

each trained nurse, if she approves of the principles contained therein, to sign the "Petition to the Prime Minister" which is placed on the last page of this month's issue. The form when filled in is to be sent to Miss Mill, Lady Superintendent, St. George's Hospital, Bombay, who will kindly forward all forms received to Miss Beatrice Kent, Hon. Secretary, "Nurses' Petition," 43, Oxford Street, London, W. 1. We trust that nurses will not treat this matter with indifference as although they are resident in India the problem of the best mode of State Registration is one which affects vitally the whole nursing cause and to ignore the call is plainly a neglect of duty.

## CONTRIBUTED ARTICLES.

### THE MYSTERIES OF THE X-RAYS—(concluded).

BY CAPTAIN C. I. STOCKLEY, R.A.M.C.

*How to take an X-ray?*—In order to take a radiogram the photographic plate is enclosed in some form of carrier or envelope, that is opaque to light but offers no resistance to the passage of X-rays. This protected plate is placed beneath that part of the patient of which a radiogram is required, and the X-ray tube arranged in a suitable position above. In some cases it may be of advantage to fix the tube beneath the table, and the plate above the patient. In either case the rays are made to pass through the patient before reaching the plate and so cast shadows of the parts of the body whose depths will vary in direct proportion to their opacity to the rays.

The *length of exposure* required is in all probability where the beginner's greatest difficulty arises. People vary in size and fatness tremendously in the various parts of their anatomy, as well as in the opacity of their tissues. Strong athletic subjects are always more opaque to "X-rays" than others of similar weight and size.

Two tubes possessing different degrees of vacuum may give totally different radiograms with the same length of exposure and the same strength of current. At the same time, if we take a standard size tube and work it with a current of one milliamperè at a distance of 24 inches from the plate it will be found that the following list of exposures will be found fairly correct.

|                                  |       |                       |
|----------------------------------|-------|-----------------------|
| Hand and toes                    | .. .. | 20 seconds.           |
| Forearm, arm and ankle           | .. .. | half a minute.        |
| Shoulder, thorax, thigh and knee | .. .. | one minute.           |
| Hip                              | .. .. | two minutes.          |
| Head and abdomen                 | .. .. | two to three minutes. |

In this simple exposure table it is assumed that the penetration of the X-ray tube is about 8 or 9 on Wehnelt's scale, and as the current passing through the tube is one milliamperè the exposure may be expressed in milliamperè seconds, *viz.*, a hand will need an exposure of 20 milliamperè seconds. When in doubt

always give an over-exposure because it can be corrected in development by adding a few drops of 10 % solution of potassium bromide to the developer.

The most essential part of the apparatus is the X-ray tube, and how to regulate the vacuum is a matter of importance. A low vacuum tube is spoken of as "soft," while a high vacuum tube is known as a "hard" tube. A soft tube has (a) a weak resistance to the electric current and therefore there is a higher milliamperage registered, (b) Rays of short wave length, (c) Less penetrating power than the hard tube, (d) A powerful action on the photographic plate.

Thus with a low vacuum (soft) tube the action on silver compounds on the photographic plate is very intense but the rays have very little penetrating power. Obviously if the rays do not get through the part X-rayed no radiograph will result no matter how active they may be in the reduction of the silver compound. So it happens that for every part of the body, there is a critical degree of vacuum of a tube, where the penetration and photographic effect of its rays are such as to produce the maximum effect in the shortest time, and this is the goal of every radiographer.

To estimate the hardness or penetrating power of a tube several different methods may be employed. Two of the chief ways are, either by the measurement of the spark gap or by a radiometer. The spark-gap is usually placed on the Induction Coil, and it will be understood that the current from the coil has the choice of two paths, either through the X-ray tube or across the spark gap. On a scale provided we can tell the approximate hardness and softness of a tube. For instance, if the current prefers to go through the tube, when the points of the spark-gap are only two inches apart, then, the tube is very soft; if the points are two to four inches apart it is a "soft tube," if four to six inches it is "medium;" while over six inches it is "hard." This scale is very convenient but is only approximate and in testing tubes one should endeavour to have the same current flowing,—let us say one milliamperè.

For if we set the spark-gap with a small current and then suddenly increase the latter, we shall find that the current all goes through the gap instead of through the tube. The radiometers determine more accurately the penetrative power of a tube. The common ones were devised by Walters, Benorst and Wehnelt and are called after the names of their inventors. All are graduated aluminium scales.

The latest type of tube, the Coolidge, is a great advance, for, here the hardness of the tube can be regulated from without, and in fact any degree of penetration can be obtained by simply adjusting the rheostat, that controls the temperature of the tungsten spiral, which forms the cathode of the tube.

2. *How to prepare a patient ?*—Certain things often cast shadows and seriously obscure the rays such are surgical dressings, metal splints, lead plasters, Plaster of Paris, zinc oxide, bismuth, iodiform, and the nurse who accompanies the patient to the X-ray room should get to know what particular dressing the patient has on under his bandage.

Owing to the comparatively small quantity of plaster in an ordinary plaster-of-Paris bandage, we can generally see through it sufficiently well to say if a fracture has been properly set and the fragments in good apposition.

Ordinary bandages, cotton, wool, lint and wooden splints offer so little obstruction to the rays that they may be ignored. Buttons and fasteners are disconcerting to the X-ray specialist and ladies should be provided with a thin dressing gown made without lining or fastenings of any kind except a ribbon for tying. They can then take off all skirts and petticoats and let the under-clothing down below the hips when the abdomen and pelvis have to be X-rayed. This obviates any necessity for even the least exposure and meets with the appreciation of the patient. Sand-bags, not too well filled, are splendid friends in an X-ray room, for they restrain the patient from making the slight involuntary movements often caused by nervousness.

In many cases in the present war surgery patients to be X-rayed have long sinuses, and it would be well for the nurse to bring a sterilised probe with her to the X-ray theatre when accompanying such patients, and to prepare the patient by putting on the minimum of dressings and bandage on the wound.

3. *How to develop an X-ray plate?*—Nurses can often relieve the pressure of work by developing the X-ray plates and so I will say a word on that subject. The development of X-ray plates present no difficulties. A proper dark room with water laid on, and a sink is of course necessary and in the hot weather in India a supply of ice is essential. If Ilford plates are used Metol-hydroquinone developer will be found the best, and a very good formula is the following :—

|                                |    |    |    |    |          |
|--------------------------------|----|----|----|----|----------|
| R.—Metol                       | .. | .. | .. | .. | 20 grs.  |
| Hydroquinone                   | .. | .. | .. | .. | 80 grs.  |
| Sodii Sulphit $\bar{a}\bar{a}$ | .. | .. | .. | .. | } 2 ozs. |
| Sodii Carb.                    | .. | .. | .. | .. |          |
| Potassii Brom. 10%             | .. | .. | .. | .. | 80 mins. |
| Aqua                           | .. | .. | .. | .. | 20 ozs.  |

With an ordinary exposure, development is complete in about 7 minutes, when the plate will appear quite black all over if held up to the dark room lamp, and the outline of the bones will be made out on examining the back of the plate.

The dish should be rocked all through the period of development and care should be taken to see that there is plenty of solution to cover the plate easily. I do not advise putting the plate with water before developing, for although one gets a slightly more even development air bubbles get on the plate more easily. Further, the dish should be kept in the darkest part of the dark room, for specially prepared X-ray plates are slightly sensitive to red light.

After development the plate is revised under the tap and placed in a fixing bath made up to the following formula :—

|    |   |                          |    |    |        |                                                             |
|----|---|--------------------------|----|----|--------|-------------------------------------------------------------|
| R. | { | Hyposulphite of Soda     | .. | .. | 1 lb.  | } Finally the plate is washed in running water for 4 hours. |
|    |   | Potassium Metabisulphite | .. | .. | 1 oz.  |                                                             |
|    |   | Water                    | .. | .. | 40 oz. |                                                             |

The metabisulphite of soda can be omitted in the last formula but then the hyposulphite gets dirtier sooner and stains the plates brown.

Care should be taken not to allow any light to fall on the plate, until fixation is complete, as this not only increases the time necessary for fixing, and is more than likely to cause a discoloured and foggy negative.

Another formula which is advised by the Ilford Company seems to be good, it is

|                                        |         |
|----------------------------------------|---------|
| 1 R.—Pyrogallie Acid .. .. .           | 1 oz.   |
| Potass. Metabisulphite .. .. .         | 2 drs.  |
| Water .. .. .                          | 30 ozs. |
| 2 R.—Potass Carbonate (anhydrous) .. . | 3 ozs.  |
| Sodium Sulphate (cryst.) .. .. .       | 3 ozs.  |
| Potass. Bromid .. .. .                 | 30 grs. |
| Water .. .. .                          | 30 ozs. |

Mix equal parts of No. 1 and 2.

Now that metol is so expensive, one of the cheapest ways is to buy Burroughs and Welcome's tabloids and I have found their hydroquinone tabloid developer very good indeed.

It must be remembered that metol and hydroquinone act differently on the photographic plate, metol being used to get good detail, while the hydroquinone ensures density. Hydroquinone acts best at a temperature of 60°. The metol should be thoroughly dissolved before adding to the chemicals, otherwise it will crystallise and be precipitated in the form of granules. Should any of these settle on the plate during development small dark spots will appear on the plate where the granules have settled.

4. *How to read a plate?*—Lastly, a short word on the interpretation of an X-ray negative. The correct reading of an X-ray negative is not easily acquired, except in the simple cases. However, if one has a knowledge of the normal radiograph, a good working knowledge of anatomy, and the clinical notes of the case, a careful inspection will generally enable one to determine if anything abnormal is present. Every X-ray room should have a set of normal radiographs taken at different ages, and for this there is no better atlas than "Atlas Typischer Röntgenbilder v. Normalen Menschen," by Grashey.

In the case of fractures screening only is unsatisfactory unless the lesion is a gross one, and a radiogram should be always taken. On a radiogram most fractures can be seen but difficulties arise even here in those fractures where there is a mere crack in the bone and no splintering or deformity.

Diseases of bone give more difficulty. In tuberculosis the outstanding feature is a loss of opacity to the X-rays. This lack of density in the bone is due to the thinning of the trabeculae. While a true tuberculosis deposit shows as a dark patch in the substance of the bone. But many mistakes have to be made before one can read an X-ray plate well and specialists in the subject have been known to mistake internal semilunar cartilages for the normal sesamoid bone in the gastronemius muscle.

Indeed the interpretation of a plate should be always left to the specialised M. O., so difficult is the subject.

In conclusion, I must say that a nurse can halve the X-ray specialist's work, but it will mean hard work and a patient attention to detail. One of the best handbooks for the beginner is that of "A Textbook of Radiology" by E. R. Morton and it is published by Henry Kimpton of London for 7s. 6d., and any nurse who is going to seriously help in a X-ray department would do well to get that book and absorb its contents.

Those nurses who do take up Radiology will find an interest in the subject, which, like a good X-ray plate, will be a thing of beauty and a joy for ever.

### AFTER "CROCS."

By Dr. A. E. MOORE.

"MUGGAR" shooting I've heard it called. The first time I heard the term I was rather mystified. A well-known sportsman and a certain member of the fair sex would make periodic disappearances from the station, and those in the know would intimate with the least little flickering of the eyelid that they had gone "muggar" shooting. Well—the haunt of the crocodile isn't overcrowded. We started off—that is, my chum and I, masculine gender, at about 9 a.m. in the car. We had borrowed the Nawab's elephant and sent him on with the kit and the tiffin. Our destination was the Jumna, ten miles off. I don't think kaccha roads are good for cars and we had six miles of it. About two miles from our destination a small jhil barred the way, so we left the car with the cleaner, waded across the jhil and trudged onwards to the river, commandeering two small boys to carry guns and ammunition. The river in this part of its course is in places only a few yards wide and in one or two spots is fordable. However, we did not want to cross just yet. The side of our approach was high, and across the river were low lying banks reaching up to a thick jungle of reeds. Cautiously we approached the banks, for the crocodile is a wily bird. To our joy we saw a fine fat fellow lying with his head away from the water, on the opposite side. He had been out some time for his colour was dead white, as the mud on him had dried in the sun. He was some 25 yards away, an ugly looking brute, I suppose about 13 or 14 feet long. Apparently he was asleep, for as a rule as soon as one approaches the crocodile flashes into the water with incredible swiftness for so bulky a reptile. Warning the boys with us to keep out of sight in the bushes, we lay down on the edge and took a careful sight. As I had a Martini Henry .450 bore and my companion only a .310 Sherwood I took the shot, for it takes more than a pop-gun to kill a crocodile, and even with a powerful rifle, you have got to hit him in the neck, or he slips into the water and you lose him. Then I fired. The huge beast writhed, opened his mouth wide and began to squirm towards the water. I fired again and missed. Tragedy of tragedies, I had no more rounds with me! Wildly I shouted to the boys to bring me some cartridges—no reply! Slowly the beast neared the edge. I fairly danced with rage