Palaeontology. — *"On the Principal Characters of the Femur of Pithecanthropus Erectus."* By Prof. EUG. DUBOIS.

(Communicated at the meeting of March 27, 1926).

The left femur was dug up at Trinil in August 1892, during low-water level of the Bengawan, when the most fossiliferous layer of the andesite tuff was again accessible. Ten months earlier the calvarium had been found in that deposit of an ancient river, at 15 m distance *in the same stratigraphic plane*. This circumstance, added to the anatomical relations between the two objects, renders it almost infinitely probable that they represent parts of the same individual.

The **state of petrifaction** is also the same. The femur has the same deep brown colour as the calvarium. It weighs 1018 gr., which is more than twice the weight of a human femur of the same size, to which the fossil, on the whole, bears a striking resemblance. The volume is 485 cm^3. Without the exostosis and without the comparatively small defects this would have been 467 cm^3. On an average Negroes and also Australians have a slightly less voluminous femur, at the same length; in Europeans, on the other hand, it is averagely much more voluminous. Assuming the cavities to occupy about half of the total volume of the bone, as in human femora, and the compact bone substance to have a specific weight of about 2.7, as all other fossil bones of the Kendeng-fauna, I estimate that more than 100 cm^3, about $^2/_5$ of all the cavities, are filled up with calcite and some pyrite. The existence of this filling can be observed through the hole in the popliteal surface and by röntgenograms.

The femur is nearly complete and little injured. Some small **defects** can only be judged properly by the study of the fossil bone itself. That hole in the popliteal surface has been caused during the excavation, a piece of compacta of a length of almost 4 cm and of a breadth of from 1 to $1^1/_2$ cm broke off and got lost. In the same way a piece in the fossa intercondyloidea, about 2 cm long, has got lost, and also a small fragment at the anterior extremity of the condylus medialis. Immediately above its lower edge the condylus lateralis further shows a round impression of the point of a crocodile tooth. Some marks of crocodile teeth are to be seen at the upper portion of the femur. Thus on the front side: in the collum, beside the caput, a shallow impression accompanied with small fractures, and between the linea intertrochanterica anterior and the lower part of the trochanter major, a deeper, round impression, directed obliquely from the inner side and above towards the outer side and below. At the back side: in the middle of the collum a semi-circular impression obliquely across fragments going from above and the inner side towards below outward; another in the upper corner of the trochanter major, which corner is further broken off; on the outer side of the crista intertrochanterica a large shallow impression at the place of the tuberculum musculi quadrati, and a small, very shallow impression 1 cm lower; a double shallow impression on the trochanter major, in the middle of the surface for the tendon of the musculus glutaeus medius. The caput femoris, preserved for the most part, presents however extensive defects on the margin of the globular articular surface, which were probably also caused by crocodiles, so that of that margin only a small part has remained preserved on the upper side, and a still smaller part on the lower side.

The large **exostosis** below the trochanter minor takes the place of the intermuscular connective tissue between the vastus medialis and the adductores, accompanying the arteria and the vena profunda femoris and their rami perforantes. The course of these blood-vessels can clearly be recognized by the grooves and perforations of the exostosis. At the same place as in Man, the musculus adductor brevis has evidently lain behind the exostosis; its lower edge being apparently indicated by that of the exostosis and its hook. On the much smaller excrescence of the inner lip of the linea aspera below the main mass of the exostosis the insertion of the adductor longus is clearly impressed, somewhat more to the front than that of the adductor brevis, which covered it above. The insertion of the adductor longus was about 10 cm long.

Measures. The whole length of the femur in the natural position (measure 2 of RUD. MARTIN's Lehrbuch der Anthropologie) is 455 mm.

According to human proportions a body height of 160 to 170 cm has been calculated from this. From particulars of the femur and the calvarium it may however be deduced with certainty that the proportions must have deviated considerably from those of Man, in the direction of those of the Anthropoids, so that the trunk must have been out of proportion longer than in Man.

The length of the diaphysis (measure 5 of RUD. MARTIN) is 373 mm. The sagittal and the transverse diameter of the diaphysis, just below the excrescence of the linea aspera, about in the middle of the length (measure 6 and 7 of RUD. MARTIN) are 29 and 28 mm. The circumference there (measure 8), at the same time the smallest of the diaphysis, is 89 mm.

At the femora of 26 negroes in the Muséum d'histoire naturelle and the Musée Broca of the École d'Anthropologie at Paris I found with lengths from 425 to 494, mean 455 mm., for this circumference on an average 83.7 mm, at the femora of 2 Australians with lengths of 443 and 458 mm a mean circumference of 83 mm; at the femora of 10 Frenchmen with lengths from 414 to 492 mm, mean 444 mm, a circumference of 86 mm, and at the femora of 3 Japanese with lengths from

410 to 422 a mean circumference of 85 mm. The femur of Trinil may, accordingly, be called anything but slender. An impression of slenderness is only due to the absence of the ordinary human "trumpet form" of the lower end. Of the Hylobatides only a short-legged race of Symphalangus syndactylus (of Gunung Sago) has a femur which is equally little slender. As with equal length the power of resistance against breaking of a bone increases as the third power of the diameter (or of the circumference) of the diaphysis, Pithecanthropus had a femur which was a fifth stronger than on an average that of the negroes. The muscular force was probably also greater in the same proportion; then with the same proportion of trunk and legs, the body weight was almost a third greater.

The equatorial diameter of the caput femoris in the transversal plane is 44.7 mm and the sagittal diameter, perpendicular to it, about 44 mm (measures 18 and 19 of MARTIN).

The distal foramen nutritium lies 196 mm above the lower end of the femur.

The greatest length of the condylus lateralis is 62 mm, that of the condylus medialis 64 mm (measures 23 and 24). In Man the lateral condylus is not always longest; in some cases the medial condylus.

The curvature of the diaphysis (measured according to RIED's method [1])) is 8 mm. The summit of the curve lies at $17^1/_2$ cm above the patellar part of the articular surface of the knee-joint. In comparison with most human femora this curvature is slight and the summit situated also at a comparatively low point. In an only moderately curved negro femur (New Museums Cambridge, N^0. 12, length 485 mm) I measure 13 mm at 23 cm above the knee-joint. Calculated to the same femur length this would become 12 mm. The femur of Pithecanthropus is certainly not straight, as most femora of the Hylobatides are. In a Hylobates agilis I find, however, the same curvature of the diaphysis (calculated to the same length) as in Pithecanthropus. Particular distinctive significance can, it seems to me, not be assigned to this height of the femur curve. On the other hand I consider it of particular significance that the femur of Trinil exhibits the strongest curvature to the front very low, at about 7 cm above the level of the patellar articular surface, i.e. at the same place where the diaphysis possesses its greatest antero-posterior thickness, because at the backside at this place the buttress of the median wall attains its greatest strength.

The "angle of torsion" (measure 28) is 19°. As in Man this angle is very variable in the Anthropoids, hence without distinctive significance.

The collo-diaphysis angle (measure 29) is 123°.

The angle between the anatomical axis and the perpendicular to the inferior tangent of the condyles (transversal inclination) is 11°, the angle

[1]) A. H. RIED, Die Schaftkrümmung des menschlichen Femur. Anthropologischer Anzeiger. Jahrgang I, p. 102—108. München 1924.

of the mechanic axis with this perpendicular 6°. With joined knees (with the soft parts) the breadth over the two great trochanters would consequently not have been more than 32 cm.

The resemblance of the fossil femur to that of Man, in contrast to

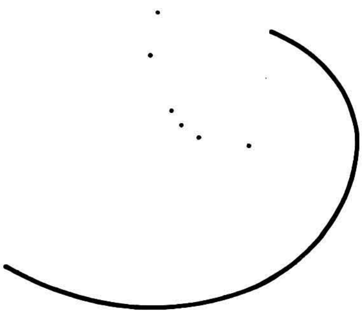

Fig. 1.

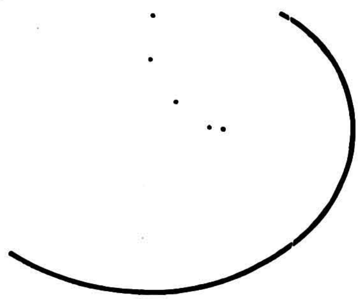

Fig. 2.

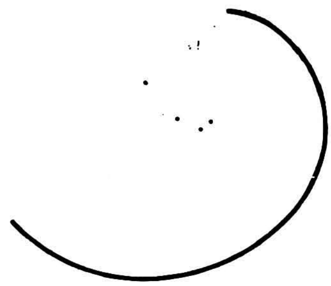

Fig. 3.

the Apes, is very marked in the knee-joint, which was adapted for perfect extension of the leg. This appears in particular when the sagittal line of curvature of the condyles is compared with that of men and apes. From cross-sections of accurate plaster casts of the tibio-femoral part of the cartilage-less medial condylus, according to the line of contact of the condyli with a horizontal plane upon which they roll, I find that in Pithecanthropus (fig. 1, natural size) the radii of the spiral line decrease from the front backwards slightly more, i. e. in the ratio of 100 : 37.5, than as a rule in Man, where the proportion of the frontmost and the backmost radius generally deviates little from that in the negro (Anatomical museum Amsterdam, length of femur 471 mm) of fig. 2, i. e. 100 : 46. In the Anthropoids the radii of curvature decrease much less from the front backward, perhaps most in Gorilla. In fig. 3, natural size, of a ♀ Gorilla the ratio is 100 : 64. In these three figures the points above the curve indicate the evolute of the shifting axis of rotation. Pithecanthropus seems to outstrip the human mean in this respect; thus also in the transverse curves of the backmost parts of the condyles, as seen from behind perpendicularly to the shaft of the femur. Especially the medial condylus is still flatter there than as a rule in Man. Compare fig. 4, natural size, of Pithecanthropus and

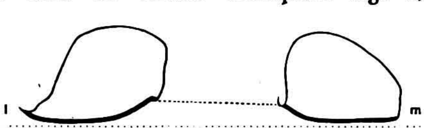

Fig. 4.

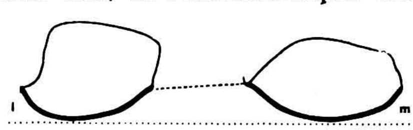

Fig. 5.

fig. 5 of the negro mentioned before (Amsterdam). In that composite articulation, the trocho-ginglymus of the knee-joint, the ginglymus component was even more predominating than in Man, in contrast to the Anthropoids. Rotation of the tibia in the knee-joint thus was of still less importance than in Man, the contrast to the Apes greater.

In the röntgenogram, both in that of the upper end of the femur and the lower end, the "trajectoria" of the human type may be recognized, though on account of the filled cavities they are not so clear as in other thigh-bones.

Two characters distinguish the Trinil femur very decidedly from that of Man. These are in physiological relation to each other, though the first refers to the form of the lower part of the diaphysis and the other to that of the trochanter major at the superior extremity of the femur.

Down to low on the popliteal surface and beginning at more than 11 cm above the level of the patellar articular surface the back side shows a *median swelling* and rounding. *Below* the linea aspera, which is not strengthened in this femur to a buttress, crista femoris or "pilastre", a median buttress has evidently developed, descending to less than 2 cm above the knee-joint. In Man, on the contrary, the ridge proceeds as a rule, with the external supracondylar line or labium laterale (*l*) of the linea aspera, to the lateral condylus, and accordingly the *lateral* condylus of Man is considered as receiving the most of the pressure of the body-weight. In Pithecanthropus the line of pressure seems to fall between the condyles, accordingly a median buttress placed lower seems to be necessary.

This peculiarity of the Pithecanthropus-femur may be best judged by cross-sections of accurate plaster casts, which are reproduced here. In

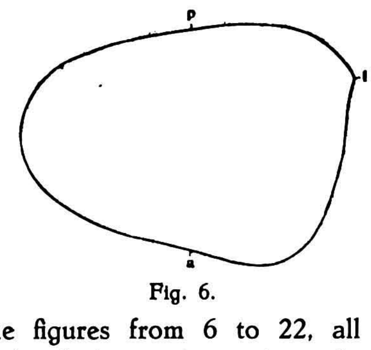

Fig. 6.

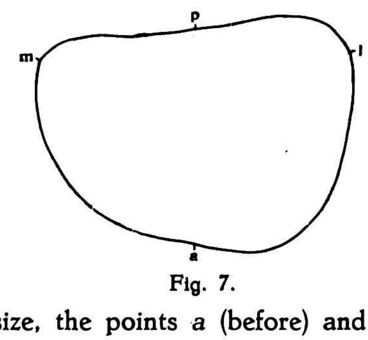

Fig. 7.

the figures from 6 to 22, all natural size, the points *a* (before) and *p* (behind) lie in the median plane of the shaft, *m* represents the continuation of the labium mediale and *l* of the labium laterale of the linea aspera. In fig. 6 of the cross-section at only 2 cm above the level of the patellar articular plane the median rounding still exists. This is absent at the corresponding level in the negro mentioned (Cambridge), (fig. 7), though the femur at that place is still somewhat less broad than that of Pithecanthropus. It is also absent in the ordinary European type, as at the femur with exostosis of Strassburg mentioned by SCHWALBE [1])

[1]) G. SCHWALBE †, Studien über das Femur von Pithecanthropus erectus Dubois. (Studien über „Pithecanthropus erectus Dubois". II Teil). Herausgegeben von EUGEN FISCHER. Zeitschrift für Morphologie und Anthropologie. Bd. 21, p. 359. Stuttgart 1921. The cross-sections of this right femur represented here have been reversed for a comparison with the other left femora.

(fig. 8, length of femur 458 mm) and in another type, with large tuberculum supracondyloideum, of a Dutchman (fig. 9, length of femur 454 mm). Fig. 10 is the cross-section of the Trinil femur at 3,2 cm above the articular surface, and fig. 11 at 4 cm above this surface. Fig. 12 represents, at corresponding level, the cross-section of the femur of the negro (Cambridge), fig. 13 at a height of 4 cm that of the Strassburg-femur,

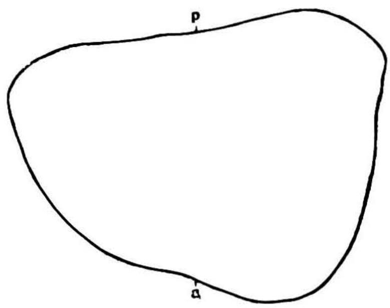

Fig. 8.

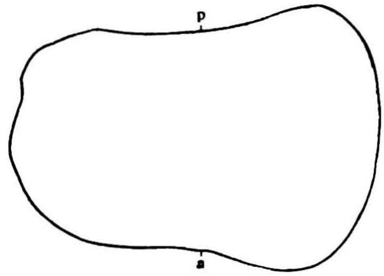

Fig. 9.

fig. 14 of one of the five roundest femora at the corresponding level (femur *H*) found by MANOUVRIER [1]) among a thousand. He explains this form by the weakening of the lateral prolongation of the linea aspera or "prolongement pilastrique" in consequence of smaller extension of the origin of the musculus vastus intermedius ("muscle crural") down-

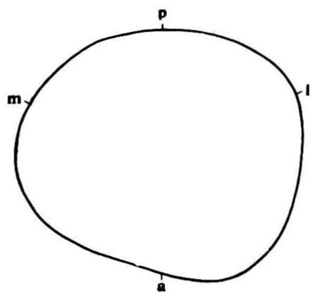

Fig. 10.

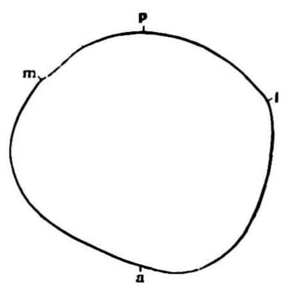

Fig. 11.

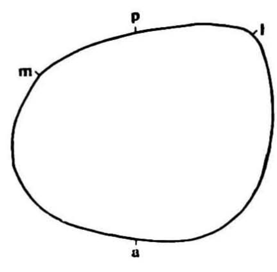

Fig. 12.

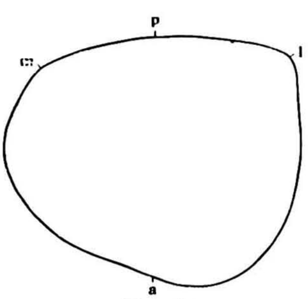

Fig. 13.

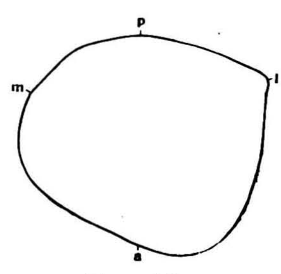

Fig. 14.

---

[1]) L. MANOUVRIER, Deuxième étude sur le Pithecanthropus erectus. Bulletin de la Société d'Anthropologie de Paris. Tome 6 (4e série), p. 560 e. v. 1895.

ward and outward. Among many human femora of various races also HEPBURN[1]) found some with strong median convexity at corresponding level, but in no human femur described or known to me does this convexity rise in the same degree above the joining line of *m* with *l*, and does it bulge upwards to such a buttress-like median swelling as in Pithecanthropus. At 7.2 cm above the articular surface the median convexity of the back side of the femur of Pithecanthropus is most pronounced (fig. 15). In the negro of Cambridge (fig. 16) the space between *m* and *l* is only slightly arched at the same level, and in the Strassburg-femur with exostosis (fig. 17) for the greater part flat. At 11 cm above the articular plane the fossil femur shows already this median buttress of the back side (fig. 18) beside the external lip of the linea aspera, the internal lip is absent. Fig. 19 is the cross-section of the Trinil femur at 17 cm above the knee joint, and fig. 20 of the Strassburg-femur at 16 cm. Fig. 21 is the cross-section of the Trinil femur at 20 cm, through the excrescence in front of the adductor longus muscle, where on the outside of the linea aspera the greatest excavation through the vastus lateralis exists, and fig. 22 at $22^{1}/_{2}$ cm, just under the large exostosis.

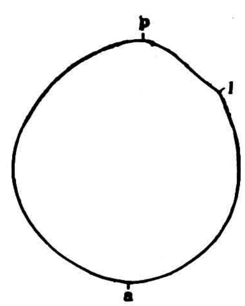

Fig. 15.

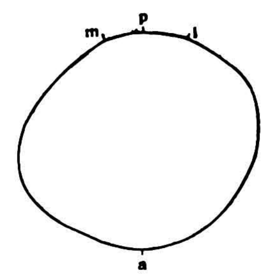

Fig. 16.

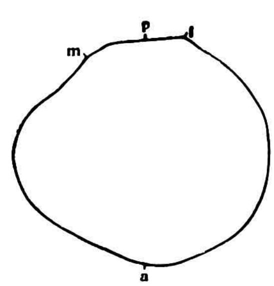

Fig. 17.

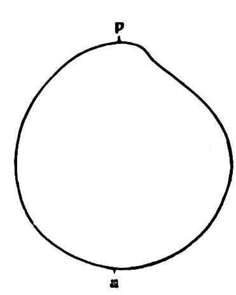

Fig. 18.

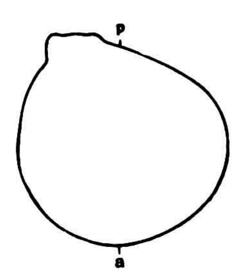

Fig. 19.

[1]) D. HEPBURN, The Trinil Femur (Pithecanthropus erectus) contrasted with the Femora of various Savage and Civilised Races. Journal of Anatomy and Physiology, Vol. 31, p. 1. 1897.

In these cross-sections of the fossil femur the complete absence of an *angulus medialis* also strikes the eye, in contrast with the human femur,

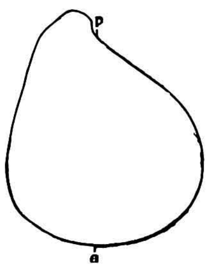

Fig. 20.

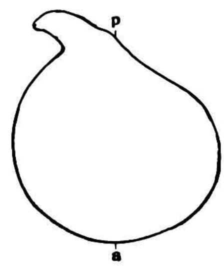

Fig. 21.

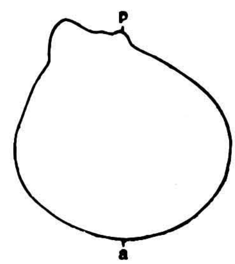

Fig. 22.

but in accordance with this bone in Apes. In Man the inner side (as angulus medialis) remains free from attachment of muscles; in the Apes, on the other hand, the origin of the vastus intermedius or of the vastus medialis continues on the inner side of the femur, enveloping this bone continuously. Thus it seems also to have been in Pithecanthropus.

It seems to me that the very peculiar shape of the lowest third part of the diaphysis of the femur of Pithecanthropus should be attributed to static and mechanic causes, as was already indicated above. But to other static and mechanic properties of a bone must also correspond other muscular arrangements. Modifications of the form of the human femur, which undoubtedly indicate modified static and mechanic qualities, are always accompanied by corresponding modified muscular actions, hence modified muscle attachments. It has further appeared from many measurements that muscular force is the greatest of the forces acting on the bones. Comparison of large and small homomorphous (related) species of animals, as Rat and Mouse, Lion and Cat, shows moreover that the relative strength of the bones is not determined by gravity (the body-weight), but by muscular force.

Now it is clearly to be seen on the femur of Pithecanthropus that the insertion of the adductor magnus below the linea aspera was different from that in Homo. Of the labium mediale, running in Man to the epicondylus medialis, only two small knobs are to be seen, at $11^{1}/_{2}$ and 10 cm, and a line between 5 and 3 cm above the level of the patellar articular surface. The small development of this part of the labium mediale is particularly striking by the side of the other, very strongly modelled muscle insertions. This, together with the rotundity of the diaphysis on the inner side, and the existence of the buttress-shaped median swelling, are circumstances which render a fleshy median attachment of the portio pubica (portio nervi obturatorii) of the *adductor magnus* in Pithecanthropus probable, a development and way of insertion differing from that of Man, but occurring, with few exceptions, in the Monkey tribe, through which the function of this muscle is modified.

Many years ago I was enabled by Professor BOLK to examine this insertion on muscle preparations of a number of Apes. I may now be allowed to represent the principal results of this investigation in the figures 23 to 30, in which *Am* indicates the attachment of the portio nervi obturatorii of the adductor magnus, *I* of the portio nervi ischiadici (musculus ischio-femoralis), *B* of the caput breve of the biceps femoris. In Anthropopithecus troglodytes (fig. 23), Simia satyrus (fig. 24), Nasalis larvatus (fig. 25), Cynomolgus fascicularis (fig. 26), Cynopithecus niger (fig. 27), also Macacus nemestrinus and Cynocephalus maimon, further Ateles paniscus

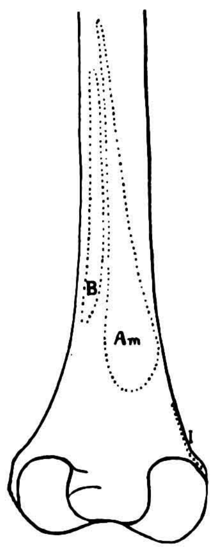

Fig. 23.

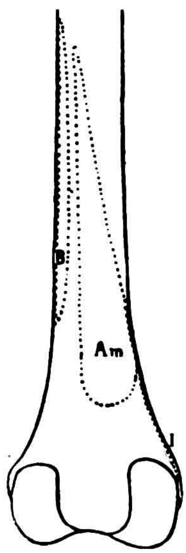

Fig. 24.

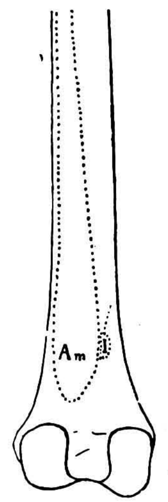

Fig. 25.

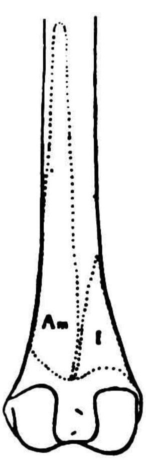

Fig. 26.

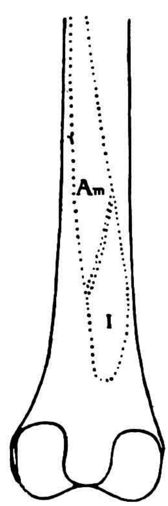

Fig. 27.

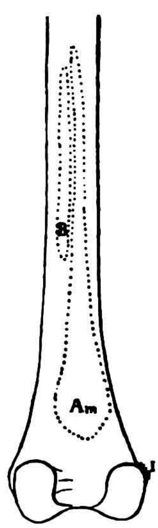

Fig. 28.

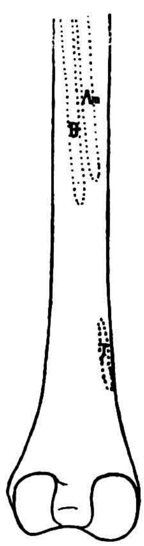

Fig. 29.

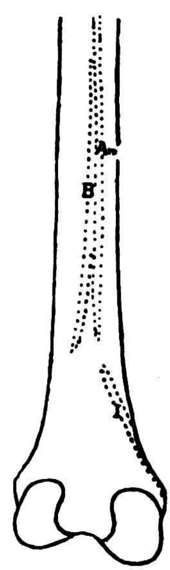

Fig. 30.

(fig. 28), *Am* fleshy and broad, is extended low as far as into the planum popliteum, which in many Apes, among others in the Chimpanzee and the Orang-utan, exhibits a median convexity certainly caused in the first place mechanically. In the movements of all these species in the trees this insertion of the very powerful muscle is particularly serviceable to bring the centre of gravity of the body from outside above the fixed leg, and at the same to turn the front to the other side. Only in the Hylobatides: Hylobates javanicus (fig. 29), H. agilis and Symphalangus the insertion of this part of the adductor magnus, though also a powerful muscle, terminates partly tendinous at great distance above the popliteal surface. To the wonderfully elastic skipping movements of the Hylobatides belongs a long femur with more tendinous insertion lying closer to the coxal joint.

On the femur of Pithecanthropus there are no traces to be found of an insertion similar to that of Man (fig. 30); that at the labium mediale of the linea aspera is seen to end abruptly where the median buttress and swelling begins, which gradually broadens over the back side of the femur to low in the planum popliteum, in the same way as this adductor muscle does in most Apes, Monkeys and Baboons. This induces me to assume that in Pithecanthropus the muscle, broadening downward, was attached fleshy at the middle of the posterior surface of the femur to low in the planum popliteum. Longitudinal slight grooves there are undoubtedly traces of this insertion. In virtue of this insertion — or rather this origin — the muscle possessed, in deviation from its function in Man, an action going hand in hand with the adducing action, of rotating the femur strongly outwards, or rather an action bringing, with fixed leg, the centre of gravity of the upper part of the body from outside above this leg, and turning at the same time the front to the other side, as in most Apes. For the rest all the muscles that rotate the femur outwards seem to have possessed this power in a high degree. The inward rotation by the portio ischiadica was, on the contrary, probably comparatively weak.

Another special character that very definitely distinguishes the femur of Pithecanthropus from that of Man, and which is in physiological relation to the just described character, is the position of the *trochanter major in the continuation of the diaphysis*. Fig. 31 (like fig. 32 postero-lateral view from photograph at a great distance) accurately indicates this position at $^3/_4$ natural size. The trochanter major shows the same prominent diagonal line *e*, which on its quadrilateral external surface extends from the posterior-superior to the anterior-inferior angle, as in Man, with the same triangular surface above it, where this line alone (in the case that there is a bursa mucosa on the triangular surface) or together with the triangular surface (in the case of non-existence of a bursa) serves for the attachment of the tendon of the glutaeus medius. Below the line *e*, at the place where in Man mostly a bursa is situated under that part of the tendon of the glutaeus maximus which is attached to the fascia lata, the external surface of the trochanter major shows, as

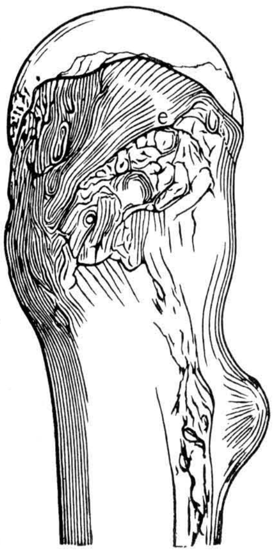

Fig. 31.

Fig. 32.

individual peculiarity, an excrescence, which evidently originated from connective tissue, in the same way as the large exostosis below the trochanter minor. As in many cases in Man, and similarly in the Apes, the tendon of the glutaeus medius in Pithecanthropus seems to have been attached not only at the prominent diagonal line, but also at the trigonal part of the surface of the great trochanter up to the superior border. Behind the said excrescence and along the crista intertrochanterica the bone is smooth. The posterior border with the whole great trochanter is directed *vertically upward.* In Man, on the other hand, as well as in almost all Apes, Monkeys and Baboons the posterior border with the whole great trochanter has an oblique direction upwards and *forward* (fig. 32, femur of a Dutchman). In Pithecanthropus the great trochanter is not placed on the diaphysis slanting forward as in Man and in the whole Monkey tribe, with the exception of two genera, but forms as it were, a prolongation of the diaphysis upwards. [1]) This points to a peculiar condition of the musculus glutaeus medius (and the m. gl. minimus) in Pithecanthropus. The direction of the trochanter major of Man, slanting forward, is undoubtedly a consequence of the forward expansion of the ilium and hence of the origin of the glutaeus medius and of the glutaeus minimus, in front of the great trochanter.

---

[1]) This is what in 1894 I expressed as concave form of the crista intertrochanterica, without then observing a difference in the form of the great trochanter.

Although in Man the thigh, which is bent in the Apes, is brought in a line with the body, and consequently the trochanter is turned forward, the ilium has expanded equally much in the same direction, not being overtaken by the turned trochanter. In the Apes, *sensu generali*, the ilium has expanded forward much less far, if at all, but nevertheless the trochanter major generally points upwards and *forwards*, on account of the habitually bent position of the femur. Thus also in Symphalangus, which though he can stretch the femur fairly far, possesses a comparatively heavy, long, and broad trunk and heavy arms, like Gorilla, through which the ossa ilii are developed somewhat more "basin"-shaped than in Hylobates, the crests of the ilia diverge, and the two spinae anteriores superiores are situated relatively far to the front. In consequence of this the direction of the powerful musculus glutaeus medius, which inserts at the upper border of the great trochanter, is such, that also with extended femur, the trochanter major points upwards and forward. This is different in the so closely allied genus Hylobates. Possessing on an average absolutely equally long femora as Symphalangus, which certainly are not less extensible, the species of this genus have an absolutely and relatively shorter and narrower trunk. Consequently the ossa ilii are not broadened and not expanded forward, but they are narrow, and placed with their crests almost or entirely transverse. The tendon of the glutaeus medius, which muscle is equally powerful in relation to the size of the body, is in consequence of this, also directed more vertical towards the great trochanter, and not obliquely backwards as in Symphalangus, and that process is not placed on the diaphysis obliquely upwards and forwards, but in its prolongation, as in Pithecanthropus.

A similar but less sharp difference in the shape of the great trochanter as between Hylobates and Symphalangus exists between Chimpanzee and Gorilla, owing to the relatively heavier trunk, and consequent forward expansion of the ilium of the latter.

Accordingly Pithecanthropus cannot have possessed a human-shaped pelvis, but as the femur could to all appearance be extended to a human degree, the pelvis may have been comparatively more human than that of Hylobates and Chimpanzee. The tendon of the glutaeus medius was inserted more posteriorly of the centre of rotation of the hip-joint, and produced, therefore, a stronger outward rotation constantly accompanying the abduction. With fixed leg the strong muscle brought the centre of gravity of the body from the other side above that leg, and turned the front of the trunk to the other side.

With such an unhuman pelvis the locomotion of Pithecanthropus cannot have been exclusively, perhaps not even chiefly, on the ground. The erect type was not perfectly developed. For not the whole structure of the body is in keeping with the erect posture and gait. This might already be inferred — judging from the preserved part of the skull — from the undoubtedly backward position of external auditory meatus, and with it of the condyli occipitales and the foramen magnum, and from the not human slope of the nuchal plane of the occipital bone, in which characters Pithecanthropus occupies a place about halfway between Man and the Anthropoids.

The movements in the hip-joint described and the greatly predominating hinge-movement component in the knee-joint render it probable that Pithecanthropus was less ground-walker than tree-climber, but did not climb with a prehensile foot, in the way of the Apes.

In the ordinary locomotion of Homo sapiens and Homo neandertalensis each leg supports alternately the body in such a way that with transversal knee axis placed as much as possible horizontally, the condylus lateralis is chiefly loaded. For this reason the diaphysis is thicker above this condylus than above the condylus medialis — and also as a rule than between the two condyli — and the linea aspera, which may be strengthened to crista femoris or "pilastre", continues from the middle, below the bifurcation of the labia of the linea aspera, in the lateral thickening of the diaphysis mentioned.

In Pithecanthropus, on the other hand, the diaphysis was thickened *in the middle* also below this point of bifurcation, up to close above the knee-joint; mostly opposite the point of the strongest forward curvature. Evidently the line of pressure lay here on the inner side of the condylus lateralis, because in the usual locomotion the supporting leg was not placed near the line of gravity of the body (though the diaphysis makes a human angle with the transverse axis of the knee-joint), but further outward; consequently the transverse axis did not remain horizontal, but descended obliquely inwards, and the pressure weighed *on the inner border of the foot.* The leg then remained in abduced position, and at the same time turned outwards on account of the peculiar attachment of the musculus glutaeus medius, which muscle certainly as a whole produced a strong outward rotation of the femur combined with the abduction. The leg on extension being still less adapted for rotation in the knee-joint than that of Man, was on adduction, through the peculiar attachment of the musculus adductor magnus also turned outside with the foot, a necessary condition if the most usual locomotion consisted in climbing trees with alternately extended legs. Hence the two muscles mentioned, when bringing the trunk above the extended and fixed leg, turned the former at the same time with its front to the other side. The femur of Pithecanthropus was, therefore, also fit for locomotion on the ground, but by no means adapted so exclusively for it as in Homo sapiens and Homo neandertalensis. Yet the erect walking on the long legs, which were adapted for perfect extension, may have been distinguished by great speed, if very long arms served at the same time as a kind of crutches. If Pithecanthropus had long arms, these could enable him to perfection to climb thick solitary trees projecting high above their surroundings, in the same way as the aborigines of Australia according to LUMHOLTZ's description (as figured at foot), but without the aid of a rope. To this specialization, which includes an erect gait on the ground, his high cephalisation, compared to that of the anthropoid Apes, is, in my opinion, to be ascribed.