 per cent to the external ones. He next found that at a particular point of exhaustion the effect was best. This point is when the band spectrum begins to disappear and the spectrum becomes continuous. Accordingly, he has adopted the system of using a tube sealed at the ends and with a short tube entering its side. The latter enables connection to be made with an air pump of the Geissler or Sprengel type. After connection with the pump, about half an hour's exhaustion gives the vacuum best for development of the X rays, the object being to hold the exhaustion at the point of maximum during the period of observation.

One very curious tube experimented with and shown in Fig. 1 had internal wire electrodes only, and these were sealed into a rod or tube of glass extending from end to end of the tube. This tube gave good X ray effects, although the electrodes were embedded in glass. In another experiment, shown in the same cut, a metallic tube half an inch in diameter and two feet long was provided with a metallic shield at one end. The shield end was placed against a plate holder containing a photographic plate. The other end was pointed at the Crookes tube. It was found that whatever part of the tube the testing apparatus was pointed at, the X rays produced the image of the aperture through the long steel tube. This showed that they are radiated in all directions from an active tube.

Combustion tube glass was chosen as material for the Crookes tube, which is blown as thin as possible. The second element of the problem reached was the fluorescent screen apparatus, its construction and fluorescing material.

Mr. Edison was early convinced of the importance of the visual as against the photographic method of observation. Dissatisfied with the barium salt used by Roentgen, he bent all his energies to the development of a new apparatus which should be superior in construction and fluorescent material to any yet suggested. During his researches he examined some eighteen hundred chemicals. To test them he used a pasteboard cylindrical box, about two inches in diameter and four inches long, with a sighting hole in its bottom. His assistant started at his laboratory shelves and brought him, one by one, every chemical in the place. Some of the chemical to be tested was placed in the inverted cover of the box, the inverted box was put in place over it, and Mr. Edison looked through the eyehole in the bottom down toward an excited Crookes tube. For four days and nights the tests went on, many salts were laid aside as fluorescent, but calcium tungstate proved incomparably the best—it is about eight times as powerful as platino-cyanide of barium.

This salt is made by fusing together a mixture of sodium chloride, sodium tungstate and calcium chloride. The calcium takes up the tungstic acid, sodium chloride being the other product of the double decomposition. Treatment with water dissolves out the sodium chloride and leaves the insoluble crystals of calcium tungstate. These are dried and sifted. Such as go through a No. 30 mesh are the coarsest used. The largest are distributed over a pasteboard screen coated with wet celluloid varnish, then finer ones are added until a smooth, uniform surface results. The screen is mounted at the end of a sighting box of pasteboard, with the prepared surface inside. The other end of the box is shaped to fit the contour of the face around the eyes.

On holding the hand over the end of such a box, if X rays fall upon it, the surface will fluoresce, except

where the shadows due to the Roentgen effect are produced, with the same perfect detail that is seen in the best of the Roentgen photographs. One grain of tungstate per square inch of screen is required for the coating.

The cut (Fig. 2) shows the apparatus now being designed for practical use. After what has been said it is easily understood. The Crookes tube is contained in the wooden box. On it the patient rests his hand or arm, and the physician, with fluoroscope strapped to his head, observes the condition of the bones. An

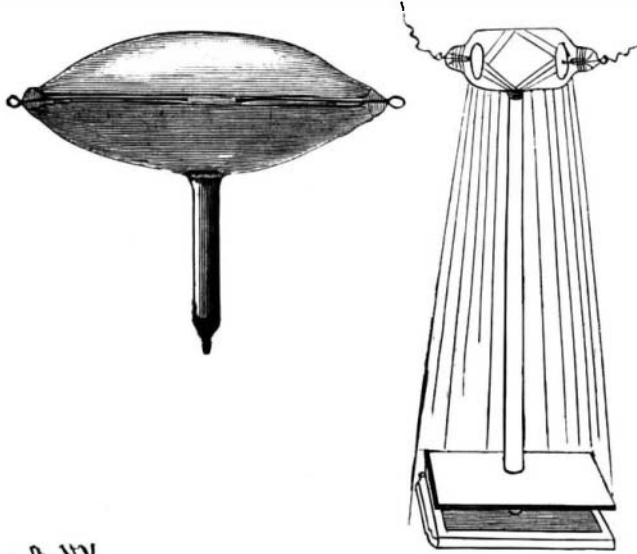


Fig. 1.—EDISON'S EXPERIMENTS WITH X RAY PHENOMENA.

induction coil with rotary circuit breaker actuated by a motor, and with Elihu Thomson's air blast to blow out the arcs, is to be part of the plant. Mr. Edison finds that a condenser impairs the effect. The sudden break produced by the circuit breaker and air blast gives the best effect.

The tube with which the writer's observations were made was placed by Mr. Edison upon his air pump. Gradually on trial fluorescence began to appear as the vacuum increased, and occasional observations were made with a pocket spectroscope to note the period of disappearance of the bands. At last the X rays began to be radiated. The fluoroscope was applied to the eyes, and its base appeared brightly illuminated. The hand was placed over it, and a shadow was produced. Every minute the effect improved until at last, almost with startling suddenness, the bones appeared in perfect outline, the flesh having almost entirely disappeared.

The lower arm, held over the end of the fluoroscope, showed the space between the two osseous members, the radius and ulna. A purse experimented with disclosed its metallic jaws and coins within it. A thick board placed between the object and the instrument



Fig. 2.—EDISON'S SURGEON'S X RAY APPARATUS.

had but little effect in dimming the image. The importance of this apparatus to the surgeon cannot be over-estimated. It will give him an instant diagnosis of his case. The photographic method involves long exposure, in itself an evil, followed by the slow development and drying of the plate, and, worst of all, the uncertainty of getting any result whatever. The fluoroscope tells the story at once. Outside of the surgeon's practice, it will be of great use to all experimenters with X rays, as giving them an instant valuation of their tubes and of their excitations.

The Cosmopolitan Horseless Carriage Competition.

In our issue of February 15, 1896, it was announced that a competition of horseless carriages would be held under the auspices of the Cosmopolitan Magazine, on the 30th of May, for a prize of \$3,000. The indications are that the competition will be very successful. The gentlemen who have consented to act as judges are as follows: General Nelson A. Miles, United States Army; William T. Craighill, Chief of Engineers, United States Army; Mr. H. Walter Webb, Vice President, New York Central and Hudson River Railroad Company; and Mr. John Jacob Astor. It was at first decided that the award should be made from the finding of the judges upon the following points: Speed, 50; simplicity and durability of construction, 25; ease in operation and safety, 15; cost, 10. It was, however, considered wise to revise the conditions of the competition as it was thought that too large a percentage was given to speed. The awards will now be made upon the following points, the maximum being 100: speed, 35; simplicity of construction and durability, 30; ease in operating and safety, 25; cost, 10. The route selected for the competition is about twenty-six miles in length, thus requiring a total run of fifty-two miles. It passes along Broadway to Central Park, through Central Park to Washington Bridge, thence to Yonkers, where the course will include five miles of asphalt pavements, then following the country Broadway to Irvington, paralleling the Hudson the entire route and passing through one of the most beautiful regions of America. The roadway over which the trial will be made would be considered fine even in France.

A PAVEMENT used in Vienna consists of granulated cork mixed with mineral asphalt and other cohesive substances, compressed into blocks of suitable size and form. Among the numerous advantages set forth in its behalf are cleanliness, noiselessness, durability, elasticity, freedom from slipperiness, whether wet or dry, and moderate cost. Unlike wood, too, it is non-absorbent, and consequently inodorous. It presents the minimum resistance to traction, and, being elastic under passing loads, does away with the vibration caused by heavy teaming. The blocks are embedded in tar, and rest upon a concrete base six inches thick. When taken up for examination they have exhibited, when compared with new ones, a reduced thickness by wear of less than one-eighth inch—this in the case of a section of a London street leading to the Great Eastern Railway station, subjected to continuous heavy traffic, the blocks having been in use nearly two years.

A Mountain of Solid Granite.

BY WILFRED WILSON.

In Burnet County, Texas, rising abruptly out of the level prairie, is a mountain of solid granite as smooth and bald as a negro's head without hair. It covers an area of seventy-five acres and rises two hundred feet above the surrounding surface. It contains, above the level of the base, one hundred million cubic feet of granite, available to the quarryman without a foot of dirt or other matter to be stripped off. The value of granite at the quarry in Eastern States is twenty-five cents per cubic foot. The granite in this mountain, at the nominal value of one cent per cubic foot, would be a million dollars for the amount of stone above the level of its base. The size of the stones which may be here quarried and moved is limited only by the capacity of machinery for moving them. Tests made by Col. D. W. Flager, of the United States Army, at the Arsenal, Rock Island, Ill., and certified by him to the Texas capital commissioners, show the crushing strength of the granite from this mountain to be 11,891 pounds to the square inch, while the ratio of absorption of water to the weight of stone tested was only 0.00094 after soaking forty-three hours. Its specific gravity is 2.8249. The granite from this mountain is pronounced equal to the celebrated Scotch granite and it contains comparatively no iron or other foreign matter. It is stripped by nature and lies in regular strata, is very easily quarried and cut, and assumes a magnificent polish. In color it varies from the red or rose colored stone, of which the State capitol is constructed, to a light gray, with various intermediate shades. Granite has been taken from this mountain for the capitol building and dam at Austin, the jetty works at Galveston Harbor and mouth of Brazos River, and the government building at Kansas City, without having any perceptible effect upon its appearance. At a distance it looks as if it had never been touched.

A TAX on vehicles, whether kept for hire or personal use, is imposed in many Western communities, on the principle that their owners should pay specially for the use of the highway, and the Indiana Supreme Court has decided that such a tax may be collected from non-residents who drive over the streets of a city.