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An Account of the Discovery and Characters of a Human Skeleton found beneath a Stratum of Chalky Boulder Clay near Ipswich.

BY

J. REID MOIR AND ARTHUR KEITH.

[WITH PLATE XXX.]

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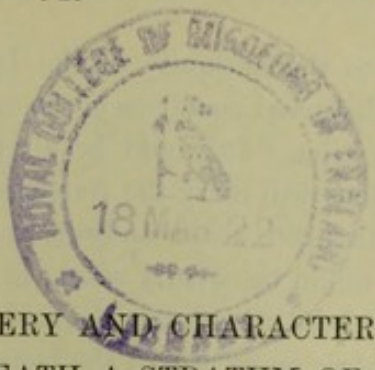


AN ACCOUNT OF THE DISCOVERY AND CHARACTERS OF A HUMAN SKELETON FOUND BENEATH A STRATUM OF CHALKY BOULDER CLAY NEAR IPSWICH.

By J. Reid Moir and Arthur Keith.

[With Plate XXX.]

Preliminary.

In this paper the authors propose to give an account of the discovery and characters of a human skeleton found beneath a stratum of chalky boulder clay. In their opinion this skeleton must be assigned to an earlier stage of the Pleistocene epoch than any human remains which have so far been discovered in England. When it is mentioned that these remains of man were found embedded beneath a superficial layer of weathered chalky boulder clay only 4 feet 6 inches (1·38 metres) in thickness and that no fossil mammalian remains have been found at exactly the same level, it may be thought that the authors are somewhat rash in supposing that the human remains were *in situ* before the deposition of the stratum of chalky boulder clay. The natural supposition is to regard every human skeleton found at a depth of four or five feet from the surface as necessarily an intrusive burial made in comparatively recent times. Our reasons for regarding the Ipswich skeleton as a representative of pre-boulder-clay man are given in detail later in this paper, but here we may summarize our evidence by saying that a burial was impossible, because the line which separates the overlying deposit of boulder clay from the underlying stratum of glacial sands was unbroken. A burial, however skilfully made, if subsequent to the deposition of the chalky boulder clay, would certainly have destroyed this line. Worked flints have been found in the stratum of boulder clay which overlies the skeleton, and in the strata of mid-glacial sands which underlie it. In their opinion the condition of the bones is in keeping with the great age assigned to them. The tibia or leg bone shows characters which have not yet been observed in man—ancient or modern. Nothing was found with the skeleton: neither metal, pottery or worked flint, nor trace of burial. The skeleton lay on its right side, in an ultra flexed posture; all its parts were represented. It was, therefore, never exposed at death, or subsequently, to any disturbing force, such as flowing water or moving ice or wild beast. It will be thus apparent that the

evidence relating to the antiquity of the Ipswich skeleton rests mainly on two points: (1) the undisturbed condition of the overlying strata; and (2) the anatomical peculiarity of the tibia. It would be absurd to expect that a specimen found under such conditions will carry the conviction which is attached to one found at a great depth of undisturbed strata and side by side with abundant remnants of a past fauna, and yet it would be equally wrong to reject the discovery as untrustworthy, because it does not fulfil the canons demanded by palæontological purists. It is at least our duty to place on record all the facts connected with the Ipswich remains so that others may weigh the evidence on which we rely. Human remains which have a claim to be regarded as Pleistocene in origin must, from the nature of the case, be of rare occurrence, and it is, therefore, all the more urgent that all details connected with such finds should be placed fully on record. For the part of this paper in which the discovery of the skeleton is related and the disposition of the strata described, Mr. Moir is responsible, and for that part in which the anatomy of the remains is given, Professor Keith is responsible. In the course of their investigation the authors have become indebted to many of their friends for advice and assistance—especially to the following:—Mr. W. Whitaker, Professor John Marr, Mr. George Slater, Dr. Smith Woodward, Mr. Charles Andrews, Professor Harvey Littlejohn, Dr. Allen Sturge, Mr. Henry Miller, Mr. Hugh Candy, and Mr. Frank Woolnough.

The Discovery of the Skeleton. Mr. Moir.

About a mile to the north of Ipswich, on the estate of Mrs. W. N. Fonnereau, is situated the brickfield of Messrs. Bolton and Laughlin, which is famous to geologists for the various deposits which have been exposed by the excavation of the London clay for brickmaking. These deposits, which are given in descending order, are:—

Chalky boulder clay.
Middle glacial sand and gravel.
Decalcified red crag.
London clay.
The Woolwich and Reading beds.

This brickfield is about ten minutes' walk from my house, and for the past six years I have been in the habit of visiting it on an average three times a week, and searching for flint implements in the beds above the London clay.[1]

It will thus be seen that I have had every opportunity of making myself fully acquainted with this particular district.

Realizing the importance of finding human bones in any of the deposits from

[1] For surface view and section of the country in the vicinity of Messrs. Bolton and Laughlin's sand pit see Fig. 1; for a section across the Gipping Valley and the arrangement of the stratum of chalky boulder clay see Fig. 2.

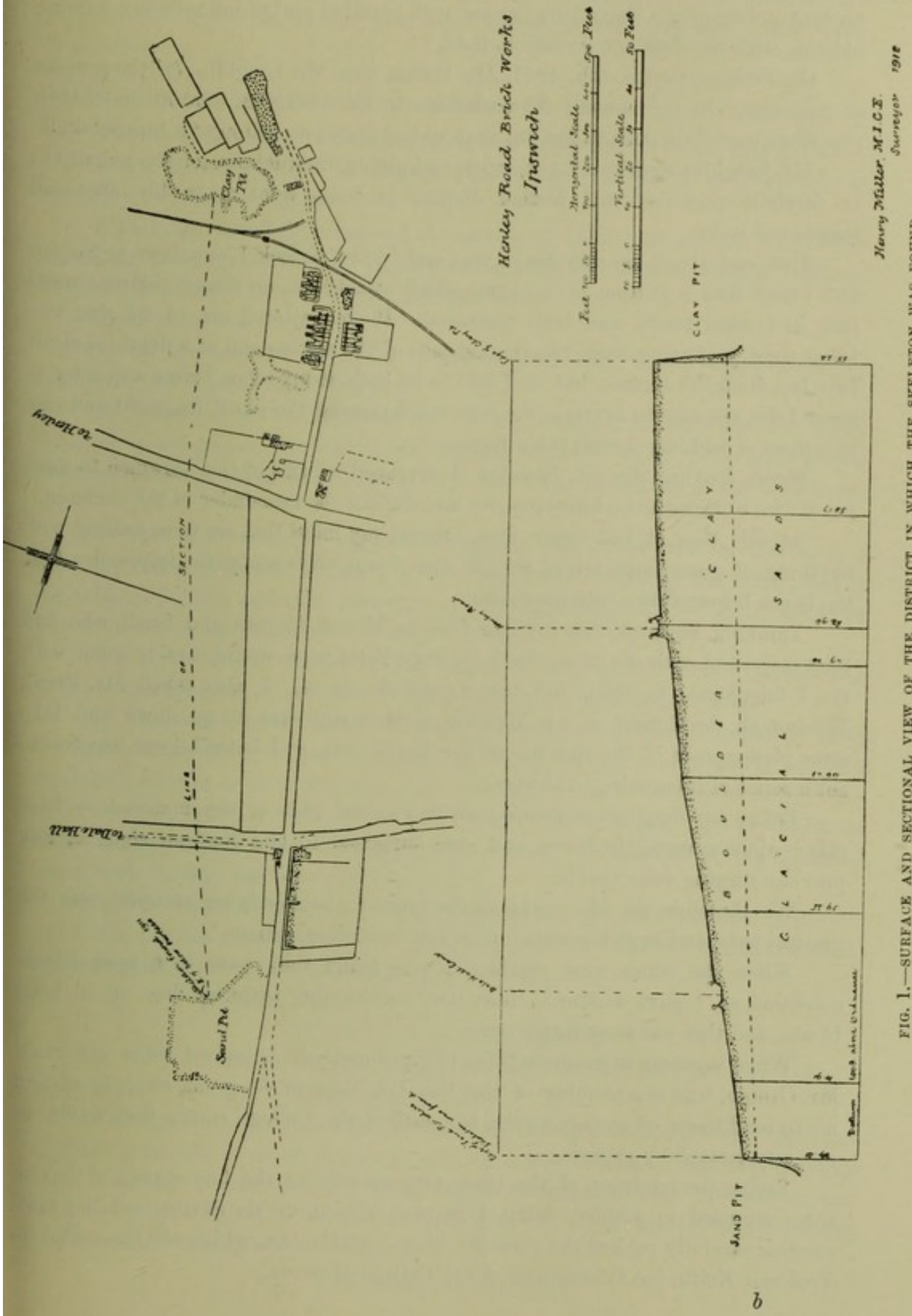


FIG. 1.—SURFACE AND SECTIONAL VIEW OF THE DISTRICT IN WHICH THE SKELETON WAS FOUND.
(Prepared for this paper by Mr. Henry Miller, M.I.C.E.)

which I have obtained implements, I have always impressed upon the workmen the necessity of keeping a sharp look-out for such remains, and of immediately communicating with me should any come to light.

On Friday, October 6th, 1911, Mr. Bolton and Mr. Laughlin, for the purpose of measuring up the amount of work done by the workmen, were in one of their pits when one of the men called out that he had found a portion of a human skull.

Mr. Laughlin went over to the spot, and giving instructions for the remains to be carefully preserved and further digging to cease, went up to his office and telephoned to me.

This was about ten minutes to two, and by two o'clock I was down at the pit, and found that a portion of a human skull, attached to an almost perfect cranial cast, and some teeth, had been recovered. It was pointed out to me that two bones were projecting from the vertical face of the section and at a depth of about four feet from the surface, but as I had to be back at my office before a quarter to three I did not stop to examine the site, but wrapping the skull fragment and cast in a piece of sacking, carried them home.

Before leaving the pit, however, I arranged for two of the workmen to meet me at two o'clock on the following day and dig out the remainder of the skeleton.

At this time it had never even crossed my mind that we were dealing with anything of great importance, and, in fact, I was quite under the impression that the bones belonged to a late interment.

Thinking, however, that my two friends Messrs. Canton and Snell, who had been associated with me in my work for some little time, would care to come with me, I telephoned to them, and they agreed to do so. I also asked Mr. Frank Woolnough, the Curator of our Museum, if he would care to go down and take some photographs of the spot where the bones were, as I knew he was anxious to get a series of interesting local views.

Before any digging commenced we had a good look at the material—a hard clay—which covered the bones, and were surprised to find that no signs of any previous digging were visible.

We therefore got the workmen to remove the overlying material with the greatest care, and kept the work under continual observation.

When the bones were reached it was found they were in a most friable condition, so I gave orders to have the surrounding material dug up in large blocks, and this was accordingly done.

When we came to examine these blocks and their contained relics my friend Mr. Canton, who is a member of the Royal College of Surgeons, strongly advised me to send them off at once to the Museum of the College, where they would be properly treated by experts.

Seeing the condition of the bones and recognizing the importance of having them attended to without delay, I at once agreed to his advice, and the same evening carefully packed the remains in a suitable box, which was forwarded to Professor Keith, the Conservator of the College Museum.

Mr. Canton, Mr. Snell, Mr. Woolnough, and myself afterwards drew up and signed a report of what we had seen when the bones were dug out. This report is as follows:—

REPORT OF MESSRS. MOIR, WOOLNOUGH, CANTON, AND SNELL.

We, the undersigned, were present at, and superintended, the digging out of the human remains found at Messrs. Bolton and Laughlin's pit, Ipswich, on Saturday, October 7th, 1911.

We all most carefully examined the section of decalcified boulder clay, under which the bones lay, before any digging commenced, and were absolutely convinced that no grave had ever been dug on the spot before.

The opinion was confirmed:

(1) By the extreme hardness of the boulder clay, which necessitated the continued use of picks in getting it up.

(2) There was not the slightest sign of any mixing of the soils (such as would occur in an old grave), the boulder clay resting normally on the underlying glacial sand, as it does in all sections known to us where the succession of the beds is the same.

(3) That in the event of a grave having been dug in the past on this spot, it is hardly conceivable that we should have dug down in exactly the same place as the original diggers, and that, therefore, one side at least of their digging would be visible in the remaining section of boulder clay.

(We invite anyone interested to visit and examine this section, when they will, we think, be convinced that no early digging has ever taken place.)

(4) The extraordinary cast of decalcified boulder clay, which completely filled the inside of the skull, we consider points to the conclusion that the clay was in a semi-fluid state at or since the time when the remains were embedded in it.[1] We think it most unlikely that the clay in its present hard condition (a condition which has apparently been present since the last great extension of the glaciers) could work its way into any skull buried in it.

(5) The bones were lying partly embedded in glacial sand and partly in decalcified boulder clay—this sand showed most plainly the lines of stratification, and was quite conformable with that underlying it.

(Signed) REID MOIR, F.G.S.
FRANK WOOLNOUGH, F.R.Met.S.
FREDERICK CANTON, M.R.C.S., L.R.C.P., L.S.A., L.D.S.
NORRIS SNELL, L.D.S.

As the question of a grave having been dug through the boulder clay had been carefully gone into by those of us who saw the bones dug out, I felt that the only thing necessary to do was to get some expert geologists to visit the section, and say exactly what the material was on each side of where the bones were found and whether it was *in situ* or redeposited.

[1] See subsequent note, p. 377.

I accordingly wired to Mr. Whitaker, F.R.S., and Dr. John E. Marr, F.R.S., and sent a note to Mr. George Slater, F.G.S., who lives in Ipswich, asking them to visit the pit with me. This they all very kindly did, and after a careful examination of the section handed in their reports, which are as follows :—

Mr. W. Whitaker's Report.

The occurrence of the human skeleton at the sand-pit, near Prospect Cottages (southward of Dale Hall), Ipswich, is difficult to explain.

The pit is worked for sand and gravel, belonging to the glacial drift, and is just where boulder clay is marked on the Geological Survey Map (48, N.W.) as coming on above the sand, etc.

Along the top of the pit, indeed the sand is in a great part capped by a brown loam or clayey sand (sometimes practically a clay) which is clearly the result of the weathering and decalcification of the boulder clay.

At the northern part of the pit there are also thin masses of boulder clay which have not been altered by weathering, and often in the loam there are lumps of boulder clay left, surrounded by the loam.

The pit reaches up to the top of the hill and is not dominated by higher ground, from which slips can have come. *There is no doubt in my mind that the pit gives a junction-section of the boulder clay with the underlying sand and gravel.*

The skeleton was found at the eastern side of the pit at this junction. The top earth was only some three feet thick, and the process of weathering has gone to such an extent, that perhaps no one seeing merely that one particular spot would say that boulder clay occurred, but there is unweathered boulder clay close by in the same sandy or loamy earth, and I can see no reason to differentiate one particular yard or so of the section from its immediate surroundings.

I could see no signs of artificial disturbance of the soil, and was told that none had been seen during the excavation. Slipping seems out of the question.

There is a remarkable thing as to the condition of the skull, which I saw at the College of Surgeons. The bony cavity is filled with earth of the same kind as that beneath which the skeleton was found, a brown loam ; and the filling is so thorough (as far as can be seen) that a cast of the cavity has been made. Now this could hardly have been done by the introduction of dry earth, the infilling material must have got into the skull in a somewhat liquid state.

I fail, however, to understand how man could have lived at the time of the commencement of the boulder clay, and I am in hopes that further excavation may throw more light on this strange occurrence. As yet we have the skeleton and nothing else.

In conclusion, I wish to say that it is well that this find fell to the hands of a man like Mr. Moir, who at once took measures to secure the remains in such a way as to leave them as much undisturbed as possible and ready for examination by skilled observers.

November 2nd, 1911. (Signed) W. Whitaker.

Professor Marr's Report.

I visited the site of the discovery of the skeleton below clay at Ipswich after the skeleton was removed, and I leave to others the proof of there having been no interment there.

My object was to discover the origin of the clay. It resembles decalcified boulder clay, and had patches of unaltered clay here and there.

It was very thin, and I should be sorry to pronounce any definite opinion about it, as my knowledge of the glacial deposits of the south-east of England is not so extensive as that which I possess of those of northern England.

I do not know how one would distinguish between boulder clay *in situ* and clay which had been derived from boulder clay at a somewhat higher level which had "flowed" as the result of being waterlogged. Such flows are often seen on beaches below boulder clay cliffs, and they strongly resemble true boulder clay.

I do not wish to suggest the clay above the skeleton had this origin, but merely that I personally am unable to distinguish a thin mass of such a clay from true boulder clay.

November 15*th*, 1911. (Signed) John E. Marr.

In another letter to me Dr. Marr says: "The material above the sand in the pit is lithologically boulder clay, which has been decalcified. All I can say is that I see no difference between the decalcified boulder clay in the higher pit, above the normal undecalcified boulder clay, and the decalcified clay above the skeleton." Also, "The slopes in the vicinity are very slight, but they may have been diminished by erosion, and I think it possible that the clay may have moved from another place. The fact that a cast of the cavity of the skull was made by clay, which seems to have been introduced in a liquid state, is, I think, in favour of this."

Mr. Slater's Report.

The pit from which the "bones" were obtained is situated a quarter of a mile west of the Henley Road, and a little to the east of the large brickyard of Messrs. Bolton and Laughlin, both pits being situated about a mile north-west of Christchurch Mansion, and bounded by the railway line on the north and the Henley and Norwich Roads on the east and west.

The sand pit is marked as such on the one-inch geological map, which also shows the junction of the middle glacial sands and the boulder clay, as occurring north of the sand pit at the time when the district was originally surveyed and the map published in 1882.

During recent years the sand pit has been worked considerably, chiefly towards the north, and is now cut back from the roadway in the form of a wide semicircle.

The floor of the pit consists of fine cross-bedded middle glacial sands upwards

of ten feet in thickness, containing intercalations of lenticular bands of clay above which, and forming the greater portion of the section, is an irregular mass of sand and gravel containing derived fossils occasionally, especially those of a durable character such as gryphoea. The gravel varies very much, both in arrangement and thickness, and maximum depth being about twenty feet.

Resting upon this sand and gravel is a band of boulder clay not more than three feet in thickness, for the most part weathered brown, but showing unmistakable patches of unweathered boulder clay, the whole thinning off on the western side of the pit.

In places infiltration has caused the junction between the boulder clay and underlying sand to be irregular, but, generally speaking, the sand immediately below the boulder clay has been protected and is highly calcareous, a small well-marked "pan" of calcareous material being well marked in places, a short distance below the junction between the boulder clay and sand.

Recently the workmen have commenced to extend the pit eastwards, in the direction of the adjoining cottages, and it was whilst so engaged that the bones were discovered.

The site where the bones were found was shown to me, October 15th, and was situated at the extreme east of the pit, about three feet below the surface, *i.e.*, from the top of the pit, immediately below the boulder clay and embedded in highly calcareous sands, a small band of the calcareous material being well marked and continuous.

As the bones had been removed and a "notch" cut down from the top of the pit to a depth of about four feet, a clear section was shown, but, of course, there was no means of ascertaining the exact condition of the material removed.

Judging from the section now exposed, this portion of the pit varies in no way from other parts of the section, and shows a clear and undisturbed section of weathered boulder clay over the calcareous sands in which the remains were found.

There is no reason to doubt that the sands and gravels are derived from glacial material, containing as they do derived jurassic material, and the boulder clay is part of the large sheet exposed so well in the neighbouring pit further to the east of Henley Road.

(Signed) George Slater.

4, *Ruskin Road,*
Ipswich.
October 21*st*, 1911.

It will, I think, be seen from these carefully compiled reports that in all its aspects this matter has been investigated in as thorough and scientific a manner as possible.

Now it appears that the main points of this discovery for consideration are :—

1. Was a grave ever dug through the boulder clay ?
2. Is the boulder clay *in situ* or redeposited ?

Regarding the first the following facts have been accumulated:—

A most careful examination of the section before the disinterment took place showed clearly that no signs of any previous digging were visible, the material in which the skeleton lay appearing *to be in every way the same* in its stratification as that which extended for some distance on each side of it (see Figs. 11, 12, 13). There was not the slightest mixing of the soils apparent such as is now to be seen where the hole dug has been filled in. I am fully alive to the fact that by the action of roots and by the percolation of rainwater all traces of disturbance or digging in a surface stratum are soon removed, but when such traces are removed the old lines of stratification cannot be reformed. No grave furniture was found with the body such as usually occurs in burials of many subsequent periods. Immediately underneath the bones a pronounced calcareous band was present, this deposit, which is often found in sand underlying boulder clay and which gives a marked effervescence with HCl is much in evidence in this pit and extends more or less continuously on either side of the spot where the remains were found. If a grave had been dug through the boulder clay the rainwater, percolating through the loose material filling the grave, would have dissolved away this calcareous deposit.

The skeleton was lying partly embedded in glacial sand and partly in boulder clay. This sand showed clearly lines of stratification and was conformable with that underlying it. This could not be the case if a grave had been dug down through the clay and into the sand.

The cranial cavity was completely filled with a red sandy loam exactly the same in composition as the stratum in which the skull lay. The cranial cast contained neither more nor less chalk than the surrounding stratum. At first it was supposed that, in order to obtain so complete a filling of the skull, the material must have been at one time in a semi-fluid condition. We have since discovered that skulls do become completely filled when buried in a dry soil. The manner in which the solid material works within the skull is obscure; all we are certain of is that the solid cranial cast may have been formed without the surrounding matrix having been in a semi-fluid condition.

On Wednesday, February 7th, 1912, being anxious to get a good photograph of the hole we had filled in after removing the skeleton, I went down to the pit and cleared away the material under and on each side of our digging.

When this was done the striking difference between the material filling the hole and that surrounding it was very manifest, as the former was an indiscriminate mixture of surface humus, boulder clay, and glacial sand, while the other showed first hard undisturbed boulder clay underlain by clean, stratified glacial sand.

Now I have no hesitation in saying that if ever a grave had been dug on this spot before, the inevitable mixing of the soils would have remained visible, and no period of time would ever convert the material which now fills the hole we dug into first hard clay and then fine chalky sand, as was present before the bones were dug up. Also, apart from this evidence, it is as well to mention that, about 100 yards to

the west of where the remains were found, the middle glacial sands come up to the surface, and that, as this is so, it is difficult to imagine that any Neolithic or other people would take the trouble to dig a grave through hard clay when soft, easily dug sand occurred close at hand. Therefore, I think, we can quite put aside any idea of a late interment.

The occurrence of such easily destroyed things as human bones under a stratum, which was deposited by an ice sheet, is at first sight rather remarkable, but my opinion is that the body of this man was covered by some depth of sand before the boulder clay was deposited. Even if the sand were only a few feet in thickness it would be sufficient to protect completely the bones from any pressure which might be brought to bear upon them. It must be remembered, too, that the erosive power of ice is very variable, as sometimes it passes over a surface of incoherent sand without disturbing it at all.

Our contention is that there was in inter-glacial times a sandy land surface to the north of Ipswich where these remains were found, and that this man died on that land surface and was covered up by the sand. This surface was afterwards buried by the chalky boulder clay. If our contention is correct then the material composing the cranial cast should be the same as that found beneath boulder clay elsewhere.

Realizing this, Professor Keith has made an analysis of some of the material of the cast, and some which I sent him from below fifteen feet of chalky boulder clay at a pit about half-a-mile distant from where the bones were found.

This analysis shows that the cranial cast is composed of 70 per cent. of very fine sand, blackish, a few fine grains of chalk, and some black specks and 30 per cent. fine chalky grey sediment. The sand from beneath the boulder clay showed 45 per cent. fine grains of sand, many small black specks, a few fine grains of chalk, 55 per cent. fine chalky grey sediment. It will be noticed that the difference is one of degree only, and there appears no doubt that both are one and the same formation.

These black specks in the sand under the boulder clay are peculiar and may have been formed by the roots of plants when the top of the sand was a land surface.

Mr. Hugh Candy has examined this black material and finds that it is composed of 37 per cent. of organic material and moisture with 63 per cent. of ferruginous sand. The black substance is evidently a vegetable derivative.

There also seems no doubt that when the boulder clay was first deposited there was a very much greater thickness of it at this spot than is seen now. The melting of the ice-sheet which laid it down would cause a lot of denudation, and during the ages which have passed since the ice finally disappeared the same process has been continually going on.

It may be asked whether we have found other bones on the same horizon as the skeleton, and we must confess that up to the present we have not done so. But at Leiston—in a deposit which underlies chalky boulder clay, and which I look

upon as middle glacial—a large tusk of an elephant and other bones have been discovered. A metatarsal bone of a deer from this deposit shows the same condition of preservation as the bones of the human skeleton. I think also that a proper search of these deposits will result in more bones being found, and other evidence to prove that the top of the middle glacial sands and gravels was a land surface in pre-chalky boulder clay times.

Now if this man was lying on this glacial sand, and was covered by the boulder clay, we can be sure that as the clay became decalcified the human bones would also disappear by the same process. This is exactly what has happened. The skeleton was found lying partly embedded in glacial sand and partly in boulder clay. The portions in the sand have been fairly well preserved while those in the clay have almost entirely disappeared. The grains of chalk in the mid-glacial sands are stained to exactly the same depth as the human bones, and it is quite evident that both have been subjected to the same conditions. This seems to me to be conclusive evidence that this man was lying in the sand before the clay was deposited, and that the processes which since then have affected the clay have also in exactly the same way affected the bones.

There is no doubt that as the overlying clay got removed by denudation, roots from the surface would find their way down to the bones and help in their destruction. This is no doubt what happened, as we have found that some roots have passed right down through the skeleton into the underlying glacial sand and into the cranial cast. The calcareous band which has been mentioned as occurring

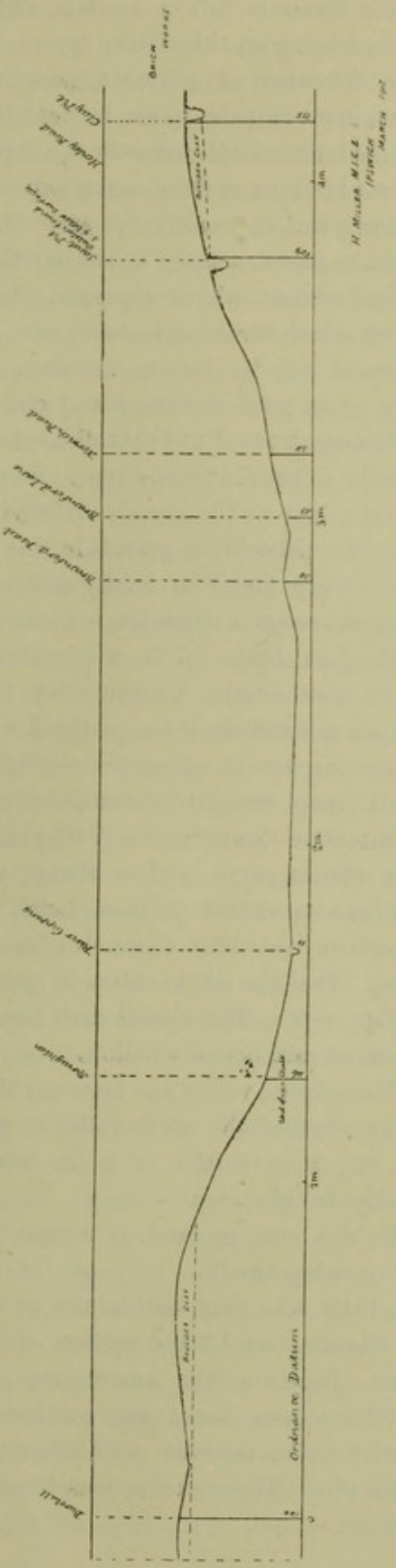


FIG. 2.—SECTION ACROSS THE VALLEY OF THE GIPPING, SHOWING THE POSITION OF THE CHALKY BOULDER CLAY AND THE POINT AT WHICH THE SKELETON WAS FOUND.

under the bones is full of rootlets, and as these do not go deeper it appears that they were feeding on this chalky layer.

The discovery of a human skeleton below the chalky boulder clay did not come as a great surprise to me, because for some long time past I have been finding well-worked flint implements in the clay and at the junction of the clay with the glacial sand; I have found some implements within ten yards of where the bones were found and at exactly the same horizon. These implements are unpatinated and in many cases as sharp as the day they were made. This fact shows, I think, that the ice-sheet which deposited the boulder clay was moving over a land surface on which these implements were lying, and some of them consequently got incorporated into its bottom moraine. Thus, having found the implements, we have by great good fortune found one of the men who made them. The worked flints discovered are of pre-palæolithic forms, and have been identified by Dr. Rutot of Brussels, as his pre-Strépy type. As no true palæoliths have ever been found in the boulder clay or the gravels underlying it, we may conclude that these deposits pre-date the palæolithic gravels in this part of the country. The true palæolithic implements are found in totally different deposits, which, as usual, occur as river terraces, and are of a much less ancient date than the glacial deposits.

This fact leads up to a consideration whether the Gipping Valley was eroded in post chalky boulder clay times (section of valley, see Fig. 2), and while I am not sufficiently acquainted with the geological facts to speak definitely on this point, yet it seems to me highly probable that such was the case. The geological map certainly shows boulder clay on each side of the valley at a high level, but none down in the Valley itself. Also Mr. Whitaker, writing to me on this matter, says: "I've always looked at the Gipping Valley in common with others, as eroded in post-glacial times. In it, as in others, there may be places where an older channel (glacial or pre-glacial) may be cut across, or followed. That the whole valley is pre-glacial is another matter, and I don't agree with that view. The glacial drift has certainly gone across from side to side, but for the most part not in a hollow.

"The present valley has been cut through this drift."

But whether the whole valley is post-glacial or not, it is nevertheless certain that a very large portion of it has been completely eroded since the deposition of the chalky boulder clay.

We can now proceed to discuss the second question: "Is the boulder clay *in situ* or redeposited."

A little less than half-a-mile to the east of where the skeleton was found is a pit showing an 18-foot section of chalky boulder clay which is undeniably *in situ*. Realizing the importance of ascertaining whether the boulder clay above the human bones was continuous with that in the other pit mentioned, I asked for and received permission to dig small pits in the fields separating the two pits. These excavations resulted in establishing the fact that the clay *is* continuous.

The northern face of the pit under discussion shows for some little distance totally undecalcified boulder clay underlain by the same stratified calcareous glacial sand in which the human skeleton occurred. But on the east side, where the bones were found, the clay is mostly decalcified, though unchanged patches occur here and there. These patches, which sometimes contain the usual derived fossils found in chalky boulder clay, merge imperceptibly into the surrounding decalcified portions, and they are without any doubt the same formation. The decalcification proceeds by means of pipes as in the chalk, but why exactly this should be so is rather mysterious. There is no doubt, however, that the cause of the decalcification is the proximity of the clay to the surface, where it is exposed to all the decalcifying agents, and in the deeper section mentioned the same condition is apparent, that is, the uppermost portion of the clay is partly decalcified. The lower portions, which are further away from surface conditions, have remained unchanged. We have been able to make decalcified boulder clay artificially, by subjecting some of the unchanged clay to the action of dilute HCl and water. This dissolved out the chalk, and we afterwards stained the remaining material with water impregnated with iron. When this is compared with samples from the two pits it is at once seen they are all exactly the same and therefore there can be no doubt that the skeleton was lying under decalcified boulder clay. The evidence against the boulder clay being *in situ* takes the form of the opinion expressed by Dr. Marr that at some period it may have got waterlogged and consequently caused to "flow." Dr. Marr's opinion is that the slopes in the vicinity of where the skeleton was found are sufficient to allow of such a "flow" taking place, and also that higher ground may have at one time existed which has since been removed by denudation. He also suggests that such a liquid condition of the boulder clay, as must necessarily have been present if it ever "flowed," would account for the complete infilling of the skull of the skeleton discovered. Now the spot where the skeleton was found is up on the plateau and is bounded on the north and south by two small valleys, and on the west at some distance by the Gipping Valley. These two small valleys were apparently excavated at the same time as the major valley was made.

It is therefore obvious that the only direction from which a "flow" could have come was from the east.

As I was very anxious to get an absolutely accurate knowledge of the O.D. levels, I asked Mr. Henry Miller, M.I.C.E., Civil Engineer and County Surveyor for East Suffolk, if he would take them for me, and he very kindly consented to do so. (See Fig. 1.) It is owing to his goodness that I am able to reproduce the admirable cross-section given in Fig. 2, which shows the exact slope of the ground from the highest point of the plateau to the east, to the spot where the skeleton was found. We found that the bones rested at about 125 O.D., and that the land surface above them is 129·01 O.D. The other pit, where the boulder clay is 15·18 feet thick, is situated just under half-a-mile to the east, and at the highest point in that direction. This point lies at 155·24 so that we have a fall

of only 26 feet in about half-a-mile, not a very serious matter, nor at all calculated to accelerate any flow, even if the clay was ever sufficiently waterlogged to allow of it. We find that the top of the middle glacial sand, where the bones were found, is only 10 feet lower than the corresponding level in the more easterly pit.

But apart from the difficulty of believing that a slope of 10 feet in about half-a-mile of a surface of sand is sufficient to allow of a "flow" of boulder clay, we have, so far, no evidence that such a "flow," and the conditions giving rise to it, ever existed. In fact, the evidence appears to be in antagonism to such a theory. In the first place the sand underlying the clay in the pit where the bones were found *is highly calcareous*, and it seems certain that such a condition could not possibly be present if at any time the clay had been removed and other deposited, because the water which would accompany any such phenomena would dissolve out the chalk from the underlying sand.

Also it is presumed that the stones in the clay above the bones would lie with their longer axes along the line of movement if the clay had ever moved in the manner suggested. This is certainly not the case as they rest at all angles in the clay. I therefore submit that the material under which the bones were lying is the undisturbed, though eroded and partly decalcified, base of the chalky boulder clay formation. The discovery of this human skeleton and flint implements on the surface of the middle glacial sand below chalky boulder clay brings up some very interesting points for discussion. In the first place it appears certain if our conclusions are correct, that the ice which deposited the boulder clay was advancing over a *land surface*, and was not associated with a period of submergence, as some have supposed. The sharpness and complete absence of patina on so many of the flint implements found on the same horizon as the skeleton, in the overlying clay and in boulder clay elsewhere, seem to make it certain that the land-ice theory must be the correct one. If we had only found the implements the evidence would not be so strong, but having found the bones of one of the men who apparently made them, the case is altogether different and the cumulative evidence overwhelming.

The chalky boulder clay under which this skeleton was found was the result of the last extension of the glaciers of what is known as the Great Ice Age, and is undoubtedly of a very great antiquity. Since its deposition most of our river valleys have been excavated and all the palæolithic and other prehistoric races lived and disappeared.

The antiquity of the chalky boulder clay has been brought home to me by a letter I received the other day from Mr. Whitaker, in which he states that at Upminster in Essex the 100-foot terrace of the Thames rests upon and is therefore less ancient than this formation. Those of you who are familiar with the Thames Valley will know better than I do what this means, but I have seen this 100-foot terrace and examined large series of the palæolithic implements found in it.

When it is realized how very ancient these things must be, and that this human skeleton found at Ipswich occurred under a glacial deposit older than any of

the river terrace gravels, it is perhaps possible to form some faint idea of the lapse of time which separates us from the days when pre-boulder clay man lived in East Anglia.

Description of the Skeletal Remains.—Professor Keith.

When the blocks containing the skeletal remains from Ipswich arrived at the Museum of the Royal College of Surgeons it was found that the bones were so fragile that it was necessary to steep each block in a solution of gelatine. In all the blocks two sharply contrasted strata were seen, the upper part of each being composed of weathered chalky boulder clay, the lower of a red glacial sand. The various fragments of bone were exposed on the surface of each block by laboriously removing the matrix of boulder clay, thus leaving the bones embedded *in situ* on the underlying sandy part of each block. It soon became apparent that there was a representation of a complete skeleton, and that while those parts which lay in the glacial sand were fairly perfect, the other parts, lying in the weathered boulder clay—which had the appearance of a red clay loam with a considerable proportion of chalk in it—had mostly disappeared. The dense bone of a shaft might be made out in an eroded condition, but as the shaft was followed to its ends, where the cancellous tissue replaces the dense bone, it became impossible to distinguish the outline, so gradually did the clay-impregnated bone fade into the surrounding matrix.

Position of the Skeleton.

It was a most fortunate circumstance that the remains of the skeleton were preserved *in situ* on the blocks, for by placing these together—at first a task with something of the nature of a Chinese puzzle in it—the posture and position of the skeleton became apparent. The photograph (Plate XXX, Fig. 2) shows these blocks assorted, as regards position, and the sketch prepared from the block, with missing parts represented by stippled lines, will show both the posture of the skeleton and the parts preserved (Fig. 3). The parts preserved belong chiefly to the right side—the side embedded in the glacial sands; practically all the cancellous bone has disappeared, the only parts preserved being the carpal bones of the right hand and part of the head of the right femur and corresponding acetabulum. The sternum, spinal column, base of the skull, foot bones and extremities of the long bones were eroded away, and if visible they were inseparable from the surrounding matrix. The skull and cranial cast, some teeth with fragments of the upper and lower jaw had been already detached from the matrix when received. It will be seen that the skeleton rests on its right side with the thighs flexed on the body and the legs on the thighs. The right hand rests beneath the right tibia and the right elbow lies under the remains of the right ribs. The left elbow acutely flexed lay over the right but under the left thigh bone; the left hand was flexed and lay under the upper end of the left humerus. In the drawing (Fig. 3) the head is shown

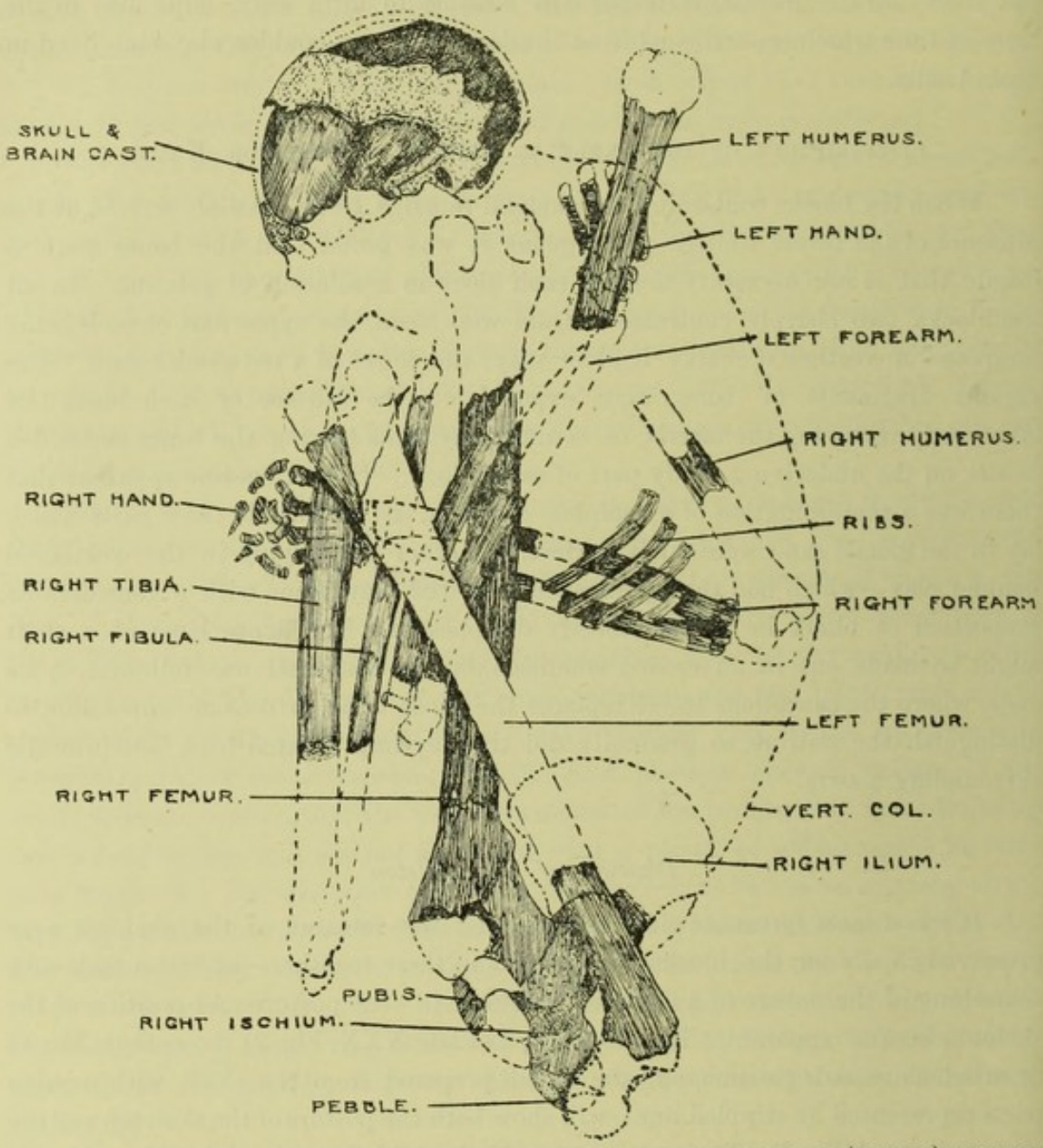


FIG. 3.—SKETCH OF THE SKELETAL REMAINS SHOWING THE PARTS PRESERVED (SHADED) AND THE POSTURE OF THE BODY. (Approximately one-fifth natural size.)

on its right side between the left humerus and distal end of the right femur. That this was its position is inferred from the fact that when the workmen first exposed the skull on the vertical face of the pit, two bones projected, one on each side of it. There can be little doubt that one of these was the distal end of the right femur, the other the proximal end of the left humerus. Whether the skull lay on its right side or was turned face upwards we cannot now tell. We know for certain the head was directed towards the south-west. The bones lie directly on the glacial sands; under the pelvis was an oval pebble, about 60 mm. long, of the same nature as occurs in the lower stratum of the boulder clay. The position of the bones recalls at once the posture of the body in Neolithic burials and of Bronze Age burials; the contracted posture is not unknown in burials of the Palæolithic period.

At first I regarded the extreme degree of flexure of limbs as a certain sign of the body having been buried—at whatever period of time burial may have taken place—but on consulting Professor Harvey Littlejohn, who has a wide experience of the posture which a body may assume at and after death, I definitely abandoned the idea that extreme flexure of the limbs was a certain evidence of burial. A person dying in a crouching or squatting posture retains that posture after death.

The Chemical and Physical Condition of the Bones.

A circumstance which at first made me sceptical of the antiquity ascribed to the skeleton by Mr. Moir was the condition of the bones. They are extremely light. They cannot, in any sense of the term, be described as mineralized. Their colour is a reddish brown, but when fractured, the freshly made surface is seen to be of the colour and consistence of chalk; the reddish tinge has penetrated only the surface layer of the bone, seldom reaching a greater depth than ·5 mm., although here and there the surface lamella to an extent of ·2 mm. may be stained red. The chalk granules in the sand are stained to a similar depth. The diploëic spaces of the bone are reddish in colour and contain fine granules of sand. In the case of the limb bones the medullary cavities and cancellous spaces are completely filled with reddish-brown loam. It is well known that the chemical composition of bones is not a safe guide to their antiquity. Mr. Hugh Candy was good enough to make an analysis of three parts of the skeleton, and the following are the results :—

	Specimen		
	i.	ii.	iii.
Organic matter and moisture	19	11	14
Calcium phosphate ...	46	70	77
Calcium carbonate ...	7	8	4
Iron oxide, etc. ...	28	11	5
	100	100	100

It will be seen that parts of the same skeleton yield a considerable variation in composition; specimen 1, which contains 28 per cent. of iron oxide, may be described as fossilized. The proportion of organic matter has been used as a test. In recent bone this element forms 30 to 33 per cent. of the total weight. In the Ipswich skeleton 10 to 19 per cent. of the organic constituents of the bone have disappeared; the proportion of the calcium carbonate has diminished; in recent bone it stands

to the phosphates as 1 : 5 to 8. In 1863 the Moulin Quignon mandible and another found in a coprolite pit at Foxhall, near Ipswich, and probably derived from the mid-glacial sands, were rejected by a body of experts because they contained 8 per cent. of organic matter, and did not show the degree of mineralization which was expected from human remains derived from strata of a mid-Quaternary Age. There are now in the Museum of the Royal College of Surgeons a series of preparations, made by Hunter about 1790—120 years ago—to show that fossils may retain a very large percentage of their organic matter. In the tooth of the mastodon he found 30 per cent. of organic matter. Gimbernat, the anatomist, prepared a jelly from the bones of the mammoth. A short time ago I had submitted to me a human skull found in a cave with the remains of Pleistocene mammals. The human skull was perfectly fresh in texture ; it was not until the discoverer showed me that the bones of the reindeer and the rhinoceros found in the same cave were in a similarly fresh condition that I was convinced that the skull was probably of the same age as the other animals.

It will be thus seen that the percentage of organic matter and the degree of mineralization are very uncertain criteria of antiquity. I note that the Engis cranium is being rejected because of its light weight and modern appearance, and yet Schmerling found it at a depth of five feet in the bone breccia of a cave containing remains of the mammoth and woolly rhinoceros. The same objection has been made to the human remains found in Quaternary or Pliocene strata at Olmo and at Castenedolo in the north of Italy. It seems possible that human bones are not affected in quite the same way as those of the greater and smaller mammals when embedded in ancient strata. In the present case we have only two specimens for comparison. One is the metatarsal of a large form of deer from the mid-glacial sands at Leiston. That specimen is light, and shows a degree of fossilization comparable with the Ipswich skeleton. The other specimen is the basal part of the antler of a large deer (*Cervus elaphus*) found at a depth of twenty feet in the glacial sands. In this case the bone is completely mineralized and heavy, quite different from the Ipswich bones. It is possible that in the case of the deer's antler it may have been derived from erosion of the red crag. Thus, in my opinion, the condition of the Ipswich bones is not incompatible with the age ascribed to them by Mr. Reid Moir.

I carried out the following tests :—I placed in separate bottles, filled with a 5 per cent. solution of HCl fragments of the following bones : (1) part of a rib from beneath the red crag ; (2) part of a rhinoceros bone found in brick earth (but probably derived from an older formation) ; (3) fragments of the Ipswich skeleton ; (4) fragments of various human crania of various ages, ranging from Quaternary date to the Neolithic period. In specimens 1 and 2 the specimens gradually crumbled away in the acid, so that all that was left was a red sediment which settled in the bottle. In all the others, with the exception of the Ipswich skeleton, the calcium salts and mineral matter were slowly extracted, leaving the original specimen represented by its organic or gelatinous basis. In the case of

the Ipswich specimens, the bone crumbled away leaving no organic basis behind; the sediment was more floccular and in larger masses than in the Pleistocene bones, but its reaction was similar in nature. So far as this rough test may serve it indicates the antiquity we suggest for the Ipswich skeleton.

Age, Sex, Stature.

The skeleton is fragmentary yet the evidence is sufficient—founded on the characters of the skull and of the limb bones—to leave no doubt that we are dealing with the skeleton of a man. The femur was approximately 500 mm. in length, the tibia about 400, from which one estimates that in life he must have had a stature of about 1,800 (5 ft. 10 in.)—or, if we use Pearson's formula (*Phil. Trans.*, 1898, Series A, Vol. 192, p. 196), 1750 mm. (5 ft. 9 in.). The first molar teeth are worn so that the dentine is exposed on the whole area of the crown; the wisdom teeth and lower incisor are slightly worn; the sutures of the skull are still unclosed. From these circumstances I infer that he was a young adult—probably between 30 to 40 years of age.

Racial Characters.

On receiving the Ipswich bones, I at once sought for those parts which characterize Neanderthal man—the supraorbital ridges, the contour and thickness of the skull bones, the teeth, the temporo-maxillary joint, the mastoid process, and it was at once apparent that all the features of Neanderthal man were absent, and that in most points the Ipswich skeleton differed very little from the present-day type of man.

Cranial Characters.

A photograph of the right side of the skull will give the reader a fair conception of the material at our disposal for a reproduction of the head form (Plate XXX, Fig. 1). The right half of the cranial cast is almost complete, only a fragment is lost over the anterior end of the third frontal convolution and a little has been lost from the region of the lambda. The imperfect condition of the left half of the cast will be apparent from the exact drawings given in Figs. 4, 5, and 6. It will be also seen that part of the cranial cast has also been broken away from the highest part of the cranial vault. Sufficient, however, remains to form a fairly reliable basis for the original head form of the individual. There is no reason to suppose the cast has been distorted by compression, although on the upper part of the frontal bone there is a distinct depression caused by pressure on the cast. The photograph (Plate XXX, Fig. 1) shows traces of root action. Rootlets had made their way through the coronal suture and into the interior of the skull. The rootlets had expanded into roots of very considerable size, as may be seen from the diameters of the perforations at the coronal suture and the wide tracks left on the surface of the cranial cast. (In Plate XXX, Fig. 1 these root tracks are exposed on the frontal lobe.) The total length of the cranial cast—from frontal

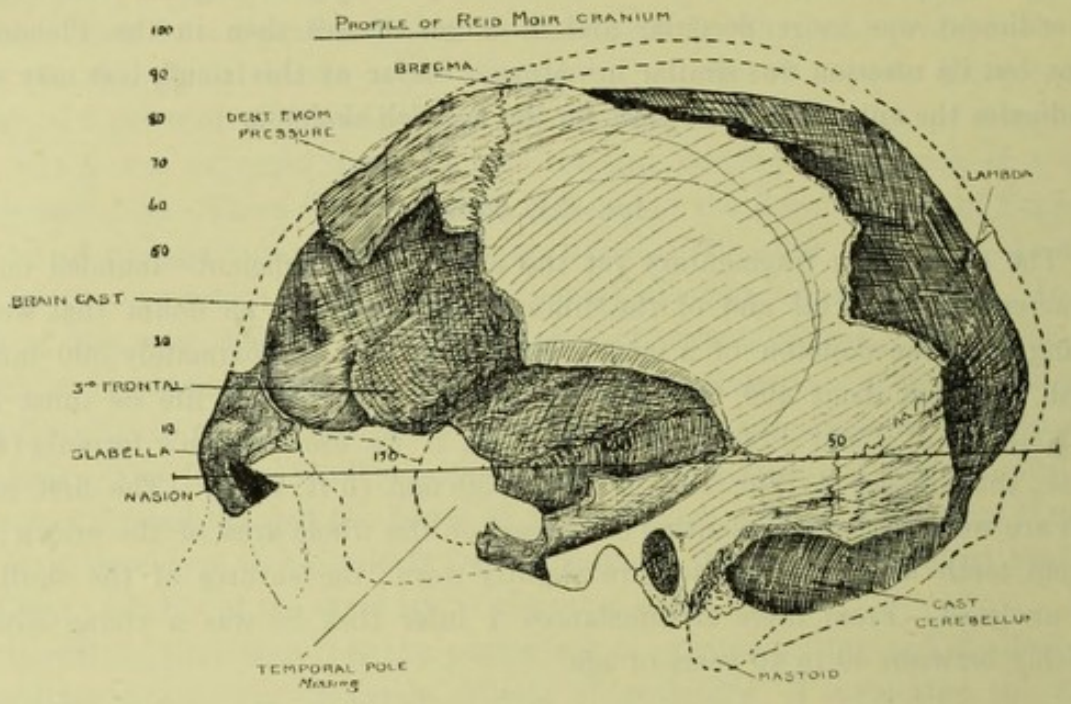


FIG. 4.—PROFILE DRAWING OF THE SKULL.
The various parts of the skull and brain cast have been transposed in the drawing from the right to the left side (one-half natural size).

to occipital pole (Fig. 4)—is 173 mm.[1] The part of the supra-occipital over the occipital poles is not preserved, but, judging from the lateral part, it was not more than 4 mm. thick. Over the frontal pole, in the region of the ophryon, the frontal bone is 8 mm. thick. Above the nasion and in the region of the glabella the frontal bone has a thickness of 19 mm., but when the frontal fragment is in position (Fig. 4) the glabella is seen to project only 15 mm. in front of the brain cast. Thus the maximum length of the head was approximately 192 mm.—made up of 173, brain cast; 4, occipital thickness; 15, frontal thickness. The analysis of the antero-posterior diameter of the heads shows no striking departure from the modern form; the glabella is 3 or 4 mm. more projecting than is common in modern British skulls. As regards width of head, the estimate has to be based on the measurements made of the right half. The greatest transverse diameter of the right half is 72 mm., 4 mm. of this measurement being due to the thickness of the lower part of the parietal bone. The maximum transverse width of the skull was thus approximately 144 mm., the width of the cranial cast 136 mm. The position of the maximum diameter of width is somewhat important. In skulls of the Neanderthal type it is situated nearer the occipital poles than in modern skulls. In the Ipswich skull the maximum diameter is situated between 55 and 65 mm. in front of the occipital end (see Fig. 6); in modern crania of the same size it is usually situated 10 mm. further forwards. The correct localization of the point of maximum width depends, in the present case, on the accuracy with which the mid point has been fixed at

[1] The measurement was made ten days after the bones arrived at the Museum. When measured two months later the cast had shrunk to 166 mm.

the posterior pole of the cranial cast (see Fig. 6). If I have made an error in fixing that point too much to the left, then the result would be to alter the position of the maximum width of the skull. I do not think an error has been made and believe that the posterior position of maximum diameter is an intrinsic character of the skull. In the drawing showing a coronal section of the skull (Fig. 5) the maximum transverse diameter is seen to be situated between 40 and 50 mm. above the ear holes; in typical Neanderthal crania it is situated much lower down. Thus as regards maximum length (192 mm.) and maximum width (144 mm.) the Ipswich skull agrees very closely with cranial forms abundantly represented now in England. The proportion of width to length is 75 per cent.

In estimating the height of the skull certain difficulties are met. The median vault of the skull, on each side of the longitudinal sinus, has disappeared from a point in front of the bregma to the region of the inion. Unfortunately, too, the part of the cranial cast which occupies the highest part of the vault (see Figs. 4 and 6) is

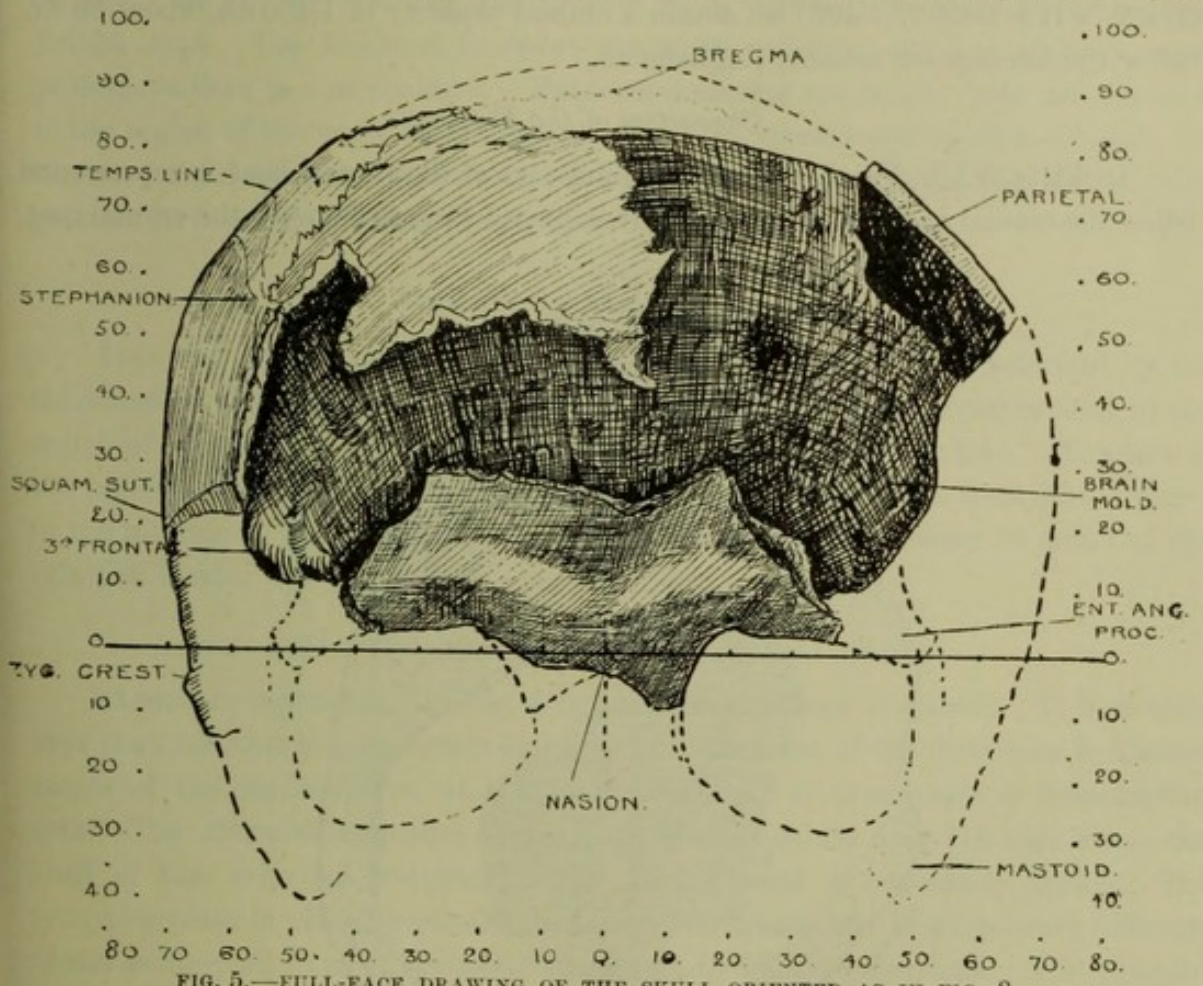


FIG. 5.—FULL-FACE DRAWING OF THE SKULL ORIENTED AS IN FIG. 8.
(Scale of reduction is indicated.)

missing. Still the vault of the skull can be restored to approximately its original form. The contour of the frontal-parietal bones and the coronal suture of the left side guide one to the position of the bregma (see Figs. 4 and 5); this is situated 90 mm. above the plane (sub-cerebral)[1] on which the skull is oriented in Fig. 4; it

[1] Sub-cerebral plane. See Keith, *Jour. Anat. and Physiol.*, 1910, vol. xliv, p. 251.

is situated 120 mm. in front of the occipital pole of the skull. In human crania the highest point of the vault of the skull is situated about 40 to 50 mm. behind the bregma and from 6 to 10 mm. higher than the bregma. In the present instance, judging from the contour of the right parietal bone and of the brain cast, the highest point was situated not more than 6 mm. above the bregma—very probably it was a little less. The brain cast and the fragment of the lambdoidal suture serve to locate the position of the lambda ; it is placed 50 mm. above and 12 mm. in front of the occipital pole—a position which is usual in modern crania of a mesocephalic shape. The highest point of the vault is thus about 96 mm. above the sub-cerebral plane and 111 mm. above the upper margin of the ear holes. It will be thus seen that it is a low skull ; in modern British crania it is usual to find that the highest point is between 100 and 105 mm. above the sub-cerebral plane and 120 to 125 mm. above the upper margin of the auditory meatus. At the same time it must be noted that equally low skulls are observed amongst the modern British. Using Pearson's formula ($L \times W \times H \times \cdot 000337 + 406$) we obtain a cranial capacity of 1,430 c.c., about 50 c.c. below the average for modern Englishmen.

Characters of the Forehead.

In Plate XXX, Fig. 1, the supra-orbital part of the frontal bone is represented below the cranial cast ; in the drawings it is placed in position over the cranial cast.

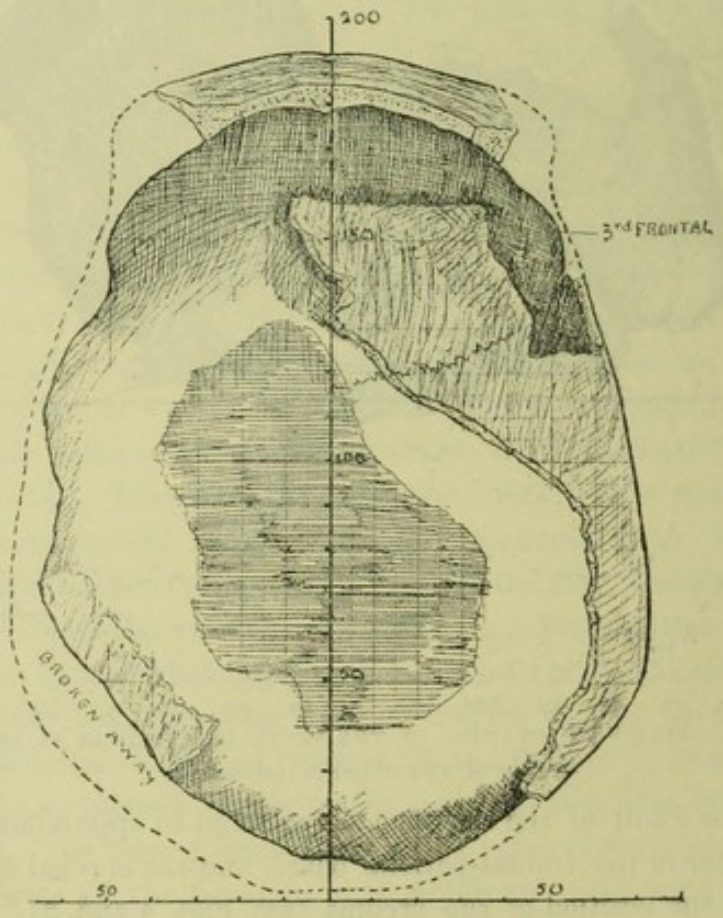


FIG. 6.—VERTEX VIEW OF THE SKULL.
The deficiencies on the vertex and left side of the brain cast are indicated. (The degree of reduction is indicated by the scale.)

The supra-orbital fragment includes the region of the nasion, glabella and ophryon and measures 25 mm. in its sagittal direction. It is 82 mm. wide and includes the supra-orbital and supra-ciliary regions, but the external angular processes are broken away. It is at once seen that there is no *torus supra-orbitalis* (Schwalbe) such as seen in Neanderthal man. The supra-ciliary eminences fuse in a slightly hollowed glabellar eminence; they are distinctly separated from the supra-orbital ridges. There is no supra-nasal recess; the nasion is in almost the same vertical plane as the glabella (see Fig. 4). The intra-orbital width is 25 mm.—a modern amount. The distance between the inner margins of the supra-orbital notches is 34 mm.; between their outer margins 48 mm. From the width of the frontal lobes of the cranial casts, the position of the stephanion and the contour of the supra-orbital parts of the frontal fragments, it is estimated that the width of the frontal bone between the fronto-malar processes was not more than 106 mm. while the width between the temporal lines, at the level of the ophryon, was between 96 and 98 mm. In all the features the Ipswich skull agrees with crania of the modern British type. The forehead, however, was more receding and the glabella more prominent than is now common. The frontal sinuses are small; they are confined to the region of the supra-ciliary eminences. The sinuses ascend 20 mm. above the nasion, extend outwards to 15 mm. on each side of the middle line and at their greatest have an anteroposterior diameter of 15 mm.

Thickness of the Cranial Bones.

It is well known that crania of the Neanderthal type are characterized by the thickness of their cranial walls—10 to 12 mm. being a usual measurement in the region of the vault. The cranial vault in the Ipswich skull is thin. Nowhere is the parietal bone more than 5 mm. thick, the frontal bone varies from 4 to 5 mm.; in the midline at the region of the glabella and nasion its measures 19 mm.; at the ophryon 8 mm.

The Temporo-Maxillary and Mastoid Regions.

These are represented in Fig. 4 by accurate tracings in profile. It is at once seen that the articular eminence and glenoid cavity are of the form seen in human crania of the modern type, and altogether different to these parts in Neanderthal man. The articular eminence is high, the glenoid cavity deep (10 mm. above the level of the articular eminence). The post glenoid is especially strong. The tympanic plate is placed vertically, as in modern crania, and is deep—very different to the anthropoid form of tympanic plate seen in Neanderthal man. The mastoid processes are broken, but the parts which remain show that they were of the prominent pyramidal form. The region of the inion is absent, but below the asterion a weak muscular impression (superior curved line) marks the attachment of the muscles of the neck, and indicates for us that in the attachment of the head to the neck the Ipswich man was altogether modern and not Neanderthal in his characters. The full prominent cast of the cerebellum also confirms this inference.

Characters of the Face.

Very little can be said about the face. The nose sprang almost straight from the forehead, there being no nasal notch. The forehead receded. The root of one zygomatic arch is present; the bizygomatic width is estimated to have been 135 to 136 mm., indicating a wide face. The muscles were certainly not greatly developed, for the temporal lines are indistinctly marked and do not rise higher on the vault of the skull than in modern man. The stephanion is 67 mm. from the bregma when measured along the coronal suture; the inter-stephanic diameter was about 110 mm. The temporal line (muscular) ascended to within 70 mm. of the sagittal suture.

The Brain Cast.

The measurements have been already given, and the cranial capacity estimated at 1,430 c.c. The low, wide, squat form of brain certainly recalls the form of brain cast seen in Neanderthal man. As may be seen from the drawings (Figs. 4 and 5), and especially the photograph (Plate XXX, Fig. 1), certain of the cerebral convolutions are very plainly indicated. This is especially the case as regards the third or inferior frontal. It will be seen to be well developed and to show no feature which is not seen in casts of modern crania. The fissure of Sylvius can be distinguished in part of its course, but shows no peculiar feature.

The Teeth.

A fragment of the alveolar border of the upper jaw, containing the first and second premolar and first molar teeth of the right side, was found; also a fragment of the lower jaw carrying the roots of the right lateral incisor and right canine. Altogether nine teeth were obtained; four of the upper series and five of the lower. In the following table these teeth are enumerated and the measurements of their crowns given. In Fig. 7 these teeth are represented in position :—

	Prox. distal diameter.	Labio-lingual diameter.
	Mm.	Mm.
1st Pm., upper, right	6·6	9
2nd Pm., upper, right	6·4	9·6
1st M., upper, right	10	11·6
3rd M., upper, left	7·5	9
1st Incisor, lower, left	5·2	6·2
Canine, crown only, lower, right	7	8
1st Pm., lower, left	6·5	7·2
2nd Pm., lower, right	6·5	7·2
1st M., lower, left	10·6	10

The teeth are thus small; the upper third molar or wisdom tooth is exceedingly small, having only the two outer and the anterior of the two inner

cusps (see Fig. 7). The crowns of the upper premolar and first molar teeth are so worn that the arrangement of cusps cannot be stated, but there is no reason to suppose they showed any peculiar arrangement. The crown of the first upper molar had a height of 8 mm.; the total length of the tooth, including the roots, was 17 mm. The spread of the roots gave a total breadth within the alveolus of 13 mm. The upper molar teeth have shorter roots than is common in modern English dentitions, but the roots are rather more separated or widely spread than is

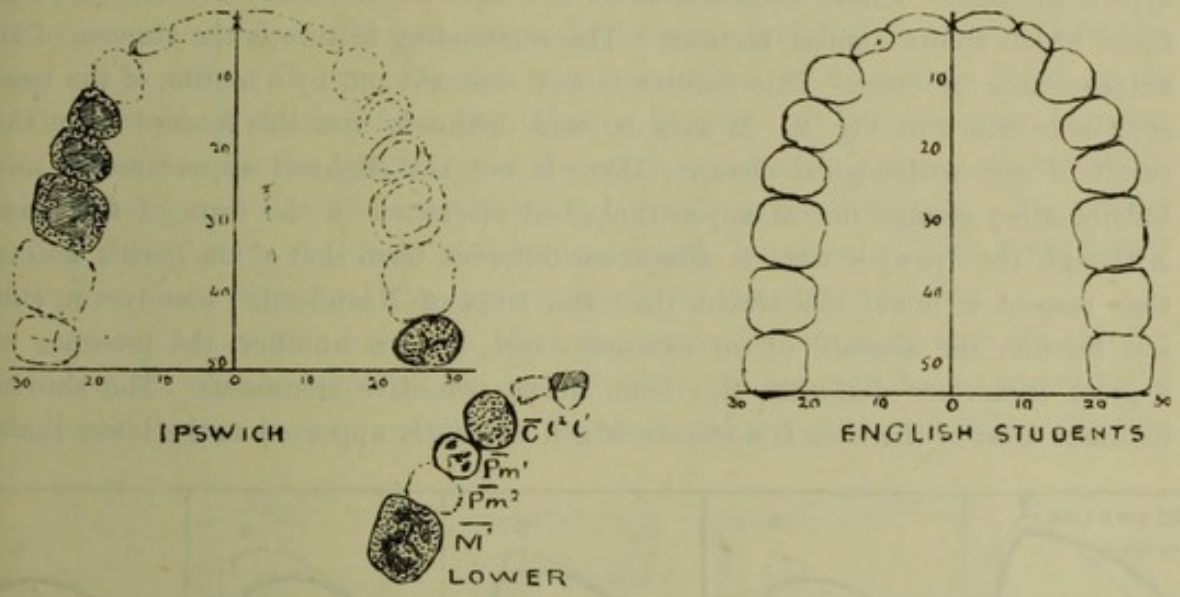


FIG. 7.—THE TEETH AND RECONSTRUCTION OF THE PALATE, COMPARED WITH THE PALATE OF MODERN ENGLISH STUDENTS.

The teeth actually found are shaded. Four of the lower teeth are also represented. (The degree of reduction is shown by the scale.)

usual. The total length of the lower incisor is 20 mm.—9 mm. representing the height of the crown. The crown of the lower canine is 9 mm. high. The first lower molar had a crown-root length of 19·6 mm., the crown height being 9 mm. The tips of the cusps are worn off this tooth, but there were plainly five cusps, the fifth being situated on the distal margin towards its labial border. When the upper teeth are replaced in an alveolar outline (see Fig. 7) it is seen that the palate must necessarily have been of small size—less than 50 mm. long and probably not more than 60 mm. wide. In English students (see Fig. 7) the palate has a length of 53 mm. and a width of 56 mm. The teeth are thus smaller than in the average-sized modern English dentition. In no sense can they be described as primitive, either in size or in form. They differ in every point from the teeth of Neanderthal man, and are more reduced in size than has yet been observed in the teeth of Palæolithic man. The fractured surface of the teeth shows the dentine of a chalky grey lustre—almost fibrous in structure. The pulp cavity and walls are stained red and contain fine granules of sand; the enamel retains its pearly lustre, being only slightly stained red. When submitted to examination by the X-rays, their substance is remarkably translucent. Certainly on the evidence of the teeth alone one would be inclined to reject the antiquity we have ascribed to the Ipswich

skeleton. When, however, the dentitions of certain reputed specimens of ancient man of a Palæolithic date are examined we will see that there is reason to believe that at an early period there existed races of mankind with small teeth.

The Skeleton.

We now turn to such fragments of the skeleton as have been preserved. Of the various bones the only one which shows a marked variation from the modern type is the tibia. I have been unable to find any bone in either ancient or modern races which shows similar features. The outstanding feature is the absence of an anterior shin or crest. This feature is best brought out by a section of the bone such as is shown in Fig. 8. It may be said definitely that this feature is not the result of any pathological change; there is not the slightest appearance of any inflammatory change nor of any pathological alteration in the form of the bone. Although the Ipswich tibia is altogether different from that of the gorilla, and in that respect is much less simian than the tibia of Neanderthal man, yet in this one feature, the absence of an extensor crest, and in another, the presence of a great transverse diameter, this bone shows primitive characters. The shin or extensor crest of the tibia is a feature which evidently appeared as the lower limbs

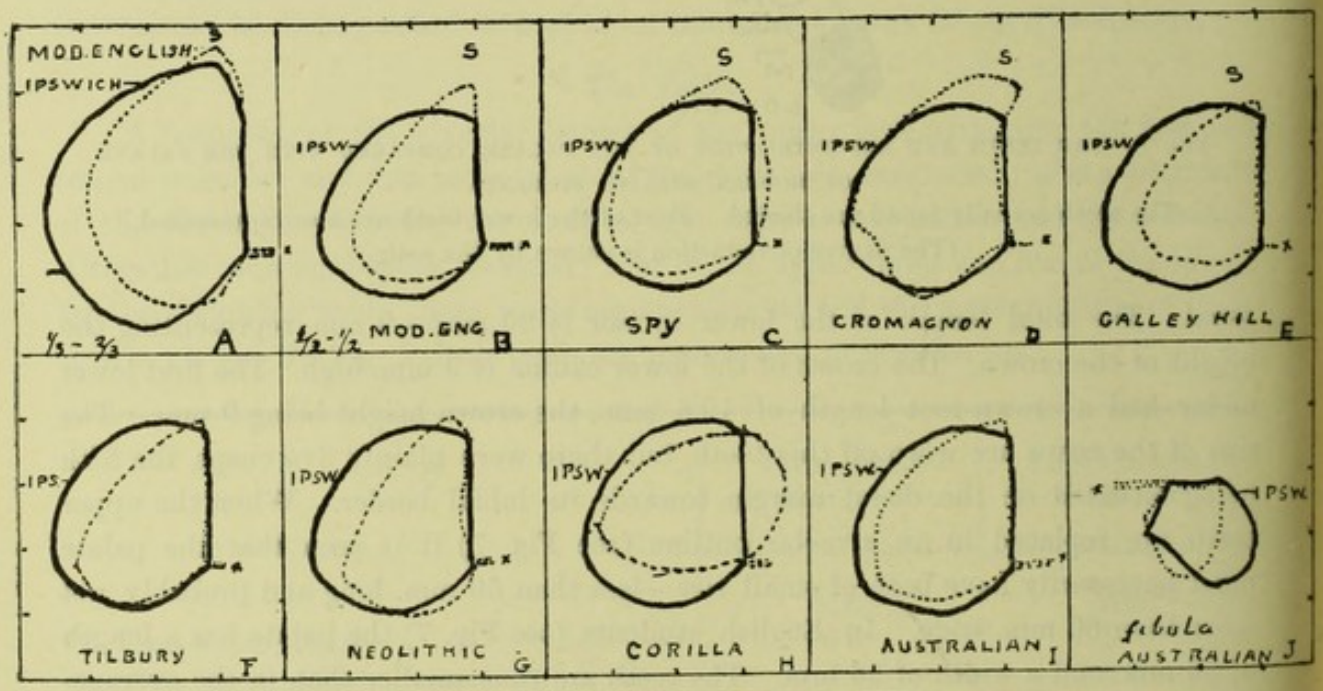


FIG. 8.—SECTIONS OF THE IPSWICH TIBIA.

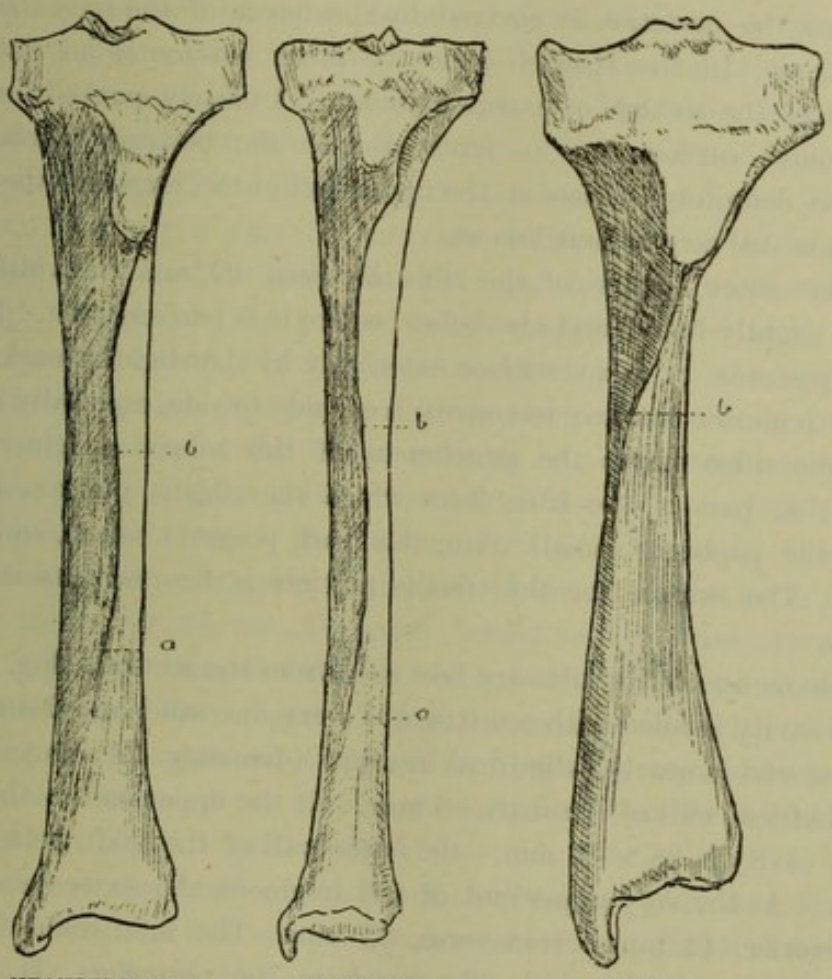
A at junction of upper and middle thirds; B, C, D, E, F, G, H, I, at mid-point. The corresponding outlines of various other tibia are indicated. The outline of the section of the fibula at the junction of its upper two-third and lower one-third is shown in J. The degree of reduction can be seen from the centimetre scale marked on the divisional lines.

became adapted for upright or pedal progression. The tibial crest is connected with the act of stepping off the toes during walking or running; it reaches its highest development in certain Palæolithic (Cro-Magnon) and Neolithic races. It will be thus seen that I attach importance to this feature of the tibia, and expect to find that it is not an individual variation but a characteristic of the Ipswich race.

Right Tibia.

The part of the shaft preserved and still embedded on the surface of the block measures 207 mm. (Plate XXX, Figs. 2, 3). The canal for the nutrient artery is seen to open 65 mm. below the upper end of the fragment; a deep groove for the artery runs from the canal towards the upper end for 20 mm. As in modern bones, the canal lies 8 mm. behind the line marking the attachment for the interosseus membrane. The position of the medullary canal is variable in modern bones; in one measuring 360 mm. the canal is 134 mm. below the articular surfaces; in another, 430 mm. long, it is only 132 mm.; so that the canal gives us no certain index to the amount which is missing from the upper extremity. It is quite clear, however, that the surface for the attachment of the popliteus muscles is absent, all except the most distal part—which is directed more inwardly in modern bones. The greater part of the ridge for the origin of the soleus muscle is present. From these facts I infer that about 60 mm. of the upper extremity of the tibia is missing.

As to the amount lost from the lower extremity, one must take the anterior border of the bone as a guide. In modern tibiæ the anterior border ceases to be sharp and begins to turn inwards on the shaft, owing to a change in the direction



NEANDERTHAL. MODERN. GORILLA.

FIG. 9.—THE EVOLUTION OF THE CREST OF THE TIBIA IN NEANDERTHAL MAN, MODERN MAN, AND IN THE GORILLA (*see* TEXT).

of the extensor muscles of the leg, at the junction of the middle and lower thirds of the tibia. In the Ipswich fragment the anterior border is a definite line—not a crest—and sharply separates the outer from the antero-internal surface of the tibia (see Figs. 8 and 9); it has not changed its position at the lower end of the fragment, so that we may infer that at least the lower third of the bone is absent. That gives a total length for the tibia of 207 + 60 + 133 = 400 mm., which is probably very near to the truth.

Whereas the shaft of all modern and ancient tibiæ tends to be three-sided, so that they appear triangular in section, this bone has only one flat surface—that for the extensor muscles of the muscles of the foot—the rest of the shaft is semi-cylindrical, so that in section the bone is " D " shaped. I have seen no tibia like it either in ancient or modern forms of man. It is not anthropoid in character; it is the exact reverse of the flattened tibiæ of Neolithic man. Its functional significance I cannot explain. In Fig. 8 sections of the Ipswich tibia are contrasted with corresponding sections of the tibiæ of various modern and ancient races.

The differences between the Ipswich and other tibiæ are best realized by contrasting sections taken near the mid-point of the shaft. In modern bones there are three flat surfaces, separated by distinct borders. The inner surface is subcutaneous, the posterior is covered by the flexor of the toes, the outer by the tibialis anticus. In the Ipswich bone the inner surface is not flat but strongly convex—as of the section of a semi-cylinder. A clearly marked line separates it from the outer surface, but its junction with the posterior surface cannot be indicated so definitely. Then at the upper end of the fragment the inner surface of the tibia is still convex, but less so.

The flat outer surface of the tibia is about 22 mm. in width, both above where it is slightly fluted, and also below, where it is perfectly flat. It is separated from the posterior or flexor surface externally by the slightly marked interosseus line. The posterior surface is convex from side to side, especially above where a wide oblique ridge marks the attachment of the soleus muscle. A faint line separates that part of the tibia from which the tibialis posticus arises from the areas for the popliteus (small triangular part present) soleus, and flexor longus digitorum. The surface for the tibialis posticus is directed outwards rather than backwards.

The characters of the tibia are best seen from the sections (Fig. 8, A, B). The medullary cavity is filled with a mixture of very fine sand and loam. The cavity at the lower end is nearly cylindrical in shape (diameter 12 mm.); the thickness of the cylindrical wall of the shaft—6 mm. At the upper end of the fragment the medullary cavity is 28 × 31 mm.—the outer wall of the shaft being here exceedingly thin. At the very upper end of the fragment the extreme diameters are: antero-posterior, 42 mm.; transverse, 33 mm. The interosseus line is 19 mm. from the anterior border and 23 mm. from the posterior. That is a normal relationship.

In Fig. 9 are shown the various stages in the evolution of the tibial crest or

shin. On the anterior border of the tibia there are three distinct sections: (1) an upper, for the origin of the tibialis anticus muscle. Its concavity is directed outwards (see Fig. 9); (2) an intermediate section—the shin or crest proper; in Fig. 9 this section lies between the letters *a* and *b*; it is relatively short in the tibia of Neanderthal man and is absent in the tibia of the gorilla. (3) A lower section in which there is no crest. The lower section corresponds to the lower third of the tibia of modern man, rather more than a third of the tibia of Neanderthal man, and to the lower two-thirds of the tibia of the gorilla. In the Ipswich tibia the intermediate section, crest or shin proper, is represented merely by a sharply defined line between the anterior and external surfaces.

Right Femur.

Part of the shaft of the right femur (middle third) is embedded on the same block as the right tibia (see Plate XXX, Fig. 2). It is important to note that the deeper part of this block is composed of stratified sand, coloured grey by the numerous particles of chalk in it. The matrix in which the bones lie is blacker, less sandy, more loamy. The distinctive character of the material or matrix round and below the bones becomes more evident when dried; there is then apparently an element best described as humus. Roots of plants end in the matrix. Another fragment (upper third) of the femur was also *in situ* in a neighbouring block; this block, too, had its deep layers composed of calcareous sand. The right femur and tibia are flexed at the knee and rest on a sandy stratum. The head and neck of the right femur lie on a third block (Plate XXX, Fig. 2); the head of the femur is still within the acetabulum, but only a part of the right ischium is visible and traceable. Enough, however, is present to show that the right thigh is ultra-flexed at the hip joint; the thigh must have been pressed to the side of the abdomen. The lower third of right femur is absent. In the block in which part of the right humerus is preserved there is also present an obscure mass of cancellous bone, which probably represents débris of the bones entering into the formation of the right knee joint. The parts of the femur present—from the upper surface of the head downwards—measure 372 mm. How much of the lower end is missing? The linea aspera is under 7 mm. wide, until it is 45 mm. from the lower end of the fragment. In the lower 45 mm. the inner border of the linea aspera becomes ill-defined and separates from the outer (which is well marked) so that at the lower end the lines are 9 mm. apart. I find from comparison with other bones—taking the point of divergence of the borders of the linea aspera as a guide—that about 125 mm. is missing of the lower extremity, and that the original length of the femur was about 500 mm. (490 to 500).

The diameter of the head of the femur can be measured; it is 47 mm.—the amount one expects in a tall man. The head is within the acetabulum. The neck is set at an angle of 120° (approximate). The great trochanter is absent (from decay), but I estimate that when measured along the axis of the neck, a line drawn from the innermost point of the head to the outermost point of the shaft at

the base of the trochanter measured about 100 mm. The neck, between its upper and lower borders, measured 40 mm. and from back to front 28 mm. The condition of the neck does not allow one to make accurate measurements.

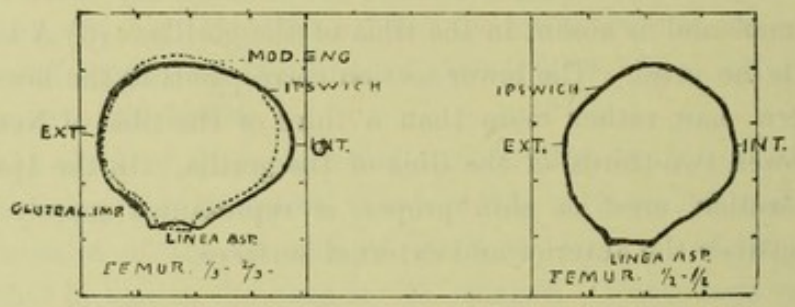


FIG. 10.—SECTIONS OF THE UPPER THIRD AND OF THE MIDDLE OF THE IPSWICH FEMUR COMPARED WITH CORRESPONDING SECTION OF MODERN BONE.

There is not a single feature of the femur which distinguishes it from modern bones. A section is given of the upper third of the shaft (Fig. 10), and it will be noted that the flattening is less than in Neolithic femora. The linea aspera is 135 mm. long, about 7 to 8 mm. wide, and only 2 to 3 mm. deep. At the upper end of the linea aspera its borders separate and one observes outside the external border a rough impression, slightly depressed, for the attachment of the gluteus maximus. The small trochanter is broken away. A ridge descends from the front of the neck to the shaft of the femur separating the inner and anterior surfaces. The inner surface in front of the small trochanter is 30 mm. wide. The ridge from the neck appears to be continued into another, which descends on the inner side of the shaft. In the lower half of the shaft this ridge is not present. The width of the shaft in the upper third is 33 mm.; its front to back diameter 28 mm. The femur is broken at the junction of the neck and shaft so that the condition of the anterior capsular (inter-trochanteric) line cannot be ascertained, but apparently the ridge was only well marked at its upper part. On the left femur the capsular line is preserved; it is such as occurs in modern bones.

At the middle of the shaft the femur measures 31 mm. from side to side, 32 mm. from before backwards; at the junction of middle and lower thirds 34 mm. from side to side and 32 mm. from before backwards. The curvature of the shaft is slight; when a straight edge is applied to the posterior surface of the shaft the deepest point of the curvature of the shaft is only 4 mm. from the straight edge. I have not given comparative measurements because it will be found that they are not different from some modern bones.

Left Femur.

175 mm. of the upper part of the left femur is preserved—very imperfectly. The head is gone and the greater part of the neck; the only feature well preserved is the anterior surface of the neck and shaft at the capsular line. The impression for the capsule is not rough nor ridge-like. The extensor surface of the left femur, as it lies in the block, is directed downwards against the flexor or posterior surface

of the right femur. The one is separated from the other by a distance of 35 to 40 mm. filled with brown loam.

In the matrix is embedded remains of the pelvis; also one large quartzite pebble—rounded—water rolled (77 and 35 mm.); a small white quartz pebble, a broken red (iron stone) pebble (Fig. 3); a number of very small gravel stones. Fibres of roots and a probable worm burrow also occur in the block containing the pelvis. It is to be noted that the block containing the remains of pelvis and heads of femora does not show the sandy stratum, only the upper or loamy layer.

Right Fibula.

This is preserved to the same extent as right tibia. Opposite the medullary foramen the fibula is flattened, measuring 17 mm. between the anterior border and the postero-external border, and 12 mm. in its thinnest diameter. The corresponding measurements below (2/3—1/3) are 17 × 14 mm. It will be noticed that the fibula is flatter and more massive than is usual in modern man. A section is shown in Fig. 8.

Other Bones of the Skeleton.

It is a matter of regret that no trace of the bones of the foot was found; one would expect them to show certain peculiar features correlated with the strange shape of tibia.

As regards the bones of the upper extremity, the humerus is certainly peculiar, but so eroded is its surface and so fragmentary is its nature that no definite statement or measurement can be given of it. The upper third of the shaft is three-sided—rather like the tibia in shape—a feature which is also indicated in the humerus of the Galley Hill skeleton. The three-sided form disappears below the insertion of the deltoid muscle—where it becomes cylindrical.

Parts of the right and left bones of the forearm were found (see Fig. 3) but in dimensions, markings and curvature they showed no departure from the well-recognized modern forms. They are slender for a man of 5 ft. 10 in. in stature. The shaft of the radius, near its middle, is 17·5 mm. wide and 12 mm. thick.

The bones of the right hand are well preserved. I isolated the semilunar, scapoid and trapezium, and compared them with the same bones of a modern hand (from a man 5 ft. 4 in. high). I could not detect in their articulations nor in their shape any departure from the modern form. In size they agreed with the bones with which they were compared. The metacarpal bones and phalanges also were in their markings and conformation in the closest agreement with modern bones. The transverse diameter of the base of the second metacarpal bone measured 20 mm.; its shaft was triangular in section; its breadth and its thickness were each 14 mm. The length of the third metacarpal is 68 mm., the fifth, 54 mm. At the bases or proximal ends the four metacarpal bones (second, third, fourth, fifth) measured 60 mm.

Racial Characters and bearing on the Evolution of Man.

When I made my preliminary examination of the Ipswich skeleton I was frankly sceptical of the age assigned to it by Mr. Moir. Here we have a man of 5 ft. 10 in., with a brain of the modern form, and quite modern in size (1,430 c.c.), with relatively small jaws and teeth, and all the features so like the men who live in England to-day that it seemed impossible that a form which lived before the deposition of the chalky boulder clay could have come down to modern times so little changed. My belief in Mr. Moir's accuracy of observation, his wide experience of the strata of East Anglia, his knowledge of the criteria which must be applied to obtain an accurate dating of fossil forms and ancient implements made me cautious of rejecting what, in a certain sense, runs contrary to our present conception of the recent and orderly evolution of man. My examination of the Galley Hill skeleton had convinced me that the modern type of man was much older in his evolution than most of us had hitherto expected. When, too, I came to examine the evidence relating to many past discoveries of Quaternary man it was apparent to me that in a great number of cases these remains were regarded as unauthentic, principally on the grounds that they were too modern in form. The discovery of Neanderthal man, and the recognition of his primitive nature, have led most anthropologists to suppose that he is a stage in the evolution of modern human races. We now know that Neanderthal man was in existence until well within the latter stage of the Quaternary period. Recent discoveries make it certain that the modern type of man was in existence long before the Neanderthal type was extinct. The Galley Hill remains and those of Bury St. Edmunds are of the modern type. There is a very close resemblance in cranial form between the cranial fragment of Bury St. Edmunds and the skull of the Ipswich man. The mandible from the coprolite pit at Foxhall, near Ipswich, possibly derived from the mid-glacial sands, is also of the modern type. It fits very well with the Ipswich skull. The Moulin Quignon mandible certainly is authentic unless we suppose Boucher de Perthes was either a fool or a rogue, and he was neither. It is of the modern type, very like the Foxhall jaw, and yet the stratum from which the Moulin Quignon mandible was derived is long anterior to the Mousterian period. The Grenelle, the Clichy, the Denise remains are, according to Rutot, pre-Mousterian, and they certainly are of the modern type. The various human skeletons discovered at Olmo and at Castenedolo, in the North of Italy, are also similar to modern human skeletons, and they are attributed to early Pleistocene and early Pliocene horizons. It will thus be seen that the Ipswich skeleton is not an isolated discovery. It is one of a great number, which, to my mind, clearly indicates that we have to seek for the evolution of the modern type of man—not in the Pleistocene but in the Pliocene formations. With the evidence derived from the discovery of the human remains, the discoveries of worked flints must also be taken into account.

Description of Plate XXX.

Fig. 1.—Photograph of right side of brain cast and skull. The supra-orbital fragment is detached and placed below. The third frontal convolution, with remains of rootlets, is plainly visible ($\frac{3}{5}$ natural size).

Fig. 2.—Photograph of the Ipswich skeleton when the blocks were grouped together ($\frac{1}{5}$ natural size).

Fig. 3.—Anterior aspect of fragment (207 mm.) of right tibia (C), placed for comparison with a right modern tibia (B) and the left tibia of Cro-Magnon man. The area for the origin of the tibialis anticus muscle lies between the asterisks ($\frac{2}{3}$ natural size).

Appendix.

Since the reading of the above paper a discovery has been made at Charsfield in Suffolk, which affords corroborative evidence in favour of the antiquity of the human skeleton discovered at Ipswich, and an answer to those of our critics who complained that no other bones had been found at the same horizon at which it occurred.

Charsfield lies to the north-east of Ipswich, and is about eleven miles distant from the spot where the human bones were found.

A small pit there, in a shallow, dry, valley, is being worked for stone, and shows an eleven-foot section composed of one-foot surface humus. Three feet of blackish gravel resting upon a weathered surface of chalky boulder clay.

FIG. 11.—SITE DURING ACTUAL DIGGING OUT OF REMAINS.
Portion of skeleton still *in situ*.

This latter deposit is about four feet in thickness and is underlain by three feet of loamy gravel.

At the bottom of the section the fine stoneless middle glacial sand is exposed.

Lying on the surface of this sand, and partly embedded in it, and in the different overlying material, a large curved tusk associated with numerous pieces of elephant bone have been discovered.

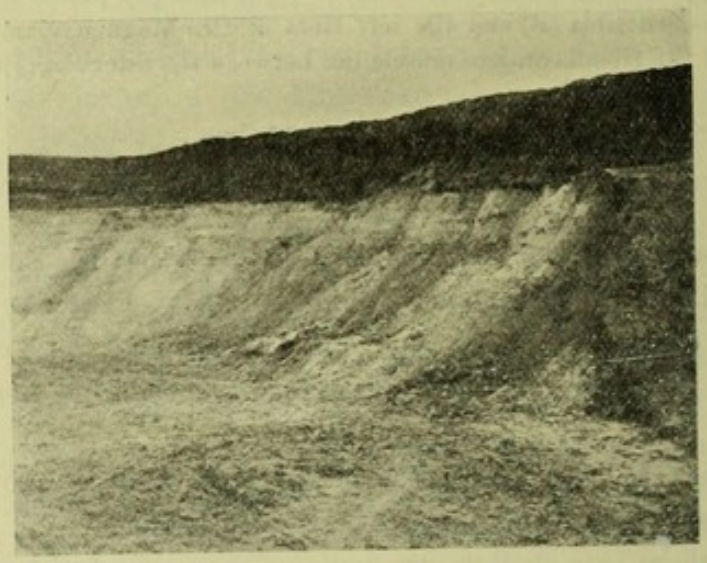


FIG. 12.—VIEW OF SIDE OF PIT WHERE SKELETON WAS FOUND, SHOWING BOULDER CLAY RESTING UPON THE UNDERLYING MIDDLE GLACIAL SANDS AND GRAVEL.

The accompanying photograph, taken by Mr. Frank Woolnough, with the

FIG. 13.—MAMMOTH TUSK WHICH WAS FOUND AT CHARSFIELD AT THE SAME HORIZON AS THE HUMAN REMAINS.

FIG. 1.

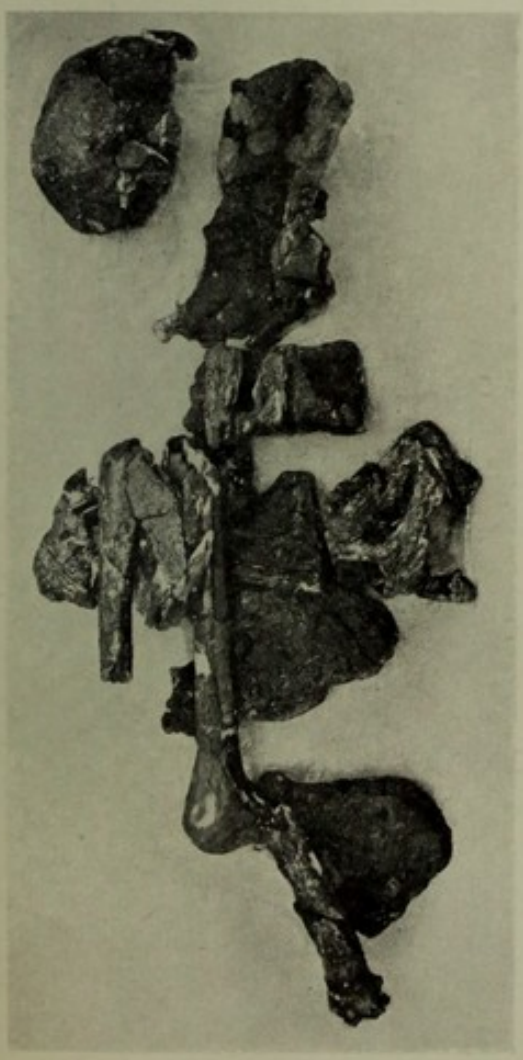


FIG. 2.

FIG. 3.

HUMAN SKELETON FOUND BENEATH A STRATUM OF CHALKY BOULDER CLAY NEAR IPSWICH.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camera suspended over the pit, shows the tusk *in situ*, which was afterwards carefully removed and taken to the Ipswich Museum.

The other photograph shows the section described above. It will be noticed that these remains occurred at exactly the same horizon as the human skeleton found at Ipswich, and examination has shown that the amount of mineralization and staining by iron are also the same in the bones themselves.

It is somewhat difficult to identify the exact species of elephant by a tusk alone, but it seems tolerably certain that the remains found are those of *Elephas primigenius*.

This interesting discovery was first brought to my notice by Mr. W. H. Youngman of Charsfield, and Mr. E. P. Ridley, F.G.S., Mr. Frank Woolnough, Curator of Ipswich Museum, and Mr. Fredk. Canton accompanied me when I went over to have the tusk removed.

It appears to me that this find affords support to my contention that the top of the middle glacial sand was a land surface before the deposition of the chalky boulder clay.

Also these two discoveries at the same geological horizon, and within eleven miles of each other, suggest that this is a deposit rich in remains of great interest, and now that owners of pits in East Anglia are beginning to realize the importance of these things it is highly probable that many other relics will be brought to the notice of scientific men, which, under ordinary circumstances, would have been thrown away as of no value.

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