PREFACE.

THE object of this publication is to put on record in permanent form some of the most striking applications of the New Photography to the needs of Medicine and Surgery.

The progress of this new Art has been so rapid that, although Prof. Röntgen's discovery is only a thing of yesterday, it has already taken its place among the approved and accepted aids to diagnosis. At the first moment, the statement that it had been found possible to penetrate the fleshy coverings of the bones, and to photograph their substance and contour, seemed the realization of almost an impossible scientific dream. The first essays were of a rough and imperfect character; week after week, however, improvements have been made in the practical application of the Art, which I venture to call Skiagraphy; and, at the present time, we are in a position to obtain a visible image of every bone and joint in the body. In essence the process is nothing more than the photographic representation of the shadow cast by the opaque bony structures, or by metallic foreign bodies, on sensitized plates. The greater part of the practical improvements that have led to the present stage of perfection of the process have been made in this country, and in some of these I have been so fortunate as to take part.

In the plates presented in this first number of a publication which will, I hope, take a permanent place in Medical literature, I have presented some examples of the more difficult and instructive achievements of Skiagraphy up to this date: and it is permissible to hope that, as time goes on, in addition to drawing upon the storehouse of Skiagraphic clinical records which I have already massed, it will be our good fortune to be able to present results more striking and of increasing importance from other workers in the new field.

I have to offer my thanks to the many Medical men who have favoured me with the opportunity of investigating and reproducing my pictures of cases under their charge, and for their permission to use the material as published. I have also to thank Mr. Herbert Newton for valuable practical assistance in perfecting methods and apparatus, both in photographic illustration and in Skiascopic examination—a procedure of which I shall have to speak hereafter.

SYDNEY ROWLAND.

429, STRAND,

April 2nd, 1896.

INTRODUCTION.

If a glass bulb, in which two platinum wires are fused through the glass, be connected with an air pump, and the wires be connected with an induction coil, and if the bulb be gradually exhausted, the following theories of phenomena will be observed to take place:—As the air is pumped out and the pressure falls, the spark gradually loses its well-known characteristics, and finally ceases to be a spark at all. The tube is now seen to be filled with a glowing column of light, which, on close observation, will be seen to be arranged in layers. This is the so-called stratified discharge. If the exhaustion be carried to a still higher pitch, a dark space will be seen to appear at the point at which the current leaves the tube (cathode); and, if it be pushed still further, this dark space (which was discovered by Crookes, and is called Crookes' space) will be seen to widen out, till finally the whole tube may be said to be occupied by the dark space, and the only evidence we have that a discharge is taking place is a brilliant greenish phosphorescence of the glass walls. It is at this point that the science of the New Photography may be said to commence.

From the phosphorescent glass there proceed in all directions the rays which were discovered by Prof. Röntgen, and provisionally named by him, for want of a better title, the X rays. As is now well known, the peculiarity of these rays is that they have a standard of transparency entirely their own. Thus many of the substances which are ordinarily opaque to light, as we know it, permit the passage of this form with ease. Thus, on the one hand, carbon, as is ordinarily used for battery plates, is extremely transparent, while on the other hand the most lucid glass is extremely opaque. Such a glass bulb, per-

manently exhausted and hermetically sealed, is known, from the name of the investigator who first studied the characters of an electric discharge in vacuo, as a Crookes' tube. This, or a slight modification of it, was the form of tube which Prof. Röntgen employed when he made his memorable discovery. With such a tube much good work was done, but the results obtained by its use are not to be compared with those which have been obtained with far greater ease and more certainty by the use of a modification of the original form introduced by Mr. Herbert Jackson, of King's College, London. I myself proposed the use of the same modification independently, but on inquiring at the instrument makers, with a view to having some made for me, I was told that they had already been at work on the same tube for some days. From the fact that in this tube the cathode plate, which is a concave disc of aluminium, focusses the cathode rays at a point near the centre of the bulb, the name focus tube has been applied to it. The anode plate is a small piece of platinum foil placed at an angle, a short distance beyond the focus of the cathode rays. Curiously enough the cathode rays do not cross like rays of light at the focal point, but behave rather like a number of fluid jets coalescing and proceeding onwards as a solid parallel vein. The point where the rays impinge on the platinum still retains its small dimensions, though the plate is placed some distance beyond the focal point. The platinum is known to be one of the most opaque substances to cathode rays, and thus very little of the radiation passes through the platinum foil. The greatest part of the radiation is absorbed by the platinum, and given out as X rays from the luminous point by a kind of diffuse reflection. The anode plate being set at an angle, the best part of the radiation is directed downwards through the sides of the bulb.

PROF. RÖNTGEN'S ORIGINAL EXPERIMENT.

It will be remembered that the original experiment of Prof. Röntgen which led to his discovery of the X rays consisted in an observation that paper coated with barium platino-cyanide lit up with brilliant fluorescence if brought within the sphere of influence of an

excited Crookes' tube covered with black paper. From this discovery Röntgen argued the existence of certain rays which were able to traverse black paper, and by inference other opaque substances, as evidenced by their affecting the barium platino-cyanide, which deduction has been so strikingly substantiated by the vast amount of work that has been done in the field of the New Photography. And in no direction has the discovery borne such practical and important fruit as in its application to Medicine and Surgery.

Some few weeks after the discovery of Röntgen, Prof. Salvioni, of Perugia, announced that he had (apparently independently) arrived at this property of the platino-cyanides of fluorescing under the influence of X rays, and had turned it to practical account by the construction of an instrument called a cryptoscope.

Salvioni's cryptoscope consisted simply of a surface of some substance opaque to light, but capable of transmitting the X rays, coated thickly with the fluorescent salt—in his case barium platino-cyanide. Since this announcement reached England—now some six weeks ago—the same fact has been reported over and over again by several workers. It is curious to note the zeal with which the newspaper reporter has seized on these successive announcements and magnified them into fresh discoveries. This craving for exciting news has been at no time better exemplified than in the extended and "booming" reports that were circulated as a result of Edison's simple telegram to Lord Kelvin. The facts of the case are, that very many substances behave as do the platino-cyanides, and that Edison simply telegraphed that he had found tungstate of soda to fluoresce more brilliantly than salts that had hitherto been tried. Whether this is so or not remains to be proved in this country. But great as has been the success of observers in other countries, it has remained for England to produce the instrument in its perfected and simplified form, and for Mr. Herbert Jackson, of King's College, to fix on the particular salt which gave the best results—results besides which all previous attempts are cast into the shade. The salt he employs is the platino-cyanide of potassium.

CONSTRUCTION OF THE INSTRUMENT.

In its latest and most perfect form the instrument simply consists of a circular sheet of black cardboard, covered on one side with the salt above named, and protected by a glass plate. To prepare the salt for spreading on the card so as to ensure the best results is a work of considerable difficulty, and it is only within the last few days that these difficulties have been overcome. The method that has been found to answer best is as follows: A sufficiency of the salt is ground to the finest powder in an agate mortar. The finely-divided substance is then made into a thick cream, with enough gum arabic to produce a mass of the requisite viscidity to adhere to the card. On the card the mass is then spread in as even a layer as possible, and the instrument is complete.

EXPLANATION OF EFFECT PRODUCED.

When such a prepared screen is placed in the path of the X rays, it is seen to light up with a vivid green light. Given that some object capable of obstructing the rays is placed between the source of these rays and the screen, it is obvious that a dark shadow of the object is cast on the screen, and is seen as such by the eye, the screen having converted X rays into light rays, as evidenced by its fluorescence.

On the accompanying diagram the effect is rendered clear. The

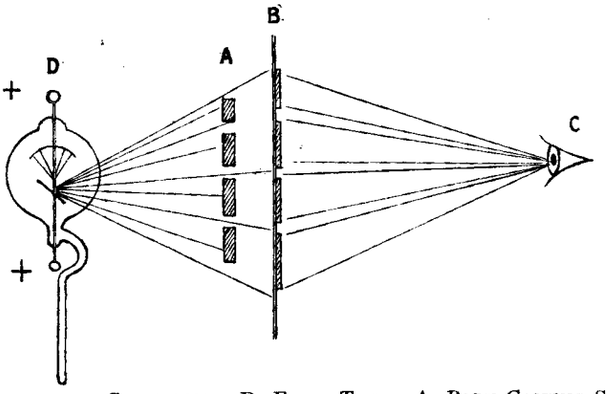


DIAGRAM OF ACTION OF CYSTOSCOPE: D, FOCUS TUBE; A, BODY CASTING SHADOW ON B, FLUORESCENT SCREEN WHICH IS SEEN BY EYE AT C.

object casting the shadow is, for simplicity's sake, represented on a perforated sheet, but the same effect would obviously be produced when the object is the human hand, for example. In this case the flesh, being transparent, casts no shadow, while the bones, being relatively opaque, cast a definite and clear image.

It must not be forgotten that the success of this instrument depends on having at command a definite and minute point of origin for the X rays. Such a point is furnished at the place where the cathode rays from the concave electrode of the focus tube strike the platinum plate. Thus, it is largely owing to the invention of this tube that the apparatus has succeeded so well in this country.

Whatever may be the scientific explanation of the exact character of the X rays, the value of their discovery to surgeons and physicians is inestimable. By means of the new radiation it is now possible to render visible certain of the interior structures of the living body, and their precise conditions of disease or of health can be objectively demonstrated, and facts which heretofore could not be known or guessed at by a complicated system of inference, are now *oculis subjecta fidelibus*. Many and various have been the extravagant stories and reports which have been circulated as the result of the Wurzburg professor's discovery. Thus, from America we have heard that Edison has been at work on photographing a human brain, and even he has been forestalled by another Transatlantic investigator in accomplishing the same object. The very manner in which these reports have reached our papers at once stamps them as canards or the result of gross ignorance on the part of those who promulgated them. Whatever may be the possibilities of the New process, it is certain that the brain will be one of the last regions to be brought within its sphere of influence.

WHAT THE NEW PROCESS CAN AND WHAT IT CANNOT DO.

Here it may be as well to define, as accurately as present knowledge will permit, what the new science of skiagraphy will or will not accomplish. The very essence of the process consists in the fact that certain structures in the body, or foreign materials which may have found

their way into it, are more or less permeable to these X rays than the tissues in which they may be imbedded. Thus, in the case of a bullet, imbedded in the bones of the wrist, the bullet will impede the progress of the rays more than the bones, and these in their turn more than the flesh that surrounds them. In order, therefore, to obtain a picture showing the state of things, it is necessary to lay the wrist on the surface of a sensitized plate and to place the tube, from which the rays proceed, on the other side (back or front) of the wrist. Under these conditions the rays will pass more or less completely through the flesh, and its shadow on the plate will be more or less a dark one. The bones, on the other hand, will impede the passage of the rays to a far greater extent, and their shadow will, therefore, be a light one. The bullet being the most opaque of the three, will almost entirely stop the passage of the rays, and will consequently appear as a white spot.

From what has already been said, a fair idea may be gained of the present condition of the new process. Fresh developments are daily being made, and eventually, it may be anticipated, will reach some such point as this :—In all cases of bony disease the present methods of diagnosis will be supplemented by skiagraphy. In bony diseases, par excellence, is the importance of an early recognition most urgent, for having located the mischief, the surgeon can in very many cases remove the diseased area, and so assist Nature in bringing about a rapid cure.

In bony diseases, then, will the process be especially useful, for the reasons already given—that the bones stand out as presenting the greatest contrast to the rest of the tissues in the matter of transparency.

PHOTOGRAPH OF APPARATUS AND METHOD EMPLOYED FOR OBTAINING A SKIAGRAM. IN THIS CASE THE LEG.

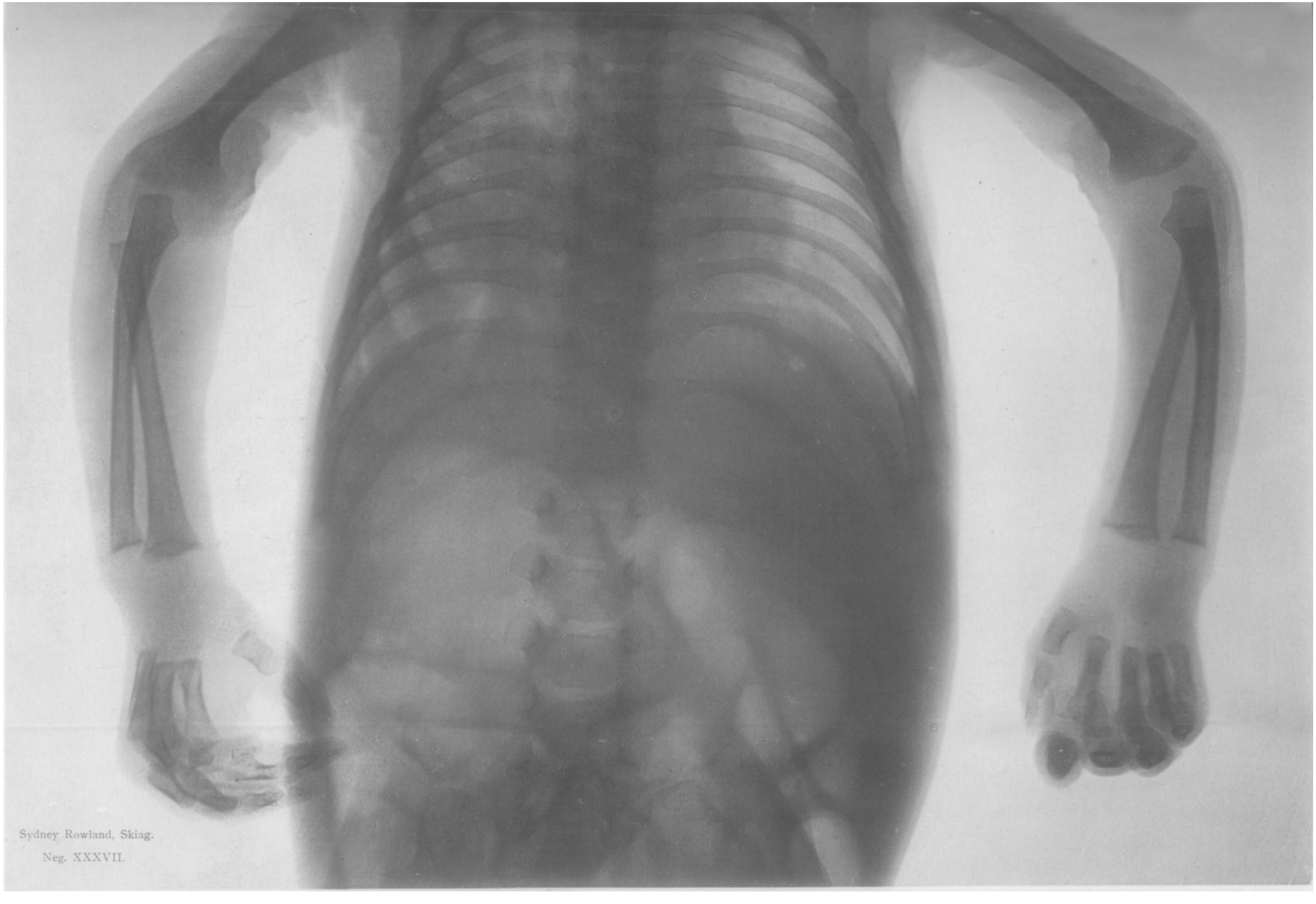
DESCRIPTION OF PLATES.

PLATES I. AND II. (*Exposure* 14 *minutes.*)

(*DOUBLE PAGE PLATE OF CHILD.*)

This double plate illustrates very successfully the skeleton of a full-grown child, aged three months. The intestines, heart, and liver cast definite shadows, and can be easily distinguished. This skiagram is the first step in the direction of obtaining photographic records of the condition of the soft parts. No doubt in the near future such will be possible in the case of adults; at present it is only possible in the case of infants and small animals.

Plate 1 and 2.



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CHILD—SKIAGRAM OF SKELETON OF FULL GROWN CHILD, AGED THREE MONTHS. NOTE THAT THE INTESTINES, HEART, AND LIVER, CAST DEFINITE SHADOWS.

PLATE III. *(Exposure 2 minutes.)*

DETECTION OF NEEDLE IMBEDDED IN FINGER.

This plate illustrates very well the usefulness of the process in the detection of foreign bodies lodged in the soft parts. It is one of many similar cases that I have successfully skiagraphed, and of which I may mention the following:—Discovery of a halfpenny in the intestine of a child. Location of a bullet in thigh of a man. Location of needles in various parts of the body in numerous cases, and many others. For the notes of the present example I am indebted to Mr. Battle, under whose care the case was at the Royal Free Hospital:

C. P., aged fifty-six, came to the Royal Free Hospital on March 4th, 1896, complaining of having run a piece of needle in her right

index finger on March 1st. There was considerable redness and swelling about the middle of the finger, especially on the outer and palmar surfaces, but no foreign body could be felt.

I took a skiagram of the finger at Mr. Battle's request, and the piece of needle was seen to be lying close to the radial side of the second phalanx of the index finger. On March 6th the finger was more inflamed, and a pustule had formed about the middle of the palmar surface of the second phalanx, where the needle was said to have entered.

Mr. Battle asked Mr. Bottomley to remove the needle. Ether spray having been applied, an incision was made along the radial border of the second phalanx of the index finger, and the piece of needle was found lying close to the bone, and extracted; it was a fragment about $\frac{5}{8}$ inch in length.

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SKIAGRAM OF HAND WITH NEEDLE IMBEDDED IN FINGER.

PLATE IV. *(Exposure 9 minutes.)* PLATE VI. *(Exposure 3 minutes.)*

MULTIPLE EXOSTOSES.

The next two plates are from the same case. Multiple exostoses, under the care of Dr. Dawson Williams, at the East London Children's Hospital, Shadwell. The plates speak for themselves, and do not need detailed description. For the notes I am indebted to Dr. Dawson Williams.

The patient was a girl, aged nine years. The distribution of the exostoses is generally symmetrical, but their size and form do not correspond completely on the two sides. The largest is on the right femur, about three inches above the knee joint. On palpation it appeared to occupy the inner and posterior aspect, and to be rounded in form with a broad base. The skiagram shows, however, that it is cone-shaped, and also that there is another similar growth on the outer side, just above the epiphysis.

It is noticeable that both these growths appear to have been somewhat more transparent to the X rays than the shaft of the bone.

On the left femur, on the inner aspect, about two inches above the inner condyle, a smaller growth can be felt.

The skiagram shows also a bony nodule on the inner aspect of the right tibia, a little below the internal tuberosity, and there is a similar but much smaller nodule at the corresponding part of the left tibia, which has also three small nodules at the base of the inner malleolus.

The hand shown in the other skiagram from this case presents an interesting deformity, of which the cause is clearly displayed. At the base of the first phalanx of the little finger is a bony growth, which has displaced the whole finger inward, and it is curious to note that a compensatory curve at the last inter-phalangeal joint appears to have been established. This exostosis also is seen to have been more transparent than the rest of the phalanx. This fact seems to render it probable that the growth is composed of cancellous tissue. There is also some overgrowth connected with the inner aspect of the first phalanx of the index finger, which has displaced the two terminal phalanges outward. There is a similar deformity to be felt at the outer side of the base of the middle phalanx of the middle finger on the opposite side.

This skiagram of the hand shows very well the condition of ossification at this age (nine years). In particular the epiphysis at the proximal extremity of the metacarpal bone of the thumb is very conspicuous. It is seen also that the epiphysis of the proximal phalanx of the little finger is not involved in the exostosis, which has in fact formed a spur on the outer side, so that the epiphysis lies in a kind of cup. In the wrist the bones which are largest, and possess most nearly their adult form, are the os magnum, the unciform, and the cuneiform. In all these bones the ossification begins before the third year (first, second, and third years respectively). The semilunar and trapezium, in which ossification begins in the fifth year, are small, and have not their characteristic form and shape. The diminutive size of the scaphoid bone, which begins to ossify in the eighth year, is striking, while the pisiform, in which ossification does not commence until the eleventh or twelfth year, does not show at all in the

skiagram. The trapezoid bone is more conspicuous than in most skiagrams of the wrist, and larger than might have been expected in view of the fact that ossification does not usually begin in it until the eighth or ninth year. It is interesting to compare the condition of the wrist in this skiagram with that shown in the wrist of the infant in Plate I. In the infant there are no signs of any ossification in the wrist, nor are the lower epiphyses of the radius and ulna visible, whereas in the wrist of the child they are of considerable size.

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SKIAGRAM OF KNEE JOINT, FROM A CASE OF MULTIPLE EXOSTOSIS.

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SKIAGRAM OF HAND, WRIST, AND FOREARM, FROM CASE AS No. XLI.

PLATE V. *(Exposure 6 minutes.)*

SKIAGRAM OF WRIST AND FOREARM, FROM A CASE OF SYPHILIS. INDICATES POSITION OF A GUMMA.

This skiagram is from a case of congenital syphilis. It shows atrophy and a condition of greenstick fracture of the radius. X indicates the site of a gumma. For the notes I am indebted to Dr. Phillips:

C.S., aged fifteen; a thin, unhealthy-looking boy. Nodes on anterior fontanelle on frontal bone and on temporal ridges on each side. No craniotabes. Right ulna felt to be thickened; also left tibia in its upper third. The right arm is held midway between pronation and supination, these movements being nearly but not quite absent. The ulna is felt to be thickened just below the centre of the bone. The radius is felt to be of normal thickness for about two inches from the lower end; the bone then diminishes rapidly, and is continued on as a thin, bony shaft, returning to its normal thickness two inches from the head. It is, apparently, fixed to the ulna, though some movement can be obtained. Over the atrophied part of the bone is a large scar, covered with thin, transparent skin. The wrist is held in position of adduction, the head of the ulna being very prominent and the whole bone being curved.

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SKIAGRAM OF WRIST AND FOREARM,* SYPHILITIC OF RADIUS. X INDICATES POSITION OF GUMMA.

PLATE VII.

HYPERTROPHIC OSTEO-SCLEROSIS OF FIBULA.

By F. C. ABBOTT, F.R.C.S., Resident Assistant Surgeon to St. Thomas's Hospital.

Male, aged seventeen. Admitted to St. Thomas's Hospital under the care of Mr. Clutton. For five months past the right leg has ached after walking and playing football. There is no history of injury. He is not clear when he first noticed the tumour, but it had been getting larger for the last few days before admission to the hospital.

A hard, apparently bony, tumour is situated around the lower half of the right fibula, about three and a half by two inches, not tender to touch, and does not involve the skin. Its main position is behind the fibula, and the external surface is but slightly involved, and here the outline of the bone itself can be traced. The bone cannot be felt to be expanded, and there is no bony crackling, the growth appearing to be around and not in the bone. (This was shown not to be the case by the skiagram.) The tendons can be felt passing over it, and the soft tissues are somewhat thickened behind. The surface is mainly smooth, but in parts nodular.

The tumour was cut down upon, and proved to be a general fusiform enlargement of the fibula with sclerosis of the bone; in fact, a true hypertrophic osteo-sclerosis. The cause is quite unknown. A portion of the bone was resected for examination, but nothing more was made out. It was simply dense bone, as the skiagram represented.

Note on the Skiagram.—This plate represents the middle thirds of the tibia and fibula of the patient before mentioned. The original diagnosis in this case suggested itself as sarcoma. The skiagram was taken with the idea that it might possibly throw some light on the subject; and although it did not completely clear up the diagnosis, this was due to our then want of knowledge of the appearance of a sarcoma

in a shadow picture. Since that time I have had the opportunity of skiagraphing an undoubted central sarcoma of the tibia, and on comparing the two cases it is seen that the sarcoma is transparent in its central parts, and far less clearly indicated generally than is the tumour seen in the plate. Had this fact been known at the time it would doubtless have thrown much light on the case and eliminated central sarcoma from the diagnosis, and it will be henceforth available.

S. R.

Plate 7.

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SKIAGRAM OF SARCOMA (?) OF FIBULA.

PLATE VIII.

REVOLVER BULLET IN PALM OF HAND.

This skiagram is introduced to show the possibility which the new method holds out of throwing light on intrinsic bone disease. The fact that bone is not absolutely opaque to X rays, but only relatively so as compared with the soft tissues, renders this possible. In the skiagram it will be noticed that the ends of the metacarpals and the entire phalanges indicate their detailed bony structure. To effect this the rays must have traversed the bone. It is curious to remark that the resulting picture has all the appearance of solidity. This appearance bears out the now universally accepted theory of the mechanical structure of bone, and is an expression of the fact that the external configuration bears intimate relations to the internal structure.

S. R.

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SKIAGRAM OF REVOLVER BULLET IN HAND.

PLATES IX. AND X.

A COMPLICATED FRACTURE OF THE TIBIA EXTENDING INTO THE KNEE JOINT.

By Surg. Lieut.-Col. STEVENSON, R.V.H., Netley.

A fracture of the femur at about three inches above the condyles was produced in a man, aged thirty-three, by indirect violence. On

the day after the accident I examined the case, and found the signs of the injury at the point above named to be very evident. There was no shortening, no depression of the upper end of the lower fragment into the popliteal space, and no increase of width across the condyles. Ten days later Mr. Sydney Rowland made two skiagraphs of the case, one from side to side, and another from the front to the back, with an exposure of fourteen minutes and ten minutes respectively; at this time one inch shortening could be measured. From both pictures together the condition of the fracture could be perfectly seen. The first one, from side to side, shows the shortening and the partial separation of the fragments, and the second shows a line of splitting from the site of the fracture into the joint through the intercondyloid notch. The advantage of the new photography in this case, both as regards prognosis and treatment, can hardly be overrated.

Notes on the Skiagram.—The subject of these two plates is one of which it is very difficult to obtain a really satisfactory skiagram. Owing to the great breadth of the lower end of the femur from condyle to condyle, it must of necessity happen that there is very great variation in the distance of the various parts from the photographic plate. Hence one condyle is apparently seen through the other, the condyle next the plate appearing much denser, but, being overshadowed by its fellow, not so well defined.

Plate IX.—The oblique white streak running from above downwards, and from left to right, is the same line of fracture seen in the next plate.

In addition, the same shell of bone elevated from the shaft is seen to extend beneath the patella.

Plate X.—The line of fracture in this plate is seen to run between the two condyles. At the same time a thin shell of bone has been raised from the shaft. This is seen in the plate on the left-hand side, between the edge of the bone and the dotted line extending upward from the patella. S. R.

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SKIAGRAM OF FRACTURE OF FEMUR EXTENDING INTO KNEE JOINT.

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SKIAGRAM OF FRACTURE OF FEMUR EXTENDING INTO KNEE JOINT.

PLATES XI. AND XII.

ANOMALOUS DEFORMITY OF HANDS AND FEET.

By RICHARD BARWELL, F.R.C.S., late Senior Surgeon to Charing Cross Hospital.

The lad whose extremities are shown in the subjoined skiagrams is sixteen years old, inmate of a home under my surgical care.

I am engaged, together with Mr. Sydney Rowland, in arranging for publication a series of skiagrams of foot deformities. But as this particular case does not fit in with our intended series it seemed well to us to let it take a separate place in the ARCHIVES OF CLINICAL SKIAGRAPHY. The deformities are in all probability not congenital, but originate in early osseous development, being due to false location and insufficient power of the osseous nuclei. This condition only affects the extremities; the trunk and the limbs, though the boy is rather short, are well formed.

In the left hand the bones of the second finger, normal in length, show out well and black, ossification is there complete. The whole of the hand did not unfortunately fall on the plate; but the bones of the fourth finger seem well formed, the metacarpal being strong with a properly formed base and epiphysial head.

With these exceptions all the metacarpal bones and phalanges are more or less deformed; the carpus, though not fully ossified and therefore difficult of comparison, seems normal. In the left hand the first phalanx of the thumb (2) and the second phalanx of the index (3) are almost entirely absent, or are only represented by a deformed piece of cartilage, which, being transparent to X rays, is not marked definitely enough to admit of clear description. The first phalanx of the index (4) ends in a globular enlargement. The metacarpal bone of the ring finger (5) ends in what is probably a semi-cartilaginous mass compounded of the epiphyses of that bone, mixed up with the epiphysis and diaphysis of the first phalanx, and with the epiphysial end of the

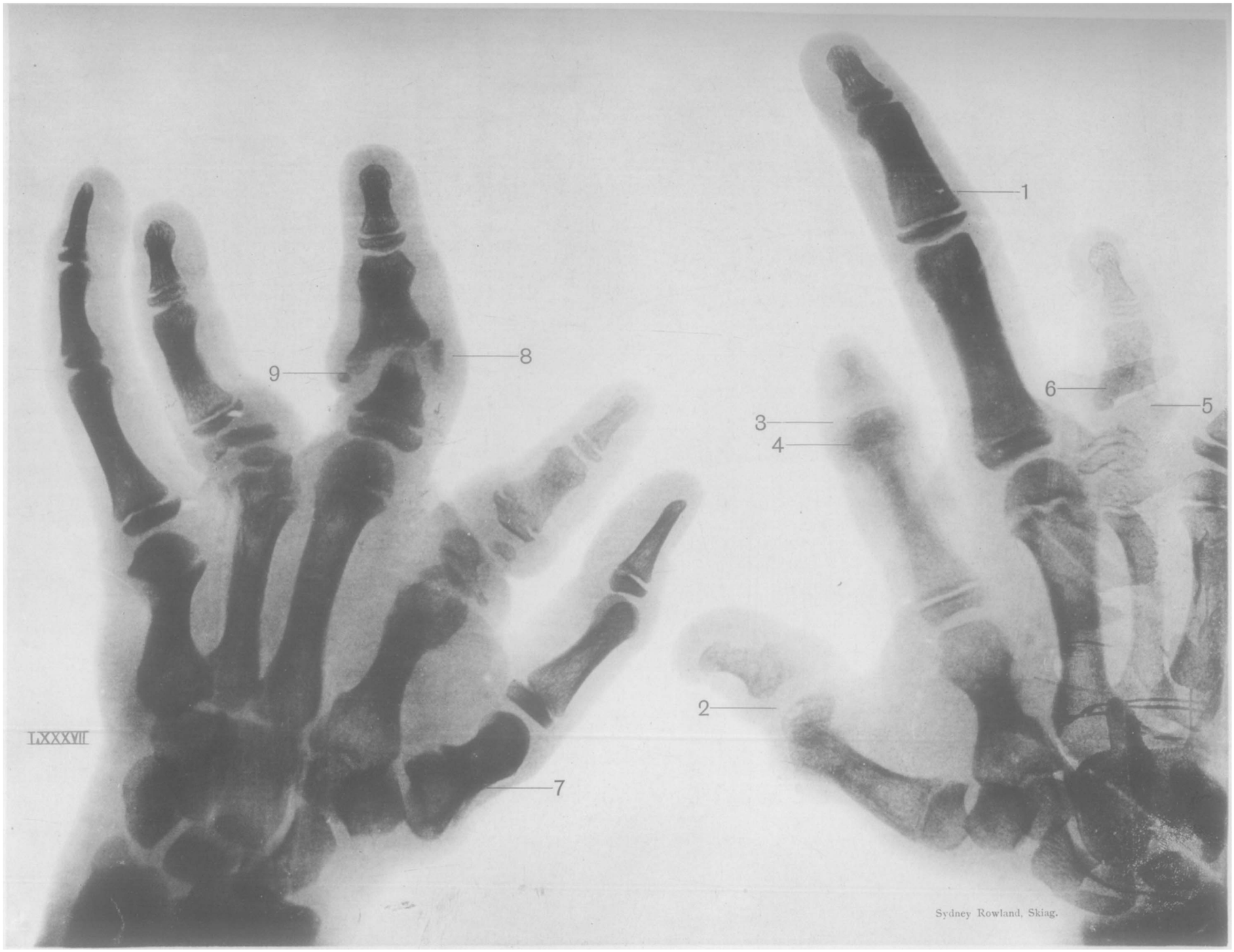
second phalanx, the stunted and deformed diaphysis of which last is thick with a very oblique base (6).

On the right side the thumb, save for a very thick and short metacarpal bone (7), is normal. The same may be said of the little finger. The first phalanges of index, middle, and ring fingers are deformed and truncated. The epiphysial end can be made out in all. The shafts are either wanting, are truncated, or are so thin as to be recognizable only by position—not at all by shape. The form of the second phalanx of the middle finger appears like a further development of the condition found on the same phalanx of the right ring finger. It appears that the dark blots, marked 8 and 9, are the displaced and barely-developed epiphyses of the second phalanx. If so, it had two ossific centres—one at each margin, forming a sort of socket for the conical end of the first phalanx to play in.

The feet exhibit very analogous conditions, complicated by pressure on the soft unformed bones, of badly-fitting boots. The right foot more nearly resembles the left hand—in it the second metatarsal bone and phalanges* are well formed and normal; therefore it projects far beyond all the other toes. The metatarsal bone of the great toe has a short truncated shaft. On the inner side of it are two dark blots, marked 10 and 11. The former appears to be the epiphysis of the metatarsal bone; the latter that of the first phalanx. Here, too, as at 8 and 9, a sort of interlocking false joint is formed. The phalanges of the three outer toes, especially of the third, are imperfect, and either in great part incomplete or still cartilaginous. Their inclination inwards is due to the pressure of boots, to which also the cramping and overlapping of the metatarsal bases may be ascribed. The left foot is more normal; the first metatarsal diaphysis, being short and thick, gives to the second toe a fallacious appearance of abnormal length. The bend inwards of the outer three toes is due to external pressure.

* It should be remembered that the second toe is in certain ways the homologue of the middle finger—for instance, in the insertion of the inter-ossei.

Note on the Skiagram.—The first impression obtained on glancing at these two plates is that the skiagram is a very poor one. This is not, however, the reason for the apparent indistinctness of the picture, for if the hand on Plate XI. be inspected, it will be seen that the long second finger of the left hand is quite distinct, while the adjoining ones are more or less indistinct. The explanation of this varying distinctness is probably to be found in the deficient ossification of certain bones: that is to say, in the inadequate deposition of calcareous matter in most of the bones, and therefore a too facile passage of the X rays. S. R.



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DEFORMITY OF HAND.

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DEFORMITY OF FOOT.

ANSWERS TO CORRESPONDENTS.

J. L.—The minimum spark required is two inches. It is necessary to have fully this length of spark, hence a coil giving a nominal three inches is the smallest you ought to have.

T. L. P.—Wrap the plates in black paper. The variety known as needle paper is very good. Use the most rapid plates you can get, and do not be afraid to push development to the utmost. There being in most cases no half tones to worry about, development is much simpler than in the case of ordinary photographic work.

IGNORAMUS.—You may know your focus tube is working correctly when one-half is fluorescing a yellowish green and the other half remains comparatively dark. After prolonged use, and especially if the platinum plate has been overheated, the vacuum is apt to increase. In this case the tube may be restored by heating over a spirit lamp until as hot as the hand can bear. Be careful to keep the tube revolving when heating, so as to equalize the temperature.

RAND.—Never work a coil from an accumulator without interposing a resistance. The object of this is to prevent short circuiting should the interruptor stick. Without a resistance under these circumstances two great risks are run. Firstly, the primary of the coil may be heated to such an extent as to melt the insulation; and, secondly, the accumulator may be seriously injured (buckled) by so rapid a discharge.

W. R. W.—In my experience the best way to manage a coil during an exposure is so to arrange the rapidity of interruptions (by altering the tension in the spring) as to obtain the most brilliant fluorescence of the tube with the most rapid make and break. Given sufficient potential to "get through" the vacuum, further effect depends on rapidity of interruption, and not on increased potential —at least, this is my experience.

KATHODE.—See answer to "Rand."

J. N.—The object to be skiagraphed should be placed as near the plate as possible. Treat the whole matter as a shadow and you cannot go wrong.

S. DE V. S.—Iodoform is very opaque to X rays. In cases that have been dressed with Iodoform, or injected with Iodoform emulsion, be careful to eliminate opacities on the plate due to this substance. Cases are recorded in which particles of Iodoform have been mistaken for foreign bodies, and even led to unnecessary incisions.

W. D. R.—As yet no substance has been found to give better results than Potassium Platino Cyanide. Its only drawback is its expense. Grind the crystals to powder, mix with gum arabic to form a thick paste, and spread as evenly as you can on black cardboard. To give the best results the salt must be fully hydrated; to ensure this, spray the screen from time to time with distilled water. It is essential to use plenty of crystals, and to have a thick layer.

PLATE XIII. Fig. 1 and Fig. 2.

SKIAGRAMS OF FRACTURE OF THE OLECRANON TREATED BY SUTURING WITH WIRE.

By ALBERT E. MORISON, M.B., F.R.C.S., C.M., Hon. Visiting Medical Officer, Hartlepools Hospital.

R. L., aged sixteen, consulted me on June 16th, 1896, complaining of weakness of the arm and pain at the back of the elbow on movement. He gave the following history:—On January 19th, while walking, he tripped in a cart rut and fell on the tip of his right elbow. Two hours after he went to a doctor, who told him the bone was broken and set it, applying splints. These he wore till January 30th, the forearm being kept at right angles to the upper arm. As it still continued weak and painful, on February 3rd he went to a bone setter, and he applied strapping to the limb. His arm did not improve, it still was very weak, and he had severe pain at the back of the elbow on movement.

Present State.—The posterior part of the upper arm is very much smaller than the opposite arm, owing to atrophy of the triceps. Movement in the direction of full flexion and extension is painful, especially the latter, and he is unable to straighten his forearm on the upper arm by about 25°.

On examining the elbow, there is a painful spot over the olecranon (Fig. 1). The process is freely movable, and separated from the ulna below by three-quarters of an inch in full extension, and one and a half inches in full flexion. A fibrous band can be felt joining it to the ulna.

Operation.—The limb was previously thoroughly purified and made aseptic.

July 23rd: Chloroform having been administered, an elastic

bandage was applied to the arm high up to make it evascular. A longitudinal incision about two and a-half inches long was made over the back of the elbow joint. The space between the olecranon and the ulna was filled with dense fibrous tissue. This was divided and removed, the elbow joint being thus opened. The olecranon was next fixed between the finger and thumb, and a thin slice removed to give a raw osseous surface. The upper end of the ulna was treated in a similar manner. The two ends of bone were then drilled obliquely, and two strands of thin silver wire passed through the holes, and on being tightened the two surfaces of bone came into good apposition. The cavity of the joint was washed out with weak corrosive lotion, and the skin wound closed with silk sutures, two sutures of the same material being passed through the periosteum. Antiseptic dressings were applied, and the arm bandaged to a straight anterior splint.

Progress and After-Treatment.—Except for sickness continuing eighteen hours patient had no inconvenience. The highest temperature was 99·6 on the evening after the operation, and the patient was allowed up on the second day.

August 1st: Wound dressed, skin sutures removed, passive movement commenced.

7th: Can get the arm almost to a right angle. Splint removed and a sling used to keep the arm at an angle of 1358.

14th: Union is apparently perfectly firm, there being no lateral movement to be obtained between the fragments. Flexion is gradually increased each day until complete. He is now encouraged to move the arm himself.

September 24th: Movement is apparently perfect, though the arm is still weak, and there is still atrophy of the triceps. This, however, is improving. The olecranon feels firmly united. Patient was sent to Messrs. Brady and Martin, of Newcastle-on-Tyne, to have the arm skiagraphed. The skiagram (Fig. 2) shows that there is still a slight space between the fragments. A point of interest is whether this space is filled in with fibrous tissue or with cartilaginous matrix which will eventually become bone. I am indebted to Messrs. Brady

and Martin for the excellent skiagrams which illustrate the case. Fig. 1 was taken on July 10th, before, and Fig. 2 on September 24th, two months after the operation.

(*Copyright.*) FIG. 1.

(*Copyright.*) FIG. 2.

SKIAGRAMS OF FRACTURE OF THE OLECRANON, TREATED BY SUTURING WITH WIRE.

(*By ALBERT E. MORISON, M.B., F.R.C.S., etc., Hartlepool.*)

PLATE XIII.

(*Archives of Clinical Skiagraphy.*)

PLATE XIV. Fig. 1.

SKIAGRAM OF FRACTURE OF LOWER END OF HUMERUS, WITH SEPARATION OF THE EXTERNAL CONDYLE.

By HUGH M'LEAN, F.R.C.S.Edin.

R. T., aged seven years, fell on 8th September from a height of about five feet, getting his arm caught between two horizontal rails in the fall. When seen, the arm was so much swollen that the real nature and extent of the injury could not be made out. These, however, were clearly seen a few days afterwards, by means of the skiagrams, to be limited to fracture of the lower end of the humerus, with separation of the external condyle. The final result has not been seen, as the case is still under treatment.

(*Copyright.*)

FIG. 1.

SKIAGRAM OF FRACTURE OF LOWER END OF HUMERUS.

(*By HUGH McLEAN, F.R.C.S., Edinb.*)

PLATE XIV.

Archives of Clinical Skiagraphy.)

PLATE XIV. Fig. 2.

SKIAGRAM OF HIP JOINT DISEASE.

By JOHN MACINTYRE, M.D., Glasgow.

Represents a case of old-standing hip-joint disease in a young lad, the normal and diseased hips being both seen.

(*Copyright.*) FIG. 2.

SKIAGRAM OF HIP JOINT DISEASE.

(*By JOHN MACINTYRE, M.D., Glasgow.*

PLATE XV.

SKIAGRAM OF SIX TOES IN EACH FOOT.

By JAMES MACKENZIE DAVIDSON, M.D.

The patient was a young lady, aged twenty, who suffered inconvenience from the extra breadth of her feet, and her surgeon decided to remove the supernumerary toes. He informs me that the skiagram enabled him to operate with much greater precision than if he had not had it to guide him.

SKIAGRAM OF SIX TOES IN EACH FOOT.

(*By JAMES MACKENZIE DAVIDSON, M.D., Aberdeen.*)

PLATE XV.

(*Archives of Clinical Skiagraphy.*)

PLATE XVI.

SKIAGRAM OF A DOUBLE MONSTER.

By J. LYNN THOMAS, F.R.C.S. Eng., Assistant Surgeon to the Cardiff Infirmary.

The specimen from which the skiagram is taken belongs to my friend Prof. Hughes, of University College, Cardiff, and is that of a double monster in which the two breeches and lower extremities are quite separate.

The duplication commences inferiorly and terminates at the umbilicus, and there is only *one* umbilical cord and one placenta. From the umbilicus upwards towards the head there is fusion of the parts, so that there is only one apparent neck and skull. The four upper limbs are well developed, and one notices the complete absence of ossification in the carpus; whilst the metacarpi and phalangeal diaphyses are osseous.

It shows two faces, one of which is perfectly formed, and the other is incompletely developed and represented only by a pair of ears fused together.

The skiagram shows two bases cranii, and two distinct columns of cervical vertebræ with their anterior surfaces facing each other; the curves of the vertebral columns are normal, and the relative sizes of each vertebra are those of the normal fœtus. I would draw attention to the curved arch between the vertebræ of the cervical region with a small gap in the middle; it is that of the inferior maxilla seen *through* the neck, the monster being on its face during skiagraphing. I have a skiagram of this monster taken with the face upwards, and it shows no trace of the inferior maxilla, as the head was thrown well back. There are but few points I would venture to draw attention to, as they are fairly distinct and of skiagraphical interest.

The lower extremities of the right monster show well the folds of the *overlapping* limbs, and I think it is a common phenomenon for folds or twists to be better marked when some other X-rays semitranslucent substance is over them. The right limb of the right monster is also apparently narrower or thinner than the left one, on account of its being nearer the film than the left one, in accordance with the well-known law of shadow formation. The ossific centre of the os calcis is conspicuous by its loneliness in the tarsi. The comparative lengths of the diaphyses of the limb bones are marked.

The four clavicles are well shown, but there is no trace of the sterna.

Prof. Hughes intends giving a fuller description of this monster before one of the learned societies next winter.

SKIAGRAM OF A DOUBLE MONSTER.

(*By J. LYNN THOMAS, F.R.C.S., Cardiff.*)

PLATE XVI.

(*Archives of Clinical Skiagraphy.*)

PLATE XVII. Fig. 1 and Fig. 2.

SKIAGRAMS OF UNUNITED FRACTURE OF BOTH BONES OF THE FOREARM BEFORE AND AFTER UNION BY WIRING.

A gentleman was riding in the park, when his horse bolted and carried him against a tree. In order to save his face he put up his arm, which thus came in violent contact with the tree trunk. He was

carried unconscious to St. George's Hospital, where the arm was put on a splint. On recovering consciousness the patient returned home. Some weeks later massage was carried out, and three months later it was clear that no union had taken place. The patient then consulted Mr. Bland Sutton, who advised resection of the broken ends of the bone. The forearm was skiagraphed by Mr. Sydney Rowland, as shown in plate (Fig. 1). The seats of fracture in the radius and ulna were exposed by lateral incisions, and a portion of bone removed from each fragment. The opposed ends of the ulna were secured in position by a loop of silver wire. An attempt was made to wire the ends of the radius, but the osseous tissue was too fragile to bear the drill, so the ends were brought into position and maintained in apposition by splint and bandages. Three weeks later the forearm was re-skiagraphed, and the improved relations of the fragments are shown in Fig. 2.

(*Copyright.*) FIG 1.

SKIAGRAM OF UNUNITED FRACTURE OF BOTH BONES OF THE FOREARM BEFORE UNION.

(*Copyright.*) FIG. 2.

SKIAGRAM OF UNUNITED FRACTURE OF BOTH BONES OF THE FOREARM AFTER UNION.

(*By SYDNEY ROWLAND, B.A., Camb., London.*)

PLATE XVIII.

SKIAGRAPHY OF THE SOFT AND THE HARD TISSUES.

By JOHN MACINTYRE, M.D.

The advantages of the new rays have been fully demonstrated in the hard tissues, and there can be no doubt they now have, and will always have, a distinct place in the diagnosis of the pathology of the osseous structures. With improvements in our apparatus the extremities are now comparatively easily demonstrated, but the regions of the skull and pelvis still offer a little difficulty in stout people. So much progress has, however, been made with the skeleton that physicians have naturally turned their attention to the photography of the soft tissues. During my earliest experiments I was impressed with the fact that in the lower animals the viscera could often be determined on a photographic plate with such definition as to give hope that in man similar results would ultimately be obtained. As far back as March of this year, I began a series of experi-

ments with a view of determining how far the heart could be photographed.

In Plate XVIII., a reproduction of the first photograph of the heart attempted will be seen. There the outline of the organ in its contained sac is perfectly distinct. Below it one can see a curve representing the diaphragm, surrounding it there are the ribs, and in the neck there is an indication of the large blood-vessels. The natural suggestion to those engaged in this study was, that if the bones of the extremities were to be photographed with a given apparatus in a certain time, less exposure might enable us to catch the soft tissues before they disappeared. Experience, however, did not bear out this idea, and instead of less force being required it was found necessary to obtain the greatest number of X rays possible with the most powerful apparatus at my disposal for the following reasons: In the first place, to obtain sharp shadows it was necessary to remove the tube a considerable distance from the object. Again, an object like the heart is deeply seated, and, therefore, there is moreover a considerable amount of tissue-fasciæ and muscle to pass through. Further, owing to movement, the exposure required to be as short as possible. Pursuing this line I gradually increased the ampères of current from the main, used a mercury interrupter, and step by step worked up so much pressure on the tubes that the glass would not stand the molecular strain. Personally, I found it of less value to judge of my current by the length of spark. One must remember that the coil is simply a transformer of energy, and that there must be a definite relationship between the amount of energy which is passing into the coil and the amount of X rays got from the tube. There are many factors to be considered between these two points, not the least important of which is the interrupter, because the sharpness of the make and break, the number of vibrations per second, as well as other things, tend to modify the force at our disposal. I find that, even with a current which registers twenty ampères across the terminals and passing through the coil directly the interruptions by means of the spring begin, the current falls to three or four ampères, as measured by

Lord Kelvin's ampère gauge. When the mercury interrupter is used it is seen that seven, eight, or even ten ampères can be registered. In testing the rapidity of exposure I was able by this means to photograph the bones of the hand distinctly with a single flash of the mercury, make and break. Ten such flashes gave me one of the finest negatives of the bones of the hand which I possess. By these means photographs of many soft tissues can be obtained, and I need hardly point out that such high currents test the tubes severely, and as a rule, I do not use the strongest currents, unless there be some good reason for doing so, preferring to give a longer exposure. I have photographed a number of pathological changes in the cardiac area, one being the case of a child with pneumonia, in which there was an enlarged right ventricle, in another, hypertrophy of both ventricles in an adult; further, a considerable number of normal conditions in children and adults have also been registered with a view to comparison of the size in different conditions before and after exercise.

SKIAGRAM OF THE SOFT AND THE HARD TISSUES.

(*By JOHN MACINTYRE, M.D., Glasgow.*)

PLATE XVIII.

(*Archives of Clinical Skiagraphy.*)

PLATE XIX. (*a*)

By GERARD SMITH, M.R.C.S.

A lad of seventeen, with advanced and permanent talipes plantaris and calcaneus of left foot. The skiagram shows well the altered form of the os calcis and its relations to the astragalus, and also the altered relative positions of the scaphoid and astragalus. The special interest of the case is in the inward rotation of the foot (a comparatively recent change), the foot tending towards varus; and the abnormal position of the outer and inner malleoli with the astragalus is striking (the foot was most carefully placed on the plate, but the tube parallel, and over and opposite the outer aspect of ankle joint).

The patient sought relief for a new symptom—great pain precisely at the spot marked X, the astragalo-scaphoid articulation, this pain being caused by the weight of the body pressing the inner malleolus against the articulation, owing to the tendency to varus.

TALIPES PLANTARIS AND CALCANEUS.

(*By GERARD SMITH, M.R.C.S., London.*)

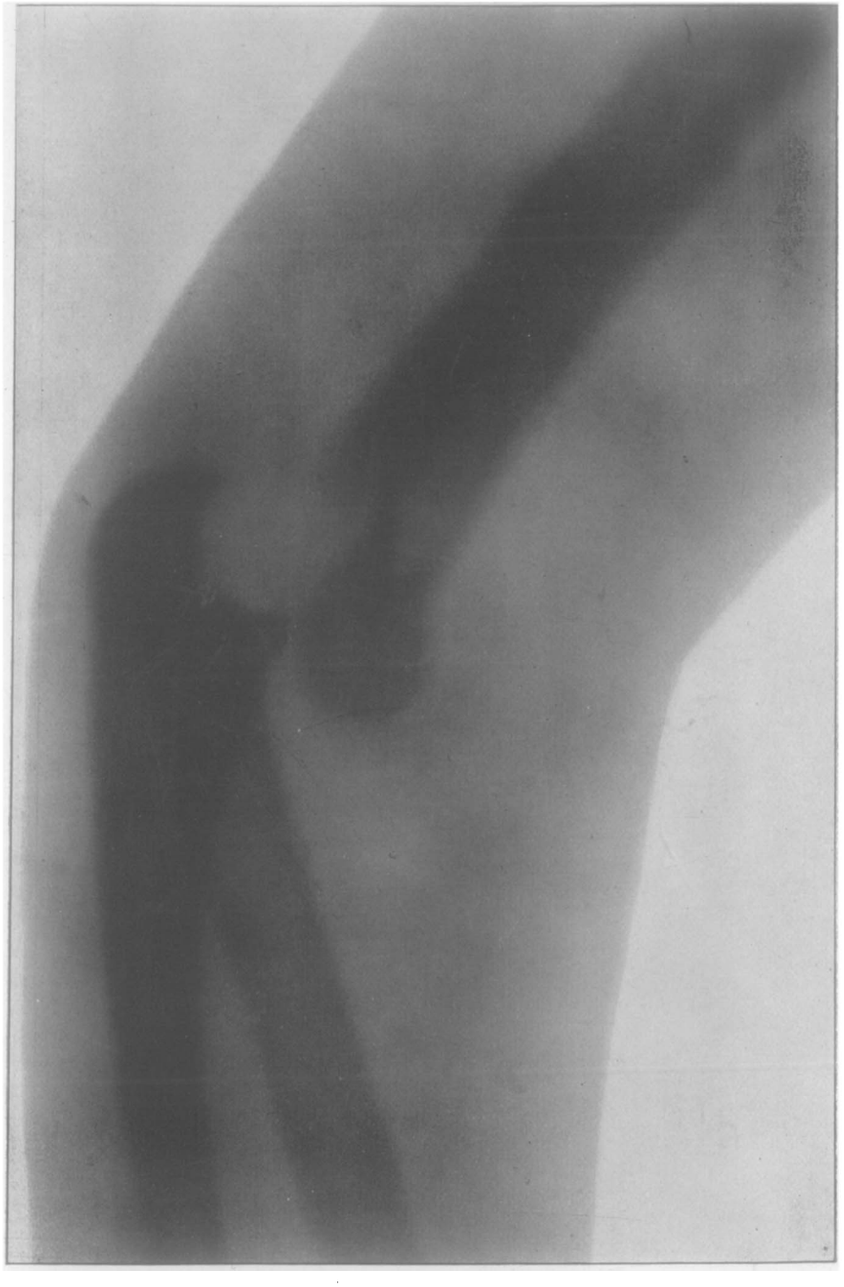
Plate XIX. (*a*).

(Archives of Clinical Skiagraphy.

PLATE XIX. (*b*)

DISLOCATION OF ELBOW—SIX WEEKS' DURATION.

By WM. JAS. FLEMING, M.D., Glasgow.



DISLOCATION OF ELBOW.

(*By WILLIAM JAMES FLEMING, M.D., etc., Glasgow.*)

PLATE XIX. (*b*).

PLATE XX. (*a*)

MULTIPLE OSTEOMA.

By W. D. HEDLEY M.D., M.R.C.S., London.

MULTIPLE OSTEOMA.

(*By W. D. HEDLEY, M.D., M.R.C.S., London.*)

PLATE XX. (*a*).

(*Archives of Skiagraphy.*)

PLATE XX. (*b*)

FRACTURE OF RADIUS AND ULNA, WITH DISLOCATION OF RADIUS BACKWARDS.

By W. D. HEDLEY, M.D., M.R.C.S., London.

FRACTURE OF RADIUS AND ULNA, WITH DISLOCATION OF RADIUS BACKWARDS.

(*By W. D. HEDLEY, M.D., M.R.C.S., London.*

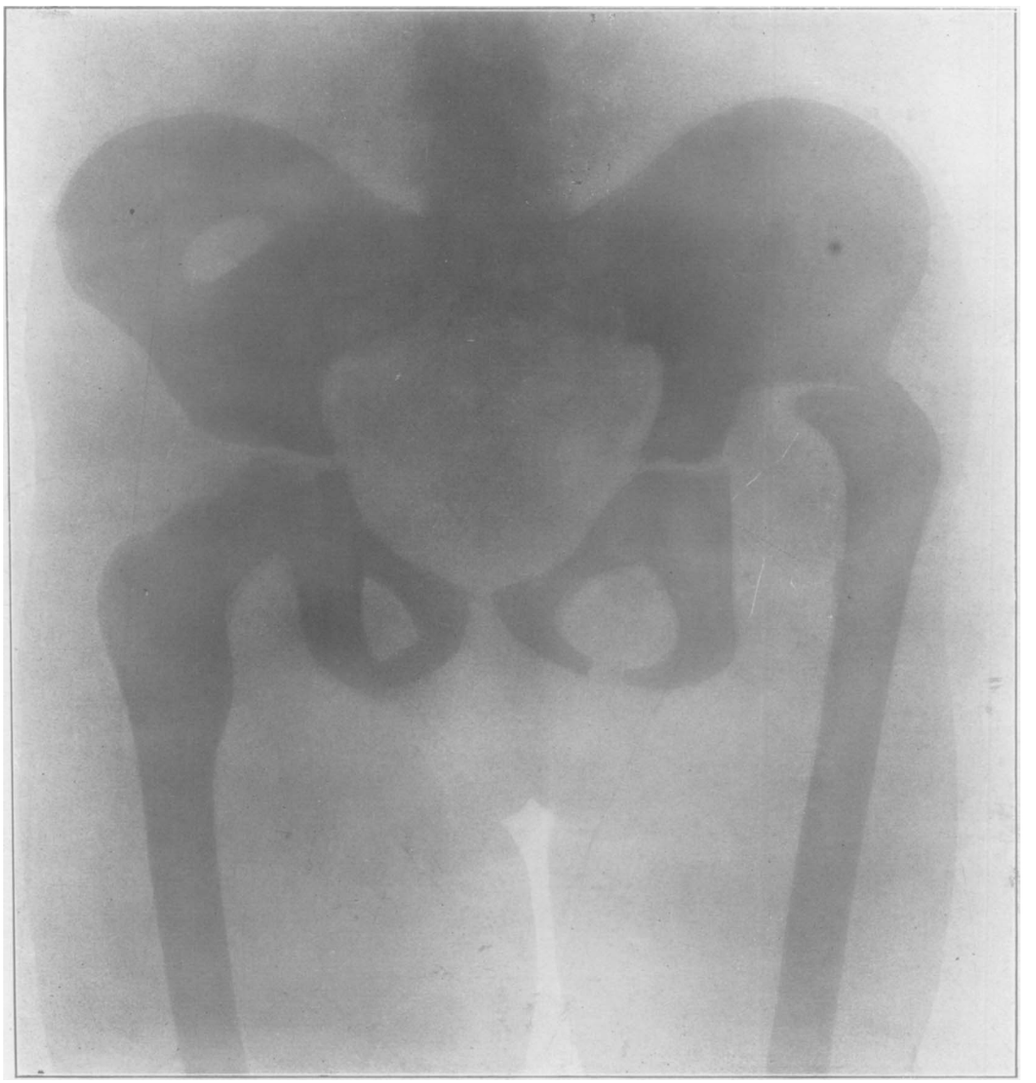
PLATE XX. (*b*).

PLATE XXI. (*Ten minutes' exposure.*)

CONGENITAL DISLOCATION OF LEFT HIP.

By J. L. THOMAS, F.R.C.S., Cardiff.

Beatrice Kennedy, aged seven years. It shows well the cotyloid cavity, the head and neck of femur, and is a suitable case for reposition of head of femur in the acetabulum ; the conditions which Brodhurst considers favourable to operative interference are present.



CONGENITAL DISLOCATION OF THE LEFT HIP.

(*Ten minutes' exposure.*)

(*By J. L. THOMAS, F.R.C.S., Cardiff.*)

PLATE XXI.

(*Archives of Skiagraphy.*)

SKIAGRAPHY IN ZOOLOGY.

By R. NORRIS WOLFENDEN, B.A., M.D. Cantab.

The editor of the ARCHIVES OF SKIAGRAPHY having kindly extended the scope of his publication to matters of other than clinical interest connected with radiography, I am allowed the opportunity of publishing through this medium the results obtained by submitting my zoological specimens to the X rays. These specimens were obtained by me while dredging in the Scapa Flow, Orkney, during the autumn months of 1896, and I propose to publish a number of plates dealing

with marine specimens — echinodermata, mollusca, crustacea, and British fishes. The results obtained have generally been very beautiful, and, I think, instructive. I have to thank Dr. Macintyre, of Glasgow, for kindly placing his laboratory and apparatus at my disposal, most of the work to be published having been conducted there in February, 1897, my specimens, preserved in spirit, having been brought south from the Orkney Islands, where they were obtained.

The ordinary spring on the induction coil was employed for some, but most were photographed with the mercury interrupter, with exposures varying from one to five minutes, and it was found that with slow interruptions of an average of five per second, the most beautiful results were obtained, with very much shorter exposures than with the ordinary spring. The tubes used were Watson's Penetrator and Palladium, Newton's, and Baird and Tatlock's (of Glasgow), all equally good.

PLATE XXII.

HOMARUS VULGARIS (THE LOBSTER).

This represents the skiagram of the common lobster, taken from above, and with an exposure of three minutes, using a ten-inch spark coil and Watson's new Palladium tube.

The anatomy of the animal is so fully described in the text-books of zoology that it seems needless to enter into any description of so common a natural history type.

The segmentation of the body is well indicated, as are the various parts of the limbs. This specimen was a male, the "claspers" of the fifteenth segment being clearly discernible.

The globular stomach, which occupies the greater part of the head, is indicated, as also is the heart and pericardial sinus.

HOMARUS VULGARIS (THE LOBSTER).

(*By R. NORRIS WOLFENDEN, B.A., M.D., Cantab, London.*)

PLATE XXII.

(*Archives of Skiagraphy.*)

PLATE XXIII.

CANCER PAGURUS (THE EDIBLE CRAB).

By R. NORRIS WOLFENDEN, B.A., M.D. Cantab., London.

This animal was submitted to the same exposure as the lobster figured in the previous plate.

The anatomy of this animal is also fully described in the text-books, and in all essential points it resembles that of the lobster. The segmentation of the abdomen is beautifully distinct. The duplicate impression of some of the ambulatory limbs was caused by the animal (which was photographed while living) having slightly shifted the legs while under exposure.

CANCER PAGURUS (THE EDIBLE CRAB).

(*By R. NORRIS WOLFENDEN, B.A., M.D., Cantab, London.*)

PLATE XXIII.

(*Archives of Skiagraphy.*)

PLATE XXIV. (*a*) AND (*b*)

THE HERMIT CRAB.

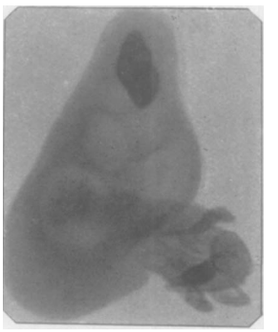
By R. NORRIS WOLFENDEN, B.A., M.D. Cantab., London.

Figure (*a*) represents the common hermit crab, which had made its home in a whelk shell, and was dredged by me from a depth of twenty fathoms. The soft body, general absence of abdominal appendages, and rudimentary appendages at the end of the abdomen, by which the animal maintains his position in the shell, are distinctly seen. One chela is greatly larger than the other, and is commonly used by the animal as a stopper to the shell entrance.

In figure (*b*) is shown a radiogram through a small sponge dredged from a depth of twenty fathoms in the Scapa Flow, Orkney, in which a hermit crab had taken his residence. The radiogram revealed the presence of a small shell embedded in the sponge.

FIG. (*a*).

FIG. (*b*).



THE HERMIT CRAB.

(*By R. NORRIS WOLFENDEN, B.A., M.D., Cantab, London.*)

PLATE XXIV. (*c*)

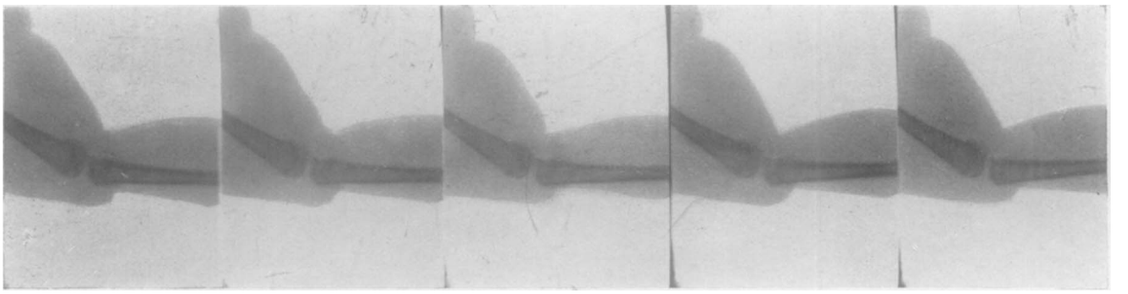
X RAY RECORDS FOR THE CINEMATOGRAPH.

By Dr. JOHN MACINTYRE, of Glasgow.

Dr. Macintyre has for some time been experimenting on the best methods of obtaining rapid exposures with a view to recording the movements of organs within the body. Two methods have been adopted, one in which the shadow of the object, as seen upon the potassium platino-cyanide fluorescent screen, was photographed by means of the ordinary camera. This, however, was found to be too slow for the purpose. The other method was to allow the sensitive film to pass underneath the aperture in a case of thick lead covering the cinematograph. This opening corresponded to the size of the picture, and was covered with a piece of black paper, upon which the limb of an animal, say a frog, could be photographed. As yet, the movements must be slow, and consequently carried out by an artificial or slow anæsthesia. In the present state of our knowledge the former gives the more satisfactory results. Some months ago, Dr. Macintyre showed, by means of the mercury interrupter, that he could obtain instantaneous photographs of the bones of his fingers by a single flash of the tube, due to one vibration of the contact breaker. At a meeting of the Glasgow Philosophical Society recently, he was able to pass a film forty feet in length through the cinematograph ; the movements of the leg of a frog could clearly be seen when demonstrated on a magic lantern screen by means of the cinematograph.

A Skiagraphic Society has been formed in London by some of the leading men interested in the study of the X rays, both in their medical and general scientific application. That such a combination is greatly needed is well recognised by all those engaged in working at the subject. All interested are requested to communicate with D. Walsh, 5, Pump Court, Temple, E.C.

FIG. (*c*).



X RAY RECORDS FOR THE CINEMATOGRAPH.

FROG'S LEG.

(*By Dr. JOHN MACINTYRE, Glasgow.*)

PLATE XXIV.

(*Archives of Skiagraphy.*)