SHERZER (W. H.)

PLATYCNEMIC MAN

IN

NEW YORK

By W. H. SHERZER

With compliments.

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(Communicated for the Report of the State Geologist.*)

W. H. SHERZER.

1. Historical.

While examining remains of prehistoric man derived from a cave upon Windmill Hill, Gibraltar, Prof. Busk and Dr. Falconer, in 1863, observed a peculiar antero-posterior flattening of the tibia. This anomaly was described some five years later before the International Congress of Prehistoric Archæology, report for 1868, page 161. One year after this discovery (May, 1864) M. Broca independently observed the same peculiarity in tibiæ derived from dolmens of Chamont and Maintenon, north-central France.† Caves, tumuli and refuse heaps in Denbighshire, north Wales, yielded similar bones in 1869 and 1871, along with a femur showing an abnormal lateral compression a few inches from each extremity. With these bones were associated those of the dog, fox, badger, pig, deer, sheep or goat, horse, water-rat, hare, rabbit, bear and eagle, which, together with a polished green-stone axe, chipped flakes of flint and crude pottery, left no doubt as to the Neolithic character of the remains.‡ This fore-and-aft flattening of the upper half of the tibia, to which the term *platycnemism* was applied, was also observed in a fragment derived from the laterite of India.

While these discoveries were being made in Wales, Mr. Henry Gillman, of Detroit, was busy exploring mounds along the southwestern shore of Lake Huron and the western banks of the St. Clair and Detroit rivers. Numerous skeletons were unearthed showing this platycnemism to a remarkable extent, the compression of the femur noted by Prof. Busk and the so called "perforation of the humerus." This latter abnormal character is

* Read before the Geological Society of America at its Brooklyn meeting, Aug. 15, 1894.

† Mémoires sur les ossements des Eyzies. Paris, 1868. Reliquiæ Aquitanicæ, p. 97.

‡ Journal of the Ethnological Society of London. New series, vol. II, 1870, p. 440. Also, Nature. Vol. IV, 1871, p. 388.

produced by the union of the two fossæ (the coronoid and olecranon) at the elbow-joint.* These bones from the Michigan mounds were deposited with the Peabody Museum and that of Columbia College, a portion of them being described by Prof. Wyman in his Fourth and Sixth Annual Reports and in the American Journal of Science, January, 1874. These discoveries furnished Mr. Gillman with material for a number of valuable articles, which appeared from 1873 to 1880, as publications of the Smithsonian Institution, the American Association for the Advancement of Science and the Michigan Pioneer Society. Researches of the past twenty years have brought to light in various parts of the country numerous instances of tibiæ more or less flattened; more than verifying the prediction of Mr. Gillman: "I can not but believe, from what I have seen, that future investigation will extend the area in which this type of bone is predominant to the entire region of the Great Lakes, if not of the Great West."† Such bones have been reported from Wisconsin, Ohio, Illinois, Iowa, Kentucky, Tennessee and Florida; have been observed by me in the World's Fair exhibits from Missouri and New Jersey and in the Peabody collections from Massachusetts and Peru. The type is found to be of common occurrence in the prehistoric remains of Arizona, New Mexico, Mexico, Oceania and the Grand Canary Islands, associated, as in the preceding, with the perforation of the humerus. Indeed, we may now reasonably expect that these characters will be found wherever ancient remains are brought to light, the percentage of occurrences varying, more or less directly, with the antiquity. So far as I am aware this prehistoric type has not yet been reported from New York, although finds must have been far from few. While conducting a field class in geology at the Natural Science Camp, on Canandaigua lake, during the summer of 1893, a well-preserved skeleton was unearthed, which will serve as a text for the discussion of platycnemism and its associated characters.

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* By "perforation of humerus" some authors refer to the supra condyloid foramen, formed by an arch of bone just over the internal condyle, giving passage to the great nerve and artery of the forearm.

† Sixth Annual Report of the Peabody Museum, 1873, p. 19. Also, Amer. Jour. of Sci., 3rd ser., ol. vii, 1874, p. 8.

2. The Locality.

The discovery was made upon the farm of Richard M. Gage, on the east shore of Canandaigua lake, in the town of Gorham, Ontario county, about six miles south of the village of Canandaigua. The farm-house stands but a few feet to the east of the lake road, upon the edge of a small cultivated field of rolling ground, about 200 yards back from the lake and from fifteen to twenty feet above its level. This field is terminated on the south by one of the typical ravines of this region, cut out of the Hamilton shales and running back at approximately right angles to the lake shore. When the lake stood at a higher level the waters from this ravine emptied into it back at the road, near the farm-house, and the eroded material was deposited so as to give now a low flat point of land. This land yielded numerous arrow-points, celts and hammer-stones and was accordingly judged to have been the site of a former Seneca village. Just back of the residence a natural knoll rises to a further height of fifteen to eighteen feet, the soil of which consists of a stratum of brownish, gravelly clay, about a foot in thickness. Beneath this clay is a bed of fine argillaceous sand, of unknown thickness, grayish in color and distinctly stratified. This land has been in possession of the Gage family since 1836.

3. The Discoveries.

At the close of June, 1893, while harrowing over the knoll, Mr. Gage rolled out a well-preserved skull, from which, however, the upper and lower jaws had been removed. An excavation was at once made upon the eastern slope, some ten feet in diameter and two feet deep, passing into the sand. Portions of two skeletons were unearthed by Mr. Gage and his workman, lying about two feet apart and in an approximately northeast and southwest position, the heads toward the south. Their being imbedded in clay showed that an excavation had been made in the sand to the depth of a foot in order to receive the bodies. According to Mr. Gage one of these bodies had been buried upon its breast, the face turned to one side, in front of which the hands were drawn up, the left one tightly clenched. Although these hand and finger bones were well preserved, care-

ful search did not reveal the slightest trace of the pelvic and leg bones. The skull was badly broken in being unskillfully removed, but was partially restored. The adjoining skeleton also lacked the lower extremities and the head, the skull harrowed out being supposed at the time to belong to it. The surrounding clay contained fragments of charcoal and a whitish substance, crumbling in the fingers, and resembling completely calcined bone. This material, however, rapidly dissolves in cold, dilute hydrochloric acid and consequently is adjudged to be simple calcium carbonate. Associated with these remains were bones of, at least, two ground-hogs and a foot bone of a deer, but neither implement nor ornament could be found. It seems more probable that these bodies were mutilated before burial, rather than that they were partially consumed by fire.

Some two weeks after these discoveries, in company with interested members of the Natural Science Camp, I visited the locality and enlarged the excavations. A massive lower jaw, and about a foot from it, the superior maxillaries were soon found, both perfectly fitting the original skull harrowed out by Mr. Gage. A few inches further away the neck vertebræ and upper extremities appeared and, little by little, the entire skeleton was brought out in relief from the clay matrix. Several good photographs were secured before the bones were disturbed, one of which was reproduced in the Rochester Union and Advertiser for July 29th, 1893. The body lay in a northwest and southeast position, the head toward the south, at right angles to the other bodies, some five or six feet to the west and apparently upon the same level. It had been buried upon its left side, the hands drawn up in front of the face and the thighs making an angle of about 135 degrees with the trunk. The legs were bent backward so as to form an angle of 45 degrees with the thighs, but as the pelvic bones decayed the right femur had dropped down and backward so as to be approximately parallel with the tibia.

An excavation had been made to a depth of ten to twelve inches in the sand and the body covered with clay, as in the case of the other two. How far it lay from the original surface can only be surmised, since the amount removed from the knoll by cultivation and rain erosion can not be determined. Overlying the skeleton was a stratum of clay, four to five inches in thickness,

containing some charcoal being much hardened, possibly by fire, although not reddened. To the character of this stratum is undoubtedly due the excellent state of preservation of the bones. No animal remains were found with this skeleton nor any utensil, implement or ornament.

These excavations were continued a day or so later by Mr. Gage, and, guided by a dipping of the disturbed clay into the sand, he came upon a crude basin-shaped structure of hardened clay which he unfortunately destroyed, not realizing its value. From his description and an examination of the fragments removed and those still in position its general nature and method of construction were determined. Some fifteen feet to the west of the bodies a hole had been excavated to a depth of two feet in the sand, three feet from the present surface and from five to six feet in diameter at the top. This had been filled in with the surface clay and a crude, hemispherical basin shaped, having an inside measurement of three feet at the rim and a depth of sixteen to seventeen inches. The walls were four to five inches thick and reddened internally by fire to a distance of one to two inches. The structure was so baked and hardened that it might easily have been removed entire by working from about it the sand and clay. It was completely filled with nearly pure charcoal, much of it oak, from limbs two to three inches in diameter. A careful examination of this charcoal failed to reveal the slightest trace of bone, pottery, implement or ornament. Just beneath the level of the rim, but to one side, were found the bones of a dog in good state of preservation. The apparent connection of this crude structure with the burials, the care with which it had been constructed, and the purity of the charcoal suggest some ceremonial use, perhaps similar to that of the so-called altars of the Ohio mounds, although it differs entirely from them in form and manner of construction. Its shape and relative proportions correspond closely with those of a stone bowl found by Mr. Moorehead in one of the Hopewell mounds, Ross county, Ohio.* Mr. Gage remembers that while setting out a vineyard, some years before, he came upon a similar mass of charcoal in this same field. Subsequently the excavations were continued westward into the

* Moorehead, Primitive Man in Ohio. Fig. xxxviii.

higher portions of the knoll. In places the sand had been disturbed to a depth of three and a half to four feet, was mixed with charcoal and the whitish calcareous substance previously referred to. Some Hamilton fossils, recent snail-shells and a small irregular fragment of burned clay were further noted.

4. Osteological Characters.

a. General.— The following brief descriptions pertain chiefly to the complete skeleton, since the comparatively few bones found of the other two were scattered before they could be obtained for careful study. This is believed to have belonged to an adult male, in middle life, whose stature, estimated in the ordinary way from the length of the femur (18.76 inches ÷ .275) was approximately five feet and eight inches. With the exception of the pelvic bones, the ribs and lower vertebræ, the bones are in excellent state of preservation, to some extent showing their original color and hardness. The larger leg and arm bones are somewhat decayed at the extremities while the more slender ones have begun to exfoliate and soften. The skull is surprisingly firm and hard. The bones throughout are massive and indicate a heavy muscular development.

b. Tibia.— In order that the most interesting peculiarities of the skeleton may be appreciated it is necessary to make some comparisons with ancient and modern tibiæ, by means of measurements, drawings and the following indices: (1) The length is taken from the tip of the spinous process, at the knee articulation, to the point of the internal malleolus at the opposite end. (2) The transverse diameter at the knee articulation. (3) The least circumference of the shaft. (4) Antero-posterior and transverse diameters, taken where the faint ridge upon the upper, posterior portion of the bone (the "popliteal line") passes obliquely down and terminates at the inner border of the bone. This is usually from one and a half to two inches below the small opening to the interior of the tibia, known as the "nutrient foramen." Some investigators take these measurements, however, at the level of this foramen. (5) The ratio of these two diameters noted under (4) obviously expresses the amount of flattening of the bone and is called the "latitudinal index." (6) Another index, the "perimetral," is obtained by dividing the least circumference by the length, and

approximately expresses the *massiveness* of the bone. A table of Gillman's * is here subjoined, made up of the means from the designated localities. For purposes of comparison there have been inserted the corresponding measurements upon the left tibia of the Canandaigua skeleton, the unit used being the inch.

LOCALITY.	1. Length.	2. Trans. diam. at knee.	3 Least circumference.	4. Antero-posterior and transverse diams.	5. Latitudinal index.	6. Perimetral index.
Detroit and Rouge rivers, Mich.	14.80	2.73	2.87	1.50—.72	.486	.185
Head St. Clair river, Mich.	14.75	2.70	2.90	1.47—.80	.548	.200
Canandaigua lake, N. Y.	15.91	3.18	3.12	1.39—.81	.583	.196
Chambers island, Wis.	14.74	3.07	3.02	1.53—.90	.588	.205
Perthi-Chwareu, Wales	13.50	2.70	2.87	1.29—.79	.612	.212
Thirteen ordinary English, London	15.10	2.86	2.90	1.27—.92	.727	.195

In its length, transverse diameter at the knee and least circumference this Canandaigua tibia is seen to exceed the means of the prehistoric and modern English tibiæ. These latter were selected by Prof. Busk at random from a drawer in the College of Surgeons, London, and are assumed to represent the modern proportions. Interest attaches mainly to the degree of flattening as shown in the fifth column. At the level indicated under (4) above for measurement, the modern normal tibia shows a subtriangular cross-section and gives a latitudinal index, which may be assumed to vary from .700 to .750+. Fig. 1 shows this outline, natural size, frequently met in modern tibiæ, but giving an index of .702, very near the lower limit of the range above indicated. Fig. 2 is a reproduction of Prof. Busk's normal tibia. Both figures show three well defined surfaces existent; an external, an internal and a posterior. In platycnemic tibia the posterior surface almost completely disappears in certain types. (See Fig. 5). Fig. 3 is a similar drawing of the Canandaigua tibia, with its smooth, oval outline and index of .583. Its companion shows a still greater compression, giving an index of .560, the two averaging .571.

* Smithsonian Report for 1873, p. 378.

The degree of flattening observed in certain cases is remarkable. Fig. 4 from the cave of Cro-Magnon, France, shows one of these extreme types, which must have had an index of but little over .400. Gillman secured two specimens from the Circular mound, upon the Detroit river, with indices of .400 and .420 respectively, while one from the Grand Canaries was found by Kuhff to fall as low as .360. Expressed somewhat more intelligibly, this means that the transverse diameter but slightly exceeds one-third of the fore-and-aft diameter.

An examination of a series of flattened tibiæ shows that the platycnemism is of two varieties, depending upon whether it is

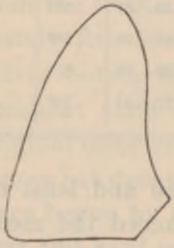

Fig. 1.

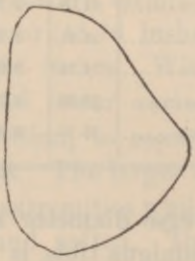

Fig. 2.

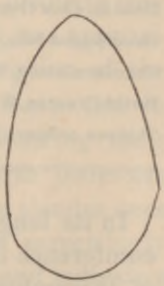

Fig. 3.

Explanation of Figures.

Cross-sections of tibiæ. The anterior margin is above, the posterior below, the internal surface to the left and the external, bearing the interosseus ridge, to the right.

Figures 1 and 2 represent the modern, normal proportions. Fig. 3 is the Canandaigua tibia. Fig. 4, Cro-magnon. Fig. 5, Gibraltar. Fig. 6 is from the tibia of a supposed "mound-builder."

attained by a relative extension of bone in front of or behind the interosseus ridge. If in front, we have the anterior variety, which commonly occurs in this country and in Wales; if behind this lateral, ridge we have the posterior variety; that which characterizes the Gibraltar tibiæ. Fig. 5, from Gibraltar, and Fig. 4 represent this latter type, while Figs. 3 and 6 fairly represent the anterior platycnemism.

It is usual to find associated with platycnemism a strong curvature of the body of the tibia, the convexity directed forwards, giving to the flattened bone what has been appropriately termed the "saber-like curvature." This peculiarity is, to some extent, shown by the Canandaigua tibiæ. When this curvature of the

body of the tibia is absent there may still be found a backward deflection of the head of the bone, so that the axis of this head neither coincides with, nor is parallel to, the axis of the shaft, but makes with it a more or less acute angle. The result of this is that when the articulating surface of the head of the tibia is placed horizontal (its natural position when man is erect), the lower extremity of the bone is deflected backward, out of the vertical line.

c. Femur.—The lateral compression of the femur, first noted by Prof. Busk and described at length by Gillman,* is here observed, although to an extent that would be insignificant if not associated with other characters. This compression occurs just above the knee articulation and from one and one-half to

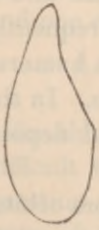

Fig. 4.

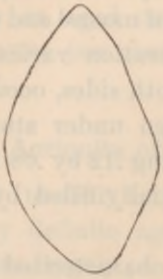

Fig. 5.

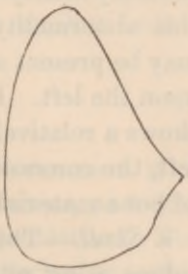

Fig. 6.

two inches below the trochanter minor. Its amount may be expressed in the form of an index, obtained by dividing the antero-posterior diameter by the transverse. In modern femora, at the indicated level below the trochanter, the outline approaches the circumference of a circle, but seems subject to considerable modification. I have found an index of .917 and one as low as .786. Gillman found a mean of .929 in a young white man, while Busk secured as the mean of three measurements an index of .783. The Denbighshire femur gave an index of .621, thus indicating considerable compression. Nineteen specimens from the Great mound upon the Detroit river showed as a maximum compression .592, a minimum of .859 and a mean of .718. Nine specimens from the Circular

*Proc. American Association for the Advancement of Science. Buffalo, 1876, p. 300.

mound gave similarly a maximum of .661, a minimum of .892 and a mean of .766. The indices for the Canandaigua femora are .772 and .764, with an average of .768, bringing them very near the mean from the Circular mound. In addition to the compression noted near each extremity the longitudinal ridge upon the posterior surface frequently becomes sharp and prominent in prehistoric femora.

d. Humerus.—The disappearance of the thin septum of bone, which separates the two fossæ at the elbow, forms the so-called "perforation of the humerus." This character has been stated to be associated commonly with those previously noted, although care must be taken to distinguish the natural from an artificial perforation. The septum, always thin, is especially liable to decay. As many as fifty-four per cent of mound and cave humeri may show this abnormality. The perforation varies much in size and it may be present upon one or both sides, occurring most frequently upon the left. In the specimen under study the right humerus shows a relatively small opening .12 by .08 inches in size. In the left, the coronoid fossa is partially filled by an abnornal deposit of bone material.

e. Skull.— This is especially characterized by heavy supra-orbital ridges, a low retreating forehead, a very prominent occiput and a massive lower jaw with teeth much worn. The length of the skull is 7.64 inches and its parietal breadth 5.43 inches, giving a latitudinal index of .711 and thus bringing it within the dolicocephalic, or long-headed type. The height is 5.98 inches, giving an altitudinal index of .783. The contents of the skull is about 95 cubic inches or 1557 cubic centimeters, a capacity considerably in excess of the means of prehistoric races and modern savages. The coronal suture is very simple and open, the sagittal near it open, but farther back becoming partially or completely obliterated. Two wormian bones occur just posterior to the mastoid processes, the larger upon the left side. The temporal ridges are not heavy but run up well toward the vertex. The entire skull seems to have much in common with the celebrated Engis skull, discovered in a cavern by Dr. Schmerling in 1833. The two have much the same contour, from whichever direction viewed, except that the Canandaigua skull has a decidedly inferior frontal development.

It is also slightly shorter and narrower, but a little higher. The molars are prominent, the extreme breadth of the zygomæ being 5.51 inches. The lower jaw, although massive, is but slightly projecting, giving but little prognathism to the skull. The teeth are heavy and much worn, even the incisors, suggesting considerable grinding activity.

A peculiar supernumerary occurs in the upper jaw, just above the first right incisor, the root projecting forward slightly and the crown passing into the enlarged anterior palatine canal.*

The second skull, found with one of the incomplete skeletons, was restored sufficiently to show that it belongs to this same type. It is rather more delicate, the supra-orbital ridges and lower jaw being less heavy, and is believed to have belonged to a female, presumably an aged one. The sutures are partially obliterated and the lower jaw contains but two shallow incisor and one canine socket.

5. Antiquity of Remains.

In the absence of utensil, implement and ornament it is difficult to assign any definite age to these remains, and this question must remain largely a matter of speculation. The state of preservation of the bones can be no criterion since this is determined by local conditions. A natural or artificial mound, in which the bones are overlaid by hardened clay, is most favorable to their preservation. There is nothing especially characteristic in the manner of burial or in the associated ceremonial fireplace. Burial upon the side was occasionally resorted to by the so-called "mound-builders" and frequently by the prehistoric eastern Indians. From such a limited amount of material no safe conclusions can be drawn from the osteological characters alone. The skulls, however, are not of the Iroquois type, being characteristically broader throughout their length and having a lower and more retreating forehead. According to Prof. Busk the platycnemism "may undoubtedly be considered a character betokening remote antiquity;"† but this is true only when known to occur in a large number of

* Described by Dr. A. L. Benedict, of Buffalo, in the N. Y. Medical Journal, August 26, 1893 p. 228.

† Journal of the Ethnological Society of London. New ser., vol. II, 1870, p. 466.

associated remains. After a hasty examination of the skulls, Prof. F. W. Putnam, of the Peabody Museum, was inclined to refer them to the eastern Indian, with nothing to indicate a burial before or after the contact with the whites.

6. Significance of Characters.

a. Platycnemism.—The flattening of the tibia, the curvature of its shaft and head, the compression of the femur and the perforation of the humerus are "*simian* characters," in the sense that they are departures from the normal human skeleton and are normally present in the apes. A male gorilla in the College of Surgeons, London, gave for the tibiæ an index of .681, a female .650 and a chimpanzee .611. For these same apes Prof. Wyman obtained indices of .670. Hartmann found this character very marked in an adult orang. So far as our present information goes, however, no ape has ever shown any such flattening as that observed by Gillman and Kuhff; man, as remarked by Busk, having far "outsimianized the Simiæ." The theory of direct descent seems unable to explain this peculiarity in prehistoric man unless, as observed by Romanes,* we assume that the particular ancestor had tibiæ much more flattened than any existing species of ape.

M. Pruner-Bey attributed platycnemism to the *rickets*, a disease which may bring about either a fore-and-aft or a transverse flattening, but affecting only the middle and inferior portions of the tibia. The error of this view was shown by Broca, who maintained that it was a *racial character*, due to a feeble development of the calf of the leg. Hovelacque and Hervé followed Broca in assigning its cause to such feeble muscular development, relative to that of the anterior region of the leg. According to this theory the relative flattening is the result simply of a transverse thinning of the posterior portion of the bone. Topinard apparently held the view that platycnemism and the perforation of the humerus were each racial characteristics. The occurrence of these characters amongst widely different peoples at once negatives such an hypothesis.

It has been asserted to be a sex characteristic, but it is now known to occur in both sexes. Busk suggested that it

* Darwin, and after Darwin. p. 96.

might be in some way connected with habits of foot prehension or the free movement of the foot found in savage man. A more recent French writer upon the subject, Manouvrier,* considers the flattening due to the lengthening and straightening of the posterior, external surface of the bone, that portion to which is attached the *tibialis posticus* muscle. This change he regards as brought about by a so-called *inverse* action of this muscle, as when the knee is raised from the foot firmly planted upon the ground. In his recent monograph upon the "Human bones of the Hemenway collection in the United States Army Medical Museum"† Dr. Washington Mathews accepts this explanation by Manouvrier and adds that the strengthening of this posterior tibial muscle and consequent modification of the bone may arise in three ways: First, by increasing the *distance* through which the knee is moved, as would be required in traversing a mountainous country; second, by diminishing the *time* in which the muscle can act, as in running and leaping; third, by increasing the *weight* to be lifted, as in the carrying of heavy burdens. To this latter he ascribes the probable cause of the flattening in the case of the Salado Indians.

If these factors, climbing, running, leaping and burden-carrying, could really bring about this platycnemism we should expect to find it much more commonly present in our modern Indians, but so far as known it is as rare with them as with civilized man. In the case of the kangaroo we find these same factors, *distance*, *time* and *weight* almost ideally represented, and yet, instead of a fore-and-aft flattening, the two tibial diameters are nearly equal, thus giving a relative flattening in the other direction. Another objection to the theory of Manouvrier is that it does not explain the *anterior* variety of flattening, this being the most common in this country and Wales, although not recognized as such by him.

According to this author, "This modification is not only for the purpose of furnishing to the posterior tibial muscle a surface of insertion larger and more favorably arranged. It renders the bone more resistant in the anterior and posterior direction, that is to say, in the direction in which it is not sustained by its

* Bull. de la Soc. d'Anthropologie. Paris, 1887. 3d ser., vol. X, p. 128. Also Revue d'Anthropologie. Paris, 1889. 3d ser., vol. IV. See also Kuhff in 2d ser., vol. IV, p. 225.

† Memoirs of the National Academy of Sciences. Seventh Memoir, Washington, 1893, p. 222.

union with the fibula and in which the weight of the body, increased by the velocity of running, tends to break or bend it." Compared with modern tibia, it is true that the prolongation of bone in front of the interroseus ridge is seldom much in excess, while the backward prolongation is generally present and pronounced; still, when a series of platycnemic tibiæ is compared, one with another, the relative amount of surface, available for the insertion of muscles, in front of and behind this ridge, shows much variation. According to the view of Manouvrier those tibia, in which the character is most pronounced, should show the greatest amount of posterior prolongation, but a comparison of figures 4 and 5 shows that such is not necessarily the case. Finding this platycnemism absent in the bones of infants and children, more frequent and more pronounced in the males, but entirely absent in a large percentage of individuals, he reasoned that it must be necessarily an *acquired character.*

What seems to be a more plausible explanation has been reached by approaching the question from another direction. If found inconsistent with known facts, or those to be discovered, it has the present advantage of most satisfactorily accounting for this and other structures in early man and their later occurrences in prehistoric and modern races. We have in both man and the higher apes a group of associated characters; in addition to those discussed, the relatively greater length of the forearm, the deformation of the pelvis, the posterior position of the foramen magnum, etc. A single character in common might be considered a mere coincidence but an entire *group* of them demands some explanation. That man has descended from the apes, as we now know them, is not tenable, so that the structural peculiarities could not have been directly inherited by man from these apes. Two alternatives remain, either man has descended from an ancient man-like ape or, independently created, he has passed through a stage when he was an ape-like man. For the purposes of this paper it matters but little which the reader is disposed to accept. The similarities in structure are believed to have been brought about by corresponding similarities in life habits, and if the theory of descent (better "ascent") is accepted, these habits are believed to have been continued beyond the time when the ape received the "breath of life" and became *man.* The one common habit, capable of suffi-

ciently reacting upon the skeleton, could have been none other than that of *tree-climbing*, after the fashion of our modern apes, the soles of the feet firmly pressed against the tree and the body held off at arm's length. The flattening of the tibia would be for the purpose of supplying, with the least expenditure of bone, additional surface for the lateral attachment of muscles producing this forcible inversion of the foot.

An inspection of the six figures shows that the surface opposite the interosseous ridge, the internal surface, remains practically unmodified in the various specimens and that the approach to the modern, normal outline is produced by the pushing out of this ridge and the straightening of the posterior surface. This is especially shown in fig. 6, taken from a supposed "Mound-builder" tibia which gives an index of .672. The significance of this is that the muscles, whose attachment we shall endeavor to locate, must have been *external*. Further, the flattening is confined to the upper half of the bone and, consequently, here must have been the main attachments of any muscles which could produce it. Obviously, muscles used in the inversion of the soles of the foot must have their tendons attached to the inner margin of the foot. Finally, in order to account for the anterior and posterior varieties of flattening, we must assume that, at least, two muscles were involved, one upon each side of the ridge, when it would be largely a matter of accident as to which gained the start of its fellow. Extra use would bring additional nutrition and growth and call for corresponding increase in bone surface. Without resorting to any knowledge, whatever, of the arrangement of the muscles of the leg, we have shown that the muscles used in the inversion of the sole and at the same time in modifying the tibia must have been attached (1) laterally; (2) externally; (3) over the upper half; (4) with tendons passing to the inner margin of the foot, and (5) there must have been, at least, two such muscles, one upon each side of the interosseous ridge. Reference to any chart, or work upon anatomy, shows that there are two strong muscles which exactly meet these requirements, namely, the anterior and posterior tibial muscles. The tendon from the former passes downward, in front of the tibia, and is attached to the base of the metatarsal supporting the great toe and to the adjacent surface of the internal cuneiform bone. The tendon of the latter passes

behind the tibia, around the side of the ankle to the scaphoid, lying just behind the internal cuneiform, and giving off branches to the other ankle bones.

Note.—The method of climbing here assumed is somewhat similar to that of the linemen of telegraph and telephone companies, although with the latter the "climbers" relieve much of the muscular strain. Since this paper was read I have had an opportunity of interviewing two Western Union linemen of six to eight years' experience. One of them located the particular "tire" directly across the body of these two tibial muscles; the other across these, and also in the back part of the "calf" of the leg.

b. Perforation of humerus.— This character is of very frequent, although not constant, occurrence in the gorilla, chimpanzee and orang. It is of common occurrence in the old world monkey, but rarer in the new. It is well night constant in dogs, wolves and hyenas, but amongst the ruminants is present only in the prong-horn antelope. It is said to be constant in the wild hog, but only occasionally present in the domesticated animal. It occurs uniformly in hares and hedge-hogs, but is rare in rats and squirrels.* The perforation has not been observed outside of the mammalia. By those who have given the subject most attention it is supposed to be caused by the direct impact of the olecranon process of the ulna, in the forcible straightening of the limb. This seems especially true in the dog, in which the process extends into the opening when the limb is extended. Habits, which more or less satisfactorily explain its presence, are known in the case of most animals, in which it occurs. The arboreal habit of apes and monkeys would seemingly lead to a sufficiently forcible arm extension, except in the case of the new world monkeys, with their prehensile tails, in which forms we may suppose that the strain is less continuous and severe. An arboreal habit in primitive man would, without doubt, lead to a similiar modification of the humerus, and its absence would be much more difficult to explain than its presence. The fact that it occurs rarely in the young is not proof that it is acquired separately by each individual. The more frequent occurrence of the perforation upon the *left* side seems scarcely to admit of explanation upon any hypothesis. It occurs to me, however, that if man, as he is at present constituted, were compelled to acquire this arboreal habit, the right hand would be frequently

* Dr. D. S. Lamb in The American Anthropologist. Vol. III, 1890, p. 159.

used for carrying and holding objects, and the strain of the bodily support would be thrown more frequently upon the left.

c. Compression of femur, etc. This character, together with the curvatures of the tibia, the deformation of the pelvis, the greater relative length of the forearms, the posterior position of the foramen magnum, and many (not *all*) of the other so-called "simian characters," frequently occurring in man, are to be explained upon the principle of "analogous variation." If we subject man to practically the same habits as the ape, we must expect his body to be similarly modified although, through our ignorance of environmental influences, we may be able to give no satisfactory explanation of all of these modifications.

7. Evidence of an Arboreal Habit.

a. Comparative anatomy.— The main evidence under this head has been presented, but it remains to explain the occurrences of these peculiar characters in ancient and modern peoples. If all races have descended from this arboreal stock these characters would be directly inherited for many generations and would abundantly appear in the ancestral stock of each branch. Changed habits, however, would slowly lead to corresponding changes in the skeleton, gradually effacing the primitive structures and leading up to what is now considered the normal type. In the case of those peoples, whose departure from the primitive type has been greatest, we should expect comparatively few "reversions." In those races which have made the least physical progress we might reasonably expect to find these ancestral characters frequently outcropping. Now, in general, it has been found that the percentage of platycnemism, of the backward deflection of the head of the tibia, and the perforation of the humerus is highest in the most ancient remains found and that it *gradually diminishes toward modern times.* In the case of the Detroit river mounds Gillman states that it was an exception to find a tibia not flattened, and whenever this occurred there was evidence of its having been of later burial.* All the tibiæ from the Gibraltar caves were stated to show this character. Mme. Cl. Royer relates once visiting M. Hamy in his laboratory

* The American Naturalist. Vol. V, 1871, p. 663.

of the *Jardin des Plantes* and finding him surrounded by an enormous mass of American bones. He remarked that platycnemism was not the *exception*, but the *rule.** Out of 100 tibiæ from Ohio, Dr. Cresson found eighteen flattened. Statistics are wanting in regard to its occurrence amongst modern peoples, but in civilized man and the American Indians it probably occurs in less than five per cent. Among the negroes it is much more common. I have examined the bones of a young negro girl which gave a mean tibial latitudinal index of .696, a femoral index of 645 and had the right humerus perforate.

In the case of the prehistoric Arizona Indians Dr. Lamb found fifty-four per cent of the humeri perforate; in the Michigan mounds they were about fifty per cent, and the Guanches from the Canary Islands gave forty-six per cent. Collections of humeri from various mounds of the United States show the perforation in from twenty to thirty-five per cent. In 156 neolithic humeri from the dolmens and grottoes about Paris it was found in twenty-one and eight-tenths per cent, while 200 Parisians from the fourth to the twelfth centuries showed the character in five and five-tenths per cent, and 218 humeri from a Parisian cemetery of the seventeenth century gave but three and two-tenths per cent. From available statistics it is believed to occur in from three to four per cent of modern civilized man and in about five per cent of our modern American Indians. In the American and African negroes the percentage may run to twenty or even thirty, being apparently quite variable. †

From the study of a limited amount of material, Fraipont found that the angle included between the axis of the head of the tibia and the axis of the shaft, had gradually diminished from 18° in the Neanderthal tibia to an average of 6.6° at the present time. In the anthropoid apes this angle averages about 25°. This backward deflection of the head of the tibia, corellated with certain characters of the femur (shape and limits of the articulating surface at the knee), proves that primitive man had habitually a, more or less, crouching posture.‡ The perfectly erect position has been slowly and gradually acquired. The same con-

* Bull. de la Soc. d'Anthropologie de Paris, 3d ser., vol. X, 1887, p. 138.

† The American Anthropologist, Lamb. Vol. III, No. 2, p. 166; also Anthropology, Topinard. Translated by Bartley, p. 298.

‡ Revue d'Anthropologie, Paris, 3d ser., vol. iii, 1888. pp. 145–158.

clusion has been reached by Collignon who says: — "We remark, indeed, that there may be deduced from the conformationof the bone of the leg an habitual state of flexion of this member and, consequently, a gait less erect and easy than that of present man and which added to the development of the biceps and the deltoid, proven by the strong projections of their insertions, would indicate a certain aptitude for *climbing*." *

We may reasonably predict that, in future discoveries, the more ancient remains will, in general, show the greater number of cases of platycnemism and of associated characters, while these will slowly but gradually disappear from the more progressive peoples. Their persistence in the lower races seems to be due, not so much to the longer continuance of the habit, which originally induced them, but to the failure upon the part of these people to acquire other habits, which would lead to the obliteration of these characters. These occurrences above noted seem to me inexplicable upon any theory of individual acquisition, but to be exactly what is demanded by the theory of inheritance and reversion.

b. Development.— Striking corroborative evidence of man's having passed through such an arboreal stage is given by a study of fœtal and infant life. The children of such people would undoubtedly have to be assisted from the ground to the branches until they had obtained a considerable size. They could not be carried in the usual way, but would be forced to cling to the body of the parent, most naturally about the neck of the mother. The young would become adapted to such a habit, as well as to clinging to the boughs after they had been transported to the trees. This would call for special modification of the arms, hands and feet.

In a fœtus eight and one-half inches high the arms are longer than the legs, and when the body is erect the tips of the fingers reach to the knee.† At birth the arms are shorter than the legs, but still relatively longer than in the adult, and over them the infant is seen to exercise a control which it acquires over the legs only much later. The grip of a young infant is surprising and enables it, almost from the moment of birth, to support its

* Revue d'Anthropologie, Paris, 2nd ser., vol. iii, 1880, p 146.
† Huxley in "Vertebrates," pp. 417-18.

own weight. Romanes reproduces an instantaneous photograph, taken by Dr. Louis Robinson, of an infant three weeks old supporting its weight from a bough for two minutes.* Such an infant can voluntarily place the upper surface of its foot back against the leg and can readily appose the soles of the feet. It may occasionally be seen to grasp objects between the feet, strongly flexing the toes, and at times separating the great toe in a very suggestive manner. One of the strange things is that structures or characters, long since rendered nearly or quite useless, should persist almost indefinitely in the young, but this is one of the most common occurrences in the animal kingdom. It is these which the infant of to-day would naturally be expected to show rather than those characters, as platycnemism, etc., which were directly developed from climbing. These will appear, according to a recognized principle, at about the same time that they appeared in the parent.

Another evidence, which I have never seen adduced as such, is highly corroborative. The most restful and, consequently, the natural color for the eyes is *chlorophyl green*. The conclusion to be reached is the same whether we assume that the eye of man was originally created and adapted to this color or that this adaptation was slowly developed by centuries of residence in and about foliage. I can conceive of no other explanations. Such an eye is certainly not best adapted to the wants of modern civilization.

c. Necessity of such habit.—It may be well, before closing this paper, to inquire whether an arboreal habit would be natural or advantageous to primitive man. If we admit that there was a savage condition, before he had acquired the habit of constructing shelters strong enough to exclude the hordes of fierce and monstrous beasts, it would seem that his very existence would depend upon the acquisition of this habit. Its advantage to him in securing certain game, fruits and nuts is at once recognized. It would, undoubtedly, be systematically practiced in youth until sufficient skill was acquired. It would be partly given up as soon as man became able to cope successfully with the beasts about him, and perhaps entirely when he learned to cultivate the soil.

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* Darwin, and after Darwin, fig. 14, p. 81.

8. Summary.

It may be well to sum up in few words the views advanced in this paper:

An early savage condition of mankind when escape from terrestrial beasts and the procuring of food forced upon him an arboreal habit. Compared with our modern apes a case of analogous variation.

The abandonment of this habit and modification of the skeleton into what is now regarded as the normal type.

Direct inheritance of, or reversion to, the primitive structures.

In this way we account for the peculiarities shown in the skeleton of our Canandaigua warrior.

Note.— Through the courtesy of the librarian of the Surgeon-General's office, Washington, D. C., I have just been enabled to read the discussion which followed the presentation of Manouvrier's paper, above referred to, January 6, 1887. In this discussion I find the subject of tree-climbing came up, but was not believed by him to have been sufficiently frequent amongst Neolithic men to bring about the observed modification of the tibia. In meeting the suggestion that it might be an hereditary character, he remarked that in so attempting to explain it, the difficulty is simply pushed backward, that there still remains the explanation of how it was produced in the ancestors and that we must eventually arrive at an anatomical-physiological analysis. Such an explanation would be required only amongst those peoples in which these agencies which he considered responsible for the character had been inoperative.