From the Author

OBSERVATIONS ON THE ANGLE OF THE NECK OF THE THIGH-BONE.

LOOSE BODIES IN THE JOINTS.

(12)

BY

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THE ANGLE OF THE NECK WITH THE SHAFT OF THE FEMUR AT DIFFERENT PERIODS OF LIFE AND UNDER DIFFERENT CIRCUMSTANCES.[1] By Professor HUMPHRY, F.R.S.

I HAVE on several occasions expressed my doubt of the correctness of the still generally accepted statement, that the form of the upper part of the femur undergoes a change in advancing years—the angle of the neck with the shaft becoming lessened, and the level of the head of the bone being consequently lowered. I do not know of a similar change occurring in any other part of the skeleton. So far as I am able to judge, it is not usual for the form of the bones to alter after it has been fixed in the adult condition, even under variations of weight and muscular action, unless the force exerted upon them be brought to bear in some new and unusual direction; their curves and angles remaining the same from adolescence onwards under ordinary circumstances. The angle of the edentulous jaw, it is true, opens out, the gums of the upper and lower jaws being thereby approximated and rendered serviceable in mastication; but this results from the fact that the teeth and alveolary processes being removed, the pull of the powerful temporal, masseter, and internal pterygoid muscles is altered in direction, and the resistance to its tendency to elevate the angle of the jaw is lost in consequence of the removal of the parts just mentioned; and a physiological adaptation to the altered circumstances is thus brought about. Again, the vertebral column not unfrequently becomes bent in the aged, the dorsal curve being increased and encroaching upon or involving in itself the lumbar and the cervical curves, more particularly the former, and the bones may be correspondingly altered in form; but this results from the failure of the extensor muscles to maintain the trunk erect, which allows the weight to the head and thorax to bear unduly upon the fore part of the column. No similar contingencies await the head, neck, or other parts of the upper

[1] Read at the Meeting of the Anatomical Society, November 7, 1888.

region of the thigh-bone; and there seems no reason why it should undergo a change of form in the aged any more than the other bones of the lower limbs. If such a change did take place, it might manifest itself in a greater prominence of the trochanters and widening of the hips, with increased obliquity in the direction of the thigh-bones as they descend to the knees; and I am not aware that any such alteration has been observed in the figure of those who are advanced in years.

With the view of putting the matter to the test, I have taken the measurements of the angle of the neck with the shaft in thirty adult thigh-bones which happen to be in the Anatomical Museum of the University of Cambridge. The average length is 18½ and the average angle is 124°; but there is a good deal of variation. In some it is as low as 113°, 114°·5, 116°, and 119°; whereas in others it amounts to 130° and even 136°. On the whole, it is lowest when the bones are short, a considerable proportion of which may be assumed to be those of women. The average angle in those which are less than 18 inches in length (averaging 16½) is 122°·5. In those above 18 inches in length (averaging 19), a considerable proportion of which we may presume to be those of men, it is 125°. This difference is to be expected, because the elevation of the pelvis above the knee, together with the narrowness of the pelvis, opens up, as it were, the angle of the neck of the thigh-bone with the shaft. There are, however, greater deviations from this than might have been expected. One bone, for instance, measuring only 17 inches, has an angle of 130°; and another, measuring only 15½ inches, has an angle of 132°. On the other hand, two bones, measuring 18 inches, have angles of only 119°; and one, measuring 19½ inches, has an angle of only 114°·5. These discrepancies I do not pretend to account for. They may have had relation to variations in the distance between the knees in the different persons; but it is evident that they throw doubt upon the inferences drawn from the measurements of the angles of individual bones, whether senile or not. I may observe that in several of those in which the angle is low the shaft is somewhat flattened at its upper part, being expanded in the direction of the arc of the curve by the greater prominence and thickness than usual of that ridge, which normally descends from the lower part of the neck upon the shaft, reminding of what is commonly observed in the curved bones in rickets, and serving the same purpose, namely, that of giving additional strength where it is needed by the presence of the curve.

I then took the measurements of the angles in fourteen thigh-bones from persons above the age of 70, in the Cambridge Museum, most of which I obtained myself, and of which I therefore know the ages. They are given in Table I. Considerable variety is here also observable. In one the angle is as low as 109°. It is an instance of extreme fatty degeneration, apparently from an old man; and there has been fracture, probably spontaneous, in the upper part of the shaft without any attempt at reunion, though the rounded edges and partially absorbed condition of the fragments indicate that the fracture is not very recent. I know nothing of the age or history of the case, the specimen having been sent me many years ago without any particulars; and it is evidently one of exceptional character. The others with low angles (116° and 113°) are from women, the one aged 96, who had been bedridden for two years, the other aged 76. In both these, more particularly in the latter, there is some of that flattening of the upper part of the shaft, and of that prominence of the line on its inner side, which I have remarked in adult bones with a low angle, and which may be taken as some indication that the low angle in these two instances is a natural conformation rather than a result of senile change. Against these three specimens with low angles must be set those in which the angles amounted to 128°, 131°, 137°, 128°, and 131°. In the remaining five the angles vary from 122°·5 to 124°·5. The average of the whole fourteen is 123°·7, which, though below the average of those in which the thigh-bone is more than 18 inches in length, is above that of those in which it is less than 18 inches; and seeing that nine of these fourteen specimens were taken from women, and that one, from a man, presents an abnormally low angle, the whole may be taken as offering a very fair mean, and certainly as offering no corroboration, of the view that this part of the skeleton undergoes any change of form in advancing years. Such change may take place in some exceptional cases, though it is not certain that even that is so; but it may be stated that, as a rule, the angle of the neck of the thigh with the shaft is the same in the aged as in the adult.

Mr Griffiths, who was good enough to assist me in all these measurements, found the angle in thirty bones, in which he took it at Berlin, to be more open than in our Cambridge specimens, amounting on the average to nearly 128°. In the only specimen above the age of 70 which he found—a woman, æt. 74, in which the bone measured 18 inches—the angle was 130°.

In the Tables III. and IV. are measurements of thigh-bones in fœtuses and young persons, which, with one exception, are all from specimens in the Cambridge Museum; there are likewise considerable and unexpected variations in the angle of the neck with the shaft; but, all due allowance made for these up and down vibrations, it appears that, on the whole, a lowering of the angle takes place during fœtal life and in the periods leading from it to adolescence, the time that is when growth is completed. In the youngest fœtus taken (2½ months, where the bone measures 1 inch) the angle is 141°, and from this to birth the angle varies from 138° to 127°, making altogether an average of 132°. In those after birth the average is 127°.

It may be observed here that the growth and conformation of the various parts of the skeleton, including the neck of the thigh-bone, are in great measure brought about by forces, which we may call developmental, acting more or less in opposition to pressure—pressure resulting from weight and muscular action. Under ordinary circumstances those forces are sufficient to effect the purpose and give the proper length and shape to the several bones. It is not, however, always so. In rickets, as we know, the forces of growth and ossification at the epiphysial lines, as well as that which gives the requisite chemical composition to the shafts, are defective. Hence the bones fail to attain their proper length, and are liable not only to bend in the shafts, but also to yield and bulge at the circumference of the epiphysial lines, which are unduly thick and soft. It is not that the cartilage growth is in excess. On the contrary, that growth takes place more slowly than natural; but the ossification of the cartilage, which takes place chiefly on the shaft side of the epiphysial lines, is actually and relatively still slower, and is also irregular, and this is the cause of the epiphysial lines being thick, soft, irregularly ossified, and bulging. These imperfections in structure and form are of course noted during the period of growth; but after growth has ceased and the epiphyses are ankylosed to the shafts, these bendings and bulgings do not occur, and the form does not alter except under diseased conditions, such as *osteomalacia*, or low inflammatory states, such as *osteitis deformans*, or, as I have before said, under some strain or pressure in a direction which the bones are not calculated to bear.

This relation between pressure and growth may serve, to some extent, to determine the angle of the neck of the thigh-bone with the shaft in the following manner:—The epiphysial line, which carries the cap-like head of the femur, and upon which the growth of the neck depends, is nearly horizontal, its direction being such as most to diminish the risk of injury; and accordingly displacement here has very rarely been observed,[1] though it is not improbable that damage sustained at the epiphysial line by weight suddenly thrown upon it may be an occasional source of hip-joint disease in young persons. This being the direction and position of the epiphysial line, when growth is most free at its proximal or *inner* part the head of the bone will be carried more *upwards*, and the angle of the neck with the shaft will be increased. When, on the other hand, the growth at the distal or *outer* part is most free, the head of the bone will be carried more *inwards*, and the angle of the neck with the shaft will be less. Now, when the pelvis and hips are narrow, as in early life, or in cases in which the thigh-bones are long, the weight falling in a considerable measure vertically upon the heads of the bones, or rather upon their outer parts, will give free scope to the growth at the inner parts of the epiphysial lines, and allow the development or persistence of a wide angle between the neck and the shaft. But when the pelvis widens, or in cases in which the thigh-bones are short, the weight falling more upon the inner parts of the epiphysial

[1] The only instance of such an accident established by autopsy that I have read is quoted by Hamilton, in his "Treatise on Fractures and Dislocations," from the *Bulletin de la Société Anat.*, 1867, p. 283. Patient, æt. 15, run over by a waggon; the limb shattered and everted, and patient, unable to move it, died in a few hours; complete separation of epiphysis, which was attached to the neck by a strip of periosteum.

lines may tend to repress the growth of the neck in this situation, and lessen the angle between the neck and the shaft. This may account for the lessening of the angle during the approach to adolescence when the pelvis is widening, and especially in women, in whom the pelvis widens most, and in whom also the thigh-bone is short. The widening of the pelvis, moreover, throws out the hips, and increases the obliquity of the thigh-bones, which is especially the case when the latter are short; and it thus, in an additional manner, determines the line of weight upon the inner parts of the epiphysial lines. Hence, as we find, when the bones are short the angle as a general rule is low, this being especially the case when the pelvis is also wide, as in women; whereas in tall men, the thighs being long and straight, and the pelvis not wide, the angle is usually open, and the heads of the thigh-bones are raised well above the level of the trochanters.

Another result of my observations, which corresponds with the remarks already made, has been to show that in cases in which, from any reason, the weight of the body is not transmitted by the neck of the thigh-bone, the angle of the neck with the shaft remains open, or, what is very remarkable, seems actually to open out.

Thus in the skeleton, in the Cambridge Museum, of a child, about five, with hydrocephalus, in which it is obvious that the delicate limbs could not have borne the heavy head, and that the erect posture could not therefore have been assumed, the angle of the neck of the thigh-bone with the shaft on each side is 148°, the length of the bone being 9¼ inches. In the Museum at Vienna I found a similar skeleton with similar width of the angles. In the skeleton of a person, æt. 25, in the College of Surgeons, with huge hydrocephalic head, and limbs so slender as scarcely to be compatible with the erect posture, the angle is 129°. In a hydrocephalic child, æt. 23 months, in the Museum of the Pathological Institute at Berlin, the angle is 145°, the length of the thigh-bones being 5 inches; in another, æt. 4 years, it is 143°, the length of the bones being 6 inches; in a third, æt. 2½, it is 143°, the length of the bones being 6 inches; in a fourth, in which the length of the bones is 6 inches, the angle is 143°; in a fifth, in which the length of the bones is 4 inches, the angle is 135°. The measurements in these five Berlin specimens were kindly taken for me recently by Mr Griffiths. The angle is also 143° in the thigh-bone, measuring 15½ inches, from a man, æt. 21, whose limb had been paralysed from infancy, and which I removed at the hip-joint on account of disease in that joint. In another adult thigh-bone, measuring 15½ inches, in the Cambridge Museum, which may be assumed, from its extreme thinness, to have belonged to a paralysed limb, the angle is 130°. In the thigh-bones of a bedridden idiot in the same museum, which measure 15 inches, the angle is 128°. In a thigh-bone in the Museum of the Middlesex Hospital, which is very thin, as if from paralysis, and which was fractured, the angle is 132°; and in the Vienna Museum the angles in the skeleton of a young idiot, with slender, feeble, sprawling limbs, are also very open. It is further to be noted that in none of these adult specimens does the length of the bone reach to 16 inches. In all, therefore, the growth of the bone has fallen short of the average standard, although the angle in all exceeds it. In all the excessive width of the angle is associated with deficiency of growth and deficiency of pressure upon the heads of the bones. The deficiency of growth we may assume to be due to the want of muscular action and the associated want of blood-supply; but the connection between deficiency of pressure upon the head of the bone and the width—greater than normal even in the child —of the angle of the neck with the shaft is highly interesting.

An illustration of the same point—the association of wide angle with absence of pressure on the bone—may be observed in some cases in which amputation in the thigh has taken place in early life. Thus in the stump of a thigh-bone, which measures 5 inches, and which was taken from a lad who died two years after the amputation, the angle is 142°. In a second, from a man whose limb was removed when he was quite young, the angle in the stump, which measures 6 inches, is 127°, that in the opposite thigh-bone, which measures 18½ inches, being 122°. In a third, on the other hand, from a man in whom the amputation was also when he was young, the angle of the stump, which measures 7 inches, is the same (115°) with that in the opposite thigh-bone, which measures 17¾ inches. In each of the two last-mentioned cases the head of the thigh-bone in the stump and also the os innominatum on that side are smaller than on the opposite side. In a fourth specimen, from a man, æt. 60, who underwent amputation in the thigh thirty-six years before his death, who had used a wooden leg, the angle of the neck with the shaft is the same, 120°, in each of the two thigh-bones.[1] In a stump in the Museum of St Thomas's Hospital, which is very short, reaching an inch only below the lesser trochanter, and also very small, indicating a lapse of many years since the amputation, though the head of the bone has a fair average size, the angle is 127°. In a short stump in the Museum of the University College, which does not show evidence of great length of time since the amputation, the angle is 135°.

The variations in the angle which we have observed in different persons, under ordinary circumstances, forbid our drawing much inference from these specimens; and the two in which amputation took place in early life, and in which we are able to compare the angles on the opposite sides, are rather conflicting. Still the specimens on the whole indicate that relief from the vertical pressure in a stump during the period of growth, tends to produce a wide angle of the neck of the thigh-bone with the shaft. It might have been thought that undue weight borne by the opposite limb would have led to some alteration in the angle on the opposite side, but the specimens do not indicate that this is the case.

The conclusions, therefore, at which I arrive are—

1. That the angle formed by the neck of the thigh-bone with the shaft varies considerably in different persons at any given period of life.

2. That it is smaller in short bones than in long bones; and that it is also most likely to be small when the pelvis is wide; the combination of these two conditions rendering it usually smaller in women than in men.

3. That the angle decreases during the period of growth; but that after growth has been completed it does not usually undergo any change, even if life be continued to extreme old age. Some change may take place in exceptional cases, but as a rule the angle remains the same from the adult period till death, at whatever age that may occur.

[1] These four specimens are in the Cambridge Museum.

4. That, if during growth the limb be relieved of the weight of the body, as in the bedridden state, in paralysis, or in a stump, the angle of the neck with the shaft usually retains the open form of early life, or even may become wider.

Angle of Neck of Thigh-Bone with Shaft.

Table I.—*Senile above* 70.

No.	Sex.	Age.	Length of Bone.	Angle.
1.	F.	103	16½ inches	122°·5
2.	M.	88	...	128°
3.	M.	Aged	...	131°
4.	M.	76	...	137°
5.	F.	76	...	131°
6.	F.	71	...	122°·5
7.	M.	76	...	122°
8.	F.	96	...	116°
10.	F.	76	...	123°
11.	M.	Aged	Fatty degeneration	109°
12.	F.	70	...	124°
13.	F.	Edentations very old	18 inches	131°
14.	F.	86	15½ ,,	125°·5

Table II.—*In Atrophy.*

No.	Sex.	Age.		Length of Bone.	Angle.
1.	M.	21		15½ inches	143°
2.	,,	Adult		15½ ,,	130°
3.	,,	,,		15 ,,	120°
4.	,,	...		... ...	132°
5.	,,	5	(Hydrocephalic)	9¼ ,,	148°
6.	,,	25	,,	... ...	129°
7.	,,	23 months	,,	5 ,,	145°
8.	,,	4 years	,,	6 ,,	143°
9.	,,	2¼ ,,	,,	6 ,,	143°
10.	,,	...	,,	6 ,,	143°
11.	,,	...	,,	4 ,,	135°

Angle of Neck of Thigh-Bone with the Shaft.

Table III.—*Fœtuses.*

No.	Age.	Length of Bone.	Angle.
1.	2½ months	1 inch long	141°
2.	4½ ,,	1 6/8 ,,	135°
3.	4½ ,,	1 6/8 ,,	131°
4.	4 ,,	1 6/8 ,,	131°
5.	4 ,,	1 4/8 ,,	138°
6.	5 ,,	2 1/8 ,,	131°
7.	6½ ,,	2 4/8 ,,	127°
8.	7 ,,	2 6/8 ,,	127°
9.	7 ,,	3 ,,	134°
10.	8 ,,	3 ,,	130°
11.	9 ,,	3 4/8 ,,	128°

Table IV.—*Young Persons.*

No.	Sex.	Age.	Length of Bone.	Angle.
1.	...	3½	7 inches	131°
2.	...	3½	...	130°
3.	...	6	10¼ ,,	120°
4.	...	10	9¾ ,,	120°
5.	...	15	14½ ,,	130°
6.	...	18	18 ,,	127°
7.	Female	19	14¾ ,,	130°
8.	,,	20	16¾ ,,	122°

OBSERVATIONS ON THE ANGLE OF THE NECK OF THE THIGH-BONE. By Professor HUMPHRY. (PLATES XVI., XVII., XVIII., XIX.)

THE photographic representations in Plates XVI., XVII., XVIII., and XIX. are chiefly from specimens mentioned in my paper at page 273 of this volume of the *Journal*. They are all in the Cambridge Museum.

Fig. 1 is the section of the upper part of the thigh-bone of a woman, reported to be 103 at the time of her death. The angle is a fairly wide one, affording no probability of its having decreased with advancing years; but the bone shows well, by its contrast with a similar section of an adult femur (fig. 2), the changes incidental to age. It is remarkably light. The whole femur, though it is a large and well-formed bone, weighs only five ounces, the reduction in weight having been caused, not by any removal from the exterior, and any reduction of size, but by absorption in the interior affecting the cancellous texture and commencing in the finer parts of that texture and, then, invading the coarser plates and the inner layers of the bone-wall. The more delicate plates of the cancelli have been quite cleared away; the stouter arches supporting the outer part of the upper wall of the neck are gone, and the still denser plates descending from the upper surface of the head to the inner wall of the shaft, in the axial or weight-bearing line, are much reduced in number and size. Further, the outer wall of the bone is reduced to an almost egg-shell-like tenuity, and can scarcely be traced over the great trochanter. No wonder that in such condition fracture easily occurs in the expanded and cancellous parts of the bone, that a slight blow upon the hip, a mere turning upon the hip in bed, as one specimen in the museum shows, may cause fracture and driving of the neck into the delicate fabric of the trochanter, or that a sudden impulse of the pelvis upon the head, as in a slip off the kerb-stone, may break the head off from the neck. In short, it is the absorption of cancelli, reducing the strength of the end of the bones in greater proportion than that of the shafts, which causes the great liability to fracture near the joints in old people.

Fig. 3 is the skeleton of the child with hydrocephalus (p. 278), in which the angle of each neck of the thigh-bone is 148°. The photographic representation scarcely gives an adequate idea of the thinness of the limb-bones.

Fig. 4 is the upper part of the thigh-bone, with an angle of 143°, from a paralytic limb, removed at the hip-joint in consequence of disease at the hip (p. 279). The circumference of the head of the bone is $5\frac{1}{8}$ inches; the length of the bone is $15\frac{1}{2}$ inches.

Fig. 5, with an angle of 130°, is judged to be also from a paralytic limb. The circumference of the head of the bone is $5\frac{1}{4}$ inches; the length of the bone is $15\frac{1}{2}$ inches.

Fig. 6, with an angle of 150°, also judged to be from a paralytic limb. The circumference of the head of the bone is $5\frac{1}{8}$ inches. The shaft is thinner than might be inferred from the view of the upper part, which is flattened. The bone measures 16 inches.

In each of these three cases the epiphyses are anchylosed to the shafts; but the shortness and smallness of all the dimensions, as well as of the head of the femur which falls short of the usual circumference by nearly an inch, indicate that the atrophic condition existed during the period of growth. In each it is observable that the lesser trochanter stands out with remarkable sharpness, the greater trochanter being small, but presenting nothing further remarkable; and in each the length of the neck is about proportionate to that of the length of the bone. The most interesting feature is the openness of the angle of the neck with the shaft, and which in two of the three exceeds that of a fœtal bone. This is also the case in the hydrocephalic skeleton represented in fig. 1.

Fig. 7 represents the stump, with an angle of 142°, taken from a lad who had undergone amputation two years previously (p. 279). It may be inferred that the limb had borne no weight for some time before the operation.

Figs. 8 and 9 represent the stump and upper part of the opposite thigh-bone (the latter measures $18\frac{1}{2}$ inches) from the man (p. 279) who underwent amputation when he was quite young. The stump is small in all dimensions, the head measures $5\frac{1}{4}$ inches in circumference, that on the other side measuring

6 inches; and the angle is 127°, that on the opposite side being 122°.

Figs. 10 and 11 represent the stump and opposite thigh-bone (the latter measuring 17½ inches) from a man (p. 279) on whom amputation was also performed when he was young. The stump is small, the head of the bone measuring in circumference 5½ inches, that on the other side measuring 6⅛ inches. The angles on the two sides are, however, the same, and are low, being only 115°.

Figs. 12 and 13 represent the stump and opposite thigh-bone from a man, æt. 60, on whom the amputation was performed when he was twenty-four years of age, when, therefore, the growing processes had been completed. Here the bones on the two sides are alike in size and form; the circumference of the head in each is 6 inches, and the angle of the neck with the shaft is 120° in each.

The cause of the openness of the angle in these three conditions, (1) the bedridden state, (2) the paralytic state, and (3) the stump, seems, as stated (p. 280), to be the absence of pressure upon the upper end of the bone from the weight of the body, to which may be added the absence of pressure from muscular action during the period of growth. During development, pressure and growing force combine, in what may be called a "harmonious antagonism," to effect the desired size and form. This is evinced in the various flexures of the spine and of the long bones. In some instances the one preponderates over the other. In tall persons, for instance, the growing force dominates, and the bones are comparatively long and straight. In rickety persons, on the contrary, the reverse is the case, and the bones are too much bent and too short. In the specimens represented in these figures the growing force was weak and the bones are accordingly short and small, but the opposing pressure-influence was reduced in a still greater degree, being indeed almost wanting. Hence the curves in the bones are slight and the necks of the thigh-bones are more nearly on a line with the shafts than natural.

FIG. 1.

FIG. 2.

Permanent Photo. Valentine Blanchard & Lunn, Cambridge.

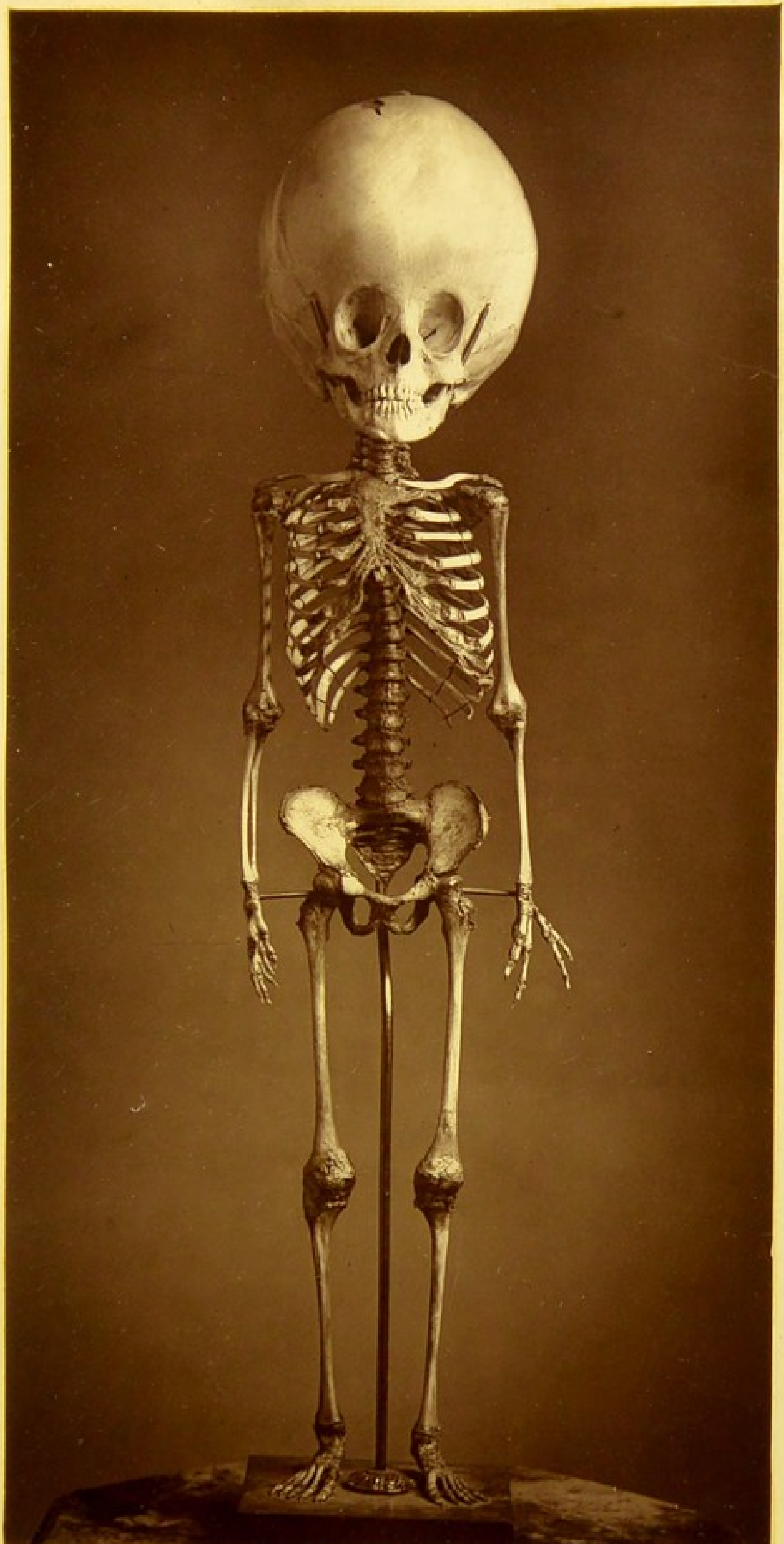

FIG. 3.

Permanent Photo. *Valentine Blanchard & Lunn, Cambridge.*

FIG. 4.

FIG. 5.

FIG. 6.

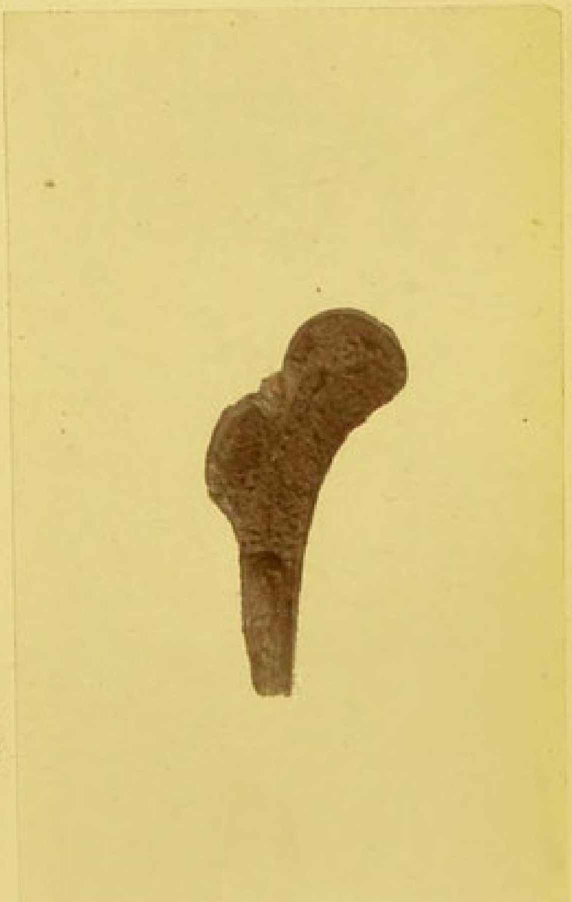

FIG. 7.

Permanent Photo. *Valentine Blanchard & Lunn, Cambridge.*

Plate XIX.

FIG. 8. FIG. 9.

FIG. 10. FIG. 11.

FIG. 12. FIG. 13.

Permanent Photo. *Valentine Blanchard & Lunn, Cambridge.*

LOOSE BODIES IN JOINTS. By G. M. Humphry, M.D., F.R.S., *Professor of Surgery in the University of Cambridge.*

(From the *British Medical Journal*, September 19, 1888.)

I have delayed replying to the able and courteous comments by Mr Sheild and Mr Howard Marsh (*Brit. Med. Jour.*, March 31 and April 14) on my letter ("Loose Bodies in the Knee-Joint," March 17) in order that I might give the consideration to the subject which their remarks demanded, and that I might examine certain specimens which I have only lately had the opportunity of seeing.

My statement was that we have a ready and sufficient explanation of the formation of these bodies in the growths from the synovial membrane into the joint; that only by an extraordinary and violent accident could a piece of cartilage or bone be broken off into a joint, and that necrosis could scarcely be credited as a cause.

With regard to the first of these points (the formation of loose bodies from the synovial membrane, which is generally admitted), I will go into a few particulars. The synovial membrane, which is continuous with the articular cartilage as its epithelium is continuous with that of the epithelium existing upon the surface of articular cartilage in early life, is prone, under morbid conditions, to the formation of cartilage and bone in its substance. This may take place in the villous processes which exist adjacent to the articular cartilages, about the lines of reflection of the membrane and at other parts, and which are not infrequently, in the normal state, found to contain cartilage cells; and it may also take place in the substance of the membrane, more especially in the vicinity of the articular cartilages, and sometimes as an outgrowth from them. A local irritation, a sprain, a wrench, or a blow may give rise to these villous outgrowths, or to one or other of them, in the otherwise quite healthy joint; and the villous outgrowths projecting into the joint becoming cartilaginous, and perhaps osseous, becoming also pedunculated, and finally detached, and losing, it may be, all trace of their former connection, constitute, as commonly admitted, the ordinary mode of formation of loose cartilages. This is more often observed to take place in a localised or isolated manner, so as to produce one or two loose cartilages, in early life, in young men and boys, whose active movements render them especially liable to sprains, and in the knee-joint, where the extent and reflections of the synovial membrane are so great and so numerous, where the range and variety of movements are exceptional, and where the leverage against the joint given by the long thigh and leg is greater than in the case of any other joint.

In some instances these bodies soon give rise to symptoms which lead to their removal. In others they remain before or after their detachment in snug quarters or recesses, and cause little trouble, affording perhaps no indication of their presence, till by some particular movement, or strain, or blow, they are dislodged, get into inconvenient positions, give rise to the well-known symptoms, and are found slipping about in the cavity of the joint. Thus a man, aged 63, from whom I removed one of these bodies, stated that when he was a boy the "knee used to slip out of place at the inner side, and used to kink at the joint." Twenty years ago a piece seemed to break away; and from that time it used to slip about in the joint, and it became larger and more troublesome. A young gentleman had for years suffered weakness and uneasiness in the knee, and peculiar sensations at the back of the joint, consequent on a sprain in childhood; but the cartilage, which was quite loose, appeared in the front of the joint only a few weeks before I removed it.

A schoolboy, aged 15, whilst playing at football, fell with the left knee bent under him. He contrived to walk home, a distance of half a mile. Synovial inflammation followed, and was for some months easily re-excited, but subsequently subsided. Two years after, whilst walking in the street, he suddenly felt a severe stabbing pain in the joint, and was for some hours unable to extend it. Similar attacks, followed by synovitis, recurred, and a loose body was felt on the inner side of the patella. Having made a subcutaneous incision through the synovial membrane, I slipped the body into the tissue outside the joint, and secured it there. This was three years ago, and the body, which was about the size of a horse-bean, now feels about the size of a pea, and has given no trouble.

I removed a loose body from the knee of a young man, who experienced severe pain in the joint three months previously, when straddling across a ditch gathering watercresses. He was set fast and could not move from his position without assistance. The pain subsided in a few minutes, and he was able to walk and jump over a ditch. Next day the joint was swelled, and had to be kept on a splint. The loose body was discovered a few days afterwards. On two occasions, one three years and the other a year previously, he had experienced sudden pains in the knee, but less severe than the last attack.

During this period in which they remain in retirement, as it were, they may slowly enlarge,[1] and undergo calcification or ossification in the middle; and the section of such a body may show a nucleus or centre of true bone, with the characteristic corpuscles, imbedded in true cartilages, with the process of ossification from cartilage to bone progressing in the ordinary manner. These loose bodies are in some instances fibro-cartilaginous, in some cartilaginous, in some fibro-cartilaginous at one point and cartilaginous at another; and the cells near the surface may be, as seen in a specimen I have just examined (a loose cartilage of the ordinary type, with bone in the middle, recently removed from the knee of a young man), flattened out and lying parallel to the surface, whereas the deeper cells are more spherical

[1] One in the museum at Vienna, which still retains its connection with the capsule of the knee-joint, is said to be as large as the os calcis.—Tillmann's *Lehrbuch der Allgemeinen Chirurgie*, p. 467.

and arranged more or less in vertical columns, thus simulating very closely the structure of articular cartilage. Such a body may therefore present closely the appearance of a portion of bone and cartilage detached from the articular surface of a bone. I do not think the last feature has been previously pointed out; but in reality such arrangement of cells in the superficial and in the deeper strata is by no means, as seems to have been thought, peculiar to articular cartilage and to be regarded as diagnostic of it. It is indeed a feature common to cartilage in various parts and under various circumstances. Thus it is found in the costal and laryngeal cartilages, as well as in loose cartilages, also in the superficial layer of the cartilage covering ordinary exostoses in parts where the whole thickness of the cartilage is not occupied by the columnar arrangement of the cells preliminary to ossification.

My attention was first seriously drawn to the formation of these bodies from the examination of the loose body removed from the knee of the young man last mentioned, which consisted of bone and cartilage, was flat and oval (an inch by an inch and a half), and was on one side bare of cartilage, and presented a plain surface of bone, so that it much resembled a portion of articular cartilage and bone. Indeed, it was much like the specimen figured 4 and 5 by Mr Howard Marsh in the paper referred to. The explanation I then gave of the condition was, that during a long period of repose this body had not only undergone central ossification, but that one side of it, through contact with, and perhaps attrition upon, the femur or tibia, had been deprived of cartilage, and its bony nucleus had been laid bare. This view certainly seems to me much more probable than the supposition that it was the result of direct injury or of a process of necrosis separating it from any part of the articular surface of the bones. The view that in this and similar cases the origin and progress was such as I have mentioned derives corroboration from a specimen in the Pathological Museum at Cambridge, where a subspheroidal or flattened osseous body with cartilaginous margin hangs by a broad peduncle from the synovial membrane into the space between the patella and the femur. The cartilage from both the patella and the femur in the vicinity have disappeared, and the surface of each bone is somewhat worn away. It is quite certain that this pendulous body is a product of outgrowth of the synovial membrane from which it hangs, and not a detached piece of bone, and that the surfaces of the patella and the femur are in process of being worn away by its attrition; and it is almost as certain that it has, in like manner, suffered from attrition on both its surfaces, its cartilaginous covering having disappeared, and its osseous part having been exposed. So that we have here a good illustration of the effect upon one another of the pendulous body and the articular surfaces.

This view also derives corroboration from two specimens in the same museum—one being that of the knee with rheumatic arthritis, mentioned in my former letter, which I excised from a man, aged 60, in which there are many loose bodies of various sizes, some cartilaginous, some with osseous centres, some loose in the joint, some connected by pedicles more or less broad with the synovial membrane. One of them occupies a concavity nearly large enough to hold it and adapted to it, in the side of the articular part of the tibia, and there can, I think, be little doubt that it, like the others in the same joint, had its origin in the synovial membrane, and that it had gradually, by pressure and friction, led to the formation of the cavity in the tibia in which it lies. In the other specimen, a loose, tuberated, bony nodule, with cartilaginous covering, larger than a filbert, is lodged, for about one-third of its thickness, in a fossa in the outer and fore part of the internal and articular surface of the tibia, which has evidently been formed by the pressure and friction of the body; and the tubercles on the side of the body opposed to it have been rubbed down so as to present a nearly smooth osseous surface. The cartilage has in great measure disappeared from the corresponding femoral condyle; and it is remarkable that movement of the joint can have taken place, notwithstanding the presence of such a body in such a position. There are villosities of the synovial membrane and "lipping" of the articular margins.

Specimen 1926, in the College of Surgeons, furnishes still better evidence of the process. In it a foreign body, an inch in its greatest diameter, attached to the crucial ligaments, has, by friction and constant pressure, worn for itself a deep cavity, with grooved walls, in the posterior and lower part of the outer condyle of the femur in which it lay imbedded and apparently immovable, and a second smaller body having similar attachment appears to have begun to wear a hole on the inner side of the under part of the internal condyle. In the museum of the Middlesex Hospital (No. 710) is a pointed fibrous growth, 1½ inch long, hanging by a narrow neck from the posterior attachment of the internal semilunar cartilage, and lying upon the articular surface of the tibia. Whether it has begun to make an impression upon that surface cannot be seen, but that it would soon have done so if it had continued in that position and gone on enlarging and hardening there can be little doubt. In a recent specimen in the same museum is a loose body, like a miniature patella, lying in a bare cup-like depression of the femur above the outer condyle; and in St George's Museum, III., 44 b, is a smaller pendulous body hanging in a cavity above the coronoid fossa of the humerus.[1]

It is clear that in these cases the bodies were of long standing, had slowly grown and hardened, and had gradually—very gradually—worn, or were in process of wearing, for themselves nests in the bones on which they laid, and they might at any time have become quite detached and lost all trace of their former synovial attachments. During the time of their repose they would have caused little or no inconvenience. It would have required a considerable force, such as a violent strain or blow, to dislodge them, to bring them into notice, and to cause them to give rise to the symptoms which indicate the presence of a loose body. Their existence would thus, not improbably,

[1] It is represented in the *System of Surgery*, by Holmes and Hulke, ii. 355; and in the College of Surgeons (1927) are two "pendulous masses of bone and cartilage" in the olecranon fossa.

be dated from the time of their dislodgment, and their origin would be attributed to the force which had dislodged them. Thus the "irregular nodule of bone" (Museum of College of Surgeons, 1931), one side of which is bare and the other covered with substance which looks like cartilage, and which presents "no indications of its ever having formed a part of articular surface, and no broken part to show that it separated from any pedicle," was removed by Mr Barwell from a retired army surgeon, aged 43, subject to rheumatic arthritis. Two months before it was removed he struck his knee sharply, and the next day he found a loose body in the joint. He had no synovitis or pain. He then missed a bony lump which he had noticed previously over the inner condyle. So also the large loose body (in the same museum, 1935), nodulated on one side, flat on the other, partly bony and partly cartilaginous, which presented "no evidence that it ever formed part of the normal surface of a joint or was ever pedunculated," and which was excised from a man, aged 40, and presented by Sir William Fergusson, was detected after a severe twist of the knee. A young man in Addenbrooke's Hospital sprained his right knee while boxing, was carried home, and kept his bed for a fortnight. He then perceived a loose substance in the outer part of the joint. After a month he could get about pretty well. As he experienced inconvenience from the substance, he came into the hospital and it was removed. I am informed that it showed no sign of having been detached from an articular surface, and presented the ordinary appearance of a loose cartilage, being about the size and shape of a strychnine nut. The joint was, to all appearance, quite sound before the injury. Instances of the discovery of these bodies soon after injury are also given in Hey's *Surgery;* in one case there were two in the same knee, the fact of there being two precluding the idea of their being the direct result of injury.

It is well known that in rheumatic arthritis these cartilaginous and osseous bodies are very liable to form in the synovial villi, which commonly enlarge in this disease; and these may be found to have become detached in great numbers. They also form in the synovial membrane, and possibly in the subsynovial tissue, and often in close proximity to the articular cartilage.

When thus situated they may grow into contact with, or encroach upon, the thickened, outgrowing, nodulated, and "lipping" margins of the articular cartilage so often met with in rheumatic arthritis. In this borderland between cartilage and synovial membrane it is not always quite easy to tell in which of these structures the osseous bodies were formed; and of two observers, one will judge that they have originated in continuity with the articular cartilage and are in process of separation from it, while the other will conclude that they have originated in the synovial membrane, and are in process of encroaching upon or coalescing with the abnormally projecting articular cartilage. The latter, which I believe to be the more common, may be often proved by noting the manner in which the several stages of growth in the membrane with approximation to the cartilage are evidenced at different parts in the same specimen. The edges of the projecting and overhanging lips of articular cartilage do, however, sometimes grow out irregularly with intervening spaces. This is well seen in specimen 709 in the museum of Middlesex Hospital; and it is possible that they may become detached from their bases, though I have not seen an instance in which it seemed very probable that this had taken place.

It is, therefore, sufficiently proved that a loose body formed in the synovial membrane may (1) come very closely to resemble, microscopically and to the naked eye, a portion of articular cartilage and bone; may (2) in course of time form, by its pressure and friction, a fossa in the articular end of a bone more or less adapted to it, in which it may lie without giving rise to any particular symptoms, from which (3) it may become dislodged and first excite attention in consequence of a blow or strain, and so lead to the presumption, which may seem to be confirmed by microscopical examination of the loose body and even by examination of the joint, that it had been detached from the articular end of the bone by the blow or strain from which the symptoms of its existence were dated. It appears, moreover, that this is no very infrequent sequence of events, and that it may occur in a joint which presents no other indication of disease.

I should add that the presence of a loose, or nearly loose, body in the knee, caused by the tearing off one end of a semilunar cartilage from its attachment, and its nearly complete severance from the rest of the disc, has been instanced by Mr Broadhurst (*St George's Hospital Reports*, vol. iii.), and by the specimen shown by Mr Bowlby at the Pathological Society on April 17.[1] Possibly also loose bodies may occasionally originate in fibrinous masses effused into the joint after the manner often taking place in ganglions.

The dominance in my mind of the view I have expressed, as to the manner of formation of loose bodies in joints from the synovial mem brane, may have led me to write in rather too strong terms against the view that they may also be formed by the detachment of portions of articular cartilage and bone by accident or by necrosis, and though on the former point I give in a little, on the latter I am still *tenax propositi*.

With regard to the former of these modes of detachment—namely, by accident—I am not aware that any reliable instance has yet been adduced of the formation of a loose body by the breaking off of a piece of articular cartilage or bone by a blow; and we can scarcely conceive such an occurrence without greater damage to the joint than appears to have taken place in any recorded case of loose body in the synovial cavity.

The specimen which has been referred to by Mr Howard Marsh, in

[1] Since the above was written Mr G. B. Gifford has sent me a portion of the external semilunar fibro-cartilage, which he removed fnom the knee of a man aged 27. It was attached only to the head of the tibia near the spine. Two years previously the man fell roughly on his left knee; in six weeks was able to walk. Ten days before the operation, when rubbing his feet on a mat, he felt something spring out in the knee. This something went out and in on moving the knee, causing much pain and inability to walk. The specimen is in the University Museum.

St Thomas's Museum, of a fragment of cartilage and bone, taken by Sir John Simon from the knee-joint of a man, and judged by him to have been detached from the articular surface by a wrench in falling three weeks before its removal, cannot perhaps now, in its bottle, be sufficiently determined. Its minute examination, however, by Mr Shattock is, I believe, confirmatory of the view of Sir John Simon. The accident to which it is attributed was followed only by some inconsiderable synovitis. Mr Teale has been so good as to send me for inspection the fragment represented by him in a woodcut in the *Brit. Med. Jour.*, May 26, p. 1109; and its rough (fractured) bony surface on one side, and articular cartilage on the other, as seen in the bottle, leave no doubt, I think, that it was, as he concludes, broken off from the articular surface of the patella by the severe wrench which he describes. Possibly it was broken off by a violent wrench against the margin of the femoral condyle, and the St Thomas's specimen may have been due to the same cause. At any rate, it must be admitted that these are two instances of the production of loose bodies in the joints by accident.

Weichselbaum[1] goes into this question, and gives the account of the elbow-joints of a strong male subject, aged 20, in each of which was a loose body, occupying a vacancy in the part of the articulating margin of the head of the radius which plays in the lesser sigmoid cavity of the ulna. The form and adaptation of these to the vacancies in the two radii, and the absence of other disease, leads him to the conclusion that they were the result of fracture. In what manner symmetrical fractures in those particular situations could occur, he does not suggest, and it is not easy to conjecture. It is further to be observed that each of these bodies was more than large enough to fill the vacancy in the head of the radius, and was composed of hyaline cartilage, fibro-cartilage, calcified cartilage, and bone, and that the thickness of the cartilage exceeds that of the head of the radius. These points he endeavours, but insufficiently, to make tally with the supposition that the bodies had been broken off from the bones, in the hollows of which they were placed. It is quite as probable that these were congenital as that they were separated by fracture. Is it not more probable that they were the result of disease? In two nearly symmetrically rheumatoid elbows in the College of Surgeons (1928–9), besides other bodies which were nearly loose, but attached—one in front and one behind the joint—there appears to be a body to the retiring angle in front of the radio-ulnar joint on each side. The coronoid process also looks as if it had been truncated by the presence of one of the bodies which, if it had been solitary, might have been supposed to have been broken off from it.

The occurrence of loose cartilages in the corresponding joints of the two sides has been observed in several cases, and I need scarcely say that such symmetrical occurrence is scarcely compatible with their being the result of injury.

Mr G. A. Syme[2] removed a loose body from the right elbow-joint

[1] "Zur Genesis der Gelenkkorpen," Virchow's *Archiv*, lvii. p. 127.
[2] *Australian Medical Journal*, July 15, 1888.

of a man aged 22. Five years previously there was a slight wrench of the joint, followed by pain and swelling, which subsided, and he felt no further inconvenience for three years, when, "while holding up the shafts of a heavy dray, it overbalanced, and he was thrown violently to the ground on his back. He retained his hold of the shaft with his right hand, and, keeping it supported off the ground, felt a strong 'jar' in the right elbow which rested on the ground. The joint became very painful, and he found he could neither straighten nor fully bend the arm; and, when he did attempt to straighten the arm, a 'lump' appeared on the outer side of the joint, but disappeared on his touching it." Efforts to keep the lump in place failed; the use of the arm was in great measure lost. Mr Syme accordingly removed it. He says:—"From the history given of the previous inflammation in the joint and the nature of the accident, I thought that the body was probably an hypertrophied fringe of synovial membrane that had become pendulous and then been detached by the accident;" and the account he gives of the specimen certainly does not seem to justify his departure from that very probable view, for, although "it consists of true bone covered on its (presumably) upper and outer surfaces by articular cartilage," which appearance, I have shown, is not uncommon in loose cartilages formed in the ordinary way, yet "on the other surface (presumably the line of fracture) it is covered by fibrous tissue"—a condition much more indicative of loose cartilage than of a fragment of articular surface detached by accident. The size and shape of the body are not given, nor the extent to which the cartilage surrounds the bone, which, be it remarked, is stated to have "an areolar appearance, as if recently ossified."

With regard to necrosis as a cause of loose bodies such as I am discussing, I must confess that the process of exfoliation, or "quiet necrosis," as it has been designated by Sir James Paget, was not in my mind when I wrote (17th March), and is not mentioned in the work to which I have referred. This, no doubt, sometimes occurs in bones, a portion dying and being slowly detached beneath the periosteum with little or no suppuration. A good instance is furnished by the bone of a calf in the Cambridge Museum, on the shaft of which is a broad, raised, sharply-defined table bone; and, on making a section, I found a loose sequestral scale, half an inch in diameter, lying in a completely-closed cavity; but it requires rather more evidence than we yet have that, in an otherwise healthy joint, a portion of bone and cartilage, presenting to the naked eye and under the microscope quite a natural appearance, has been the seat of necrosis, and has in consequence been separated. Surely the death—the necrosis, however quiet—of a portion of articular cartilage and bone must leave some structural traces of the process by which that death was brought about, and which attended upon it; and a necrotic piece of bone and cartilage could scarcely present the perfectly normal character which the loose bodies supposed to have been thus detached are said to have had.

Still I could not help feeling that the very remarkable and interesting case given by the late Mr Teale in vol. xxxix. of the *Medico-Chirurgical Transactions*, and quoted at length by Mr Howard Marsh, did seem to justify this view. My good friend Mr Teale has, however, kindly sent me the specimen from the Leeds Museum for examination. I find that the loose body does, as described, present very much the appearance of a portion of articular cartilage and bone, and is nearly adapted to the space in the condyle of the femur from which it is supposed to have been detached by some necrotic process. On the other hand, it was situated on the under and outer part of the internal condyle, a very sheltered spot, where a blow even from a beer barrel could scarcely cause the change in question. Secondly, the cavity in which the loose body lay is at one part continuous with the intercondyloid fossa, a situation in which synovial growths have a tendency to form and to work their way into the surfaces of the condyles, especially that of the internal condyle. Thirdly, the articular margins present—in no very marked degree, it is true—the lipping indicative of rheumatic arthritis, in which disease, we know synovial growths are very liable to form. Fourthly, the cavity in the condyle occupied by the loose body is smooth, slightly uneven, with a well-defined edge of cartilage, and presents no indication whatever of ulcerative or other process by which the loose body can have been detached, but rather that of absorption from pressure. Fifthly, at the circumference of the loose body the cartilage is projected into a flail-like edge, and above this edge it extends, with a smooth contour, upon the upper or applied surface of the body, where it gradually fades and is partially continuous with the cartilaginous nodules next to be mentioned. Lastly, the upper or deeper surface of the loose body—that applied against the condyle—is slightly knotty or tuberculated; and these tubercles are found, on microscopical examination, to be composed of true cartilage, which is continuous with the cartilage of which the body is composed. In this cartilage calcification has taken place at parts, but no trace of bone is to be found. These features, especially those last mentioned,[1] seem to preclude the possibility of this body having been detached from the articular surface by necrotic process or in any other way, in spite of the peculiar circumstances which favour the view taken by Mr Teale and others, and to accord, on the whole, best with the supposition that the body was an outgrowth from the synovial membrane, which gradually formed for itself the cavity so nicely adapted to it. The same remark must, I think, apply to the layer of fibrous tissue found in the corresponding situation on each of the symmetrical bodies removed from the otherwise healthy knee-joints of a young man by Mr Holden, quoted by Mr Howard Marsh.[2] It can scarcely be supposed that this tissue would have been formed upon a surface separated by necrosis

[1] The flail-like edge of this body and the tuberculated character of its applied surface, with the border of cartilage remaining upon that surface, are fairly represented in the figure at p. 788 of this *Journal* for April 14th.

[2] *St Bartholomew's Hospital Reports*, vol. iv. p. 256; and *Brit. Med. Jour.*, April 14.

from the articular end of a bone. This remarkable case is to some extent paralleled and probably elucidated by that reported in the *American Journal of Medical Science*, October 1848, in which two oval flat bodies weighing, one 283 grains, and the other 257 grains, and measuring $2\frac{1}{15}$ inches by $1\frac{1}{16}$ and $\frac{5}{8}$ in thickness, and the other $2\frac{3}{8}$ inches by $1\frac{1}{16}$ and $1\frac{9}{16}$ in thickness, were removed from the knees of a man aged 43, who recovered from the operations and was able to walk with perfect ease. That these bodies were of synovial origin is rendered probable from the statement that he had swelling and severe pain in the knees when he was 17; and three years afterwards he found a movable body just above the right patella, and, after a short interval, a similar body in the left knee. A cast of these bodies in the College of Surgeons' Museum shows them to have been uneven on the surface.

In the case carefully described and figured by Klein,[1] where two bodies, each composed of a layer of cartilage and a layer of bone, occupied a fossa in the outer part of the internal condyle of the femur, the idea of their having been separated from the articular surface is negatived—first, by there being two bodies; secondly, by one of the bodies still retaining its connection with the synovial membrane, thus indicating its origin; and, thirdly, by the cartilaginous coverings extending over the smooth edges of the loose bodies, upon their applied surface beyond the deeper level of the surrounding articular cartilage. This last point—the extension of the cartilaginous covering in a smooth manner over the edge of the loose body on to its applied surface, between that surface and the bony surface of the cavity of the condyle—may, I think, be taken as a proof, in any case, that the loose body has not been separated from the articular surface either by necrosis or direct force, but that it has been formed independently, and that, by friction and pressure upon the condyle, it has rubbed a cavity in it, and has been more or less completely deprived of its cartilaginous covering on one side. If this test be applied, it will, I think, be found to indicate the improbability of detachment by necrosis in most, if not all, of the instances with regard to which that view has been entertained. It does so in the cases just mentioned, as well as in the second case represented by Mr Teale in the *Brit. Med. Jour.*, May 26, p. 1109 (which specimen I have had the opportunity of seeing), where there were two loose bodies, one of which retains attachment to synovial membrane; and another loose body in the same specimen shows well the usual effects of rubbing on one side. It does so in the instance represented by Cruveilhier,[2] and often quoted as an example of a loose body detached from the articular surface. It does so, as far as I can judge, in the case of the loose body (No. 947 or 647) in the College of Surgeons referred to by Mr Howard Marsh, which also looks as if there were some remnants of cartilage upon its bony, or applied, surface. In the

[1] Virchow's *Archiv*, xxix. 190.

[2] *Anatomie Pathologique*, livraison ix. pl. 6 fig. 3, and copied by Bardeleben, *Chirurgie*, ii. 637, fig. 87.

specimen in St George's Museum (III. 140), which has been elsewhere referred to, the loose body is not apparent; but the cavity which it occupied in the condyle is in the situation into which, as I have before said, bodies formed into the adjacent part of the synovial membrane are liable to intrude themselves.

Mr Bernard Pitts showed me a specimen in St Thomas's Museum, in which from the under part of a condyle of the femur, in each of two knee-joints of the same person, a flake of cartilage, about a quarter of an inch in diameter, appears to be in process of separation, and its flocculent deeper surface is still connected by threads to the fossa in the cartilage from which it is being detached. The patient was under 30, but the effects of rheumatic arthritis are shown in the extension of the articular margin, and in a slight villosity of the synovial membrane, also in fibrous or velvety degeneration of the articular cartilages, especially in the neighbourhood of one of the separating fragments; and it seems probable that the separation of these fragments was being brought about by a modification of that change in the cartilages which is so common in rheumatoid disease. This view derives confirmation from the presence of cartilaginous bodies, such as I have mentioned, in the synovial membrane. In what number these existed, and whether any of them were pendulous in the joint, is not now apparent.

The conclusions, then, at which I arrive are :—

1st. Although I am not aware of any instance in which a portion of articular has been detached by a blow, yet in two cases (Simon's and Teale's) this appears to have resulted from a violent wrench. In each case the loose body so formed was removed by operation.

2nd. In none of the instances that I have read of, in which the formation of a loose body has been attributed to necrosis, does the evidence of such process appear to me to be satisfactory. The resemblance in structure of certain of these bodies to articular bone and cartilage as an argument in favour of that view, and it was perhaps the strongest, is, in a great measure, set aside by the discovery that this resemblance exists, also, in loose bodies formed in the ordinary way, namely, by synovial outgrowth; these being found in microscopical characters and general features much to resemble portions of articular bone and cartilage. They may, however, be distinguished by one or more of the following features :—(1) The presence in greater or less amount of fibro-cartilaginous or fibroid, as well as cartilaginous tissue in the body. (2) The imperfect denudation of the bone upon the rubbed down, or applied, surface of the body, so that remnants of cartilaginous or fibro-cartilaginous or fibroid tissue are found there. (3) The varying thickness of the cartilaginous covering, which in some parts may exceed that of normal articular cartilage, and its extension over the rounded edge of the body, to a greater or less extent, upon the circumference of its applied surface. (4) The knotty outline of the osseous nucleus and the imperfection of its bone-formation. (5) The size of the loose body being greater than that of the cavity in the condyles, so that it rises above the level of the surrounding articular cartilage. The presence of any one of these features renders a derivation from the articular surface very improbable; and the combination of two or more of them renders it almost impossible.

Recently, in a knee in this dissecting-room, two quite loose cartilages with ossifying nuclei were found—one, of the size of a pea, under the fore part of the external interarticular cartilage; the other of the size of a bean, upon the middle of the same interarticular cartilage, which was here softened and partially destroyed. The latter, by its pressure upon the femur, had caused softening of the articular cartilage in a limited area; and the softened portion, together with a thin layer of subjacent bone, was in process of separation. The specimen is in the University Museum, and is interesting as showing a necrotic state of cartilage, with the changes observable in cartilage under this condition.