

## Pathological Section.

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Mr. S. G. SHATTOCK, President of the Section, in the Chair.

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**A remarkable Case of Diffuse Cancellous Osteoma of the Femur following a Fracture, in which similar growths afterwards developed in connection with other bones.**

By W. H. BATTLE and S. G. SHATTOCK.

**De femoris osteomate diffuso post fracturam evoluto.**

### SUMMARIUM.

AEGER, puer annorum quattuor de sede cecidit, femore suo sinistro in hoc modo fracto.

Solidata est fractura. Tumor autem apparebat (sarcoma osteoides ut videretur), et membrum amputatum est.

Membro in longitudinem secto, femur, extremitatibus suis exceptis, tumore osseo circumdari repertum est.

Parietis compacti axis aliquantulum devius fracturae locum indicat.

Tumor ex osse ubique constat cujus cancelli telâ adiposâ implentur.

Scrutatio microscopica telam tumoris osseam probat normalem esse.

Inter cellulas adiposas, locis in quibusdam, telae medullaris inseruntur tractus ex myelocytis cum granulis tenuibus constantes, ex myelocytis cum granulis crassis, ex lymphocytis, erythrocytis, deinde, inter has cellulas compressis.

Neque telae sarcomatis nec inflammationis adsunt notae.

Neoplasma itaque osteoma simplex ac benignum haberi debet.

Notandum est quod annum post unum hujus pueri matris membrum inferius amputatum est femoris adversus tumorem.

Hic tumor ex cartilagine in trabeculis imperfecte calcificatis dispositâ constat, cujus cancelli telam connexivam continent.

Cavitas femoris medullaris non occluditur.

Sarcomatis notis absentibus dubitari non potest quin neoplasma benignum sit. Chondromatis osteoidis, ut appellatur, in classe includendum est.

Osteomatis evolutio post femoris fracturam in puero, exemplum, igitur, fit hereditatis tumorum benignorum quae apud chondromata atque osteomata tam insignis et bene probata est.

In puero fracturam, opinamur, neoplasmatis causam excitantem fuisse, et neoplasma ipsum e callo reparante ortum esse.

In puero eodem, insuper, osteomata postea apud femur dextrum excreverunt, apud tibiam dextram, atque e radio et ulnâ.

Tumor qui portionem femoris dextri inferiorem amplexus est sua sponte disparuit.

E syphile haud aegrotaverat puer.

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The following case is of so great rarity and, at the same time, of such interest, both clinically and pathologically, that we venture to think it worthy of a full and illustrated record. Clinically the lesion gave rise to an error of diagnosis, for the case was regarded as one of subperiosteal sarcoma, and upon this supposition the limb was disarticulated at the hip. Nor can it be said that this is the only form of lesion that has given rise to a similar error, and we may add to the clinical account of the case some examples in which a marked difficulty has attached to the diagnosis.

The patient, W. S., a boy, aged 4, was sent to St. Thomas's Hospital by Dr. Dowding, of Chatham, in 1901, for a tumour of the left femur. This presented some unusual characters, and he was shown to the Fellows of the Medical Society at one of the clinical meetings of that year.<sup>1</sup> He is stated to have been quite well up to the time of the following injury: he broke his left femur in April, 1901. The limb was put up in plaster of Paris, which was removed at the end of three weeks on account of excessive swelling of the thigh, which was said to have reached three times the size of the other one. The femur united, and the patient was able to walk about. The swelling was said to be diminishing.

<sup>1</sup> See *Trans. Med. Soc. Lond.*, 1902, xxv., p. 327.

On examination the left femur was found to be the seat of a hard fusiform swelling, the thigh measuring 15 in. in circumference—twice the size of the right. There was no pain or tenderness, and the child appeared to be in good health, and got about without splints. No enlarged glands could be felt in the groin or any other part of the body. All the bones of the skeleton were examined by means of the X-rays, but nowhere could any abnormality be detected excepting in connection with the left femur.<sup>1</sup> Concerning this bone, the skiagraphic diagnosis made was periosteal sarcoma.

Amputation at the hip-joint was performed on November 8, 1901, by antero-posterior skin flaps, the abdominal aorta being compressed by the thumbs of an assistant. The muscles were divided down to the innominate bone. Very little blood was lost, and the operation was well borne. The patient was discharged from the hospital on January 18, 1902. His general health was then very good. The only other abnormality in the skeleton appeared to be a thickening of the left ulna below the elbow-joint; here there was some tenderness with limitation of the movements of the joint, and rotation of the radius was also impaired.

As regards the family history of the case, the patient was, at that time, the only child, and there was no history of tuberculosis or syphilis. It is, however, a remarkable fact that a few months later the boy's mother developed a tumour of her right femur, for which amputation of the thigh was performed by Mr. Cotman at the Rochester Hospital in 1903. The mother is, at the present date, alive and well, no recurrence of the tumour having taken place.

Mr. Pitcairn, the house surgeon at the Rochester Hospital, has, within the last few days, informed us that a younger brother of the boy, aged 2½, was admitted in July, 1907, with a fracture of the right femur a short way below the middle. The child was under care on account of the development of an extensive tumour of the thigh, the circumference of the limb at one time being 19 in. A portion of the growth was removed for microscopic examination, the report being that it consisted of well-formed bone, with connective tissue and cartilage in process of ossification.

On June 9, 1903, the boy whose case is described in the present communication was again brought to St. Thomas's Hospital on account of swelling on the right femur. This was situated at the lower part of

<sup>1</sup> The various skiagrams referred to, and the reports upon them, were furnished by Dr. A. H. Greg.

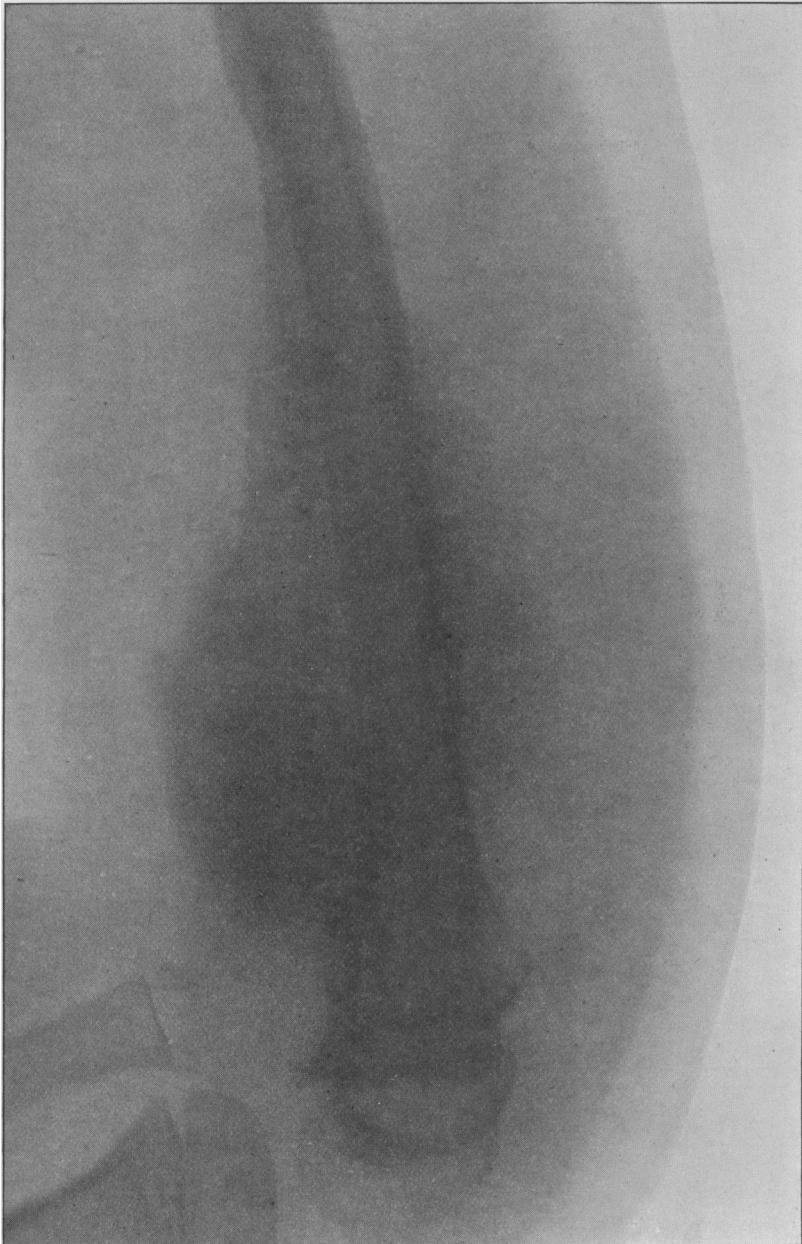


FIG. 1.

A skiagram of the right femur, showing a formation of bone surrounding the lower half of the shaft. When the limb was skiagraphed four years later the tumour was found to have disappeared.

Femoris dextri skiagramma. Osteoma portionem diaphysis inferiorem amplectitur. Tumor sua sponte disparuit.



FIG. 2.

A skiagram of the radius and ulna. From each bone a flattened, irregular osteoma has grown, apparently in connection with the interosseous membrane.

Radii ulnaeque skiagramma. Ex utroque osse osteoma, in membranâ interosseâ, ut videtur, excrescit.

the shaft of the bone, and formed a rounded, hard, bone-like elevation the size of a large orange. It surrounded the lower part of the diaphysis. It was not particularly tender, and the patient could walk on the limb without pain, using a crutch. The disease was regarded as a sarcoma of the same kind as the original growth on the other femur. As it was thought that there were some faint indications of "lines" at the angle of the mouth, a course of hyd. cum cretâ was prescribed. The general condition was good, and he was active in his movements like an ordinary healthy child.

The boy was readmitted to the hospital on March 5, 1907, for renewed examination, as it was reported that he had developed a further tumour on his right leg. A year before he had hurt his right shin in a fall on the pavement. He was taken to a local hospital and admitted the following day on account of much pain in the shin and a swelling. An incision was made into the swelling and a diagnosis of sarcoma was made, but nothing further was done. The pain and the swelling afterwards diminished to some extent. On readmission his general health was good and he was bright and cheerful. The appearance of the patient had, however, altered considerably; the head had become larger and presented a somewhat peculiar appearance, being much widened across the frontal region, whilst it projected markedly in the occipital region, as if from large, fairly symmetrical bony prominences.

Report of the X-ray department, May 7, 1907: "The boss on the skull is a thickening of the outer table."

The forearms appear deformed, especially on the ulnar sides, where the bones project unduly below the elbow-joints. Both arms are abducted.

Report of X-ray department, May 7, 1907: "In the forearms the bones are deformed and present small osseous projections which show no characters of inflammation and have no resemblance to sarcoma. There is no evidence of fracture."

There was a large fusiform swelling of the tibia, hard to the touch, evidently osseous, and not at all tender. It measured  $10\frac{1}{2}$  in. in circumference at the widest part, and did not extend either to the knee- or ankle-joint.

Report of X-ray department, May 7, 1907: "The right tibia has a large osseous tumour on it; the bone, which is bent, can be just made out going through the tumour. The tumour has a skeleton of bone which is not arranged like that of an ordinary periosteal sarcoma; the outline, too, is circumscribed as in an osteoma. There is no appearance of active disease."

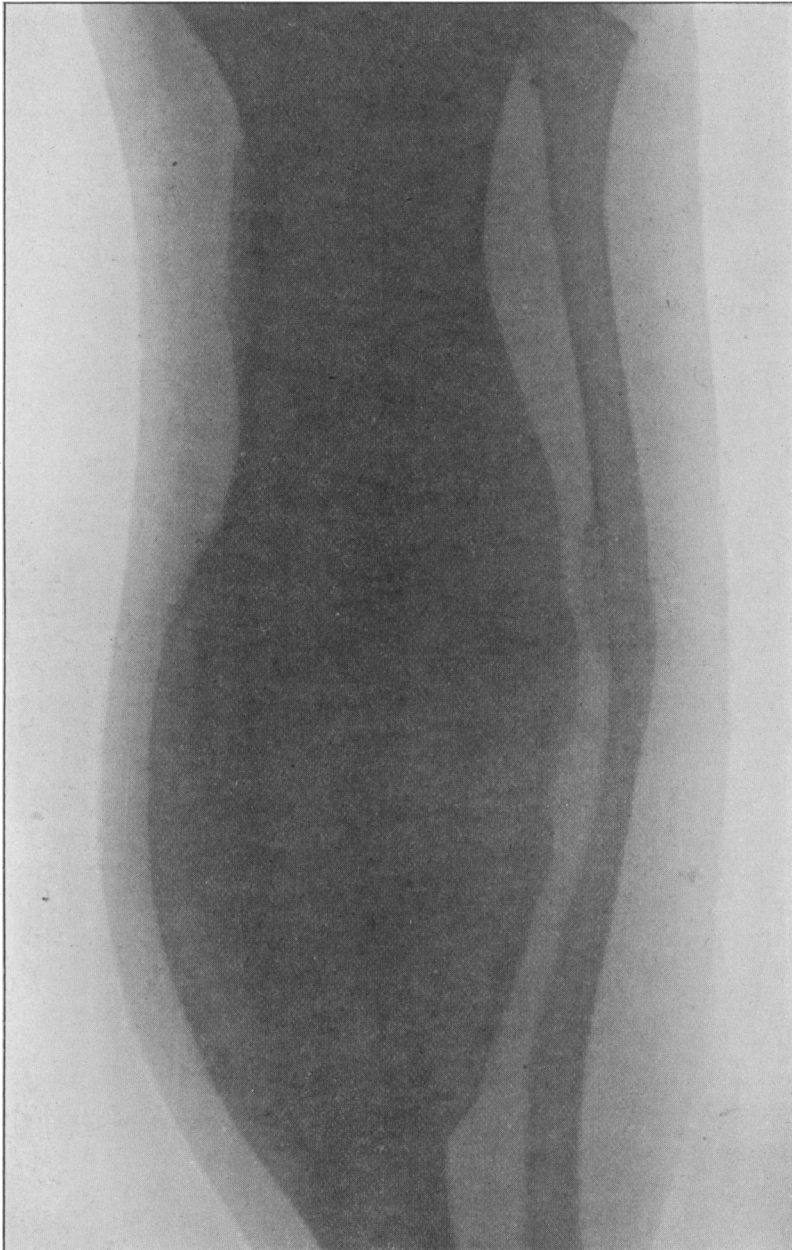


FIG. 3.

A skiagram of the right tibia, showing a fusiform formation of bone which appeared after a fall on the pavement. Slightly reduced.

Tibiae dextrae skiagramma. Diaphysis tumore osseo fusiformi circumdatur. Tumor post contusionem apparuit.

There were at this date no clinical signs of the previous tumour of the right femur.

Report of X-ray department, May 7, 1907: "The right femur (on which in 1903 there was a growth with all the appearances of a periosteal sarcoma) is now wide and abnormally transparent."

When this patient was shown at the meeting of the Medical Society no operation had been performed, and the opinion of the Fellows was asked for on the question of diagnosis. The following suggestions were made:—

(a) That the disease was a periosteal sarcoma of the femur, resulting from injury.

(b) That there had been a large subperiosteal extravasation of blood with subsequent ossification.

(c) That the swelling was a redundant growth of callus following the fracture of the bone.

On the whole, the suggestion which received most support was the one that the growth was a subperiosteal sarcoma. This was apparently confirmed by the result of the X-ray examination at a later date, and in accordance with this opinion amputation at the hip was performed. The pathological examination of the tumour, the subsequent appearance of other osseous growths of a non-malignant character, the disappearance of one of these under observation and the continued well-being of the patient prove this to have been an error.

A like mistake has been made on more than one occasion in regard to traumatic subperiosteal hæmatoma of a long bone, a lesion which has been known to arise in adult subjects who were otherwise in sound health.- Needless to say, the disease for which the hæmatoma has been mistaken is the hæmorrhagic form of subperiosteal sarcoma.

Whether osteoma or subperiosteal hæmatoma following an injury, such cases so simulate the graver disease and so urgently suggest the propriety of amputation that the diagnosis becomes of the greatest importance, and it is a diagnosis which demands the highest acumen, both clinical and pathological, for its elucidation. Apart from cases of the second kind known to us indirectly or from a part-association in their diagnosis, there is in the Museum of St. Thomas's Hospital the femur of an infant showing such a hæmatoma, the case being one in which the error in question was made (No. 366 F). The specimen is a vertical section of the femur, from which the periosteum has been detached for the lower three-quarters, the separation extending inferiorly to the epiphysial line. The cavity before incision was filled with a clear,



brown, viscid fluid. (The blood-clot now filling it is due to a recent hæmorrhage, which followed the exploration of the swelling.) On the front of the denuded shaft the space reaches a maximum depth from before backwards of 1·7 cm. and behind the shaft a depth of 2 cm.

In connection with the periosteum which forms the outer wall of the cavity, a thin shell of new bone has been produced, and, as told by microscopic section, a notable amount of cartilage. The parts were removed after death from a child aged eight months, who was under the care of Dr. Coutts and Mr. C. S. Wallace.

The infant was breast fed for a week only, then fed with barley water and Nestlé's milk for five months, and, lastly, for three months with "Allenbury's" No. 3 Food. There was one other child in the family with marked rickets who had been fed in the same manner. For a month previously to admission to the East London Children's Hospital, the right leg had been tender, and for six days swollen and red. When admitted the thigh was found to be slightly swollen, shining and red. There were no abnormal signs in any of the other limbs. The swelling of the thigh extended, and as egg-shell crackling was obtained, an incision was carried down to the surface of the enlarged bone. This on being divided was found to be an osseous shell, about  $\frac{1}{8}$  in. in thickness, enclosing a cavity filled with a clear, brown, viscid fluid; the shaft of the femur, bare of periosteum, was felt running through the middle of the space. The fluid proved sterile on culture. The general condition of the patient became steadily worse, and death took place on September 9, 1904, the child having been admitted on August 5, 1904.

In a paper elsewhere published, one of us (W. H. Battle<sup>1</sup>) has adduced further examples of the formation of swellings on the long bones (many of them following injury), in which the diagnosis from sarcoma may be difficult or even impossible. Of these perhaps the most common is excessive formation of callus after fracture. It is well known that undue movement of the fractured ends of a long bone will cause the formation of an excess of callus, but it is apparently in certain conditions of the nervous system that the largest formations are met with. Whether it is that owing to the nervous disease the parts involved are less sensitive to pain, and therefore are kept less quiet than in a normal individual, it is difficult to say. Possibly, owing to the loss of trophic influence, the formation of reparative material is not kept within proper bounds. Be this as it may, I (W. H. Battle) do not regard the result as in any way

<sup>1</sup> *Lancet*, 1904, ii., p. 580.

the direct consequence of the syphilitic infection which caused the disease for which the patient was under care at the time of the accident; that is to say, the swelling is not the result of a syphilitic osteitis, nor due to the formation of gummata. In one case mentioned (*loc. cit.*) the patient was suffering from locomotor ataxy. She was a very stout woman, aged 35, whose femur snapped at the neck as she was walking along a road. The patient was admitted forty-five days after the injury, during which time she had been kept in bed with a long outside splint applied. The limb was shortened 1 in. and a large bony swelling occupied the upper fifth of the femur, interfering with the action of the hip-joint. X-ray examination showed this to be osseous in nature and to be associated with a fracture of the neck of the femur. The swelling diminished slowly, being still very evident upon examination two years later.

One of us (W. H. Battle) has under observation at the present time a man, aged 45, who has had symptoms of general paralysis of the insane for about three years. This man fell in the street and sustained a fracture of the left femur in November of last year. The fracture was in the upper third of the shaft, and the superior fragment was very sharp. The patient on more than one occasion took off his bandages and splints and attempted to get up. When seen a month after the accident, there was much shortening and eversion of the limb, whilst the thigh was occupied by a great swelling which made it several inches larger than the right and suggested the presence of a sarcomatous growth. It was stated that this extensive swelling had only appeared a month after the accident. He had had very little pain, and his general health appeared good. X-ray examination, five weeks after the injury, showed the tumour to be an excessive formation of callus with ossification in the neighbourhood of the fracture. His reflexes were normal, but there was some increased frequency of micturition.

When osteitis deformans attacks one bone of the skeleton only, especially where there is a history of injury, some considerable difficulty may be experienced in coming to a correct conclusion. One of the cases mentioned (*loc. supra cit.*) was that of a married woman, aged 50, who was sent into St. Thomas's Hospital for a swelling of the right hip, which she had noticed for six weeks. A shortening of the limb with inward rotation caused inquiries to be made into her past history. It was found that she had worn a high boot for two years, ever since a fall in her kitchen. The limb was  $2\frac{1}{2}$  in. shorter than the other and the hip was considerably enlarged. X-ray examination showed that she had sustained a fracture of the neck of the femur, the upper part of the shaft,

with the trochanters, being very much thickened by osseous formation. The bone was trephined; the microscopical appearance of the piece removed "suggested a chronic osteitis." Under the X-rays the arrangement of the bone resembled that seen in osteitis deformans. Her reflexes were normal, and there was no evidence of disease elsewhere, although the patient was an emaciated, feeble woman.

In the same paper (*loc. cit.*) a photograph is reproduced of the thigh of a young man with a swelling of the posterior part. The case was sent up as a doubtful one of sarcoma, but the shortening of the limb, the way in which the swelling shaded off on to the bone above and below, together with the result of X-ray examination, made the diagnosis of osteitis deformans certain.

Another condition giving rise to a swelling which simulates sarcoma of a long bone is quiet necrosis. The amount of enlargement here may be quite out of proportion to the extent of bone which has undergone necrosis. The sequestrum, indeed, is in some instances so small that even the use of the X-rays has not proved sufficient to clear up the nature of the disease and prevent the removal of the limb.

So far as we are aware, the only instance on record of the condition known as leontiasis ossea affecting other than the bones of the head is to be found in the *Transactions of the Pathological Society of London*. Here the fibula and the hyoid bone were affected, as well as the bones of the skull and face. The case is perhaps the most pronounced that has yet been observed, and is recorded (with plates) in the *Transactions of the Pathological Society*, 1865, xvii., p. 243, by Dr. Charles Murchison, the patient having been under the care of Mr. Bickersteth, of Liverpool.<sup>1</sup>

The patient was a man, aged 34, in whom enlargement of the bones of the face was first noticed when he was aged 14. Thirteen years after this a similar hard swelling appeared along the course of the left fibula. As the facial enlargement increased, the cavities of the mouth and nose were greatly lessened, and the eyeballs extruded. Neither the integuments nor the soft parts were implicated in the disease. The patient had not suffered from syphilis, either congenital or acquired. One brother had a similar enlargement affecting the upper jaw on one side; this growth had also commenced about the age of puberty, but had for many years remained stationary.

After death no visceral disease was found. The bones affected were those of the face and cranium, the hyoid, and the left fibula. The

<sup>1</sup> A plaster cast of this extraordinary specimen was recently presented to the Museum of the Royal College of Surgeons by Prof. A. Grünbaum.

disease of the skull consists in great thickening and induration, the condition being due chiefly to the growth from the outer surface of numerous, closely aggregated, smooth, dense, botryoidal excrescences, varying in size from a hempseed to a small cherry. The only bone of the skull not involved is the occipital. The lower jaw presents the most remarkable change. It is enormously thickened in every direction; little trace remains of the condyles, coronoid processes or sigmoid notches, the whole being converted into two huge bilateral globular masses. The hyoid bone partakes in the same process, the body being much thickened and raised in botryoidal eminences. The shaft of the fibula, as seen in transverse section, is enlarged and rarefied in texture; the medullary canal is not occluded.

From the posterior and internal aspect there springs a great overhanging bony mass,  $4\frac{3}{4}$  in.  $\times$   $5\frac{1}{2}$  in. in its chief diameters. The greater part of this osseous mass is made up of dense bone, with here and there an extremely delicate cancellous structure; the dense bone, on close examination, is seen to be perforated with numerous minute apertures.

A case of localised enlargement of the tibia, which is interesting in connection with the subject of our paper, will also be found in the *Transactions of the Pathological Society of London*, xxxvi., p. 388. There is, however, no definite proof that the patient had sustained a fracture of the bone. The case was reported by Mr. Bilton Pollard, and is discussed later on in the present communication.

#### *PATHOLOGICAL ACCOUNT AND PATHOLOGICAL REMARKS.*

By S. G. SHATTOCK.

THE nature of the condition will, perhaps, be most readily understood from the description of the specimen which I have drawn up for the Pathological Catalogue of the Museum of the Royal College of Surgeons, to which it has been added. The inner half of the left thigh and upper portion of the leg of a child, the parts having been divided sagittally. The entire limb was removed by amputation for the tumour shown, which appeared after the femur had been fractured by a fall. In the surface of the section, opposite the middle of the shaft of the bone, there is an indication of the fracture in a slight irregularity in the line of the proper compact wall, and in an interruption of the medullary canal.

The fracture has healed without displacement. In connection with it there has been produced a large tumour, the extent and disposition of which at first suggests its being a subperiosteal sarcoma. The new formation is most prominent on the anterior aspect, when it attains a maximum thickness of 4·5 cm. ; posteriorly, where thickest, viz., opposite the site of the fracture, it does not exceed 2 cm. It involves, on both aspects, almost the entire length of the shaft, although on the front the volume of the growth is some five times or so that behind the bone. The anterior portion of the neoplasm presents itself as a hemi-elliptical mass intimately incorporated with the compact wall of the shaft, except inferiorly, where for a distance of 1·5 cm. it overlaps the anterior surface of the femur without being continuous with it.

Above the position last referred to the growth, for a short distance, is superficially lobulated, the structure being here penetrated by narrow septa of connective and muscular tissue. The highest part presents a somewhat similar configuration. Posteriorly the most prominent portion of the tumour corresponds with the plane of fracture, where it is continued downwards as a superficially lobulated sheath of diminishing thickness, almost as far as the epiphysial line. Above the plane of fracture it is represented by an investing process not more at first than 0·5 cm. in thickness, which becomes more and more attenuated as followed upwards, and terminates 0·4 cm. below the summit of the great trochanter. The compact wall of the shaft of the femur is traceable throughout beneath the new formation on both aspects, although its proper surface has lost some of its natural sharpness from a certain degree of superficial involvement.

There is nowhere any trace of similar growth in the medullary canal, which is occupied with adipose marrow. The growth presents but little vascularity, the most vascular area being that immediately behind the seat of fracture. To the naked eye, its structure is uniform throughout, and consists of finely cancellated osseous tissue, the interstices of which are filled with fatty medulla. If its texture be compared with that, say, of the upper end of the shaft of the tibia, no difference is discernible beyond that of the disposition of the cancelli in the two positions. There is nowhere the slightest trace, even at the surface, of a sarcomatous formation. The growth, from a naked-eye scrutiny, must be classed as an osteoma. A portion of the tumour, including the free surface, displays after maceration and subsequent treatment with ether a uniform somewhat finely cancellous structure, the trabeculae of which are everywhere normally calcified.

A skiagram was taken of the preparation in order to see whether it would give any clue as to the nature of the growth. In its general form and disposition the tumour could not be diagnosed by this means from a subperiosteal sarcoma. Nevertheless, with the knowledge gained by the examination of the specimen, it is not difficult to recognise the presence of finely cancellous bone throughout the swelling, the texture being practically identical with that in the cancellous ends of the femur itself. Less clearly these appearances were indicated in the skiagram of the tumour taken before the removal of the limb. In this it was recognised at the time that the textural picture of the growth was unusual and that it differed from that of an ordinary osteoid sarcoma.



FIG. 4.

Portion of a skiagram which was taken from the bisected limb after preservation by the formalin method. The area selected is from the higher end of the growth, and includes the adjacent part of the femur. Throughout the new formation a delicate cancellous structure is discernible, even at its very surface, the texture being practically identical with that in the cancellous end of the femur itself. Natural size.

Membri skiagrammatis portio, femoris extremitate superiori inclusâ. Neoplasma ubique monstrat telae structuram osseae cujus cancelli haud illis dissimiles sunt qui femoris ipsius extremitatem constituunt. Magnitudinis naturalis.

*Histology.*—Both frozen and paraffin sections were made, a portion of the growth including the surface and overlying muscle being selected

for examination. Decalcification was carried out by means of phloroglucin and nitric acid. For the study of the proper medullary elements Ehrlich's tri-acid and Leishman's stains were used. The structures displayed consist of normal adipose tissue in which lie slender osseous trabeculæ of equally normal character.

(1) To take the osseous constituent first. The trabeculæ comprise a uniform matrix and included corpuscles. In some portions of their extent certain of them are invested with a single series of osteoblasts, all the normal stages of cell inclusion in the matrix being obvious. The presence of canalicular systems in the matrix in connection with the

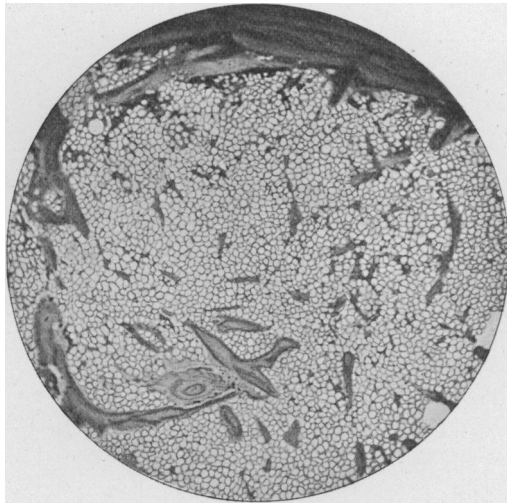


FIG. 5.

A microscopic section of the growth, including portion of the overlying muscle. It is constructed throughout of cancellous tissue, the spaces of which are filled with medulla, chiefly adipose tissue. Hæmatoxylin and eosin; 2 in. objective.

Neoplasmatis sectio microscopica, musculi suprajacentis portione inclusâ.  
Ex telâ osseâ normali ubique constat cujus cancelli medullâ, præcipue telâ adiposâ implentur.

lacunæ completes the characteristic normal structure. Here and there a group of osteoclasts lies against some portion of a trabecula, which is correspondingly eroded. Where the trabeculæ are not invested with osteoblasts the osseous substance lies in immediate contiguity with the fat. The actual surface of the growth is formed by a fibrous membrane with which the suprajacent muscular tissue is intimately incorporated.

The overlying muscle presents itself as longitudinally disposed fasciculi of normally striated fibres with intervening zones or strata of fibrous tissue; in the immediate neighbourhood of the growth the muscular bundles cease, a similar form of connective tissue to that distributed between the fasciculi completing the limit of the tumour, with the difference, however, that it is here more richly provided with cells. The adipose tissue filling the intervals between the ultimate or most superficial series of trabeculæ lies in actual contact with this capsular

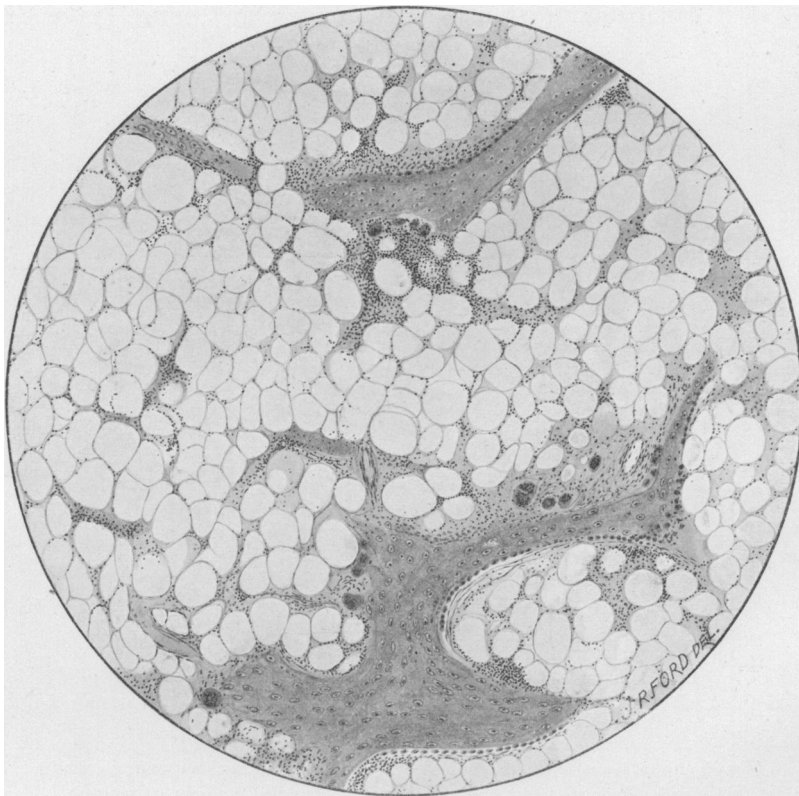


FIG. 6.

Portion of the section shown in fig. 5, somewhat more highly magnified. Two trabeculæ of normally formed bone are shown; these are in places invested with osteoblasts and in places eroded by osteoclasts. The intervening material consists of adipose tissue, in which strands of smaller-celled true medullary tissue occur. Zeiss obj. A, Oc. 4.

Neoplasmatis sectio microscopica. Ex telâ osseâ normali ubique constat cujus cancelli medullâ, præcipue telâ adiposâ, implentur. Inter cellulas adiposas inseruntur telae tractus medullaris verae.



membrane, that is to say, there are no limiting or circumferential laminæ of bone, and although a trabecula here and there meets the membrane obliquely, they mostly impinge upon its under surface in a vertical, or almost vertical, direction. At the sites of impingement the deepest, more cellular zone of the capsule is prolonged inwards upon the trabeculæ. The formation of bone must therefore be ascribed to this cellular or formative zone, which answers to the deeper layer of the

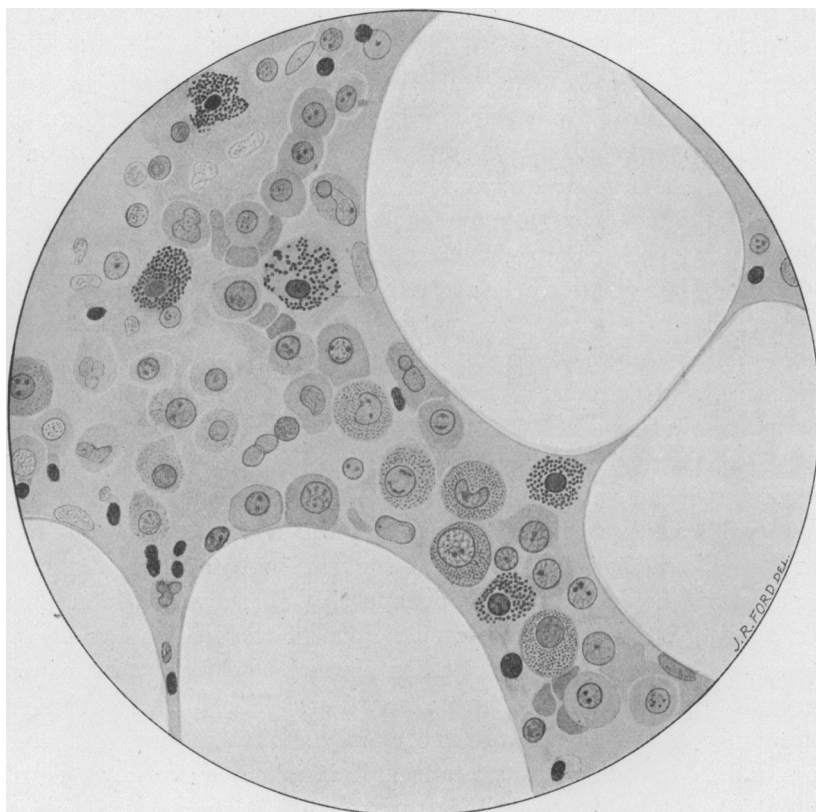


FIG. 7.

A microscopic section from the same situation as the preceding, as studied with  $\frac{1}{x}$  oil immersion; Leishman's stain. Between the large vesicles of fat there is shown a strand of proper medullary tissue. In this may be recognised finely granular myelocytes with a single spherical or oval nucleus, lymphocytes, coarsely granular eosinophile or fuchsinophile myelocytes; and here and there a red corpuscle, intercalated and misshapen, amongst the other elements.

Sectio microscopica liquore Leishman tincta;  $\frac{1}{x}$  obj. Inter cellulas adiposas in telae medullaris tractu discernuntur myelocytii cum granulis tenuibus, lymphocytii, myelocytii cum granulis crassis, et inter has cellulas erythrocytii interpositi.

periosteum. Indeed, as there is nothing between the surface of the shaft and the surface of the growth, the membrane investing the latter cannot but represent the periosteum.

(2) *The Medulla*.—By far the chief area of the section consists of ordinary adipose tissue, throughout which the osseous trabeculæ are uniformly distributed. The most interesting feature, however, is the presence of narrow strands of proper medullary tissue which track between the fat cells in different positions. In places they are quite absent, and they are most pronounced in the immediate neighbourhood of the periosteum. The proportion of true medullary tissue to the fat, however, is quite a low one. On a critical study all the forms of cell that make up the red marrow are recognisable. The chief number consist of finely granular myelocytes (with a simple spherical or oval nucleus) and of lymphocytes, and in conspicuous numbers there occur coarsely granular eosinophile or fuchsinophile myelocytes, the other elements in a given group consisting of erythrocytes, packed amongst and distorted by the other cells; here and there a nucleated red cell or erythroblast is encountered, or a polymorphonuclear leucocyte.

This remarkable new formation, distinctly referable to the injury, the fracture, and consisting throughout of well-formed cancellous bone with appertaining true medullary tissue, must be classified as an osteoma. It is an osteoma that has arisen, in its initial stage, as a callus formation, which, for some as yet inexplicable reason, has transgressed the normal bounds and exhibits all the physiological attributes of a tumour. Without the invasiveness, which is the cardinal mark of malignancy, it displays all the independence or anarchy of growth which characterises a benign tumour. It presents none of the histological marks of inflammation, and we must altogether discard the view of its being an inflammatory production, syphilitic or other. The growth of such an osteoma ensuing upon a fracture is certainly as rare as that of a sarcoma arising under the same circumstances, if it is not more so. One of us (S. G. Shattock) has discussed the latter sequence in recording an example of it.<sup>1</sup> The growth in this case arose at the site of a fracture of the humerus and occurred in a policeman who broke his arm in a heavy fall against an iron railing; this took place four and a half months before his admission into St. Thomas's Hospital. Splints had been kept on for five and a half weeks; when these were removed the arm felt normal, and union was complete. A month and a half after the discontinuance

<sup>1</sup> *Trans. Path. Soc.*, 1896, xlvii., p. 261.

of the splints the patient noticed for the first time a lump in the region of the fracture; this increased somewhat rapidly afterwards, and for a while was regarded as an excessive production of callus. Recovery ensued after amputation at the shoulder-joint, but death took place about two years later with symptoms of recurrence in the chest. The rarity of such a sequence was fully recognised by Virchow, who had himself the opportunity of examining only one example, viz., a case in which Langenbeck had disarticulated the arm of a man, aged 23, for a growth which had appeared a year and a half after a fracture. The large proportion of cartilage in the microscopic sections from the case recorded in the *Transactions of the Pathological Society* is, as was therein pointed out, noteworthy in connection with the exciting cause of the growth; it relates the new formation to the reparative callus, which, as is now generally known, in simple fractures, in the case of the human subject as in that of the lower animals, undergoes a certain amount of cartilaginous metaplasia.

In the *Transactions of the Pathological Society*, 1885, xxxvi., p. 388, Mr. Bilton Pollard has described under the title of "Hypertrophied Callus of the Tibia and Fibula" the case of a patient who, when a year old, fell off a chair and injured her left leg so as to disable her for a fortnight. Whether the leg was then broken or not could not afterwards be discovered. Nothing further was noticed until a year and a half after the accident, when the leg was found to be swelling in the middle; it was not painful, and locomotion was not interfered with. When the patient was admitted into University College Hospital, under the care of Mr. Marcus Beck, she presented a considerable enlargement of the middle of the tibia and there was a second swelling on the fibula. The tumour was supposed to be an ossifying sarcoma, and the leg was amputated. When the tibia was afterwards sawn down it was found to be the seat of a fusiform growth which microscopically presented a basis of cellular connective tissue, through which spicules of normal bone were evenly distributed. The macroscopic figure accompanying the paper shows the whole of the growth to be of a uniformly cancellous structure. The fibula was the seat of a similar but less extensive formation. Nevertheless, this case of Pollard's differs from the present in two important particulars: (1) the original shaft has been completely replaced by the new formation, which also fills the medullary canal; (2) the histological picture is markedly different, for the interstices of the cancellous tissue are not filled with medulla, either adipose or other. The attempt might be made to explain away the macroscopic

dissimilarity by assuming that the new growth has arisen in connection with the internal or intramedullary callus as well as with the external or subperiosteal, and that the original compact wall of the shaft has not been invaded by any neoplasm (as it would be by a sarcoma), but that in the ordinary process of growth the shaft has been removed, and instead of being renewed it has been replaced, and come to be represented by the abnormal tissue, somewhat as in the progress of rickets, where the compact wall of the shaft of a bone, without being itself diseased, is removed *pari passu* with an excessive production of finely cancellous and imperfectly calcified bone of periosteal source.

In the case of the rachitic calvaria, the tables, like the compact wall of the long bones, disappear in the progress of the disease, the general texture of the skull becoming finely porous throughout and in macroscopic characters like that seen in the presclerotic stage of osteitis deformans, with this difference, however, that in the rachitic skull the trabeculæ are so imperfectly calcified that microscopic sections may readily be cut without any artificial decalcification. In discussing these changes<sup>1</sup> I have advocated the view that the osseous overgrowth occurring in rickets should be regarded as inflammatory.

With Mr. Bernard Pitts I have described at length<sup>2</sup> a remarkable case in which the upper two-thirds of the tibia of an adult, a woman, aged 37, was completely replaced by a non-calcified, finely cancellous bone; on careful inquiry syphilis, whether congenital or acquired, was in this case excluded. I did not regard the lesion as any form of sarcoma, and as it could not be identified with any condition hitherto described, I ventured to give it a distinctive name, viz., "non-calcifying plastic osteitis." It may be mentioned, in passing, as corroborative of the diagnosis against sarcoma that, although the amputation, which was carried out just above the knee, was performed in November, 1895, the patient, when seen three years later, was free of recurrence, and that she died of pulmonary disease about five years ago. The material filling the spaces of the non-calcified bone was not true marrow, but a very cellular connective tissue, without fat cells or myelocytes.

In regard, therefore, to Pollard's specimen I am disposed to agree with those members of the Morbid Growths Committee (which reported upon it) who viewed the lesion as a hyperostosis referable to an inflammatory process rather than an overgrowth of callus. The complete

<sup>1</sup> *Trans. Path. Soc.*, 1891., xlii., p. 235.

<sup>2</sup> *Trans. Path. Soc.*, 1897, xlviii., p. 176. The specimen is preserved in the Museum of St. Thomas's Hospital.

disappearance of the wall of the shaft and its replacement by the new bone, together with the extensive filling of the medullary canal and the absence of medullary tissue from the interstices of the new bone, seems to me to relate the formation to an inflammatory process and to displace it from the group of true osteomata. I know of no instance in which, in the case of a simple fracture, the wall of the shaft has vanished in the callus: and against the view, moreover, of an excessive callus formation must be placed the fact that the enlargement was not observed until a year and a half after the accident, whatever the nature of this may have been. An examination of Pollard's specimen (No. 1241 D, College of Surgeons Museum) leads me further to regard it as of the same character as that already referred to and described by myself in the tibia. As in the latter case so in the other, the new tissue is demarcated almost abruptly from the normal cancellous tissue of the tibia above and below, being mapped out by its abnormally fine texture and paler colour; and what makes the likeness still nearer is the circumstance that the new bone in Pollard's case is imperfectly calcified, though not to the extreme degree shown in the other.

Pollard's specimen I have re-examined microscopically by means of frozen sections cut vertically (without artificial decalcification) from the most prominent part of the tibial enlargement. The histological picture comprises well-formed trabeculæ (and included corpuscles) lined with osteoblasts; osteoclasts occur here and there. Between the trabeculæ there is throughout a young connective tissue rich in elongated cells, and with an imperfect indication of fascicular arrangement; the cells are separated in different degrees in different places by delicate intervening fibrillæ; nowhere are there any proper myeloid elements, and there is not a single fat cell. The trabeculæ are mostly unstained, refractive and calcified; some present an eosin-stained uncalcified margin.

There is no macroscopic trace at either epiphysial line of the changes pathognomonic of rickets, and this disease may be excluded. The chief difference between the two specimens is that in the adult tibia the new bone has replaced the old and filled the medullary canal *without producing any external swelling*. The imperfectly calcified and finely porous bone in both cases is much like that found in progressing rickets. In rickets, as in the other cases, I should regard the anatomical lesion as of the same nature, *i.e.*, an inflammatory formation of bone, in which imperfect calcification has occurred; the name already used in connection with the lesion of the tibia would apply to rickets—the lesions affecting the bones are anatomically those of a non-calcifying plastic

osteitis or periostitis; we find in the uncalcified subperiosteal tissue of rickets the interstices of the finely cancellous "bone" filled with a cellular connective tissue in which scanty numbers of lymphocytes and polymorphonuclear leucocytes occur.

Not only may rickets be excluded in Pollard's case, but so may syphilis. There was no history or evidence in the patient of congenital syphilis; and the new formation differs from a syphilitic one in its circumscription amidst the original bone. Its mere volume might be matched in a syphilitic infection. In the museum of St. Mary's Hospital there is the ulna of a syphilitic infant, which shows a pyriform enlargement involving the upper two-thirds, the swelling attaining a diameter of 2.5 cm., whilst the diameter of the unaffected portion below is but 0.5 cm., and the extreme length of the bone only 10 cm. The shaft within the periosteal node has been so rarefied as to be unrecognisable, though some indication of it is afforded by the vertical trend of the cancelli in the deeper part of the swelling; the medullary canal is not filled in; other of the bones were likewise affected.

Into the definition of a cancellous osteoma doubtless we should now insert, as a necessary part, the presence of marrow, *i.e.*, of adipose or of true medullary tissue, or both. But although such a basis of distinction between a true cancellous osteoma and an inflammatory formation might be made during the progressing stage, it must be allowed that the connective tissue filling the interstices of an inflammatory production of new bone might at a later date become infiltrated with fat and so acquire the characters of the unessential adipose element of medulla. In the case under discussion, however, the growth following the fracture was of recent date, and it can only be classified as a true cancellous osteoma.

In both Pollard's case and that described by Mr. Pitts and myself, the circumscription of the newly formed, imperfectly calcified, and finely cancellous tissue is striking; and I may add yet another illustration of what I believe to be the same anatomical condition. In the goat it is not rare to meet with an enlargement of the lower jaw, in which the bone is replaced by a finely porous osseous tissue, so soft that microscopic sections can be readily prepared without any decalcification. The disease has been described in the *Transactions of the Pathological Society*, xl., by Mr. W. G. Spencer. It is illustrated by many specimens in the Museum of the Royal College of Surgeons, and I have myself had the opportunity of examining others which were sent to me by Professor Sherrington when Superintendent of the Brown Institution—the same

source, indeed, which furnished Mr. Spencer with his. It is observed in goats of from two months to three years of age, and chiefly in females kept for milking. The age of some of the animals excludes rickets, nor are the epiphysial signs of this disease present in the long bones in those examples where the animal is young, *e.g.*, two months.

In an early stage there is observed a symmetrical swelling of the lower jaw, between the angle and the molar teeth, the jaw feeling softer and being capable of indentation; as the disease progresses the whole of the jaw, the body, and rami become involved. The upper jaws may exhibit similar disease. The close connection of the morbid changes with the teeth is noteworthy; it suggests the origin of an infective

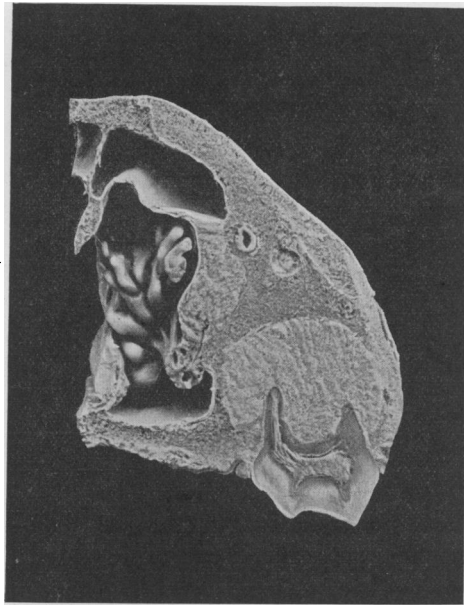


FIG. 8.

A section of the superior maxilla of a goat, showing a somewhat circumscribed interstitial formation of imperfectly calcified tissue which has grown within and replaced the original bone. The new formation immediately surrounds the fangs of one of the molar teeth. Natural size. (715jD, Museum Royal College of Surgeons.)

Maxillae superioris caprae sectio. Telae connexivae osteogeneticae imperfecte calcificatae monstratur moles quae pro telâ normali substituitur et dentis radices amplectitur. Magnitudinis naturalis.

process occurring by way of the alveoli. In some cases the ends of the long bones present a similar replacement of normal by abnormal tissue. What appears to be the same disease, says Mr. Spencer, had been previously noted by many veterinary surgeons in the horse. My own sections, made without any artificial decalcification from one of these diseased jaws, show a finely cancellous bone, some of the trabeculæ of which are quite devoid of earthy salts, yet they otherwise present all the detailed structure of normal bone and are closely surrounded with osteoblasts. In other trabeculæ central calcification has occurred. The material within the cancellous spaces is throughout a cellular connective tissue, without proper medullary cells or fat; a few osteoclasts are present. The connective tissue is of a looser or more open texture than in Pollard's specimen or in the tibia described by myself. Their circumscription would be the only ground for classing these different formations amongst tumours. In such a classification they would be interstitial osteomata, *i.e.*, tumours growing interstitially in, and replacing, the bone, as differentiated from exostoses or enostoses; and to indicate their imperfect classification they would be "osteoid osteomata." The absence of medullary tissue, however, forbids the adoption of such a nomenclature.

The new formation described in the present communication is, on the contrary, a true osteoma, the growth of which followed upon a fracture, for not only is it non-invasive, and therefore not sarcomatous, but it has throughout the gross structure of cancellous bone, the spaces of which are everywhere filled with fat, between the cells of which there lie strands of true medullary tissue comprising finely granular and coarsely granular myelocytes, with lymphocytes, intermingled with red corpuscles. The subsequent growth of a subperiosteal osseous tumour on the opposite right femur of the same child, and which, so far as can be judged by the skiagram, is of the same kind, is remarkable, and still more so is the appearance of a further fusiform osteoma around the middle of the shaft of the right tibia, and of less considerable, flattened and subdivided outgrowths from the radius and ulna. The formation of one of these, *viz.*, that on the tibia, followed an injury—a fall on the pavement. The amount of bone formation and its multiplicity recall the cases of multiple osteoma which led Virchow to retain with some approval the traditional term "ossific diathesis," meaning by this an idiosyncrasy for producing bone under conditions which do not avail in normal individuals. In myositis ossificans the same thing is witnessed. It is impossible to explain the widespread formations of bone in this disease without assuming some general predisposition. The mere fact that the muscles are first



inflamed does not of itself suffice, for myositis does not in other cases terminate in such a way. There is a myositis fibrosa as well as a myositis ossificans. The osteomata springing from the radius and ulna are clearly, as shown by their flattened form and their position, of the kind which grow into muscular attachments, aponeuroses, and ligaments. We may find the same combination of such ill-defined osseous outgrowths and true osteomata in other cases of multiple exostosis.

In the Museum of St. Thomas's Hospital there is the skeleton of an adult affected with multiple bony tumours (Spec. No. 602). Some of these are pedunculated and have a lobulated surface, but in certain situations the excrescences take the form of exaggerated muscular and fascial processes.

Some may be inclined to place the present case amongst those of "redundant callus" formation. But such a clinical group is too ill-defined. It comprises examples of different pathological conditions, and it is more accurate to differentiate such, as far as is possible, according to their anatomy and pathogenesis. Certainly, in the majority of cases, the formation of redundant callus after fracture results from want of immobility during the repair. This of itself may be sufficient, from the mechanical irritation it involves, and explains why such examples are chiefly furnished by fractures of the upper end of the femur.

But here, again, the influence of collateral conditions must not be overlooked. In some cases of tabetic arthropathy the amount of new bone formation accompanying the destruction of the articular ends of the bones is very striking. And in the repair of a fracture in tabetic patients, as Mr. Battle has pointed out, huge formations of bony callus may take place.<sup>1</sup> The exact pathology of such results cannot be given. If the excessive formation of callus is to be referred to an altered trophic influence resulting from the disease of the central nervous system, it must be remembered that this *may* act by favouring the action of other factors, as well as in the more hypothetical manner suggested by Mr. Battle in the earlier part of this communication. The possibility of an auto-bacterial infection of the injured parts leading to a chronic inflammation must be kept in mind, *i.e.*, an inflammation arising from the action of micro-organisms already in the tissues, the action of which was held in check until the advent of the injury. And, apart from tabes, there is no doubt that a proper inflammatory process must be invoked to explain the exuberant formation of callus in certain cases.

<sup>1</sup> *Lancet*, 1904, ii., p. 580.

In regard to the transport of living bacteria to the organs of healthy animals during life, I may cite some remarks from a communication of my own in the *Transactions of the Pathological Society*, (1902, liii., p. 436): "From the early experiments of Tiegel<sup>1</sup> up to the latest of Ford, the solution of this question, presenting at the outset so delusive an exterior of simplicity, forms quite an episode in bacteriological history. The presence of bacteria in a living state, but one, so to say, of suspended animation, is a possibility not foreseen in the early stages of the inquiry. The experiments of Tiegel (who concluded that the normal viscera are *not* free of living bacteria) were made by submerging pieces of the freshly excised organs of animals in molten paraffin (110° C.—150° C.), which was then allowed to set. After a variable time of from four to twelve days the paraffin block was broken and the contents examined microscopically.

The experiments of Ford<sup>2</sup> consisted in transferring portions of the organs of healthy animals, suddenly killed, into nutrient media, the surfaces of the pieces themselves being first sterilised by cooking in the flame. Inoculations were made at the end of the first and third days by drawing up some of the juice of the organ in a sterile glass pipette, subsequent inoculations being made until positive results were obtained or a sufficient time had elapsed to show that the viscera were absolutely sterile. The cultures arose from those inoculations which were made from the original material on the sixth, seventh, or eighth day, or even as late as the seventeenth. The result was that in healthy domestic animals 70 per cent. showed bacteria in the internal organs provided that a sufficient time was allowed to elapse between the removal of the organs and their final examination. From the guinea-pig, for example, were isolated *Staphylococcus pyogenes aureus* and *albus*, *Bacillus proteus*, *B. coli*, *B. subtilis*, *B. mesentericus*. The tubercle bacillus is not given in the lists. The observations of Pizzini are therefore worth bearing in mind. Pizzini<sup>3</sup> inoculated guinea-pigs with the lymphatic glands from the bodies of forty persons who had died of non-tubercular affections; tuberculosis resulted in 42 per cent. of the experiments, the bronchial glands being those which most frequently gave a positive result. In the human subject the results, so far as the peritoneum is concerned, have been confirmed by Mr. L. S. Dudgeon, who has cultivated the *Staphylococcus albus* from the blood effused into the peritoneum in 17 cases of extra-

<sup>1</sup> *Virch. Archiv.*, 1874, lx., p. 453.

<sup>2</sup> *Journ. Hygiene*, 1901, i., p. 277.

<sup>3</sup> *Zeitsch. für klin. Med.*, Berl., 1892, xxi., p. 329.

uterine pregnancy, 2 of rupture of the spleen, and 1 of rupture of the liver.<sup>1</sup> In the guinea-pig Mr. Dudgeon also finds the *Staphylococcus albus* often present as a normal inhabitant of the omentum, and he points out that the presence of non-bacterial substances injected into the peritoneal cavity (chalk suspended in salt solution) appears to increase its activity there in the majority of cases.<sup>2</sup>

Malgaigne<sup>3</sup> cites at length the case of a man who sustained a fracture of the upper third of the right femur from a fall from a horse. The case was treated by Dupuytren by means of direct extension, and afterwards by the double inclined plane. This change of position caused the fragments to incline one over the other, marked swelling and great pain following. Callus formed slowly and remained deformed. The patient, nevertheless, got up. The callus swelled and became the seat of acute pain; the limb became œdematous and of violet colour. All the means of treatment adopted were unavailing.

Only towards the third year, under sea bathing, did the pain, swelling, and congestion in great part disappear. The two fragments were surrounded with a large mass of callus. Blisters, and finally an issue, were used. Some months later the limb recovered its colour and form. Malgaigne refers briefly to two other similar but less marked examples, and concludes by observing that this affection of the callus has the character of a chronic inflammation involving the parts. Here the view of an auto-bacterial infection best explains the result, the inflammatory process having, of course, stopped short of suppuration. This view is rendered still more probable by the case afterwards cited by the same author, where a man, aged 18, sustained a fracture of the middle of the femur, and attempted to walk and resume his work at the end of the fourth week. Six weeks later the limb had shortened 2 in., and the callus had acquired an enormous volume; abscesses had formed in many parts.

Another matter of surprise in connection with the present case is the spontaneous disappearance of the osteoma on the right femur. As shown by the skiagram taken in 1903, the lower half of the shaft of the right femur was then surrounded by a somewhat irregularly fusiform bony tumour, whilst the skiagram taken in 1907 showed that this had disappeared. Abernethy, nevertheless, has recorded what in this regard

<sup>1</sup> "The Bacteriology of Peritonitis," Dudgeon and Sargent, 1905.

<sup>2</sup> *Trans. Path. Soc., Lond.*, 1906, lvii., p. 171. L. S. Dudgeon and A. Ross.

<sup>3</sup> "Traité des Fractures et des Luxations," i., 1847.

is a comparable case.<sup>1</sup> And it is noteworthy that in this, also, the appearance of the bony formations would follow the receipt of an injury. "A youth, aged about 14, was brought to me whose back was greatly deformed by irregular hillocks of earthy matter heaped up upon the spinous processes of the vertebræ. The ligamentum nuchæ was ossified, so that his head was immovably fixed, being drawn backwards and slightly inclined to one side. There were exostoses on the os brachii of both arms, and the tendinous margins of the axillæ were converted into bone, and pinioned his arms so closely to his sides that it was difficult to insinuate the fold of a napkin between them and his chest. There was an exostosis on the pelvis, between the sacrum and os innominatum, *and various others had formed at different times and disappeared*, but those which I have mentioned were permanent. Being a robust and spirited youth, he was disposed to exertion, and if, in a forcible effort to accomplish any purpose, which his manacled situation obliged him often to make, *he accidentally struck his head, or any projection of a bone, a temporary deposition of earthy substance in the injured part was always the result.* He had had the toothache a little before I saw him, and the remains of an exostosis, which had been considerable, still appeared on the lower jaw. Two years after the time I first saw him the youth came to London again, and the exostoses which I have described seemed to be pretty much in the same state; several new ones, however, had formed on the extremities; one in particular extended itself from the pelvis along the thigh in the direction of the sartorius muscle, and impeded the motions of the limb."

As already stated by Mr. Battle, the right lower limb of the boy's mother, a woman aged 24, was likewise amputated for what was clinically supposed to be a sarcoma, the operation having been carried out by Mr. Cotman, of Rochester, about a year after the limb of the child had been removed by Mr. Battle. The amputated limb, which had been buried since February 17, 1903 (the date of the operation), was exhumed in April and sent to me for examination, notwithstanding which, microscopic preparations of the tumour show quite clearly its histological structure, a preservation possibly in part due to the saturation of the tissues with the anæsthetic during the operation. The growth on the femur, after removal of the surrounding soft parts, presents itself as a bilobed or transversely constricted mass, which does not completely surround the shaft, the outline of which is traceable on

<sup>1</sup> Abernethy, "Lectures on the Theory and Practice of Surgery," 1830, p. 169.

one of its aspects, though misshapen from the growth of a long lamina of new bone, which is scarcely anywhere connected with the tumour, but resembles the expansions met with as intramuscular or intrafascial osseous outgrowths. In cross section the lesser of the two lobes or subdivisions of the mass measures  $2\frac{1}{2}$  in., and consists of a somewhat coarsely but fully hardened cancellous tissue, the spaces of which are filled with fat; the surface is closed with a thin layer of compact tissue. The larger lobe, which has a diameter in cross section of 4 in., presents a closer or finer cancellous texture, and is in places so imperfectly calcified as to be resilient, like sponge. The outer surface of this portion is lowly lobulated or tuberoso, but intact and sharply defined; in places it is finely porous, elsewhere closed with a thin compact lamina. Portions of the outer surface are so imperfectly calcified as to be quite elastic. On longitudinal section the two lobes are found to be discontinuous, being separated by a sheet of fibrous tissue which reaches down to the remains of the shaft, one apposed surface being regularly convex and the other concave. The remains of the shaft, incorporated with the tumour, together with the medullary canal, which preserves its patency, are traceable in the section. In some situations the compact wall of the shaft is quite intact beneath the growth, the periosteum intervening, showing that a portion of the mass has grown around or overlapped the original bone.

*Histology.*—Sections of one of the low nodules of the superficial part of the larger of the two divisions of the growth were cut vertically to the free surface, the spot selected being one in which the tissue was resilient and sponge-like from imperfect calcification. The sections exhibit throughout a cancellous structure, with a uniform mesh, the trabeculæ composing which are somewhat coarse and are composed of hyaline cartilage. The spaces of this cancellous cartilage, as it might be called, are filled with a loose connective tissue, by no means very cellular, and neither the cells nor the fibrils of which have any definite disposition. From this inter-trabecular tissue the development of the cartilage is readily traceable. Cells lie against the trabeculæ in all stages of inclusion in a hyaline matrix; these cells, although somewhat small, are contained from the first in spherical spaces, and pass by all gradations into the larger spherical cells occupying the more central parts of the trabeculæ. Sometimes amongst the smaller cells in process of inclusion, or just included, characteristic groups of two occur with flattened sides of apposition; and nowhere do the enclosed cells present the flattened character of the proper osseous corpuscles in the lacunæ of membrane bone. If any

true membrane bone is anywhere in process of formation, its amount is insignificant. In the more central parts of the trabeculæ the matrix is in different degrees calcifying, the cells themselves retaining their large size and spherical forms. The actual surface is composed of hyaline cartilage in which no calcification has taken place, the matrix being clear and quite devoid of granules.

The zone of cartilage bounding the surface is traversed with connective tissue so as to present a trabecular structure; but the spaces are narrower than elsewhere, and the connective tissue occupying them is more cellular. Both the trabeculæ (the cells of which are here smaller) and the tissue between them, however, merge directly, on the deeper aspect, into the larger-celled cartilage and into the loose connective tissue filling its cancelli, respectively. The tissue of the smaller spaces presents no sarcomatous characters; it is simply connective and chondrific. Sections of the deeper, somewhat harder, portions of the larger division of the growth, cut after decalcification in picric acid, display the same structure. The tissue in the cancellous spaces of the cartilage has none of the characters seen in a chondrifying sarcoma, but consists of loose connective tissue with cells devoid of any regular disposition and by no means conspicuous in numbers.

This tumour cannot be classed with inflammatory formations for the obvious reason that it is so extensively constructed of true cartilage. The ultimate transformation of large areas of it into cancellous bone, holding fat, removes it from the group of sarcomata. The new growth finds its place amongst those described and named by Virchow osteoid chondromata. There is no reason for regarding it as a malignant formation, nor does Virchow's name either exclude or imply malignancy. We may relate the neoplasm in its general characters to the peripheral chondromata which grow around the larger bones in the adult, and in which extensive formation of true cancellous tissue may take place—ossifying chondroma. In both forms the bulk of the growth is cartilage, but in the ossifying chondroma the formation of bone proceeds after the normal type; the matrix of the cartilage is first calcified, and the calcified tissue with included cells is then penetrated by vascular connective tissue, from which is laid down membrane bone in the spaces resulting from its destruction. In the osteoid chondroma the formation is essentially cancellous. It might almost be said to consist of cancellous cartilage. The cancelli are formed of cartilage, and although secondary additions to the trabeculæ may be made from the connective tissue filling the cavities, this occurs without the original cartilaginous substance being

removed. In the normal process of intracartilaginous ossification, the only remnants of the cartilage, it will be remembered, which form any constituent of the proper bone are the lines of calcified matrix between the rows of cartilage cells, the latter cells disappearing before the invading connective tissue. In the osteoid chondroma the tissue, indeed, recalls that produced at the epiphysial line in rickets, for in this disease the proliferating cartilage is riddled with the vascular ossific

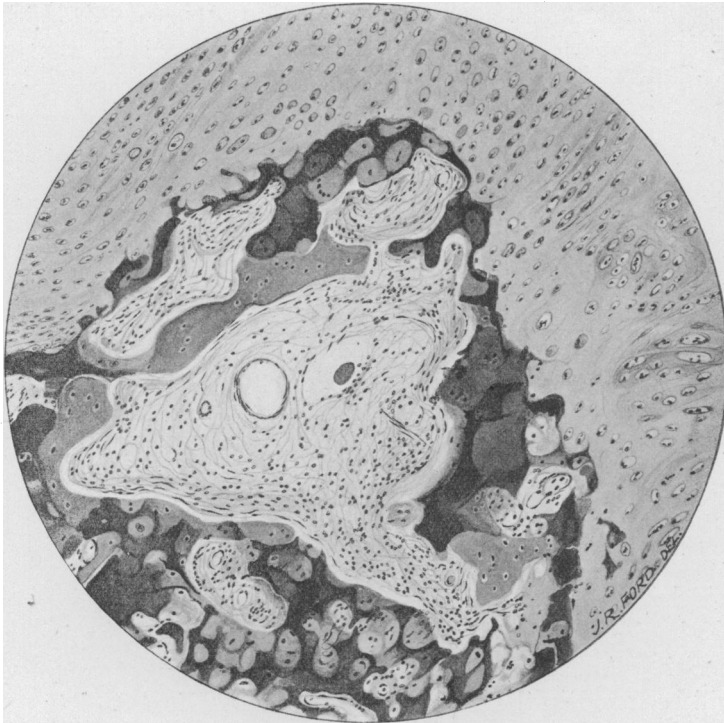


FIG. 9.

Portion of a chondroma, showing the manner in which true bone is produced, viz., by the removal of calcified cartilage and the substitution of membrane bone formed from the invading connective tissue. The calcified cartilage is distinguishable by the darker way in which it has stained.  $\frac{2}{3}$  objective.

connective tissue from which membrane bone is formed, but without the cell-containing trabeculæ of the cartilage being removed.

The conclusion at which we arrive in regard to this tumour is that it is benign, and that it is classifiable as an osteoid chondroma. The

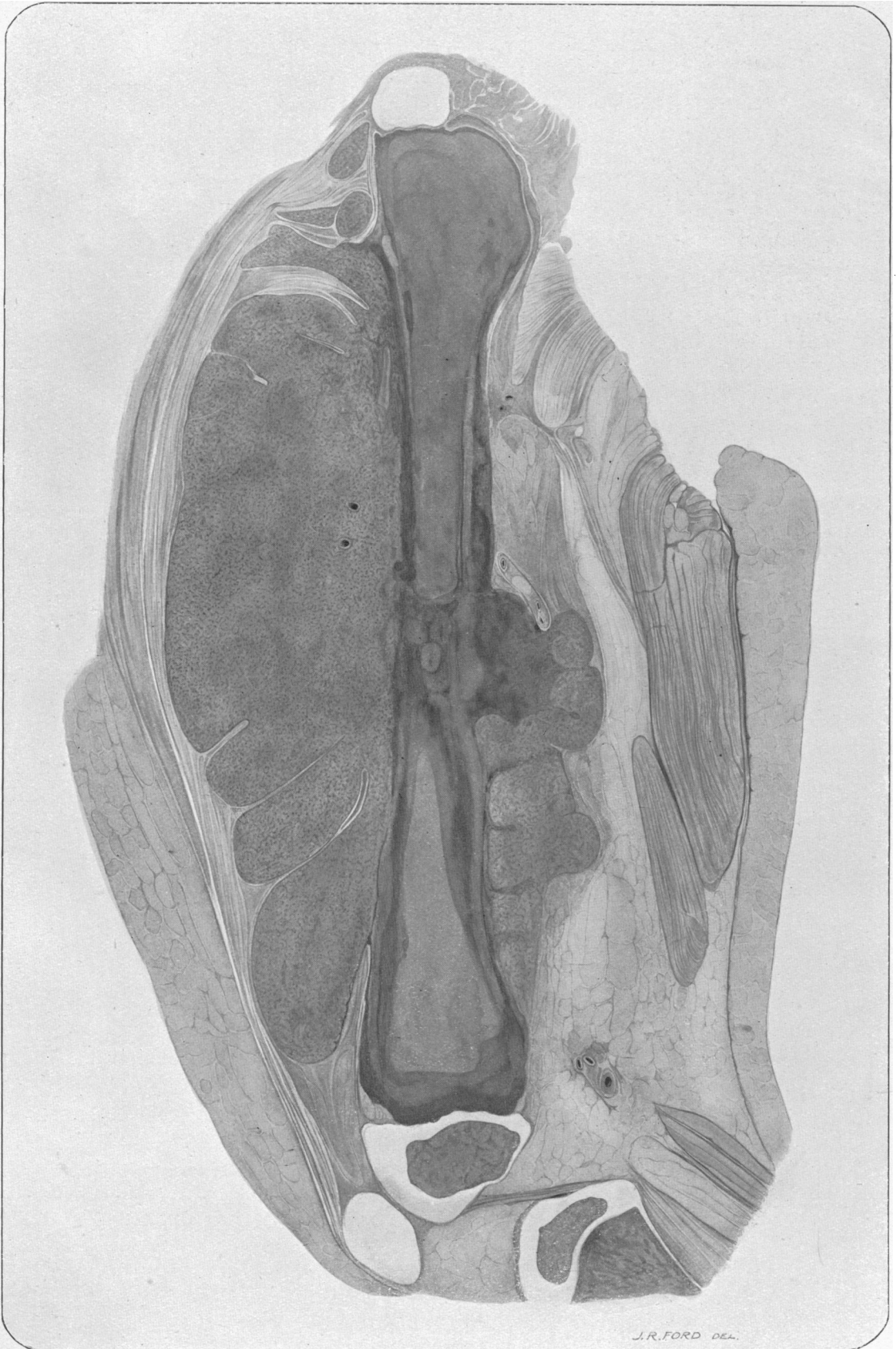
growth of the osteomata in the patient's two children becomes, thus, an example of the heredity of benign tumours, which is, in the case of chondromata and osteomata, so striking and well established.

#### ADDENDUM.

A younger brother of the patient was admitted, under the care of Mr. Battle, into St. Thomas's Hospital on February 3, 1908, for an extensive tumour of the right thigh. The patient, who was aged  $3\frac{1}{2}$ , was sent up by Mr. Pitcairn, of the Rochester Hospital, where he had been admitted on July 11, 1907, for a simple fracture of the femur due to a fall. About three weeks after admission it was noticed that the thigh had become much larger than it should have been, and by December it measured 19 in. in circumference. Since that time there had been some diminution, the circumference of the limb being  $14\frac{1}{2}$  in. A microscopical examination of a small piece of the tumour removed by operation at Rochester was made by the Clinical Research Association, the report being as follows: "The specimen consists at one end of well-formed bone, at the other of young connective tissue, and in the middle shows newly formed cartilage in process of ossification." Under the X-rays the tumour exhibited an osseous structure exactly resembling that of the growth around the fractured femur recorded in the preceding communication.

The patient was shown at the meeting of the Medical Society of London, February 10, 1908; and excepting for the very large tumour, which was hard throughout and without pain or tenderness, he appeared in fair health. An account of this case, with an accompanying photograph, will be found in the *Transactions of the Medical Society*.





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BATTLE & SHATTOCK *Diffuse Cancellous Osteoma of Femur.*

EXPLANATION OF PLATE.

Illustrating the communication on Diffuse Osteoma of the Femur following Fracture.

By W. H. BATTLE and S. G. SHATTOCK.

A sagittal section of the thigh, showing the extensive growth of normal finely cancellous tissue around the shaft of the femur, which followed a fracture of the bone. The fracture has healed without displacement. The shaft is traceable through the tumour, no extension of which occupies the medullary canal.

Slightly reduced. (Mus. Royal College of Surgeons.)

TABULA.

Ad dissertationem "De osteomate diffuso post fracturam evoluto" illustrandam.

W. H. BATTLE et S. G. SHATTOCK.

Crus in longitudinem sectum. Neoplasma monstratur praegrande, ex telâ osseâ constans, quod sicut sarcoma, femur amplectitur.

Fractura sine fragmentorum dislocatione reparata est.

In medio tumore discernitur femur cujus neque paries compactus nec cavitas medullaris invaditur.

Figura aliquantulum diminuitur.