TRUTH ABOUT X RAYS

A Correct and Lucid Statement of the Facts About the New Photography.

SOME ERRORS CORRECTED

Gross Exaggerations Are Current, Yet Wonderful Results Have Been Attained—What Scientists Really Think of It.

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The curious form of radiation discovered by Professor Rontgen of Wurzburg university, continues to attract much attention, the scientific world being largely occupied with the question, "What is it?" while the general public is more interested in the question, "What will it do?" Reports of experiments by Professor Rontgen and his followers have made one answer to the latter question familiar:—the rays discovered by him will pass through many substances that are opaque to ordinary light, and since they will affect a photographic plate just as light does, shadow pictures of objects enclosed in opaque matter may be made. The word "photograph" applied to these shadow pictures is unfortunate, as by a photograph we usually understand a picture of an object taken by light reflected from that object. No such picture can be taken by the newly discovered radiations. They cannot take, for instance, a full-face picture of a man, though they can throw a shadow of his profile on the sensitive plate. And since they can traverse flesh more easily than bone, the bones in the shadow picture of a man's hand stand out black while the surrounding flesh appears dimmer.

To this somewhat sensational discovery that the skeleton or a living being can be photographed, or "shadowgraphed," while it is yet clothed with flesh, we are indebted probably for the great public interest shown in Professor Rontgen's discovery, for that discovery is only the latest development of a series of investigations that have been going on for the past 30 years in England and Germany, none of which have attracted great popular attention, although they have been eagerly followed and discussed by students.

Ever since the mercury air pump was made so perfect that nearly all the air could be pumped out of a glass bulb, the behavior of the remnant has been noticed and wondered at. It is so peculiar that the air remaining in such high vacua is often said to be in a "fourth state of matter," the other three states of matter being respectively the solid, the liquid and the gaseous. If two metal points be soldered into the bulb so that a rapidly alternating current of electricity can be passed through the gas from an induction coil, we have what is called a "Crookes' tube," so named from William Crookes, the distinguished English physicist and chemist, from whose experiments the first clear light on these phenomena was gained. When the exhaustion of the tube is sufficiently high there proceed from the negative electric pole (called by physicists the "cathode") faint rays or streamers, which have been named "cathode rays." These move in straight lines and cause many objects on which they are directed to shine with a wonderfully beautiful phosphorescent light. They also exert pressure, as was beautifully shown by Crookes, who constructed one of his tubes with a miniature glass railway within it, on which rolled a little wheel like a windmill. When the cathode rays struck this the wheel rolled rapidly from one end of the tube to the other. The steam could also be shifted about by magnetic attraction. All these discoveries were not so sensational from a popular point of view as the photography of an invisible object, but they were more so to scientists, for at first sight they seemed inexplicable, and they convulsed the scientific world for a long time. Finally most people settled down to acceptance of Crookes' explanation, which considered the "rays" to be streams of air particles (probably actual molecules—the smallest particles obtainable) charged with electricity and shown off from the negative pole or cathode just as a charged pith ball is repelled from an electrical machine. The reason that the phenomenon appeared only in a high vacuum was, according to him, that the air or gas of ordinary density, even the density of the so-called "vacuum" under the bell of an old-fashioned air-pump, the molecules are not free to move for sensible distances without striking against one another—their "free path," in other words, was too small. This explanation has been given without comment in most of the orthodox books on physics. But about two years ago, German experimenters threw a bombshell in the English camp by showing that the cathode rays would pass through thin films or sheets of certain metals, and that by inserting an aluminum "window" in the glass tube they could even be made to pass out into ordinary air. Hence, it was argued, they could not be streams of molecules, but must be a kind of light, and Lenard, one of the German investigators, pointed out, in additional support of this view, that the rays would produce photographic impressions. If he had followed this up, Rontgen's discovery would have been antedated. As it is, these experiments have again thrown into doubt a matter that was once thought by many to be definitely explained. The English stand by Crookes, the Germans by Lenard, and each side has obtained new experimental evidence that only adds to our perplexity. If the rays are streams of electrified gas, how do they strike through solid objects and take photographs? If they are a kind of light, why do they drive windmills and follow a magnet?

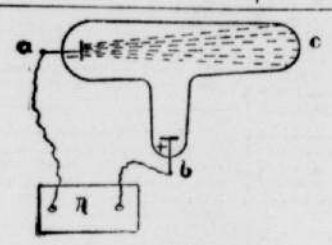

Fig. 1.

Fig. 2

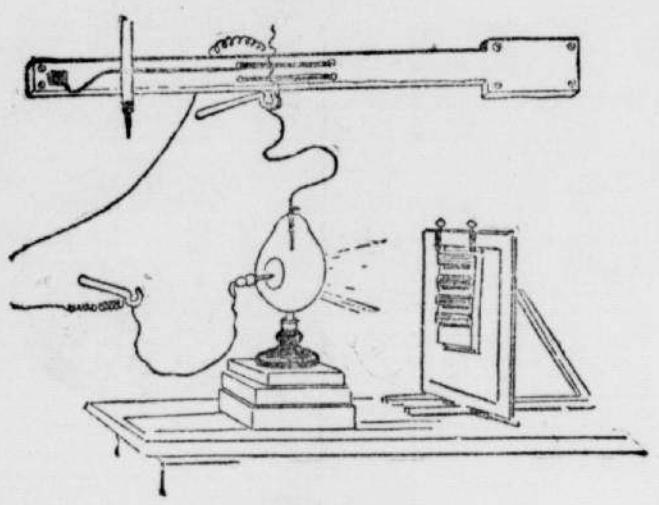

Fig 3.

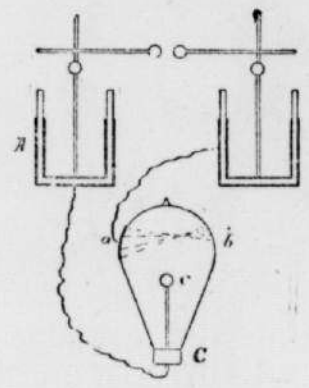

Fig 4.

Fig 1.—Typical Tube Showing Cathode Rays. A. Induction Coil. a. Negative Pole or Cathode. b. Positive Pole. c. Rays.
Fig. 2.—Form of Crookes Tube so arranged that the Rays when deflected by a Magnet, turn a mill. AA. Electrodes. B. Windmill. C. Rays concentrated by Mirror. M. Magnet.
Fig. 3.—Edison's arrangement for Making Roentgen Shadowgraphs.
Fig. 4.—Arrangement used by Prof. Pupin of Columbia. A. B. Leyden jars. C. C. Single Electrode or vacuum bulb. a. Strip of Tinfoil on outside. b. Rays.

It can now be seen that Rontgen's discovery was only the logical outcome of a long series of previous experiments. To say this is not to belittle him, for this is the usual course of discovery and invention. Rontgen's discovery is that the cathode rays, or that part of them capable of taking photographs, or perhaps a second kind of rays generated by them, will pass not only through an aluminum window, but through the glass sides of the tube itself and through most solid substances, and that they will so pass with different degrees of ease. If they passed through all substances alike, the shadow-pictures already referred to could not be taken; it is only because, for instance, the bones are more opaque to them than the flesh that we can make a shadow photograph of the skeleton of the hand.

Photographed by Mr. A. A. C. Swinton th .6212 inch thick; exposure 4 minu rough a piece of black vulcanized fiber, tes. (Mr. Swinton's own Hand.)

The actual discovery was made by accident, and in his original description of it, read at Wurzburg last month, Professor Rontgen does not dwell particularly on the photographic possibilities. He made the discovery by noticing that a phosphorescent substance near a Crookes tube over which a cloth had been thrown gave out a gleam whenever the current was sent through the tube, although the cloth prevented the tube's light from being seen. The discoverer is decidedly of the opinion that the rays which pass the glass walls of the tube are not the cathode rays, but a hitherto unknown kind of rays generated by the cathode rays in the glass itself. Hence he calls them the X rays, since the letter X is used in algebra to designate an unknown quantity. He bases his conclusion largely on the fact that a magnet will not deflect the new rays, while its power over the cathode rays is one of their most peculiar characteristics. Others note the fact that Lenard discovered some time ago that the cathode rays were not simple, but made up of several different kinds of radiation, some of which were deflected by the magnet more easily than others.

Rontgen suggests, in accordance with the general German belief, that the cathode rays are a kind of light, or at least akin to light, that the new rays are vibrations lengthwise in the other, instead of crosswise, as those of ordinary light are supposed to be. Such vibrations have long been looked for by physicists, and it is natural that any new phenomenon should be ascribed to them. But Rontgen himself admits that there is not yet any positive evidence for his view.

The discovery once made, the experiments were quickly repeated and amplified all over the world, since they require no very delicate manipulation nor costly apparatus. In this country they have been performed with great success by Professor Wright and Mr. Bumstead at Yale, by Professor Trowbridge at Harvard, Professor Paupin at Columbia, and by Thomas A. Edison.

The possible use of the Rontgen shadow-protography in surgery was suggested in the first reports of the discovery. Professor Wright has succeeded by its means in locating exatcly a large number of shot in the body of a rabbit, and in Montreal a bullet was found in a man's leg by the same means. No one has yet succeeded, however, in photographing any of the internal organs of the body, for the obvious reason that these organs transmit the rays about as well as the surrounding flesh, and hence cast no separate shadow. No very sensational results in this line can be looked for probably, unless the sensitiveness of the process is much increased, and all reports that Mr. Edison, or any one else is preparing to photograph the human brain, with any prospect of success, may be looked upon with suspicion.

One direction in which the invention promises to be particularly useful is in the detection of flaws in metal, as in castings, armor plate, etc. A weld so finely made as to be quite invisible to the naked eye is brought out at once in a shadow-photograph by the Rontgen rays.

The process of making the shadow-photographs, as at present carried out, is of the simplest. The object is placed on the plateholder, and the Crookes tube is suspended close above, thus throwing a shadow of the object through the plate-holder, on the plate within. The feat may be performed in broad daylight, since sunlight cannot penetrate the plate-holder, while the X rays can.

Shadow photographs have also been made recently by placing the object and the plate between electrodes in open air, without the intervention of the Crookes tube at all. This, however, is not cathode photography, but the development of a form of electro-magnetic photography that has been performed many times in the past two years. More than a year ago a photograph of a coin made in the dark by Professor Sanford of Leland Stanford university by laying it on a photographic plate and subjecting it to a powerful alternating discharge, was reproduced in a large number of technical papers. The sensitive plate in this case is affected by electro-magnetic waves proceeding across it. It is possible, however, that there is a real connection between this process and cathode photography, and that when this connection is known the whole mystery of the cathode rays will be cleared up.

It must be assumed, however, that all processes of photographing by invisible rays are the same. There are many kinds of invisible rays, for instance, those of invisible heat, as from a stove that is not heated to redness. It is now possible to photograph with these last, as well as with the invisible ultra-violet rays of the extreme upper part of the spectrum. The Rontgen discovery, like most widely noticed discoveries, has been productive of a large amount of sensational predictions and foolish suggestions, many of them the result of a partial knowledge of the subject, although some may perhaps bear fruit in new discoveries. The hope that great practical results will follow in the way of photography of the interior of solid bodies, as has already been pointed out, seems hardly warranted by anything that has been done so far. The possibility that the rays may have some peculiar effect on the human system has excited interest, but none has yet been discovered, although Thomas A. Edison has announced that he is about to experiment on their properties as germs killers. As is well known, ordinary sunlight is fatal or injurious to the growth of disease germs, and the new rays may possibly be more so. During a recent attempt to photograph a mouse with the rays, the animal, which was supposed to be drowned, revived, and this incident was made the most of, in a sensational manner, but the experimenter himself said that he believed the rays had nothing to do with the mouse's recovery.

One of the directions in which new discoveries may follow is that of rendering the image or shadow cast by the rays visible to the eye.. A process proposed by Mr. Thompson, a New York electrical engineer, is to receive the shadow picture on a surface covered with a fluorescent substance instead of on a photographic plate. Fluorescence would be excited in varying degrees, according to the proportion of the rays transmitted by the object, and a shadow picture of it would thus appear corresponding to the shadow photographs already taken. This process has not been developed in detail, but there seems to be no reason why it should not succeed, although the hopes of the inventor, if, as alleged, he expects by its aid to see the human heart beating in the living body, may never be realized. It must be remembered, however, that in a discovery of this kind, delicacy of result depends largely on perfection of detail in the process, and the generation that has seen the development of the modern photograph, together with the kinetoscope, the telephone and the phonograph, need not be surprised at anything in this line. Only, the skeptics may be pardoned for wishing to see before they fully believe.

A Windfall.

Charles Pickett, a young man who has been working for different persons in Hood River since last summer, received a letter last Monday from his mother, living at Crawfordsville, Ind., which stated that an uncle of the young man had died recently, leaving $32,000 worth of property and money to him and a brother and two sisters. This will give them $8,000 apiece. Young Pickett is now at work for A. B. Jones, with whom he had bargained to work until the close of the next strawberry season. The young man says he will stay with Mr. Jones as long as he agreed to, and will then go back to Indiana to claim his legacy.

A multitude of claims for an article weakens each individual claim.