ROENTGEN OR X RAY PHOTOGRAPHY.

The discovery of X ray photography by Roentgen will serve not only to immortalize the physicist who so fully developed it before giving it to the public, but it will render the year 1896 distinguished as the "Roentgen photography" year, as 1894-95 are distinguished as the "argon and helium" years. It seemed as if the limits of human discovery were being reached, but the wonder of the new photography only emphasizes the possibility of other victories to be won in the world of science. It was by aid of a fluorescent medium that the course of the rays was traced and the proof of their penetration of solid opaque organic screens was reached.

Roentgen's first experiment consisted in placing near a Crookes tube, which was enveloped in black paper or pasteboard, a screen whose surface was charged with a fluorescent substance. On exciting the Crookes tube, the surface of the experimental screen became luminous. A book of a thousand pages was placed between the tube and the screen, but the luminosity persisted. Wood and aluminum were also tried with like result, and it was found that if the hand were interposed the image or shadow of its osseous skeleton was obtained on the fluorescing and luminous surface. To try the effect of the newly discovered rays upon a photographic plate was but natural. It was tried, a photograph through an opaque screen resulted and the discovery was complete. This account disposes of the story of the discovery having been made accidentally.

The experiments, as described by Continental authorities, require a coil giving a spark from 2·4 to 3·2 inches long. Four inches is named as a good distance to intervene between the Crookes tube and the sensitized plate, and ten to twenty minutes are given as the limit of exposure. We publish in the SCIENTIFIC AMERICAN SUPPLEMENT of this week, No. 1050, Roentgen's photograph of the bones of the human hand. An interesting feature in it is the ring on the finger. The metal cuts off the rays far more than do the bones, as the latter cut them off more than the muscular tissue or epidermis does. Hence in graduated intensities we find shown the full outline of the hand in light color inclosing the darker outline of the bones, while the metal ring shows darker than all.

It is with no small gratification that we are able to put before our readers the exact details of the experiment, as carried out by Prof. A. W. Wright, of Yale University. He was among the first of the American experimenters, and his results figure as among the most successful ones yet obtained.

The arrangement of the apparatus is clearly shown in the front page engraving, which was prepared from sketches made by our artist in Prof. Wright's laboratory.

On a clamp support is carried the Crookes tube. Prof. Wright used one of approximately spherical shape of the type originally used by Prof. Crookes to show the dependence upon the negative pole of radiant state phenomena. The tube was experimented with in two positions, the plate or one of the wires being made the cathode, the bulb being always so placed as to keep the cathode uppermost.

The excitation was furnished by an induction coil, the primary of which was excited by a five-cell storage battery and the secondary was taken as giving 200,000 to 300.000 volts potential, corresponding roughly to a spark length or distance between electrodes of two to three inches in air. Wires from the secondary were connected to the terminals of the Crookes tube as shown, the negative wire to the upper electrode.

On the table, a few inches below the tube, the sensitized plate contained in an ordinary plate holder was placed, and on its slide of ebonite were placed the objects to be photographed. They were a purse with coins in it, a box containing aluminum wire weights, a pasteboard pill box in which some balls of different metals were placed embedded in cotton, medals and coins, and a lead pencil. The tube was excited for some minutes, the plate was removed and developed, and the results are shown in a reproduction of the photograph which Prof. Wright furnished us. This photograph is of the highest interest. It shows the objects detailed above. On one side can be seen the dim shadow of a box with the bent wire aluminum weights in it strongly outlined; the pencil shows the lead through the wood; the purse reveals its contents; the box with the little metal balls does the same, while the coins produce at least their contour. All these effects were produced through the ebonite cover of the plate holder. The plate used was a very rapid Cramer dry plate; the image was developed with eikonogen.

The photograph we reproduce possesses historical interest, as being one of the first of the Roentgen photographs produced in the United States.

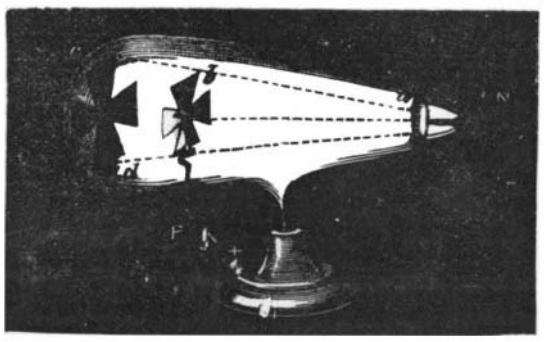
From Prof. Wright we have received the following latest particulars concerning the details of his experiments:

"A curious peculiarity of the plates which have been subject to the cathode rays, as compared with those which have been acted upon by light, is their great sluggishness in development. The image does not appear at all for a relatively long time, and then comes up very slowly, so that the development must be continued a very long time to bring out all there is in the picture. When this is fully out a remarkably strong and dense negative results, with very strong contrast. Cramer and Seed plates of the highest degree of sensitiveness have been used in the later experiments. The time of exposure may be shortened by placing the objects on sensitive plates nearer the Crookes tube, but the definition in the picture is then not so good. The plates should be opposite the cathode."

At the meeting of the Royal Photographic Society, in London, on January 21, Mr. J. W. Gifford, of Chand, showed a number of Roentgen photographs which he had produced, using five to ten minutes' exposure. He stated that he had obtained somewhat similar results without a Crookes tube, using the sparking electrodes of an induction coil to photograph a hand inclosed in a box with a photographic plate.

It is some eighteen years since Crookes tubes were prominently brought into service. They are simply tubes or vessels of thin glass into whose walls platinum wire electrodes are sealed hermetically and which are then exhausted to a very high degree, to about one millionth of an atmosphere. The tubes are of different shapes, to enable different experiments to be performed with them. We reproduce, from an article on Crookes tubes in our SUPPLEMENT, No. 189, of August 16, 1879, a view of one of the tubes, which is of special interest, as showing the production of a shadow by a cathode discharge. The cross is made of sheet aluminum. The cathode connection is made at N, the anode at P. The walls of the tube become luminous under the effects of the discharge, with a shadow of the cross projected on them.

While the shadow shown is of a certain interest from the point of view of analogy, it must be remembered that the X rays are distinguished by Prof.



CROOKES TUBE, SHOWING SHADOW.

Roentgen as sharply from cathode rays as from ordinary light rays. Light rays can be refracted or bent from their straight course by passage from one medium of transmission into another, they can be reflected from surfaces of substances which they cannot pass through. The cathode rays can be bent to right or left out of their straight course by a magnet: but the X rays act most anomaiously. While transmitted with varying facility by different substances, some being opaque to them, others transparent, and while these different substances vary in degree between full opacity and almost full transparency for the rays in question, neither reflection nor refraction of X rays has been absolutely proved to exist. A very small index of refraction has been indicated, not shown, for the rays, and an imperfect demonstration of reflection has been made. In their simplicity and directness of action they even suggest gravitation, except that there is no screen for the universal force.

There is now opened a limitless field for experiments, possibly special plates, prepared with fluorescent or other compounds in the emulsion, may be used, and the extension of the scope will interest the professional world from surgeon and physician to metallurgist and engineer. Every day brings accounts of new experiments, it being proposed even to take a photograph of a man upon a plate large enough to receive the shadow. It is said that a negative plate six feet high is being prepared with that object.

The non-refractability of the rays makes it impossible to produce a reduced image; every object photographed as it is done by radiant energy directly must be done by its shadow, and the shadow must be practically of the same size as the object or a little larger. Again, as no light is used in taking the photograph, there is no way at present of determining the proper exposure, the photometry of Roentgen rays being as yet unaccomplished.

Etymologically there is a chance for a new name—a photograph taken without light being an etymological absurdity.

From the point of view of pure science, it is impossible to predict what the result will be. We have a radiant force or energy which penetrates matter with varying degree of facility, yet which apparently cannot be refracted. We have something which may greatly modify our views of the action of the luminiferous ether, and which may help us eventually to a tangible theory of the great cosmic mystery—gravitation.

We especially desire to refer our reader to our SUPPLEMENT of the present week for Prof. Roentgen's original memoir on his great discovery, which we did not have space to publish in this issue. There will be found a succinct account of his investigations, set forth in form which should make his work a model for future investigators.

The Housemaid and the Dustpan.

To those who know the true inwardness of things the sight of a housemaid brushing a dusty carpet is suggestive of many evils. The death of Pasteur has reminded the world of what is constantly present in the thoughts of medical men—namely, that while micro-organisms are the great producers of disease, dust is the great carrier of micro-organisms. Now that we know these things, it is distressing to find how little our knowledge is put to practical use, and to see old customs still unchanged, old habits which we know to be destructive carried on, and to find the housemaid on her knees, with her brush and dustpan, stirring up dust to the detriment of everyone, and breathing germ-laden particles to her own destruction. It needs but a small amount of common sense to see that if carpets must continue, a thing greatly to be deprecated, they should be rubbed with a damp cloth rather than brushed, and that if, in deference to prejudice, they must be brushed, this should be done by a covered American sweeper with plenty of damp tea leaves. Of all ways of removing dirt from a carpet the worst is by the use of the ordinary short brush, which involves the housemaid kneeling down in the midst of the dust which she so needlessly creates, and drawing it into her lungs with every breath. For ordinary household use something like linoleum, something which can be washed with a wet cloth every morning, would seem to be the best covering for floors; but if carpets must be, and it is impossible to teach the present generation the evils of seeking present comfort at the expense of future risks, at least let us remember that carpets may be washed even where they lie; that, till the day of washing comes, a closed sweeper is far better than a brush, and that the worst form of brush is one with a short handle.—British Med. Journal.

A New Heavy Liquid.

A new heavy liquid has been discovered. Mr. S. L. Penfield describes its preparation in the December number of the American Journal of Science. Mix equal proportions of the nitrate of silver and thallium, and on heating the mixture it fuses at 75 degrees C., forming a clear mobile liquid of density 4·5, which mixes with water in all proportions. It can, therefore, be used to separate mineral particles of densities below 4·5. When still heavier particles have to be separated, the proportion of thallium may be increased. When the ratio is 3:4 the mixture fuses below 100 degrees C. and has a density of about 4·7. At 2:4 the fusing point becomes 150 degrees C. and the density 4 8; at 1:4 it is about 4·9 and fusion only takes place at 200 degrees. Finally, when pure thallium nitrate is used, the point of fusion is 250 degrees C. and the density closely approaches 5. This high range of densities, together with the fact that the salts do not attack many minerals, make the liquid especially valuable for mineralogical purposes. A convenient separator is described by the same author. It consists of a thimble-shaped cup, into which a wide tube is made to fit. The tube can be closed at the bottom by a hollow plug. This plug being removed, the heavy liquid is poured through the tube into the thimble, and the minerals are thrown in and stirred. The heavy particles sink into the thimble, and may be removed by closing the tube with the plug and withdrawing the thimble. The latter is then replaced, and the operation repeated with dilute liquid. With some practice an elaborate separation by densities is rapidly and easily accomplished.

THE United States Consul-General at Bogota, in a recent report to the state department, expresses the belief that American merchants are not alive to their opportunities in South American markets. For instance, if a merchant of Bogota sends an order to an American manufacturer for goods cut to a certain length and width, the manufacturer writes back that he does not cut goods in those dimensions, and will not fill the order unless the goods can be taken as they are. For this reason the foreign trade in that part of the continent is being largely taken by German and British manufacturers, who are more accommodating in this respect.

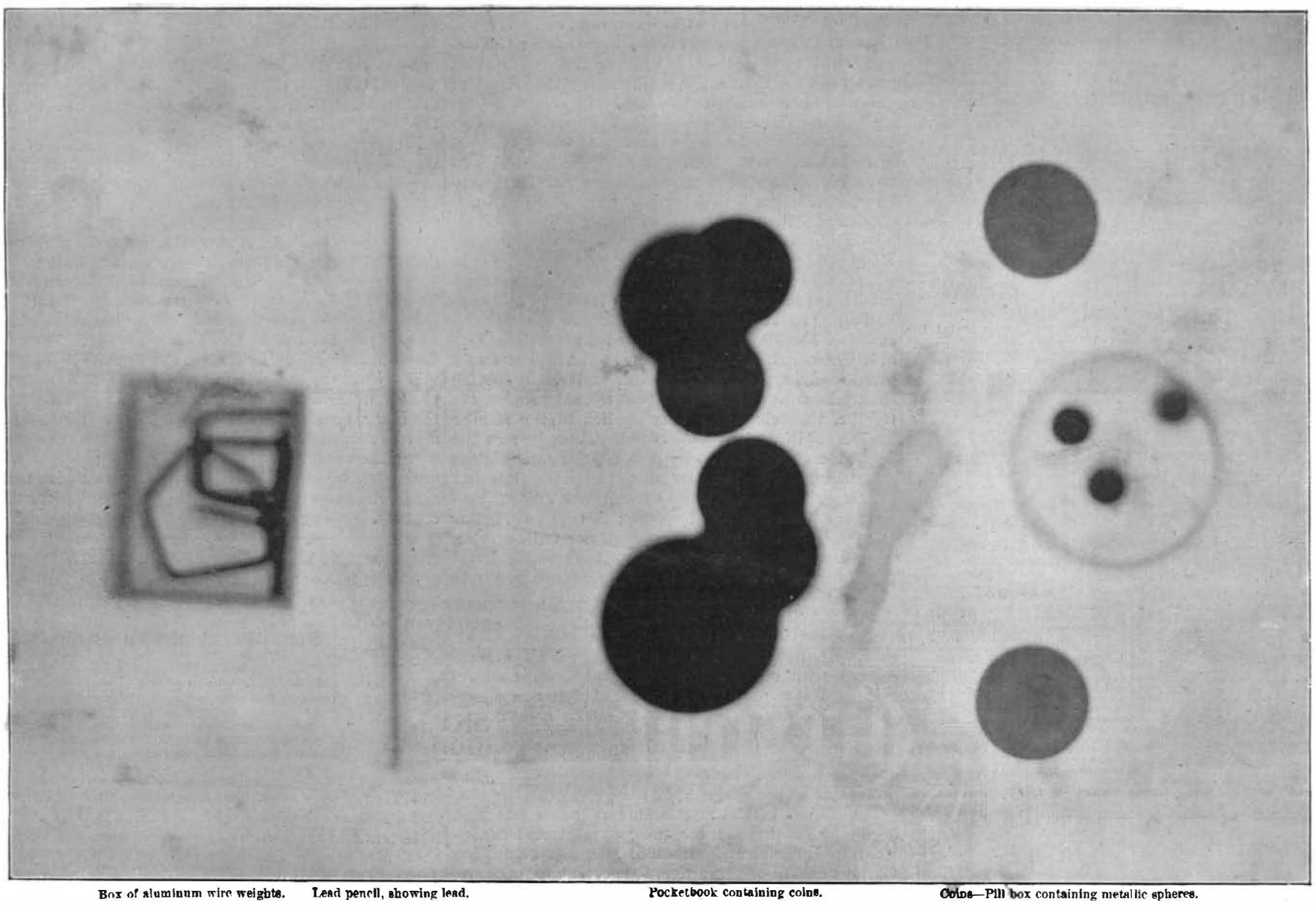
TWO Sicilian scientists, says Popular Science News, Grassi and Rovelli, have recently discovered that the housefly is the intermediate host of a species of tape worm which does much harm among chickens. The chickens eat flies whose bodies contain the larvæ of the tape worm.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class matter. Copyright, 1896, by Munn & Co.]

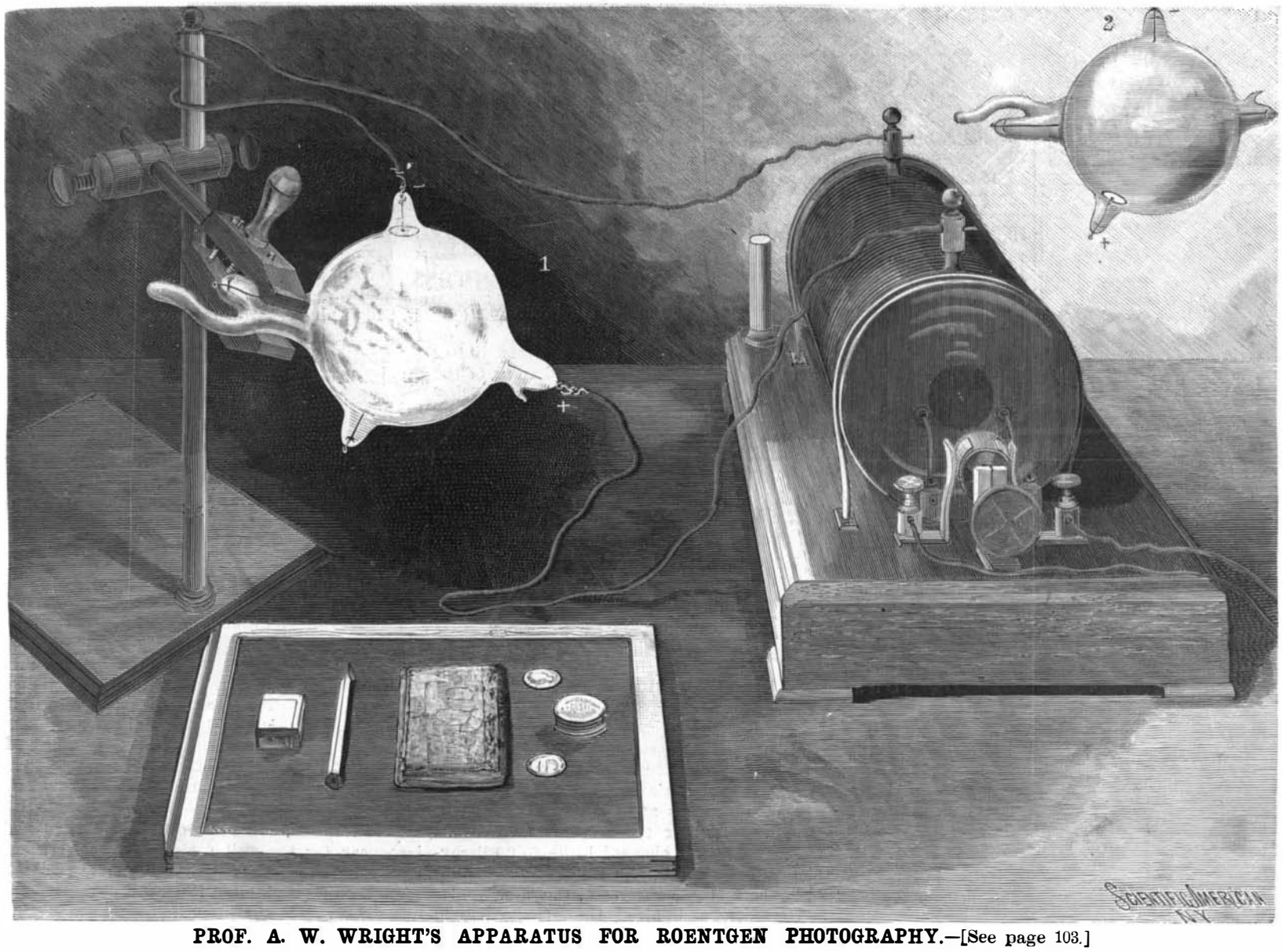
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXIV.—No. 7. ESTABLISHED 1845. NEW YORK, FEBRUARY 15, 1896 $3.00 A YEAR. WEEKLY.



Box of aluminum wire weights. Lead pencil, showing lead. Pocketbook containing coins. Coins—Pill box containing metallic spheres.

RAY PHOTOGRAPHS TAKEN BY PROF. A. W. WRIGHT AT YALE UNIVERSITY.



PROF. A. W. WRIGHT'S APPARATUS FOR ROENTGEN PHOTOGRAPHY.—[See page 103.]