THE PRESENT STATE OF X-RAY WORK.

BY PROF. WILLIAM C. PECKHAM.

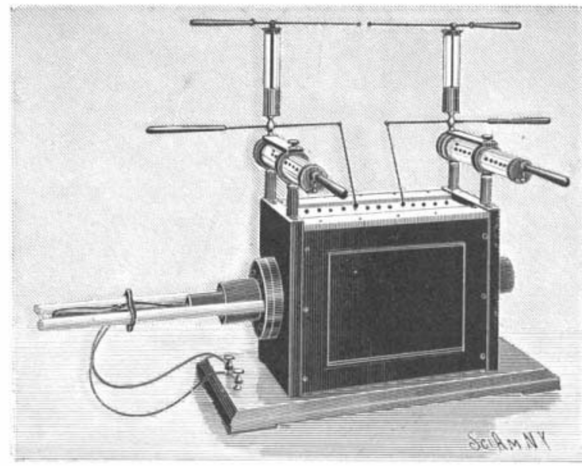
Five years have elapsed since Prof. Roentgen startled the world by the announcement of his discovery of the rays which are now quite commonly called by his name. We can now judge whether it is to be of permanent value to man.

We must admit that no more is known to-day as to the essence of the rays than was contained in Prof. Roentgen's original paper. Thus their identity in character with light rays has not been established by the usual tests. They do not behave like any other radiation known to science; yet scientific men are generally of the opinion that they belong in the ultra-violet region of the spectrum, perhaps having the shortest wave length of any known radiation—so short that it is not possible to deviate them from their course by any known form of reflecting or refracting substance. It is not settled whether the rays originate within or on the outside of the tube. Some hold that they proceed from the anode within the tube, pass through the glass and on in straight lines. This seems a most reasonable view, since the platinum of the anode is the seat of the highest activity while the tube is producing rays, becoming white hot under its terrific bombardment from the cathodic streams. But others hold that these streams, upon striking the glass of the tube, set up the X-rays, which therefore proceed only from the outside of the glass.

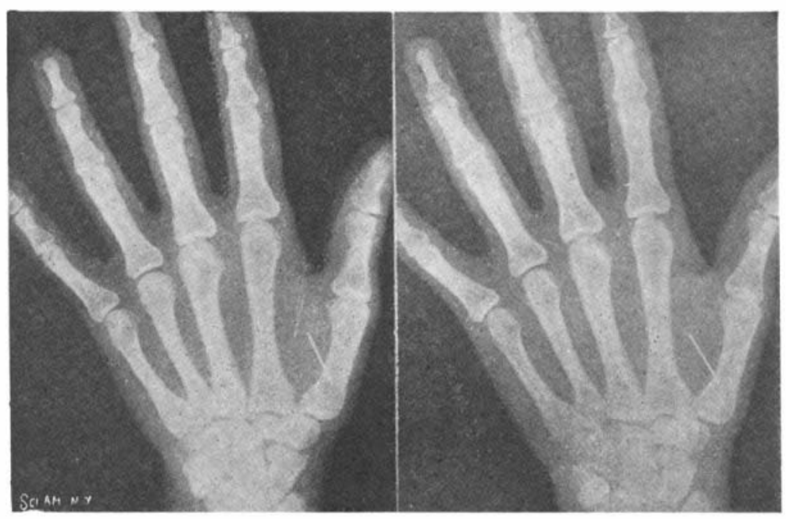
In disclosing and locating foreign bodies buried in the tissues, great progress has been made. There are now several apparatus by means of which the combination of two radiographs will show the location of the article sought at the intersection of two lines drawn through the body of the patient. A simpler method for reaching the same result has been devised by Dr. G. P. Girdwood, of McGill University, Montreal. He has succeeded in making stereoscopic radiographs. This is done by making two exposures, one after the other, from points two and a half inches apart. These points are accurately located, and the tube is placed with exactness in the positions determined for it. The two exposures are made exactly alike, and the plates are developed as nearly alike as possible. We reproduce herewith a hand in which is a needle. Before the stereoscope the appearance of solidity in these pictures is remarkable. The reader may verify this with a stereoscope. The exact location of the needle is easily seen. It is upon the palmar side of the hand, inclined from the thumb bone toward the center of the hand. The cut can be made with all the certainty of vision, down across the needle. In the case of fractures and dislocations, the stereoscopic view shows the exact location of the disturbing fragment of bone, and the setting can be made with certainty. A curious feature of these views is that they are reversible. If you look at the picture from one side, the view is as a front view; if from the other side, the view is a rear view.

Five years ago it was thought impossible to make a picture which would show the condition of the soft tissues of the body. This is now easily done. Almost every organ of the body can be depicted upon the sensitive plate. Enthusiastic practitioners with the rays claim to be able to detect the existence of certain diseases before the ordinary symptoms can be heard or seen, and while, in many cases, they are still curable. The various calculi of the bladder, gall sac, and the kidneys may be located. The surgeon may know when to operate upon a kidney with certainty. Consumption, even in its incipient stages, may be demonstrated, and the condition of the lungs may at any time be portrayed. An X-ray photograph will show a cavity of the lung, or a space filled with liquid, or an adhesion. Some claim that consumption in its early stages has been cured, and the dread lupus has been destroyed by direct application of the rays.

The later forms of tubes leave little to be desired. The penetration has increased with the development of the tube, until to-day a good picture of the thickest parts of the body can be had in a few minutes' exposure. In recent forms of tubes the vacuum is adjusted automatically by inclosing a substance which may be vaporized by heat.



THE A. W. L. UNIVERSAL COIL.



A STEREOPTICON RADIOGRAPH FOR LOCATING FOREIGN OBJECTS.

In the static machine many changes have been made since they have been employed for X-ray work. They are now built with sixteen plates, eight revolving plates, of 72 inches in diameter. Even greater advances have been made in the construction and design of the induction coil, and now few large coils are made with a cylindrical secondary. A spark length of one inch per pound of secondary was considered large not long ago; but coils are now built giving much more than this.

A coil recently designed by Dr. Rollins presents features of interest. It is a universal coil, giving sparks of all lengths up to its maximum length of 13 inches. There are thirteen sections in the secondary. These are joined to each other, and the junctions of the sections are brought out to balls upon the top of the box, as is shown in our cut of this coil. The sliding rods, bent at right angles, control the number of sections which are in action at once. When the rods rest upon adjacent balls, a spark of a quarter-inch is given. The rest of the secondary is idle. Above these discharging rods are seen two Leyden jars, to the inner coatings of which are connected two rods which may be brought together or separated, varying the character of the discharge accordingly. The horizontal glass tubes contain a multiple spark gap. By adjusting these the proper spark gap for the tube may be quickly obtained. The primary coil is also movable, and may be slid in and out by the handle on the left, so that the inductive action may be made weaker or stronger, as desired. With all these adjustments at one's disposal, a tube can be taken, which shows only a reddish Geissler discharge, and brought up to full power in a few seconds. Most of the separate features of this coil are not new, but their combination gives the operator a range of power and resources which he has not had in one apparatus.

ELECTRICAL GYROSCOPES.

BY HOWARD B. DAILEY.

The advantages of a gyroscope whose action can be maintained for any desired length of time are obvious. Mr. George M. Hopkins in "Experimental Science" has described several forms of this curious instrument in which the various agencies of steam, compressed air, and electro-magnetism are ingeniously employed to render the rotation of the disks continuous. The apparatus represented in the accompanying engravings are unique, as they are possibly the first examples of continuously-acting gyroscopes using static electricity as a motive agent. Fig. 1 is a modification of that familiar type known as the "gyroscopic top," or unbalanced gyroscope, whose singular gravity-resisting powers seem to defy all attempts at satisfactory explanation in any simple, popular way. In this experiment a 6-inch disk of sheet vulcanite 3-16 of an inch thick is mounted on a short pivot-pointed steel axle, in a frame formed of two parallel pieces of light vulcanite tubing. The upper ends of these tubes, which are of unequal lengths, are fitted into parallel grooves in the opposite sides of a 2-inch hollow wooden ball; and are secured in place by a slender binding rod of straight brass wire, whose threaded projecting ends are provided with polished aluminium screw knobs. The hollow ball is obtained by splitting a solid ball in halves, which are hollowed out as thin as possible and glued together again, after which it is given a conducting coating of tin-foil cemented on in small pieces with shellac varnish. The surface is then carefully rubbed down with some smooth instrument. Hollow balls and tubing are used for the reason that the less weight the gyroscope has to sustain, the slower and more stately will be its movement about its point of support. The shorter of the vulcanite tubes has passing through its lower end a cup-pointed brass screw, which serves as the outer bearing of the axle; the inner bearing being an indentation in a light brass sleeve embracing the longer tube at about its middle, and forming the anchorage for the 3-16-inch steel arm upon which the gyroscope proper is suspended. The lower end of the longer tube bears a small dumb-bell shaped aluminium receiver, presented endwise toward the disk, and adjusted, like the wooden ball, very close to its edge. The two insulated receivers gain opposite electrification from stationary points of supply through flexible rubber-covered conducting cords in a manner presently explained.

The vertical support for the gyroscope is a rod of vulcanite, eleven inches high. In its upper end is drilled a 5-16 inch hole 3 inches deep. A pointed steel pivot upon which the system revolves passes loosely through a brass bushing in the upper end of the hole and rests in a cone-shaped depression in a

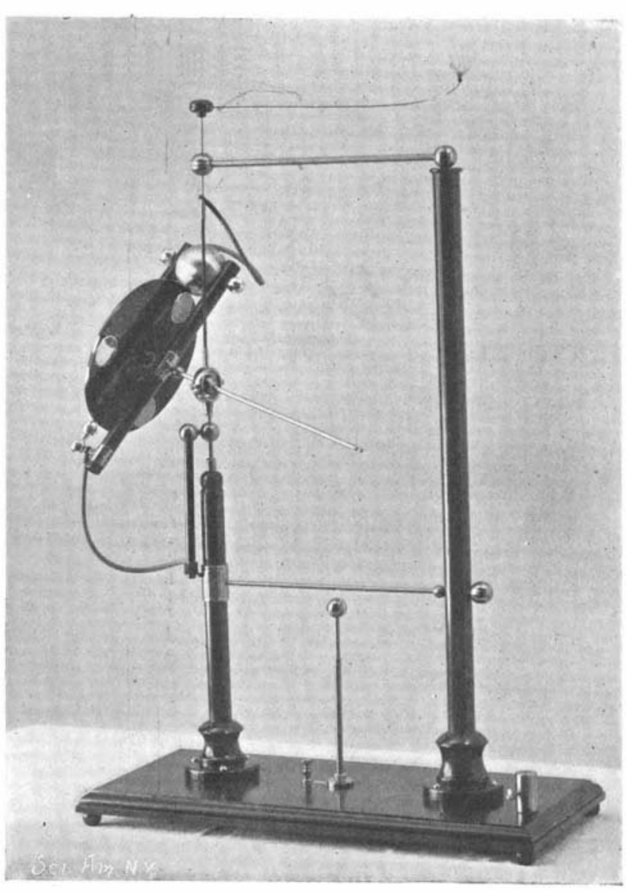


Fig. 1.—ELECTRICAL GYROSCOPE.

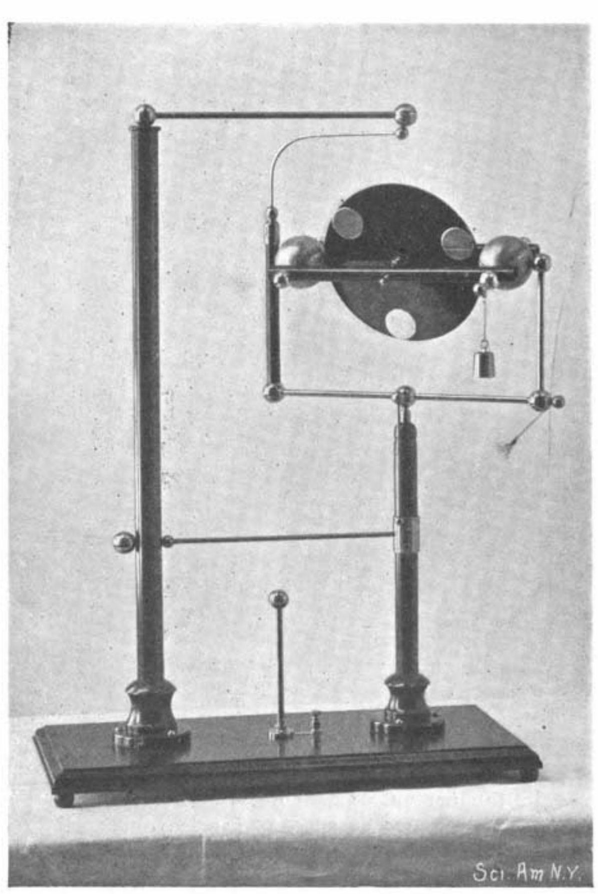


Fig. 2.—BOHNENBERGER APPARATUS DRIVEN BY STATIC ELECTRICITY.