PROCEEDINGS

OF THE

Cambridge Antiquarian Society,

27 October, 1913—25 May 1914

WITH

Communications

MADE TO THE SOCIETY

Michaelmas Term, 1913 and
Lent and Easter Terms 1914.

No. LXVI.

BEING THE EIGHTEENTH VOLUME.

(Twelfth Volume of the New Series.)

Cambridge:
DEIGHTON, BELL & CO.; BOWES & BOWES.
LONDON: G. BELL AND SONS, LTD.
1915

Price 7s. 6d. net.

CAMBRIDGE ANTIQUARIAN SOCIETY

PROCEEDINGS AND COMMUNICATIONS

PROCEEDINGS

OF THE

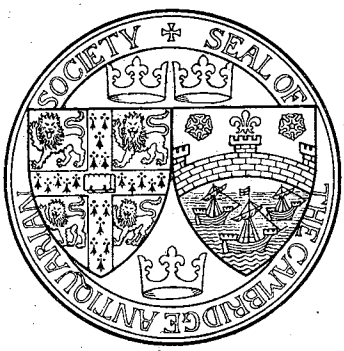
Cambridge Antiquarian Society,

WITH

COMMUNICATIONS

MADE TO THE SOCIETY.

VOL. XVIII.



NEW SERIES.

VOL. XII.

1913—1914.

CAMBRIDGE:

PRINTED FOR THE CAMBRIDGE ANTIQUARIAN SOCIETY.

SOLD BY DEIGHTON, BELL & CO., LTD.; AND BOWES & BOWES.

LONDON, G. BELL AND SONS, LTD.

1915.

Cambridge:
PRINTED BY JOHN CLAY, M.A.
AT THE UNIVERSITY PRESS.

CONTENTS

n. p. means that the Communication has not been printed in full.

n. p. means that the Communication has not been printed in full.

LIST OF ILLUSTRATIONS

FLINTS.

By T. McKENNY HUGHES, M.A., F.R.S., F.G.S., F.S.A.,
Woodwardian Professor of Geology.

(Read October 27th, 1913.)

CONTENTS.

Introduction.

THE interest of this subject arises of course from the use of flint by men of almost every race and age for domestic purposes and for implements of war and the chase.

What I propose to do in this communication is to give a short sketch of the mode of formation and destruction of flint so as to suggest some limits within which we may speculate as to whether certain examples are the work of man or of nature. I do not now discuss the geological age of the deposits in which

they have been found except so far as is necessary to understand the nomenclatures referred to.

So long ago as 1868 I brought the subject before the Soc. Antiq. London by exhibiting a large collection of natural and artificially dressed flints and reading a paper in which I explained the bearing of the collection in these words: "It has often been urged as an objection to our receiving worked flints as evidence of the existence of man, that even those who are familiar with the forms which are to be referred to nature, and with those also which, from their association, are undoubtedly the work of art, are frequently unable to determine whether a given specimen should be referred to the one or the other. The objectors very reasonably ask if only your most skilful archaeologists can form an opinion on the subject, and even they are often obliged to leave it in doubt, may not special combinations of the fortuitous circumstances which produced the doubtful forms, give even those more highly finished weapons about which all archaeologists are agreed? Their difficulty is increased by the occurrence of forms which might be referred entirely to nature, under circumstances where we must in all probability account for their presence by supposing they were brought there by man; as, for instance, in the bone caves, where a large number of relics are found, similar in every respect to those produced by natural causes, but which, from other evidence, we believe were, if not fabricated, at any rate introduced into their present position by man. It becomes, therefore, a point of considerable interest to inquire what are the forms into which flint naturally breaks up, and what the kind of evidence from which we would infer that individual specimens should be referred to human agency.

"Seeing, then, that nature might produce many forms similar to some of those that we feel sure, from other evidence, were fashioned by man, it is interesting to inquire how far those more highly finished forms which, from the evidence of design exhibited by them we now, without hesitation, refer to human agency, were suggested by simpler forms to be referred to fortuitous fracture. We might expect, *a priori*, that any primæval race who would require stone implements would first

use such forms as they found suited to their purpose. Then selecting those which most nearly approached these, they would by a few rude blows, remove irregular projections, and adapt them to their purpose. But it is highly improbable that they would first attack a large block of stone, and chip it into some ideal form not suggested by previous experience.

"The collection which I have made is intended chiefly to illustrate this point."

This paper was published in abstract in the *Proc. Soc. Antiq. London*, Vol. IV. p. 95, and in full in the *Geological and Natural History Repertory*, No. 34, May 1, 1868, p. 126, with illustrations of the mode of formation of the bulb of percussion as part of a double cone[1], etc. In the same year I exhibited the collection at a Soirée of the Geological Society and then gave it to the Museum of the Geological Survey in Jermyn Street, where it has remained concealed ever since. But I think it throws great light on the question which has again assumed importance, namely the discrimination between naturally and artificially chipped flints.

I do not publish any illustrative figures with this paper, for one reason because it would require too many to enable the reader to follow step by step the line of reasoning which I offer, and also because I exhibit in the Sedgwick Museum the series of specimens upon which I base my arguments, and thirdly and principally because drawings or even photographs of such things as eoliths can rarely be relied upon to convey a true impression of the object represented, and altogether fail to give any idea of the small differences in the condition of the surface, colour, etc., upon which the experienced collector of flints chiefly relies.

Anyone who has tried to make flint implements or has had much to do with flints must have had it forced upon him that some pieces do not lend themselves to the object he aims at producing, and that nature furnishes forms in outline like those known as implements, and also in certain circumstances chips them accidentally in the same way as man does designedly.

[1] For "cone *in* cone" read "cone *on* cone," i.e a cone truncated by another broader cone. The expression cone *in* cone refers to a different structure.

Those therefore who would carefully criticise the evidence upon which they are asked to admit the existence of man, or of what some call man's precursors, in deposits of a more remote antiquity than has hitherto been assigned to his remains, should make themselves familiar with the natural forms and varieties of flint, whether due to the original mode of formation or produced by fracture or weathering or by both. And as the weathering of flints is largely dependent upon their texture and structure, and these are due to their mode of formation, it will be well to consider this first.

Papers on the making and unmaking of flints by Prof. T. Rupert Jones[1] and Prof. Judd[2] may be consulted with advantage.

Formation of Flint.

There was once a great controversy as to whether flints were sponges and other organisms replaced by silica as the chalk was being deposited or were due to the replacement at some later time of portions of the chalk which accidentally contained sponges and other fossils. Bowerbank and Toulmin Smith in the desire to support their respective views have left us a valuable collection of observations and illustrations.

If water under pressure will hold more carbonic acid[3] and more rapidly carry off carbonate of lime in the form of a bicarbonate, and water at a high temperature will carry silica in solution, we have a simple explanation of how portions of the chalk can be replaced by flint; for pressure and temperature are greater at the depths to which we know the chalk has been depressed. This is certainly a *vera causa* but not the only one. Why certain parts of the calcareous rock are replaced and not others depends upon local conditions, such as the presence of organic matter, and chemical reactions which

1 "On Quartz and some other forms of Silica." *Proc. Geol. Assoc.* Vol. IV. p. 349.

2 "The unmaking of flints." *Ib.* Vol. x. p. 219.

3 See Report Scientific Exploration of the deep sea in H.M. Surveying Vessel Porcupine 1869 by Carpenter, George Jeffreys and Wyville Thomson. *Proc. R. Soc.* No. 121, 1870, p. 397.

are not always apparent. A useful note on the mode of formation of flint will be found in the paper on the genesis of flint by the Rev. A. Irving[1].

We learn from a more extensive examination of the rock that the flint was not formed during the deposition of the chalk but long afterwards, when the chalk had been consolidated and uplifted and joints and faults had been produced in it; for some flint, known as tabular flint, occurs by replacement of the chalk on either side of a joint or fault, and these tabular masses retain the mark of the original crack.

Another proof that the chalk was jointed before the formation of the flint is furnished by the specimens (See Pew II., Shelf 1) in which the flint seems to have been fractured and re-cemented. When however we examine some of these more closely we see that the pieces do not fit one another, and we must suppose that there are some pieces missing, for it would be impossible to build up an ordinary tuberous flint with what appear to have been the original pieces. But no such missing pieces are found and the rock never shows evidence of any such a process. What we do see however, when we find a flint of this kind *in place*, is that the divisions between the apparently separate pieces of flint coincide with joints or faults in the chalk, and the silica which has replaced a portion of the chalk was arrested in its progress by these divisional planes and had spread between two joints before it could cross the joint into the adjoining block. An illustration may sometimes be seen in the flags under Trinity Library. In certain states of the weather the damp discolours portions of a flag, but does not for some time get across the joint between the flags so that the edge of the stain is longer on one flag than on the next.

The ordinary tuberous flint occurs along the beds, sometimes uniting to form an irregular but almost continuous layer six to ten inches thick[2]. When a mass of tabular flint happens to traverse tuberous flints the two often coalesce in such a manner as to indicate contemporaneous formation, and some-

[1] Brit. Assoc. Birmingham, 1913. Rept. Section C. *Geol. Mag.* Oct. 1913.
[2] *Mem. Geol. Survey*, Vol. IV. p. 95.

times the growth of a tuberous flint seems to have started again after a period of cessation of growth[1].

There is a great deal more flint in any one of the beds in which tuberous flints occur than could be accounted for by the silica present in the organisms found directly connected with it; but, if we suppose that it is derived from other sources such as the sponge spicules scattered through a great thickness of chalk, dissolved out of one part and precipitated in another, there is no great difficulty about it.

This being so, we cannot feel sure that the source of the silica was all within the chalk, or that part of the chalk in which it is now found, for it is on that supposition difficult to explain why the flint is confined to the upper beds and not common to the lower parts which were most deeply depressed. Moreover we find in the lowest Tertiary beds shells wholly replaced by silica, which shows that silica travelled freely in solution in the beds overlying the chalk after its upheaval, jointing and denudation. In other and often much older formations also we find a more or less pure flint to which the name of chert is conventionally given.

There is considerable difference in the forms assumed by the tuberous flints depending upon varieties of structure in the chalk which it has replaced. About Balsham we find a large proportion of small flints fluted and pointed and sometimes twisted. In Kent the layer of massive irregular lumpy flint mentioned above occurs at one definite horizon for miles[2].

On the coast of Norfolk a very curious formation may be seen on the shore near Sheringham[3]. Infiltration seems to have occurred along a series of vertical holes in such a manner that cylindrical masses of flint are formed one above the other for a considerable depth. These are sometimes as much as four feet in diameter, the walls being from a few inches to a foot in thickness. The idea that they are due to sponges (akin to the existing "Neptune's Cup") is shown to be untenable

[1] Cf. Cayeux, "L'étude micrographique des terrains sédimentaire," p. 362.

[2] *Mem. Geol. Survey*, Vol. IV. p. 95.

[3] Woodward, H. B., *Mem. Geol. Survey*, "Geology of Country round Norwich," 1881. *Mem. Geol. Survey*, "Cretaceous Rocks of Britain," Vol. III. p. 260.

by their having a hole right through, by some of them consisting of two cylinders one within the other but separated by several inches of chalk, and by none of them showing sponge structure, though of course they contain scattered spicules as does the surrounding chalk. The larger "paramoudras" are almost always broken into pieces, which however lie in their original relative position. An amusing explanation of their name was given to me by Sir Charles Lyell. Dr Buckland observing some of them in a quarry asked the men what they were called, when one of the workmen, willing to oblige a gentleman, invented a sonorous word on the spur of the moment —"We call them paramoudras, Sir." This went into Dr Buckland's notebook, and has been accepted as the name of these objects ever since.

There are also large cup-shaped sponges, of which one is exhibited in Pew II. W, Wall case.

The flint near Cambridge and Brandon is brittle when first extracted, but when it has got rid of the "quarry water" it is black, homogeneous, and tenacious. Further north, as in most of the flint bearing beds of the Norfolk coast, it is mottled grey and white of unequal texture and tenacity. Some flints more readily break into flat, others into curved pieces. Some seem to be irregularly jointed.

This explains the preference for the flint of certain localities among the primeval flint-using folk. They well knew and regularly visited the places where the flints which best suited their purpose could be obtained.

The outlines of the masses of flint in the chalk are in most cases sharply defined, but sometimes, especially in the chalk of the northern parts of East Anglia and in Yorkshire, we find that the silica has only partially replaced the chalk and occurs either in alternations of thin bands or pervades the whole lump interstitially, so that there are parts, especially on the margin of the flint, in which there is much carbonate of lime in the flint which is then of a lighter colour and in the destructive processes of weathering this part most readily becomes changed by the solution of the carbonate of lime in it.

Fracture of Flint.

Of no less importance than the building up or formation of flints is their mode of fracture and weathering which is, as stated above, largely dependent upon their texture and structure and this in turn upon their mode of formation.

In the Chalk the flints once formed are comparatively safe except where volcanic action or recent movements have altered, crushed and shattered them, but when they are scattered over the surface, or occur in superficial deposits, they are exposed to all sorts of influences which modify them in form, condition of surface, colour, brittleness, and other characters.

For our present enquiry the fracture of flint is of greatest interest. Pew II. W, Shelf 2. If we strike an ordinary homogeneous flint with a hard pebble or round-headed hammer, the two bodies, owing to their elasticity, are compressed and come in contact over a small discoidal surface. The flint, pressed in and shattered, breaks in flakes so thin that the edges may be regarded as leaving a curved surface, which, when the shattered part has been removed by the weather, appears as a shallow basin, while a conical nipple with an apex of 110° often remains under the discoidal area when the action of the weather has not entirely removed this portion also.

As the result of these processes we commonly find on the face of dressed flints, in church walls for instance, a number of small circular bruises with concentric rings or pits and a small nipple, central and symmetrical, or lateral and oblique, according to the direction of the blow. Or it may be the whole of the bruised flint has been flaked and weathered out, leaving a shallow basin-like depression. This is the explanation of the "pitted flints" which we find scattered about the surface of the ground. These flints have received repeated small blows and have been subsequently exposed to the action of the weather.

If, however, the blow be sufficiently strong to break up the flint, and we might regard the action of the hammer as punching out a portion of the flint, then the nipple described above "behaves with" the hammer and drives out a conical mass which if prolonged would have an apex of 30°, so that the

result is a long narrow cone truncated by a short broad cone with a more or less sharply defined shoulder between the two. This shoulder is often repeated in clear steps or obscure undulations all along the length of the narrow cone, producing what is known as conchoidal fracture, and, where circumstances offer a shorter or easier way, the break flies along it, producing an endless variety of recurved and plate-edge forms. Explanatory figures of these were given in the paper quoted above[1]. If the blow be delivered on the margin of a flint a slice only of the cone on cone or double cone is struck off, producing a flake, a part of the truncating cone being seen in the "bulb of percussion," some of the small discoidal surface of contact between the two elastic bodies being generally apparent. The direction in which the blow has been delivered is shown by the outward curve of the conchoidal fracture.

Another mode of fracture of flint is by the expansion and contraction due to changes of temperature and moisture. A common result of this is seen in the crackly surface and hackly fracture of flints which have been baked in lime kilns or in burning weeds.

Where however this process has been less violent, as in the case of flints exposed only to sunshine and frost and rain, we often find a tendency to tear along curved planes so as eventually to loosen lenticular pieces. These however do not show a bulb of percussion and rarely any marked conchoidal fracture, but assume shapes which, when subjected to accidental blows along their edge in the surface soil or on the shore, approach and have probably often suggested forms made and used by man.

The Weathering of Flint.

The colour and patina produced on the surface of flint by weathering is commonly appealed to as a proof of the genuineness of implements, and is therefore a point of some importance in considering the evidence for the occurrence of human remains in any deposit.

[1] *Geological Repertory*, No. 34, May 1, 1868, pp. 128—131.

Ordinary flint consists of two kinds of silica, one less soluble and the other more soluble. When the more soluble, sometimes from analogy spoken of as the colloidal part, is removed, the remainder, having interstitial spaces left, reflects the light which the homogeneous mass absorbed, and the flint is white as snow and powdery and light as chalk (Pew II. W, Shelf 1). This is well seen in some of the pebbles in the Tertiary beds of Barton and elsewhere, and may be produced artificially by boiling flint in a strong solution of caustic soda[1].

There are also flints the surface of which is whitened by the reflecting faces due to innumerable small cracks, but neither does that furnish us with a sufficient explanation of the surface condition of the flints which whiten most of our gravelly soils in East Anglia.

There may be a solution of a portion of the exterior, and there may be innumerable small tension cracks, but, though these may prepare the way for other changes, they will not by themselves explain the polished white or yellow film that coats our surface and gravel flints. We must refer the matter back to the chemists and ask them whether there is not some process of hydration which changes the outside of the amorphous glassy flint.

In this connection we may refer also to the wonderful polish induced in some cases on flints in gravel or clay, which makes them shine as if dipped in a thin varnish of transparent chalcedony.

The colour and patina produced by the weathering of the surface of flint is undoubtedly of importance in considering the evidence for the occurrence of human remains in any deposit. In the case of large implements it has much force, but in the case of arrow heads and other small instruments even the white colour and patina may be obtained by making the instrument out of a thin flake from the exterior of a deeply weathered stone and giving the patina by polishing.

[1] Hill, Wm., *Proc. Geol. Assoc.* Vol. XXII. 1911, p. 61.

Flint Implements.

Having made ourselves familiar with the forms and textures of flints, arising out of their mode of formation, and studied their natural susceptibilities in respect of fracture and weathering, let us now examine some of those shaped by man for various purposes and endeavour to arrive at some method of discrimination between them and those due to natural agencies.

This is a question to which no one can give a certain answer in every case. There are some in which the experienced eye at once recognises design, and there are some which the trained observer recognises as identical with what are commonly produced by nature, but there remain a number which, as Sir John Evans used to say, must be carried to a suspense account—which may be unfinished instruments rejected as misfits, or the results of combinations of natural accidental operations such as I have been describing. Let us now take a few groups of naturally shaped flints.

Figure Forms.

First there are those which are called "Figure Forms." M. Boucher de Perthes[1] was the first to call serious attention to these. He was the man who in 1857 announced the discovery of palaeolithic implements in the valley of the Somme; and it is often said in reply to those who criticise adversely the evidence upon which a more remote antiquity is now claimed for man than had been previously supposed, that the same thing was done in the case of Boucher de Perthes' discoveries. But the rejoinder is obvious. Had Boucher de Perthes not supported a correct theory by bad evidence the acceptance of his views would not have been so long retarded. We cannot in science give a bill of indemnity for false reasoning though it was in support of a suggestion which afterwards turned out to be true.

Boucher de Perthes thought that there were flints which from the accident of their mode of formation and weathering bore a resemblance to figures of the whole or part of animals

[1] *Antiquités Celtiques et Antédiluviennes*, 1847, 1861.

and that some of these, though not wholly fashioned by man, were selected by him and often chipped here and there to improve the likeness.

The small perforated bead-like sponge *Coccinopora globularis*, though a natural form, was supposed by some to have been collected and used in a necklace or armlet from the occurrence of large numbers in a small area. But other fossils, such as "The Devil's Toe-nail," are more abundant in certain gravel pits, owing to that part of the gravel being derived directly or indirectly from the original deposit in which those fossils were most abundant. With the greater chances of finding a resemblance offered by the lower animals we may expect to find some even closer likenesses.

The collection which I exhibited on the occasion of reading this paper is I think a *reductio ad absurdum* of such fancies. The only thing I could do beyond calling your attention to it is to point out some particular cases in which the mode of growth of the stone is obvious. These specimens will be found exhibited in the Sedgwick Museum, Pew II. W, Shelf 1 B, and can be studied at leisure.

There are several flints resembling legs, one a full-sized rather gouty foot. There is a skull slightly distorted and the head and face of a man with a prominent aquiline nose, a small figure of a woman or doll. These are all accidental developments of tuberous flints. Among those resembling the lower animals there is the head of a small dog on a stand, the head being a tuberous flint with which the stand, a piece of tabular flint, has coalesced (see above p. 30). An eagle perched on a rock is produced in the same way. Sheep are represented in one case, even the texture of the wool being given by the pitted surface of the flint (see p. 33).

I found in the Museum a specimen on which some unknown humorist of long ago had written "supposed to be the hardened heart of Pharaoh."

An interesting result of difference of texture in the original chalk is seen in certain banded flints. Bands of colour are produced by infiltration of water either carrying a metallic oxide in solution or altering matter already existing in the rock.

The manner in which some of these effects have been produced in the Northamptonshire ironstone has been discussed by Professor Judd. The "Monghton Whetstones" under Ingleborough offer good examples of the rounding off of the corners so that the central nucleus is spherical or egg-shaped. Flint lends itself very readily to this action, and being sometimes of diverse texture owing to imbedded organisms or differences in the chalk which has been replaced, we find infiltration irregularly arrested or controlled. Where an organism has affected the porosity of the flint, though the organic structure has ceased to be apparent, we sometimes find a portion of the flint banded, with a sharply defined outline to the banded part. Sometimes the banded area is an elongated cylindrical figure with regular curved bands due to infiltration crossing it like the septa in an orthoceras. In these cases we have a figure the outline of which has been determined by an organism, while the conspicuous markings have nothing to do with it but are due to infiltration and chemical action subsequent to the disappearance of the organism.

The bands resulting from these processes have often very different powers of resistance to weathering owing to the mineral changes which have been set up, and we often find on a flint whose outline has been determined by an organism and whose banding has been produced by infiltration, a corrugated surface subsequently produced by weathering and we get an accidental resemblance to the pupa of an insect or even to a trilobite (Pew II., A 6).

But most of the flints which have an accidental resemblance to forms of living creatures or other natural objects are due to the irregular development of the ordinary tuberous flint modified occasionally when it has replaced a part of the chalk affected by joints or irregularities of texture, or is a combination of tabular and tuberous flint.

Yet these, under the title of "Figure Forms," are being again seriously regarded by some as evidence of man's choice, and, when a little chipped as if to improve the likeness, of man's handiwork[1].

[1] W. M. Newton, *Journ. Brit. Archaeol. Assoc.* March 1913; *Geol. Mag.* Vol. x. Sept. 1913, p. 424.

The criticism of such inferences is based upon the lines of inquiry into the natural modes of formation, modification and destruction of flints which I have endeavoured to lay before you. They are but accidental likenesses such as you find in potatoes, artichokes, the finger-and-toe in roots, in the damp stains on a wall or the forms of clouds. I exhibit (Pew II., A 6) a placid camel's head, a weasel with its upcurved back, a lumpy whale :

HAM. Do you see yonder cloud, that's almost in shape of a camel?
POL. By the mass, and 'tis like a camel, indeed.
HAM. Methinks it is like a weasel.
POL. It is backed like a weasel.
HAM. Or, like a whale?
POL. Very like a whale.

Hamlet, Act III. Sc. ii.

There Hamlet and Polonius left their fanciful similitudes in the ever-changing clouds, but nowadays the equally fanciful recognition of shapes of man and beast among the innumerable forms accidentally assumed by flint is again finding favour.

That out of the millions of flints that I have seen I should have been able to pick up one here and one there which has an accidental resemblance to a man or beast or plant is not so strange.

Chipped and Flaked Flints.

Such suggestions are interesting and amusing, but they do not lead directly to further inferences of great importance.

Not so the supposed recognition of human work on flints found in the deposits of our high plateaux or taken out of Glacial Deposits or the base of the Red Crag.

On that recognition and at present on that alone we depend for the inference that man or an implement-making precursor of man lived in the remote ages to which those deposits are assigned—for the character and the provenance of the human bones said to have been found in some of them are still matters of controversy. I am prepared to admit that the Suffolk Bone Bed, or Norfolk Stone Bed, i.e. the Basement Bed of the Red Crag, is of much later date than would be implied by bracketing

it with the lower Pliocene beds rather than with the overlying deposits of the encroaching Glacial Sea. But that is unimportant for our present enquiry.

It is improbable *a priori* that man existed when the Red Crag Sea was creeping over the sinking area on which the Suffolk Bone Bed is seen to rest or that he can have dropped implements in Norfolk and Suffolk in Glacial times, whether we believe that sea-borne ice or a Scandinavian ice-sheet was the agent of deposition.

However that may be, with the exception of some unsettled cases of doubtful bones said to have been found in deposits of uncertain age, the whole theory of man's existence in the several ages to which the deposits are assigned depends upon the recognition of design and man's handiwork upon certain flints found in those beds.

If nature produces forms identical with those, *cadit quaestio.* We have only to prove the particular negative to overthrow the universal affirmative that all such flints must have been fashioned by man.

Forgeries.

Any one who has taken pains to make flint implements himself knows well that the flints of certain areas lend themselves more readily than others to the process of manufacture, and also, if he wants any peculiar forms he soon learns that they are more apt to occur as the result of the weathering of flint of exceptional structure and texture and, may be, of limited distribution. This is the kind of experience which makes one receive with great suspicion the argument that because a considerable number of flints fractured into certain similar forms occur in one deposit or locality they must be referred to a separate race and age.

For instance, the Norfolk flint is very apt to break into curved fragments. Among these adze-shaped, beaked, and rostro-carinate forms are common. What wonder, then, that we should find a few of these in the basement bed of the Red Crag, a deposit which represents the sweepings of the old land surface where this very kind of flint was being broken up.

To enable us to form an opinion as to whether any particular examples can be taken as showing evidence of man's work it is obviously desirable not only to make ourselves familiar with the mode of formation, fracture, and weathering of flint, but also to examine carefully all available examples of the behaviour of flints during the process of trying to fashion one into an implement. For this purpose skilfully made forgeries are especially useful.

There is a very large number of forgeries in public and private museums, and I have thought it worth while to make a collection of such in order if possible to be able to distinguish them from the genuine implement.

The result of my study has been to enable me now to set aside some implements as certainly genuine and some as undoubtedly forgeries, while some do not show sufficiently distinctive characters to enable me to refer them with confidence to one or the other. Many of those exhibited I know to be forgeries because I made them myself (Pew II., Cabinet d) so that, taking that for granted, I may point out some characters in which they differ from ancient implements on which the condition of the surface has been modified by ages of exposure to the action of the weather and other circumstances.

Referring to my remarks (p. 33) on the fracture of flint, it may be remembered that under the influence of blows, a flint breaks and tears into thin flakes which subsequently are removed by weathering. A newly made implement commonly has, still attached to the flint, some of these small flakes which are often more conspicuous in consequence of the film of air beneath them, whereas in the ancient implement these have been weathered away. Also I explained how a kind of patina was produced on the surface of the flint partly by the removal of some of the more soluble portion, so that the minute interstitial spaces thus produced give rise to innumerable small surfaces, and these reflect the light which is absorbed by the unweathered homogeneous and translucent flint.

The hackly fracture near the edge which is due to repeated blows on or near the same spot is if not removed at any rate much modified by time and weather.

These points are observable also on the highly finished small implements which I exhibit. Some of them are by the celebrated Flint Jack of long ago, who was so successful in taking in collectors. Unfortunately when that imposture was detected many people did away with all the doubtful specimens they possessed and thus destroyed what we should now regard as useful evidence. Other specimens now exhibited (Pew II., Cabinet a, b, c) are by a modern far more skilful hand.

Among these you will notice some which appear to have the light colour and patina of the genuine implement. This, as I have already explained, p. 35, is arrived at by selecting a flint, the exterior of which has been whitened by the weather to a considerable depth, or which, as happens sometimes, has been weathered all through. Such a piece when dressed into the form of an arrow head or larger object has already the colour and easily takes the shine of an implement which has been exposed to the weather for ages.

Some of them I once showed to Sir John Evans, who remarked "These would deceive even the elect." The way to test such specimens is to break them, when it can generally be seen whether the alteration is from the exterior of the finished implement or all through. But this of course spoils the specimen.

Thus the value of a collection of forgeries consists not only in the opportunities it gives for studying the characteristics of freshly fractured surfaces and thus educating the eye and hand to detect forgeries offered as genuine, but also in helping one to understand the *modus operandi* and often in explaining why certain specimens proved in the making to be unsuitable for the purpose intended and were thrown away as misfits. It is however only by persistent efforts to manufacture implements oneself that one becomes familiar with the ways of flint and able in most cases to form an opinion as to whether nature can have produced any specimen submitted to us or whether it must be the work of man.

One of the tests appealed to as proof that a given specimen was really obtained from the gravel deposit in which it was said to have been found was the occurrence of incrustations on

its surface. This incrustation was generally carbonate of lime which it does not take long to precipitate and which may be formed long after the deposition of the bed. One of the forgeries exhibited (Pew II., Cabinet) was dipped in the fine calcareous mud washed down from the Norfolk cliff near Cromer, this soon dried and set, and by removing the superfluous part with a brush we got the "incrustation" left here and there.

Recent.

The most satisfactory way of approaching a question of this kind is to proceed from the clear and better known examples to the more obscure; and, with this in view, I exhibit a collection of recent implements (Pew II., Table Case a). Modern races of low civilization now use or have recently used implements of various material such as flint and obsidian, as among the North American Indians; glass picked up from wrecks, etc., as on the coast of Tierra del Fuego; igneous rocks, generally basic, more rarely acidic; quartzite; and other rocks of less common occurrence, as fibrolite, varieties of jade, etc., etc.

The study of stone implements of comparatively recent date and the mode of manufacture as recorded by travellers cannot fail to throw much light upon the subject before us. It is a common observation that some races are still in their Stone Age, and when we run our eye over a collection of implements from Australasia (See Pew II., Table Case) we cannot help being struck by the similarity between the forms recently in use there and the polished stone implements of Europe. Or, if we turn to the arrow heads from far Japan, North America, or the Yorkshire Wolds, we have the questions forced upon us, are these distributed in this manner by the migration of peoples, or are they only the result of independent development arising out of similar requirements?—questions easier to ask than to answer. They apply to many forms besides the arrow heads, and offer a useful caution to those who find in such a term as "Aurignacian" for instance, an explanation of the wide distribution of some of the simplest forms of flakes and scrapers.

By studying the uses to which such implements are put in recent times, we learn much that will enable us to draw correct inferences as to the prehistoric specimens.

We may consider these various implements as originally intended for either domestic use, the chase, or war.

Probably most of them were first employed for domestic purposes—for digging up roots, cutting wood, breaking nuts and bones and so on. They were used in the chase, as in the case of the polished stone weapon with which the urus was pole-axed in Burwell Fen (Pew I., II., Wall Case, centre). Some, as the arrow heads, were originally made for the chase. Then they were used in war and modified when necessary.

So the English bill, which was an instrument made for chopping wood, became one of the most effective weapons of the English footsoldier.

Finally, when these early stone weapons had been superseded by metal and an ancient stone axe was picked up here and there, its finish and artificial look struck the finder as a thing to be referred to some mysterious origin, and it was thought to have fallen from the sky and was called by the Greeks *κεραύνια λίθος*[1]; by others, thunderbolt or elf shot.

When we come to enquire how these ancient weapons were hafted, we cannot do better than examine a few recent methods and trace them back as far as we can into prehistoric times (Pew II., Drawers). Here we shall find the polished weapon of the South Sea Islander whipped on to a suitable wooden handle with split withies, or further back in the Lake Dwellings the hatchet mounted in a small piece of Red Deer antler and this set in wood, a method which took off the jar and helped to save the handle from splitting. This and the loss of the valuable axe head was an ever present danger which in the Bronze Age was often guarded against by providing the socketed celt or the palstave with a loop by which it could be attached to the handle.

[1] C. W. King, *Archaeol. Journ.* Vol. 25, 1868, "On a Ceraunia of Jade converted into a Gnostic talisman."

Neolithic.

Through reproductions in recent times of forms which met the requirements of earlier but not always less civilised man, and through the ages when metal was so little known or so scarce that stone still continued in use, we feel our way back into the obscurity of prehistoric times. No one studying this subject should be without Sir Charles Hercules Read's clear and comprehensive *Guide to the Antiquities of the Stone Age in the British Museum.*

Lord Avebury gave us the useful division of Neolithic and Palaeolithic, to which some now add Eolithic for all forms referred to still earlier ages.

These three groups are of course broken up and will be still further subdivided as time goes on. There is much doubt as to when the Neolithic Age began. When the chisel-shaped instrument first superseded the rounded leaf-shaped form of Palaeolithic man, some inventor saw the advantages of an even cutting edge and found out how to produce it by grinding the end of the stone and finally the whole surface of the implement.

Neolithic implements have generally but not always straight sides. They are often rough dressed, but it is not clear whether this is not only in the case of unfinished specimens.

The essential characters of the Palaeolithic stage are that the implements have curved outlines and are never polished.

The most marked difference between a genuine polished implement and a forgery is that the ancient maker ground the surface to reduce the implement to the general shape required and neglected the small depressions, the margin of which therefore cut the ground surface with a sharply defined line, and the grinding did not appear in the depression.

The modern fabricator almost always not only grinds but polishes the surface of the implement and in the process obliterates the sharp edge of the depressions and gives them a polish similar to that of the general surface of the implement. This is more commonly seen in felstone forgeries than in those made of flint; but when attention has been drawn to this point and it

has reached the fabricators, they will easily modify their methods so as to escape detection by this character at any rate.

Rough Neolithic implements as well as earlier types often seem to be suggested by common natural forms, as may be seen in my collection in Jermyn Street referred to above p. 28. This is interesting as showing, or at any rate suggesting, that Neolithic man did not derive all his forms by modification of the previous Palaeolithic types but again started fresh from nature. Nor did he when going back to natural forms take the oval, leaf, or tongue-shaped flints which, being fairly common, seem to have suggested to Palaeolithic man the outlines of the strong and serviceable instruments which we find associated with his remains.

With Neolithic man we find the fauna and flora of the Fens, with Palaeolithic man the fauna and flora of the River Terraces; but I am now dealing with the forms and characters of the flints used by him, and not with the contemporary fauna and flora.

Transition from Palaeolithic to Neolithic.

General Pitt-Rivers[1] pointed out that the flints scattered broadcast over the ancient flint workings of Cissbury, with which the Grimes Graves flints are identical, yielded forms intermediate between Palaeolithic and Neolithic; and Canon Greenwell[2] arrived at the same conclusion with regard to Grimes Graves; while some have gone further and thrown all the Cissbury and Grimes Graves flints into the Palaeolithic. Any one who examines the large collection which I have brought together and arranged in the Sedgwick Museum will I think be convinced that whether or not some of them may be regarded as similar to, and others only slight modifications of, recognised Palaeolithic types, there are also a large number of

[1] Lane-Fox (afterwards Pitt-Rivers), *Journ. Anth. Inst.* Vol. v. p. 357; *Archaeologia*, Vol. XLII. 1869, p. 53. See also Willett, E. H. *ib.* XLV. 1875 (1880), p. 337.

[2] Greenwell, *Ethn. Soc. Lond.* Vol. II. 1870 (1876), p. 419.

distinctly Neolithic forms, though none are polished. I have already discussed these questions more fully elsewhere[1].

So much doubt has been thrown upon the authenticity of the solitary greenstone implement brought by the workmen to Canon Greenwell that it cannot be admitted as evidence.

My collection may be taken as fairly typical, seeing that I dug with General Pitt-Rivers at Cissbury and have collected on and about Grimes Graves since long before the ground was so much cleared by collectors.

I have also shown elsewhere[2] that there is sometimes found on the borders of the Fens a thin flat implement in which the sides are straighter than in the typical Palaeolithic specimens and the outline approaches a rectangular form (Pew II., Table Case). This I have suggested may belong to an intermediate stage between Palaeolithic and Neolithic implements.

If further investigation should confirm these views, then the great break between the Palaeolithic and Neolithic Ages would disappear.

I have arranged a row of implements from Grimes Graves and another from Cissbury parallel to the Palaeolithic series from St Acheul, etc., and selected them so as to represent as nearly as possible the various typical Palaeolithic forms, from which it will I think be clear either that the tradition of certain types went on or that in the embryology of a flint implement certain forms were always apt to be first flaked out.

Palaeolithic Caves.

For our present purpose we may conveniently consider the Palaeolithic stage under two heads:

(1) The older Alluvial or River Drift, and
(2) The Troglodytic or Cave Deposits.

Here I would acknowledge the assistance I received in the arrangement of the specimens from Miles Burkitt, B.A., Trin.

[1] *Proc. Camb. Ant. Soc.* R. XXXVI. May 15, 1876, No. XVIII.; Vol. III. No. 4, 1879, p. 26. *Cambridge Review*, Vol. 7, Nov. 11, 1885, p. 66.

[2] "Archaeology and Geography of the Fenland," *Journ. Brit. Archaeol. Assoc.* Dec. 1899, p. 10.

Coll., who is now carrying his researches into a wider field, and has recently brought some of the results of his work before us in clear and admirably illustrated lectures.

It seems to be pretty well established that the cave men are generally later than the men of the river terraces and the men whose remains occur on the plateaux[1]. There is no great break between them, and some river drift types are still found in the older caves. Caves have been occupied by man and the lower animals through all time; and cave deposits, except where disturbed by interments, burrowing animals, occasional floods, etc., are generally preserved as originally laid down.

A small series from the Palaeolithic caves of the South of France is exhibited in the Museum, Pew II., Table Case, west side, a, b, c, d.

These were collected before the cave deposits had been worked out, and before so many people had visited the localities with a view to selecting good specimens of what they considered typical of the place and age.

Moreover, they were all collected when travelling with either Sir Charles Lyell, Sir John Evans, or Professor Prestwich, while many other experts of our own country as well as foreigners joined them and gave me the benefit of their advice and guidance. So I claim for this collection some little personal value and interest.

If it be true that the mode of fracture of flints depends upon characters which vary much locally, it is clear that classifications based upon the length of flakes, the curvature of the faces and the colour and condition of the surface must be received with caution. Yet it may well be that certain races in various ages for some reason, perhaps only because the flint which occurred near them lent itself to certain forms, preferred one or other of the different types and took trouble to obtain the material from which they could most easily be produced.

If now we turn to the specimens we shall have an opportunity of forming an opinion as to how far these remarks are justified.

[1] *Arch. Journ.*: *Proc. R. Arch. Inst.* Vol. LXIX. No. 274, 2nd Ser. Vol. XIX. No. 2, pp. 205—214.

Let us take first what has generally been considered the oldest cave deposit, namely that of Le Moustier. The overlap of the older Palaeolithic and the Troglodytic is seen in the Cave of Le Moustier, from which I exhibit implements of the older type, though I must admit that some of them are not above suspicion (Pew I., Table Case).

Le Moustier is characterised by the occurrence in it of the mammoth and of leaf-shaped implements resembling those of St Acheul, while certain other forms of dressed flint are of such frequent occurrence as to be regarded as distinctive. The most common of these are rough rhomboidal forms with one corner more carefully trimmed for use, and also one known as a side-scraper or racloir, i.e. a half-moon-shaped instrument with the curved outer margin chipped to an edge; though both of these occur also in other caves to which a later age has been assigned, as shown in the collection Pew I., Table Case a, b, c, d. The flakes are small and thick and many of them are developed into rough scrapers of the type now referred to as Aurignacian, but a fine core which I obtained myself in the cave of Le Moustier shows that long flakes like those now called Magdalenian have been struck off it.

The disappearance of the mammoth and the appearance of reindeer has been held to coincide with changes in the character of the remains of every-day domestic life of the cave dwellers. Accordingly Laugerie Haute and Laugerie Basse have been pointed out as belonging to a later date. Laugerie Haute and Laugerie Basse seem to have dropped out of notice, and between Le Moustier and La Madeleine are now intercalated Aurignac and Solutré, the former marked by the prevalence of a thick short instrument showing every gradation from a conical core to a scraper; while the Cave of La Madeleine, occurring close by, was regarded as the newest of the four and was supposed to owe its different characters to gradual development of fashion and habits, by lapse of time and change in opportunities. The similarities, however, will be seen to be much greater than the differences and to be far more important; for the recognition of an ever increasing number of stages based on evidence obtained from far separated stations is regarded by many as somewhat

hasty. Our confidence in the judgment of some of the observers is much weakened by the boldness with which they introduce glacial epochs in Palaeolithic or even Neolithic times to explain or accentuate changes in the succession of human events.

M. Commont[1] accepting some of the numerous schemes of subdivision of the Glacial Epoch in our more northern latitudes has the following judicious remarks upon their application to France.

"La vallée de la Somme n'a pas été soumise directement aux influences glaciaires. Mais il n'est pas douteux que la formation des différentes terrasses (en relation elles-mêmes avec les plages soulevées du littoral et dépendant du déplacement du niveau de la mer) est en corrélation étroite avec les époques glaciaires n'ayant été marquées dans notre région que par des périodes plus humides ayant occasionné un ruissellement plus intense et un surcreusement des vallées."

What he really infers is that there were earth movements and changes of sea-level during the formation of some of the valley deposits of the north of France, and he suggests that the earlier of these may have coincided with glacial conditions in countries much further north.

In the Sedgwick Museum these cave specimens are arranged as in the case of the other Palaeolithic implements, in rows. The top row contains specimens from Le Moustier. The second row specimens from the Laugeries, almost all of which are from Laugerie Haute, as from Laugerie Basse I obtained hardly anything except bones worked and unworked. In the third row are the objects from La Madeleine; below which are small groups of specimens from other caves.

If now we run our eye, not from right to left along the contents of each separate cave, but from the top to the bottom of each column, we shall see the succession from the older forms of Le Moustier, by the intermediate series of the two Laugeries and Les Eyzies, down to the newer types of La Madeleine; while specimens from Lourdes and Sorde are placed as nearly as possible in their proper order. Space did not allow of the

[1] *Op. cit.* p. 252.

display of the bones and bone instruments alongside of the stone, but they can be studied in adjoining cases.

Of course during the long ages of occupation many caves saw a succession of inhabitants who differed may be in race and habits, while climatal changes were going on and the fauna of the country was changing too, and this has been observed in some caves. It is difficult to explain or realise at all how there could be such differences between different caves. Why did not the Mousterian folk for instance, when they came, occupy and leave their mark in every available cave in the district?

Near by may be seen various collections and specimens which illustrate different parts of the subject. There is a large series (Pew II.) of specimens of local interest. These have been picked up on the surface of the ground or procured from workmen or given to me by friends. They rarely have any association which would enable me to assign an age to them, and therefore they are merely grouped according to their form in order to facilitate comparison.

Among them there are two flint flakes from a tribulum near Smyrna where it was recently seen in use for breaking up the ears of corn and separating the grain.

Sir John Evans in his work on the Stone Implements of Great Britain[1], that wonderful monument of knowledge and careful research, has discussed the origin of the innumerable flakes used "semper, ubique et ab omnibus," and describes (p. 257) the tribulum as possibly accounting for their presence in such large numbers in certain localities.

The flakes from the Smyrna tribulum are highly polished on several faces—by use as I was told. I have placed with them a small collection of flakes from our own district, but none of ours are polished. If the chipping of the end of a flake producing the form known as a scraper flake was sometimes produced by use, we ought to be able to detect some relation between the character of the chipping and the mode of insertion and use of the flakes.

The wide-spread use of such an implement to-day strengthens

[1] *The Ancient Stone Implements, Weapons and Ornaments of Great Britain*, by John Evans, Lond. Longmans, Ltd. 1872, p. 2.

the probability of its having been common in this country at one time. My friend, Ivor H. N. Evans, B.A., writes to me that "the Dusuns of N. British Borneo...use a sort of bamboo hurdle with projecting spikes of hard wood on the under surface. This implement is used for harrowing, after the wet rice fields have been ploughed up into a slush with a very primitive type of plough. The hurdle is drawn by a buffalo, and a man stands on it exactly as shown in your sketch. I imagine that, with the excellent substitutes of hard palm wood and bamboo abounding, stone flakes were but little used."

From the analogy of the various saw-like instruments made by modern uncivilized races by setting sharks'-teeth or other sharp cutting material along the edge of wooden blades we may conjecture that there were in ancient times many instruments with flint teeth similarly inserted along the edge.

This might also explain the occurrence of numbers of fragments of flint of approximately the same small size in certain localities all over the world. These are commonly called "Pygmy Flints[1]" (Pew II.). Some of them are chipped along the edge, but whether by design or wear it is difficult to conjecture.

There are also two specimens placed side by side in the same box as they were produced out of his pocket by a gamekeeper, who informed me that he had picked them up on the hill above Brandon; the one is a small tanged and barbed flint arrow head, the other an almost identical socketed iron arrow head.

Palaeolithic—River Drift.

Palaeolithic implements have been classified according to their form, and attempts are being made to establish stages based upon these forms and their supposed order of appearance in time; but in many cases these seem to have a topographical rather than a chronological significance.

The form usually regarded as the oldest of this stage is named Strepian from the Belgian locality Strépy, but that

[1] Gatty, Rev. Reginald.

called Chellean from Chelles in the Valley of the Seine about seven miles above Paris and supposed to be of somewhat later age than that of Strépy, is more important for our present purpose, because it is said to occur in the lower beds of St Acheul, near Amiens, respecting which we have the careful work of Professor Commont to refer to.

Attention has only recently been called to the two varieties of the pointed implements (coup de poing or hand-axe) which have always been obtained in abundance from the gravel pits near Amiens.

The one which is named Chellean is more roughly dressed than the other pointed implement which is said to be found only in the newer part of the deposit and named Acheulian after the well-known locality St Acheul.

In the Chellean type the large flakes taken off it produce a coarsely wavy edge, and the broad end is much thicker though still flattish, while it often happens that much of the cortex or original exterior of the flint is left. Yet it tapers to a fairly fine point with concave or reentrant edges, a form which requires some care in the making.

The Acheulian pointed implement is flatter at the broad end and is much more closely flaked so that the edge is more even and is generally straight or bulging.

It is stated that when remains of animals are found associated with these types of implement in the gravel, the older forms, *Elephas antiquus* and *Rhinoceros merckii*, occur with the Chellean, and the newer forms, *Elephas primigenius* and *Rhinoceros tichorhinus*, with the Acheulian.

But many of these inferences depend largely upon *ex post facto* evidence, and it is not easy to pronounce upon such variable objects as these pointed implements which graduate into one another through every shade of difference, nor to say of each sample whether it should be referred by its form to the rougher or to the more finished group.

Some think that the Chellean was not a more ancient form but only a less well-finished tool chipped out sufficiently to serve some rougher purpose; but, whether the views sketched out above be confirmed or not, the name Chellean may be useful

to distinguish a particular form, which, as may be seen in the series exhibited (Pew I., Table Case e, f, g, h), occurs on almost every Palaeolithic site.

The still older Mesvin, Maffle, and Reutel Stages of Dr A. Rutot belong to the Eolithic.

In East Anglia we have not had many opportunities of studying the sequence of deposits in which various forms of dressed flint might, from the analogy of the observations recently made in France, Belgium and elsewhere on the continent, be expected to occur in chronological order. Most of our specimens have been obtained from gravel diggers who do not notice whether the stone was thrown out from the bottom or fell in from higher beds. Many of them are found on the surface or are ploughed up. We have, however, procured a sufficient number to show that certain forms are more prevalent than others in certain localities, and may arrange them according to the classification of such careful observers as Professor Commont, who says, speaking regretfully of what might have been learned had any competent observer watched the early excavations in the Somme Valley, "Ce serait encore un document susceptible de mettre au point cette question si controversée du niveau stratigraphique des différentes industries. Mais pour cela il nous fallait recueillir l'ensemble des silex mis à jour, et non quelques pièces isolées et choisies[1]."

There is no such thing in East Anglia as a river gravel in which the stones have been rolled into pebbles, but there are plenty of examples of subangular gravels heaped up by the sea. Over large areas where the sea has had time to reduce all irregularities the beach deposit is made up entirely of pebbles, but where a pebble occurs in our river gravels it must have been introduced into it as a pebble.

On examining the subangular gravels of the terraces or plateaux the first thing to be noticed is that the whole mass presents a reddish yellow, mottled appearance owing to the different colour of the fragments of which it is made up, except where bands coinciding with water levels have got uniformly stained by iron oxides. On closer examination the flints are

[1] *L'Anthropologie*, T. XIX. 1908, p. 529.

seen to differ in size, mode of fracture, and condition of surface, and do not resemble the flints derived directly from the chalk, such as are seen in any talus from the Chalk-with-flints or such as the unweathered flints which are found in the Boulder Clay. The flints in the gravel are like those seen all over the surface where they are subjected to fracture and alteration by blows, or by hygrometric, thermometric, and chemical change.

The gravels with all their differences of composition and stratigraphical arrangement are in this respect similar down to the bottom; and in fact what we see is that all the yellow subangular gravels are *arrested surface soils.* They are the winnowings of the superficial deposits which have been shifted along from time to time in spate and flood, but have never been rolled in river or sea for a sufficient time to wear out the characters they acquired when exposed on the surface. It was when they were on the surface that the lenticular flakes were torn out; it was when they were exposed that they had the hackly fracture given them. These characters could not be produced in the deep gravel.

In this kind of gravel flint implements are found, and the implements resemble the other flints in all the characters indicating weather action on the surface of the ground. Here we get the answer to a difficult question; namely, why should all those primeval folk drop implements of every variety into a river bed. The answer is,—they did not. The implements were only swept down with all the other surface debris during storms of rain. Some were oftener and further moved and got more of their angles worn down. Some were only just hurried along and buried once for all.

In this connection it is interesting to note that when a flint has been long lying on the surface of the ground the upper exposed side is weathered white, but the lower face which lies on the soil retains the dark colour of the unweathered flint. We have specimens from Egypt in the collection presented by W. Seton-Karr (Pew II.) which illustrate this. They got broken in two and one half fell one way up and the other half the other way up. Now that the two pieces have been

joined together half of the surface on each side is dark and half light.

The importance of this observation for our present enquiry is that when we find a flint of which one side is whitened and the other retains the original dark colour we know that it is a surface flint, even though we find it now buried in gravel.

The surface from which they all came represented an unknown but vast lapse of time, and the whole period of which we are speaking was one of vicissitudes of climate and weather and more or less extensive and important movements of upheaval and depression.

Therefore, while we welcome all tentative classifications founded on the form of flint implements and receive with an open mind all suggested reference to human agency of forms which we had always considered natural, we must bear in mind how very complex the problem is and how many unknown quantities we are dealing with, and, where proof is impossible, carefully criticise and balance probabilities.

I have arranged a series to illustrate the distribution of the various forms of Palaeolithic implements. Pew I., Table Case.

The top *row* is all from St Acheul.

The first two in the row, following them from left to right, are flattened pear-shaped. These represent the Chellean.

The third in the row is the flat, pointed implement in which the edges instead of being concave or reentrant are straight or bulging, and the broad end is not so thick as in the Chellean. This is the type known as Acheulian.

The fourth is the oval form of similar thickness at both ends and uniformly dressed all round the edge (*limande*).

The fifth is slightly curved to the small end which is thin and pointed. This type is generally smaller than the third above mentioned which in other respects it most resembles.

The sixth is the humped-back type which seems to connect this series with some Neolithic forms.

The seventh is a large flake generally dressed on one side only. This very obvious suggestion of a useful instrument offered by a simple natural fracture is in one way or another, and in larger or smaller specimens, common throughout every stage.

The second *row* is from Mildenhall. From this locality and the adjoining district I have obtained a very large number—too large to attempt to display—but which can be seen on application by any who are interested in the subject. As I procured these from gravel diggers and found only a few myself, I have no evidence except that offered by the condition of the specimens as to their exact provenance. It will be seen that the selection, arranged in order from left to right, below that from St Acheul, is almost identical with it.

The third *row* is from the South coast of England and exhibits the same varieties of form. Parallel to these are wave worn specimens of which I found several myself below the Barton Cliffs.

The fourth *row* is from India, where though the material is different the forms are the same, and the fifth *row* is from Africa.

If you look along the *rows* from left to right you will be struck by the variety of distinct forms from each locality and then if you run your eye down, along each column from the top to the bottom you will see that these varieties occur on every well-known site.

This inclines one to be sceptical as to chronological sequences based upon such differences unless the varieties have been found each at one horizon only, in clear sections by competent observers and in a sufficient number of localities to justify the inference.

At the end of this series are a number of specimens illustrative of various points referred to. Among the most interesting are a thick pear-shaped implement from Egypt and from St Acheul, and one almost exactly like them which was said to have been found with two others in Dent, i.e. one of the western dales of Yorkshire.

I may here record that I once found at the bottom of a peat bog on Widdle Fell a large unworn piece of flint apparently fresh from the chalk. It was not *in* the peat but on the clayey soil in a channel between the masses of peat. This I left in the museum of the Geological Survey in Jermyn Street.

Note the specimen from Mildenhall of which one side is dark the other light, showing that it has been long exposed on the surface, and beside it is a broken Egyptian specimen of which one half is dark and the other half which lay the other way up has been bleached: also the small selection of flints which had fallen on to the beach from the Solent gravel capping the Barton Cliff, and had got so rolled in a few hundred yards that on some of them the traces of dressing are hardly recognisable.

There are also some specimens with a twist in the edge. It has been suggested by some that this was intended to facilitate the grip of the instrument during use, while others have offered the impossible explanation that it was to give a rotary motion to the spear to which it was attached.

It seems to me that the explanation is that when you are dressing an implement it is easier to strike the proximal than the distal part of the edge, so that unless care be taken to correct this tendency the right near edge gets more chipped.

Eoliths.

This is a subject which it is exceedingly difficult to treat satisfactorily except by producing the specimens relied upon as evidence and pointing out the characters supposed to indicate human or natural agency.

The examples of reproductions and the actual specimens from which they were drawn, which I have mentioned above (see Pew I., Wall Case), will I think convince anyone of the importance of this caution.

Personal experience and the impressions derived from it count for a great deal, because there are local differences in the original conditions of formation which have produced varieties of form and texture in different localities. An observer who has gained his experience among the great continuous layers of tuberous flint in Kent, and the gravels which cover the surface of the ground there, would be surprised, when he got among the small flints of Balsham, which are like drawn out and twisted bits of dough; while anyone who had worked among the black

flints of Brandon, which ancient and modern flint knappers have sought as most suitable for their purpose, would hardly realise that he was dealing with the same material when he struck the light coloured mottled flint of more northern areas and got among the paramoudras of the Norfolk coast.

Such differences tend to produce different forms among the flints exposed to the action of natural forces on the surface of the ground, or washed from the surface to form deposits of gravel.

"Palaeolithic" includes all the earlier Stone Ages about which we have at present any certain knowledge. But there has long been an eager scrutiny among deposits of more remote ages in the hope of discovering some trace of still earlier man or man's precursor. The material most likely to survive the waste of ages is the almost insoluble flint; and accordingly flints that could be easily held in the hand and showed the scars of blows were collected, and, when a number had been obtained in which groups having a certain similarity to one another could be picked out, these were presented as evidence of intelligence in selection and skill in adaptation and accepted as types of ethnological and chronological significance.

These being regarded as the *most ancient stone* implements then known were called Palaeotatoliths. But the superlative, afterwards concealed in the abbreviated form Palaeotaliths, was felt to impose an undesirable limitation, and Eolith, only a little less precise in this respect, was adopted and now stands, like the newest of the five houses on the Cornish coast each called "The Last House in England."

M. Rutot distinguishes three subdivisions, which he names after the localities where he obtained the specimens on which he bases the classification, namely Mervin, Maffle, and Reutel. He would probably prefer to have them included in the Palaeolithic bracket.

The term Eolith is convenient enough to indicate briefly that we are talking about all prepalaeolithic or less clearly defined stones which have by anybody been attributed to human workmanship.

These Eoliths are on stratigraphical evidence referred to different ages extending over a vast range of time. Some are

from the Plateau gravel and Middle Glacial of Searles Wood, some from the Suffolk Bone Bed. The age of the deposits in which they are found is not however the question with which I propose to deal now, but only the character of the flints which under the head of Eoliths are referred to the agency of man.

One great difficulty meets us in this enquiry and that is that whereas an immense number of these Eoliths are figured you can seldom from a figure form a correct idea of the form or condition of surface of any such object. In this connection I would call your attention to the drawings of some examples from Ightham and the originals from which the drawings were made. There is one Palaeolith among them (see Pew I., E. Wall Case).

If Eoliths are, as I believe, only accidental forms naturally produced by the many forces that are always acting upon surface flints, they must be of every age and every stage of formation, and no difficulty arises as to their occurrence in any association. But, if they are definite types of human work belonging to an earlier and presumably less advanced civilization, then the newer Palaeolithic form should not occur in deposits characterised by numerous Eoliths.

It is generally held that Palaeolithic forms never occur in an undisturbed bed with Eoliths, though they are commonly found together on the surface or in superficial, or in disturbed deposits. If they are found together in the same bed, we must accept one of two hypotheses; either the Palaeolithic implement has got into the deposit with the Eoliths by some subsequent disturbance of the deposit, a question which I have recently discussed[1], or the deposit must be of the age of the newest object found in it. If we are told that a certain deposit is of Roman date from the occurrence of coins of Vespasian, etc., in it, and we afterwards find a coin of Elizabeth in the same undisturbed layer, we must assign the deposit to the later date, and so the stratigraphical evidence for the great antiquity of that lot of specimens fails.

Referring now to the series which I collected on the Plateau above Salisbury in company with Mr Blackmore, whose

[1] *Proc. Roy. Arch. Inst.* Vol. XIX. p. 205.

courtesy in helping me to appreciate the evidence I take this opportunity of acknowledging, I must confess that to my eye these specimens are ordinary subangular flints broken by surface accidents of every kind but showing no uniformity in the direction, intensity, or apparent object of the blows. I cannot imagine how flints could lie about on the ground with animals trampling on them and crushing them against one another; with hot sun and moisture and frost contracting, expanding, bursting them, and in more recent times with agricultural implements striking against them and knocking them against one another, without exhibiting traces of the treatment they had received in fractures of every kind especially along the thinner parts and the edges likely from the form of the fragment to be most exposed. Moreover they are too common; they cover the ground and occur all through thick beds of gravel. You can obtain them everywhere, not as you might Palaeolithic or Neolithic implements, one here and one there, except where we are obviously on a station, such as Grimes Graves, where they were made. These Eoliths you can get by the cartload.

You can see similar forms, where fresh flints have been shot in heaps for road making, or if you follow the steam roller or the cart wheel. You find them battered on every shore, stained in every gravel pit and weathered all over the surface of the ground. You could pick up in time a series of almost any form that fancy might suggest. I long ago invited the Philosophical Society of Cambridge to consider the evidence upon which these stones were referred to human agency[1].

Stone instruments have always been and are still used by man. They differ somewhat, but not so much as one might expect, according to the material available. Obsidian and chert have many of the good qualities of flint. Quartzite and basic igneous rocks are tough and tenacious and have been used for many of the rougher classes of implement, but flint is the most commonly available in our part of the world, and practically what we have first to seek is some method of discrimination between those pieces of flint which owe their

[1] *Camb. Phil. Soc.* March 9, 1896.

character to man's handiwork and those which *may have been* produced by natural agencies. We ask:

(1) Is there evidence of design in the treatment of the specimen?

(2) Are there no natural operations producing similar results?

Flints Naturally Flaked and Chipped on the Norfolk Coast.

It is not only the outline of the stones which is relied upon as evidence of man's work. It is pointed out that some are chipped in such a way as to suggest or prove that these flints have been dressed with the intention of producing an instrument designed for a definite object, and those who question this inference are challenged to show similar results due to the operations of nature.

I think we can hardly take a more fair example in order to bring this question to the test of observation than we get from an examination of the action of the waves upon the same type of flint upon the corresponding shore at the present day.

I need not dwell long upon the action of the waves in lifting stones and hurling them against the cliffs and shore. Every pebble tells of this; for if you examine a flint pebble closely you will find that it is covered with small bruises, indicated by concentric rings, and showing that it is not only by the push and drag of the waves rubbing them down that they become pebbles, but also by blows hard enough to initiate the bulb of percussion which I have described above.

In storms these pebbles are lifted high into the coil of the wave so as to be often landed on a promenade or ledge of rock, or they are dashed against other stones on the shore. All the stones on a shingly shore show traces of this battering. No matter whether nature or man wields the hammer, the results are the same.

But we are asked what is there on the shore to hold a piece of flint in the same position as that in which a man would hold it so that it may get chipped along one edge while

the rest of the flint is untouched, and then sometimes shift it so as to expose another edge to the waves.

This can be perfectly well seen along the coast, say from Sheringham to Trimingham in Norfolk.

First of all there is the shore deposit of mixed gravel among which angular flints are seen tightly wedged, and these are found to be chipped along the exposed edge.

Then there is the Cromer Till, a remarkable tough tenacious sandy clay in which there are many angular flints; and these are not infrequently found with an edge exposed, which gets chipped according to the direction of the principal wave action.

Besides that there are beds of sand and gravel cemented hard by iron oxides and full of angular flints. These in like manner are held as in a vice and presented at various angles to the impinging pebbles. I exhibit specimens of all of these (Pew II. B, d), some with the imbedded and chipped flint in place.

In our enquiries into the earlier traces of man's handiwork three questions naturally present themselves:

(1) What is the age of the beds in which the traces are found?

(2) Is the chipping certainly contemporary with the formation of the beds in which the flints are found?

(3) Is it undoubtedly the work of man?

1. When such good geologists and experienced observers as Sir Joseph Prestwich and Sir Ray Lankester, to select the two protagonists, agree in the contention that such remains have been found in the Plateaux gravels and the Suffolk Bone Bed respectively, formations to which they have each paid special attention, one must have very strong proofs to the contrary to justify scepticism, and I must say that having had considerable opportunities for forming an opinion on this point, I agree with them as to the age of the beds, only premising that some of those beds have undergone disturbances subsequent to their deposition, which must affect the answer to the second question.

2. This question I have discussed elsewhere[1], and I came to the conclusion that the occurrence of Palaeolithic implements in the Plateau gravel was due to the infolding of the surface soil and of portions of the underlying deposits owing to the solution of the chalk and chalky drift below them.

3. The question plainly stated is this. Certain flints occur in deposits of earlier date than any in which on evidence other than these flints we have proofs of man's existence. These flints are either suggestive of selection or have a number of pieces knocked off so as to produce what is regarded as a serviceable instrument; and the question is, were these struck off by man or by some natural process?

It is to this that I have chiefly tried to lead up in this communication, referring to collections in the Sedgwick Museum which illustrate the points referred to.

Mr Reid Moir has long been trying to test this question by observation and experiment, and has arrived at the conclusion that nature does not produce the forms in question. I must however say that I have failed to arrive at the same conclusion, but find that identical forms are produced under shore conditions which must have been similar to those under which the Suffolk Bone Bed was laid down, and I have by imitating natural processes, produced similar forms.

Guide to the Collection of Flints, etc.

Although the exact position of specimens in a museum like ours cannot be adhered to for ever, but must necessarily be modified as additions come in and as new furniture is acquired, still it will I believe assist those who wish to study the subject if I explain the arrangement which I have found it possible to carry out so far.

In Pew II., West Wall Case are the specimens showing the formation of flint; above these the specimens illustrating the fracture of flint and its mode of weathering.

[1] *Proc. Roy. Arch. Inst. Arch. Journ.* Vol. LXIX. No. 274; 2nd Ser. Vol. XIX. No. 2, pp. 205—214.

At the far north end of this wall case are natural forms similar in outline to some referred to human agency and also a series showing natural chipping similar to that on artificially produced implements.

On the middle of the lowest shelf are the natural forms simulating figures of men and the lower animals.

The Eoliths are arranged alongside the human bones in Pew I., East Wall Case. The overflow will be found in the drawers below.

Among these we must look for examples of flint which, though apparently naturally produced so far as outline is concerned, are so chipped along the edge as to suggest that they may have been used by man ("utilisés"). Here also we must seek examples of what is meant by implements which show evidence of chipping at a later time than the first dressing ("retouchés").

The Palæoliths come next the Eoliths, and are continued in the drawers at the bottom of the West Wall Case in Pew I. Those from the Mildenhall district are placed first because I have been able to make such a large collection from that part of the country. Those from the valley of the Somme come next as being from the first place of note for Palaeolithic implements, and also because everyone engaged in their study must first refer to the admirable work of Professor Commont in that district.

In Pew I. in the east side of the Table Case a selection of Palaeoliths is arranged to show the recurrence of similar forms in most of the typical sites. A succession of well-recognised forms is arranged from left to right, and each *row* represents a different locality; so that running the eye down from top to bottom we see in each *column* the best example from each locality of each type our small collection could furnish. I must here repeat the caution I have already given that these are not obtained *in situ* in a section but procured from workmen, and therefore that I have been guided by form alone in the arrangement of this particular series.

On the other side of the case the series is started again by a row from the Mildenhall district and carried down through rows from other localities.

Where there is a little space to spare I have placed some small series bearing upon the question, as for instance the forms intermediate between Palaeolithic and Neolithic from the Fenland; and on the other side of the case the stumpy pear-shaped implements from Africa, St Acheul, and Yorkshire.

In Pew II., Table Case west side, the flints from the Palaeolithic caves may be studied. They are placed in rows from right to left, each row representing a cave; while similar varieties of form are arranged in columns, so that the recurrence of similar forms in different caves can be seen at a glance (see p. 50).

On the other or east side of the Table Case selections of local specimens are grouped according to form, with, where possible, a geographical arrangement also.

As only two out of the sixteen table cases necessary to complete the furniture in the mahogany gallery have yet been supplied, it is impossible to do justice to the collections; but this sketch will help students and others to consult the series now described. The sculptured bones and casts from the caves are in small glazed oak boxes at the end of the Table Case in Pew II. Recent and Neolithic implements and specimens of doubtful age are arranged in the drawers in the Wall Case, east side of Pew II.