CONTRIBUTED ARTICLES.

THE MYSTERIES OF THE "X-RAYS."

By Capt. C. S. Stockley, R.A.M.C.

DURING the last few years a great deal of mystery has been thrown around the subject of X-ray and this mystery has been magnified by the press and the chitter-chatter of the club. A few general principles will help those who know nothing of the apparatus to understand and appreciate something of its mechanism.

In these war days when medical men are at such a premium, and when we read reports of the scarcity of doctors, it is well that the trained nurse should be able to help in any X-ray department, more than she has in the past and to be of real assistance a nurse must know the principles. One Corporal in the R.A.M.C., who knew the principles of electricity has done splendid work on one of our fronts, practically halving the X-ray specalists work in that particular hospital.

"It was in the year 1895 that Professor Röntgen of Würzburg discovered the presence of the mysterious X-rays during the course of certain experiments. 'X' is indeed the sign in this case that denotes an unknown quantity, for even at the present day little more is known of these rays, than when Röntgen first gave his discovery to the world. But the knowledge of how they may be produced and how they may be adapted to the uses of man has rapidly progressed, opening up so many new fields of investigation and throwing so much fresh light upon clinical facts that we are apt to forget the "X" and take for granted the new faculty they have given us, the power of *seeing through* the human body."

There are many types of apparatuses but I shall confine myself to describing those used in some of the Army Hospitals and they will serve to illustrate the principles and mechanism in general.

The apparatus required for making an X-ray examination consists of five essential parts :

(i) The power from the electric mains or local accumulators.
(ii) The induction or Ruhmkorff Coil.
(iii) The interrupter or break.
(iv) The tube which generates the rays.
(v) The photographic plate or fluorescent screen by which the action of the rays is rendered visible to our eyes.

The Induction Coil is used to induce a current of sufficiently high potential. It is an apparatus consisting of two associated coils of insulated wire employed for the production of currents of mutual induction. By this means a voltage of 50 or 100 volts is transformed into that of 20,000 or 50,000 volts although the total energy is the same.

If one were to attempt to pass the electric current direct through the vacuum tube by connecting the positive and negative terminals of the accumulator to the corresponding terminals of the tube, no rays would be produced,

the reason being that the force or pressure of the current would be insufficient. To explain this let us take an analogy. Suppose one has a cistern full of water with which to produce a fountain. If the cistern is placed on a level with the fountain the water will only trickle away from the fountain, but no spray will result. Why ? Because there is not sufficient force or pressure. But if the cistern is taken to the top of a house or a pump employed, the force or pressure of the current of water will be increased and the fountain will play. This is by no means a perfect illustration but it is easy to understand in order to intensify the current of electricity some contrivance is necessary and the best known one is called after its inventor Ruhmkorff's Coil. The coil is made up of (*a*) a *primary coil* consisting of a number of sheets of metal or wire of soft iron insulated from each other, and usually called the core, round which a number of turns of thick copper wire are wound. (*b*) *the secondary coil* consisting of many thousand yards of thin insulated wire wound round the primary core.

Underneath the induction coil there is usually placed the *condenser* which is an apparatus for storing the large amount of electricity induced. It consists of a number of sheets of thin tin-foil insulated from one another by waxed paper.

The next part is the *Interrupter or break*. For practical purposes there are three types of interrupters in use :

(1) The Vibrating or Nieves hammer.
(2) The Mercury Interrupter.
(3) The Electrolytic Interrupter.

The Nieves hammer is attached to the induction coil. There are two regulating screws. One regulating screw carries a fixed platinum contact and the other is mounted on the back of an iron block or armature. The other screw is for regulating the tension.

The Mercury Interrupter is the one universally used and there are a great number of different patterns but all are worked on the same principle.

The Watson Dreadnought has the motor, for driving the interrupter, above, and a mercury jet rotates in an iron vessel below. Hydrogen gas is used as a dielectric but ether vapour can be used.

A dielectric is any substance or gas which offers high resistance to the passage of an electric current and gas is thus used to assist in breaking the current.

Then there is the Sanax Mercury Interrupter which is a centrifugal interrupter made by a standard firm. This Interrupter has the motor below and has a small steel pear-shaped bowl mounted direct to the axle of the motor and inside this bowl is about 10 ozs. of mercury and some paraffin oil or alcohol, as a dielectric.

Lastly, there is the Electrolytic Interrupter which is coming more into prominence because of its simplicity of construction. It is composed of a platinum wire which is immersed in dilute sulphuric acid contained in a lead-lined box.

The principle involved is one of electrolysis which causes hydrogen and oxygen to appear on a current being passed through and these gases form an insulating mantle around the anode which interrupts the current.

The most important factor in the X-ray apparatus is the X-ray tube itself which generates the rays.

Sir William Crookes in 1891 studied the effect of electrical discharges in high vacuum tubes and first designed a tube. Since his day many evolutionary changes have taken place in the tube at the hands of Röntgen, Leonard and Herbert Jackson.

To-day the X-ray tube is manufactured by first the blowing of a glass sphere with a neck. Then various metal parts or electrodes are introduced through the neck and all in turn are sealed in position by a glass blower. Various names are given to the different parts of the X-ray tube, the heavy metal end which carries the target is called the anticathode, while the lighter less complicated end is called the kathode. Then in most tubes a separate anode end is supplied which may or may not be joined externally to the anticathode and that has the effect of making the tube steadier in action. The anticathode is the all-important part, since at that end heat is generated. The target of the anticathode is put at an angle of 45 degrees to the axis of the tube, so as to throw the main part of the X-rays to one side of the tube. Many tubes have a regulating chamber of mica, which acts as a reservoir of air, and it is connected to the terminals of the tube by stiff wires by which, when the current is allowed to pass, the vacuum of the tube is decreased.

The working of the X-ray tube depends upon the fact that when a high voltage current, such as off a main or accumulators, is made to pass through a glass tube from which nearly all the air has been extracted, sparking no longer takes place between the terminals but the current passes across the gap in an invisible stream from the positive to the negative pole. In doing so it produces several important phenomena inside the tube. From the negative pole or kathode within the tube a stream of rays of extremely short wavelength is repelled perpendicularly in every direction. This radiation is known as the *kathode stream*; it can be deflected by a magnet and has the property of giving rise to a green fluorescence inside the tube which must not be confused with the invisible X-rays. When these kathode rays strike against any metallic substance they set up the remarkable form of radiation to which the name of X-rays was given by their discoverer, Röntgen, in 1895. In the modern form of X-ray tube the kathode or negative terminal is made of aluminium and has a concave surface, thus bringing the kathode stream to a focus at one point upon the face of the positive pole. The latter terminal is called the antikathode or target because it receives the bombardment of the kathode stream.

In order to render the action of the rays visible a fluorescent screen or photographic plate is necessary.

The fluorescent screen consists of a film of barium platino-cyanide spread out upon cardboard and if the part of the body to be screened is put between the rays and the screen in a dark room the shadow of the bones is thrown upon the screen.

In writing this article I have thought of those who desire to know the principles of X-ray rather than those who are actually working an apparatus. Next month we will discuss more the properties of X-rays and touch upon the much more interesting parts in their relation to medicine and surgery.

References.—1. Knox's X-ray.
2. X-ray Diagnosis and Treatment. Bythell and Barclay.
3. Arthur and Muir Manual of Practical X-ray Work.
4. Textbook of Radiology, by Morton.

ACCOUCHEMENT OUTFIT FOR INDIAN WOMEN.

By Dr. Ruth Wilson.

IT has always seemed to me that one of the chief difficulties we have to contend with at Indian confinements is the lack of material for carrying out practical cleanliness.

Medical women take with them bags packed with all that can be needed, but midwives and dais, cannot afford to do so, with the result that the labour goes on pretty much as if no one but the untrained dai were present.

When I was in practice I was not infrequently asked by Indian men of the middle classes what they ought to get for their wives confinements. It was not an easy business to make the list of things required. Sometimes the man was unable to get them and if he did the dai was often unaware how to use them. Husbands used sometimes to ask the dai what they should get and I noticed that under these circumstances a dai usually ordered a water-proof sheet and a douche can both of them rather expensive, and hardly providing all that was needed.

The most necessary articles for a dai to carry, I suppose, are soap, scissors, antiseptic lotion, and a small basin. These she ought to supply herself with, unless the municipality under which she is working will do so.

I have been trying during the past year to put together a packet containing the articles which the patient might reasonably be expected to provide and the possession of which would enable an Indian dai possessing the first named articles to conduct a labour in a middle-class or poor Indian house with all the essentials of cleanliness.

The models taken were Hartmann and Southall's accouchements outfits.

Every effort has been made to turn out inexpensive articles as it is realised that nothing else will be at all freely used. The packet now shown was made at the Lady Hardinge College and consists of the following :—

1 waterproof sheet (a yard square of brown paper tarred, and a single layer of gauze laid over).
2 sanitary sheets each 2 ft. square, consisting of gauze and tow (one intended for use at the confinement over the water-proof sheet, the other during the puerperium).
16 sanitary diapers of gauze and tow,
36 swabs of tow.