SOME APPLICATIONS OF THE "X-RAYS" IN DIAGNOSIS; ILLUSTRATED BY LANTERN SLIDES, SKIAGRAPHS, AND THE FLUORES- CENT SCREEN.

By WILLIAM S. HAUGHTON, M.B.;

Assistant-Surgeon to Sir Patrick Dun's Hospital, and Demonstrator of
Anatomy, T.C.D.

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It is with very great diffidence that I bring forward my communication before the members of the Academy this evening, as I feel sure you are all fully aware of what Röntgen photography has done up to the present, and its possibilities in the future, when applied for purposes of diagnosis in medicine and surgery. I shall, therefore, confine my remarks more particularly to those cases which have come under my own notice, and to the experience which I have gained in observing them.

After a study and practice of the application of "X-rays" in medicine and surgery during the past fourteen months, it appears to me that for convenience of description we may best divide those cases in which the process is applicable into three classes:—

I. Those cases in which the information obtained is *certain and complete*.

II. Those cases in which *some information is always obtained*, but it is not always complete.

III. Those cases in which *some information may be obtained*, but it is seldom complete.

Firstly, those cases in which the information obtained is *certain and complete*. In this class we may place—

- (a.) *Fractures.*
- (b.) *Dislocations.*
- (c.) *The fracture peculiar to early life, commonly known as Epiphysiary Fracture or Separation.*
- (d.) *The Location of Foreign Bodies.*—In the trunk, limbs, neck, and certain parts of the head, provided the foreign body consist of any of the *metals* (aluminium being excepted), *glass, china,* and some other substances.

Secondly, those cases in which some information is always obtained, but it is not always complete. In this class we have—

1. *Diseases of Bone:*—

- (a.) Rarefaction or Condensation of bone from any cause—*e.g.*, necrosis or periostitis.
- (b.) Tubercular disease of bone.

2. *Tumours of Bone:*—

- (a.) Osteomata.
- (b.) Enchondromata (particularly if ossifying).
- (c.) Sarcomata.

In the Third Class—those cases in which some information may be obtained, but it is seldom complete—we must include the skiagraphy of the trunk (with the exception of *foreign bodies*, as mentioned in the *first class*).

A skiagraph taken through the trunk, to locate a renal or vesical calculus; fracture, dislocation or disease of the vertebræ; to demonstrate the size or shape of the heart or liver, or a mediastinal tumour, yields a result which, up to the present time, is at best rather obscure. Still some useful observations have been made, and there seems little doubt that with progressive improvement in the apparatus—particularly of the “tubes”—much better results will in time be obtained.

With regard to my first class, it may be objected that the

information is not always *complete*. Now if we except the hip-joint and its neighbourhood—which is very opaque to “X-rays” owing to the great mass of muscles surrounding it—I think that the results obtained should always be complete, provided a good apparatus is used, in experienced hands, and with due precautions.

The case of a foreign body, say a needle in the foot, will serve as an illustration. Much discredit has often been thrown on the process, because after a skiagraph has been taken, showing the position of the needle clearly, the operation which followed has failed to discover the needle. This failure is usually due to one of two causes—either that the needle has moved during the interval between the skiagraphing and the operation, or else that the skiagraph was not taken intelligently. The first cause of failure can be easily remedied by using the fluorescent screen immediately before operation; this of course often requires a portable apparatus. The second can be readily overcome by taking two skiagraphs in planes at right angles to one another.

To take a skiagraph intelligently requires some common sense, but it also requires an accurate knowledge of osteology and the anatomy of joints.

To return to the “missing needle.” In order to locate a point in space accurately we must have measurements in the three dimensions in space—length, breadth, and depth. Now the skiagraph of the needle in the foot, taken from above the foot, shows accurately the relations of the needle with regard to the length and breadth of the foot; but we know very little of the precise depth of the needle, and so the all-important question to the operator as to whether his incision is to be on the dorsal or plantar aspect is still unanswered. Hence the failures.

The simple expedient of taking a second skiagraph at right angles to the first will, of course, reveal the depth of

the needle, and show whether it is placed nearer to the dorsal or plantar aspect. This method applies to all parts of the body in dealing with opaque foreign bodies. I may here state, that I believe the screen is much preferable to photography for the location of foreign bodies.

What has been said about "taking" a skiagraph applies equally to the intelligent "interpretation" of one, with this addition—for accurate interpretation one must have considerable experience in skiagraphical results.

It has been stated that the application of "X-rays" is limited to a very narrow field in surgery; but if we consider what a large proportion of everyday surgical practice is composed of fractures, dislocations, obscure epiphyseal fractures, tubercular disease of bone, and foreign bodies, I think it may be fairly claimed that the field of its usefulness is not so limited as it may at first sight appear.

With regard to the dermatitis sometimes following exposure to "X-rays," it is of interest to note the very small number of cases recorded out of the thousands experimented on. Of course this may arise from a very natural reticence on the subject. But still, if it were of frequent occurrence we should hear more of it. As far as we can judge, it appears only to follow very protracted exposures (an hour or more), or very frequently repeated short exposures, such as an exhibitor of the process must undergo. Protracted exposures are very undesirable on all accounts, and, therefore, I believe dermatitis should not occur at all with careful and cautious handling.

We should also note the interesting query of Dr. Lynn Thomas, of Cardiff—"Do 'X-rays' cause dermatitis?" In a letter on this subject in the *British Medical Journal* suggesting the possibility of the dermatitis being the result of an electrical influence in the neighbourhood of the conducting wires, he cites the fact that in some cases currents of unnecessary power were used.

In the cases which I have experimented on (over 150 patients) I am pleased to state there has never been a complaint of any discomfort whatsoever. Doubtless many other applications of the process in pathology might be quoted, but I have merely touched on those which have come under my own notice.

There are three tests which a good skiagraph should stand:—1. There should be a strong contrast between bone and flesh. 2. The outline of the bones should be clear and sharp. 3. There should be a good indication of the cancellous network in the interior of the bones.

Any good apparatus will give the first; but the second and third depend on the accurate rigidity of the part during exposure, to obtain which one requires a model patient, or a steady assistant. Indeed, the greatest difficulty I have had to overcome has been to study the conditions of maximum ease for each position of the limbs.

I fear I have already taken up too much of your valuable time, and I must ask your indulgence while I show you some lantern slides, after which I will hand round some skiagraphs, and then, if any members wish it, I shall be very pleased to show them the fluorescent screen working.

Mr. Haughton then projected on the screen a number of lantern slides illustrating the three classes of cases he had referred to—those of dislocations, foreign bodies (needles, bullet), tubercular disease and necrosis—demonstrating the various conditions remarkably well. Other slides also showed clearly the position of foreign bodies (safety pin and coin) in the larynx, bronchi, and oesophagus, inserted in the dead subject, in which also a good indication of the arteries in the root of the neck was obtained owing to the opaque injection which they contained.

PLATE I.^a

No. 1.—Fœtus nine months : female. This skiagraph shows well the state of ossification at this stage of development. Note particularly the semicircular canals in petrous portion of temporal bone, the enamel caps on the still unerupted incisor teeth, also the condition of the elbow, wrist, knee, and ankle joints, contrasting the carpus and tarsus with regard to the relative amount of bone (ossific centres) and cartilage.

^aThe “negatives” from which these plates have been prepared all show much more “detail” than any “reproduction” process can represent. And it is the original negative which must be referred to in any critical examination of a skiagraph.

FIG. I

PLATE II.

- No. 2.—NORMAL HAND.—*Young Adult*. Note cancellous tissue, also the extra sesamoid bones over the index and little finger metacarpals.
- No. 3.—NORMAL HAND.—Aged six years. Note centres of ossification of the phalanges.
- No. 4.—NORMAL WRIST.—Aged eighteen. Note line of ossifying cartilage between epiphysis and diaphysis of lower ends of ulna and radius: the styloid process of ulna is still unossified.
- No. 5.—NORMAL ELBOW.—Aged three years. Most of the parts forming the joint being represented as “cartilaginous,” and therefore transparent to “X-Rays.”
- No. 6.—NORMAL ANKLE.—*Young Adult*. Note arrangement of cancellous tissue in os calcis and astragalus.
- No. 7.—ABNORMAL HAND (congenital).—Aged eleven. Note that epiphysis for lower end of radius and ulna are normal—but carpus is represented by two or three elements more or less fused together. The long digit is the little finger, while the rest of metacarpus and phalanges are represented by the metacarpal of thumb, which bears on its head its own two phalanges, bent at an angle to one another, plus two other phalanges, and a lump of bone.
- No. 8.—CONGENITAL DEFORMITY OF THUMB.—Double distal phalanx. Cancellous tissue well seen in carpus and thumb metacarpal.

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PLATE III.

"CLASS I."

- No. 9.—EPIPHYSARY FRACTURE OF OLECRANON occurring at the age of ten years by muscular action, and some twelve years before skiagraph was taken; at present united by fibrous tissue, and a good and powerful joint.
- No. 10.—DISLOCATION OF BOTH BONES OF FOREARM BACKWARDS.—Adult Without fracture, but with enormous swelling, and effusion into joint.
- No. 11.—FRACTURE OF OLECRANON.—Adult. Comminuted.
- No. 12.—FRACTURE OF EPIPHYSIS OF LOWER END OF HUMERUS.—Aged eight years. After treatment in plaster, which had accurately replaced the epiphysis. Note that olecranon process is still unossified.
- No. 13.—UNUNITED FRACTURE OF TIBIA.—Aged five years. Lateral view.
- No. 14.—NEEDLE IN FOOT.—(Normal adult female). "Vertical view."
- No. 15.—NEEDLE IN FOOT.—(Same case as No. 14). "Lateral view." Showing needle within $\frac{1}{4}$ inch of plantar surface, which is resting on a thick book.
- No. 16.—ANTERO-POSTERIOR VIEW OF TRUNK—(Dead subject)—Showing "safety pin" in larynx and a "coin" in cesophagus.

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PLATE IV.

"CLASS II."

- No. 17.—TUBERCULAR DISEASE OF HEAD OF METACARPAL BONE OF INDEX FINGER.—Aged sixteen (?). The disease had been quiescent for some years, but skiagraph shows that the shortening of index finger is permanent, and due either to complete absorption of head of bone or "*premature union*" of head to shaft.
- No. 18.—TUBERCULAR DISEASE OF MIDDLE AND PROXIMAL PHALANGES OF LITTLE FINGER.—Aged thirteen (?). The disease here was recent. Note the "*rarefaction*" of the ends of these two phalanges, due to "*rarefying osteitis*," also "*premature union*" of epiphysis to diaphysis at base of proximal phalanx.
- No. 19.—OSSIFYING ENCHONDROMA OF METACARPAL BONE OF MIDDLE FINGER.—Note curvature of deformity of metacarpal of ring finger, corresponds to curve of base of tumour.
- No. 20.—NECROSIS OF LOWER THIRD OF ULNA.—Note ulcerated surface on ulnar side of forearm; the lower half of shaft of ulna is seen to be *thickened*; several areas of "*rarefaction*" are seen in the bone suggesting the outline of a sequestrum. Note "*cloaca*" at junction of middle and lower thirds of ulna on inner side under ulcerated surface. These points were all verified on examining the excised bone.
- No. 21.—Same case as No. 20.—*Three weeks after operation*. Note that periosteum in neighbourhood of lower end of ulna has begun to form a new styloid process and articular surface.
- No. 22.—EXCISION OF ELBOW JOINT.—Note bony excrescences on ends of humerus, ulna and radius; also some islands of bone laid down in periosteum lying behind the new joint.
- No. 23.—TUBERCULAR DISEASE OF KNEE JOINT.—Aged five years. Note thickening of shaft of femur (lower end), also central abscess near lower end of its diaphysis; also general disorganisation of knee joint. The quadriceps extensor muscle and its tendon are also indicated.
- No. 24.—NORMAL KNEE JOINT.—*Adult female*. (Same case as No. 25). Note that articular surfaces of femur and tibia are sharply cut and well defined.
- No. 25.—TUBERCULAR DISEASE OF KNEE JOINT.—Contrast articular surfaces of bones in Nos. 24 and 25, and it will be seen that in the diseased joint the *outline* of the articular surfaces of femur and tibia is obscure and ill-defined owing to rarefaction, while the "*cartilaginous gap*" is also diminished owing to erosion of the cartilage. (One marked symptom in this case was "*starting pains*"). Note commencing bony ankylosis between external condyle and outer surface of spine of tibia. The tendon of biceps is well seen.

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A large number of skiagraphs still further illustrating the application of the process were then handed round, after which, the hall being darkened, a demonstration with the fluorescent screen was given, during which the bones and joints of the leg up to middle of femur: of the arm, up to and including the shoulder joint, were clearly shown, also the cervical vertebræ, some bones of the face, and finally the movements of the heart and of the diaphragm and liver during respiration were well seen.

In the four plates which follow are reproduced some of the skiagraphs exhibited.