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103. On the Origin of Eoliths.

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water. When the tub is emptied after the lapse of twenty-nine hours the condition of the flints suggests the following sequence of events. Those first affected assume eolithic forms and are subsequently rolled and worn ; at a later stage some of them are subjected to further shocks which give them the appearance of re-worked implements ; in this condition they would resemble later (re-worked) eoliths. In any case it is demonstrated that the cement tubs of Mantes produce eoliths which are astonishingly like those of geological formation. As I showed in my previous paper, the arrangement of the machine proves that the pseudo-eoliths are chipped, not by any part of the mechanism, but by the shock and pressure of one flint against another. The rapid action of the water resembles that of the Rhone, Rhine, and other rivers when in flood, while smaller streams would be still more impetuous. The pot-holes formed by rivers are known to every student of geology. Anyone who has ever studied the ancient gravels of the Seine or Somme and other rivers, will be readily convinced that their volume was once very different from that which we now see. To-day they can scarcely carry down pebbles of small size, but formerly they deposited strata of the coarsest gravel, containing rolled blocks exceeding a metre in diameter. All this presupposes a torrential river-action such as no longer exists in these regions at the present day, but was experimentally reproduced at Mantes.

The investigator or the collector who believes eoliths to be intentionally made must now produce them from sites where flint is not naturally present and torrential conditions did not prevail, and he must support his contentions in every case by proper geological evidence. I may repeat here a statement which I have made before, that I do not myself regard the action of water as the sole agent in the production of eoliths ; the eocene eoliths of Duan, to which I alluded in my previous paper, are a proof to the contrary. If under the term eolith are included certain flints which are contemporary with the established palæolithic industries, but have been merely utilised and thrown away, the more finished implements found in association show that forms indistinguishable from the earlier so-called eoliths were then produced by man. Such forms are found not only near Paris, but also in association with St. Acheul types on the Kent plateau,* and on the Nile and the Zambesi with forms characteristic of the local industries in stone. But the accurate inquirer will not be content to infer tertiary man from the mere occurrence of eoliths unsupported by independent evidence, for such products may just as well have been created by natural as by human agency, and up to date we have no independent evidence that man himself was there to make them.

HUGO OBERMAIER.

Archæology : Eoliths.

Warren.

On the Origin of Eoliths. By S. Hazzledine Warren, F.G.S.

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On seeing the interesting discovery of "Machine-made eoliths" by M. Marcellin Boule,† it appeared to me that it might be of interest to give an outline of a somewhat similar line of investigation upon which I have been engaged for some years. I have arrived at the same conclusions as M. Boule, namely, that these flints with variously chipped edges known as "eoliths" cannot in themselves be looked upon as giving any satisfactory evidence of the presence of man.

Unfortunately, different authorities hold different views as to that which constitutes an eolith ; what one classes as an eolith another takes to be the work of Nature. We see this exemplified in Mr. Lewis Abbott's reply to M. Boule in a recent number of MAN. ‡

* It is now held by advocates of plateau man that palæolithic types are not found in true association with eoliths in the plateau gravel, but only sporadically on the surface.--[ED.]

† *Comptes rendus Paris Acad. Sciences*, June 26, 1905. A fuller account in *L'Anthropologie* XVI., 1905, p. 257. See also Dr. H. Obermaier, *Archiv für Anthrop.*, N. F. IV., 1905, p. 75

‡ 1905, 80.

Moreover, there are different classes of eoliths, formed by different processes, whether these be human or natural. I feel, therefore, that it is advisable, before proceeding further, to define what is meant here by an eolith.

The term "eolith" was originally given by G. de Mortillet to the fire-shattered flints of the Aquitanien of Thenay. It was subsequently widened in its application to include everything considered to be the work of man prior to the Pleistocene period.

FIGS. 1-3.

Sir Joseph Prestwich, in his original communications on the subject, described certain rude palæolithic implements from the chalk plateau

of Kent, and also certain other chipped flints, constituting a definite series of forms, which were of a non-palæolithic character. These latter he named "Plateau implements." It is these—the non-palæolithic "plateau implements" of Sir Joseph Prestwich—that I take as the type series of the forms referred to here as eoliths.

I have conducted a series of experiments on the accidental production of these forms by pressure. These experimental eoliths were exhibited at the conversazione of the Geologists' Association in November, 1900, when they naturally received great opposition from the advocates of eolithic man. I have refrained from publication until now in the hope that I might have an opportunity of going over the chalk plateau of Kent, and of investigating the high level drift in which the flints have been found. At the same time, field work has no actual bearing upon the question whether these flints are or are not the work of man. Moreover, I have found them myself in many different localities; in fact, their presence appears to be general wherever broken flints of suitable shape occur, though their abundance varies greatly.

FIG. 4.

I first found accidentally chipped flints of these eolithic types upon roads which had been stoned for some little time, but which were still loose. Most of the characteristic eolithic types, including even "borers" with reverse working, may be found upon careful

search being made in these situations. On examination I found that they were not made by the stroke of the horse's hoof, nor, as a rule, directly by the cart wheels. These had supplied the necessary pressure, but the actual flaking had been executed upwards by the reaction of the ground on which they rested. I have found all the splinters still sticking in the ground and occupying the notch or hollow chipped out of the edge of the flint.

At the next stage of the enquiry a suitably shaped flint was taken, that is to say, one with at least one nearly flat or slightly concave surface, such as those of which "eoliths" are formed. Such a flint was placed with its flat surface on the ground, and one of its edges upon the rounded surface of another stone level with or slightly rising above the surface of the ground. It was then found that by bringing a weight to bear upon the flint a good example of the 'hollow scraper' or notched type of eolith was immediately produced. Even a sustained heavy pressure, or sudden stamp with one's heel, was sufficient for this purpose in some cases.

FIG. 5.

The remarkable fact is that, when the edge of a flint is pressed against another stone, the resultant notch in the edge of the first flint is not broken away in one piece but in a quantity of small splinters, producing the effect of parallel flaking on the broken edge. In most, if not in all, cases there is a certain amount of slip or lateral movement between the two stones. This results in a kind of grinding action, and it is possibly this, in part at least, which causes the succession of fine splinters to be removed. The forms produced are not confined to the simple notched type, but depend partly upon the shape of the flint operated on, and even more, upon the nature of the surface upon which it rests. But as the stone, or stones, on which it rests and against which it is pressed, are usually more or less rounded, a corresponding hollow or notch is by far the commonest form produced. A borer with reverse working is imitated by two such notches being made a short distance apart and from opposite sides of the flint. The chances of this happening accidentally are more remote than in the case of the single notch, and these forms are consequently far more scarce.

FIG. 6.

In the production of some of the "machine-made eoliths" of M. Boule, it appears to me that something more than merely rolling has been going on. I think that some of the flints must get wedged, or in some other way ground together under pressure, as might very well happen in the washing mills described by him.

Now, if flints can be ground together under pressure by the action of "soil-creep," or other of the multifarious vicissitudes of Nature—which, I take it, none will deny—then it is demonstrable that such forms as the eoliths must necessarily be produced.

In working the palæolithic drift of High Down, in the Isle of Wight (*Geological Magazine*, 1900, p. 406; 1902, p. 97), where I did most of the digging myself, I found an eolith closely and tightly adhering to the rounded stone which had made it, and against which the notch accurately fitted. There is no doubt that the two stones lying

adjacent to each other in the drift had, through the action of "soil-creep," been pressed or ground together. The round stone, being of an unsuitable shape, was unaffected, the flat piece of flint was converted into an "eolith." Not only was the notch chipped out of one edge where there was a slight excrescence on the rounded stone, but, there being an intervening concavity on the same stone, the opposite edge of the "eolith" was also chipped in an outward curve along a more extended line of contact.

It has previously been suggested by Professor T. McKenny Hughes,* Mr. W. Cunnington,† and, prior to the present eolithic controversy, by M. G. de Mortillet,‡ that such forms as these eoliths might be formed by pressure against other stones. Here we have strong evidence of the actual production of such a form, in Nature, and by this process.

Since writing the above, I have read with much interest the articles on this subject in the November number of MAN.

The Rev. H. G. O. Kendall§ raises the question of the age of the early palæolithic implements found associated with the eoliths on the chalk plateau. I think it is hardly justifiable to eliminate the distinctive *eolithic types*, and then class as "eolithic" the implements of purely palæolithic type which belong to a well-marked, and long recognised, stage of the palæolithic period.

It is, however, undeniable that these early palæolithic implements belong to an ancient drift of the plateau of Kent; it is also true that they only occur as derived specimens in the valley gravels below a certain level. But these plateau drifts have probably been re-distributed many times, and it must not be concluded that the last re-distribution was prior to the existence of the present valley system. Such hill-drifts are not always of the same age. Indeed, they are sometimes contemporary with certain of the gravel terraces in the valleys below. This is the case in the Isle of Wight, where the early palæoliths only occur as derived specimens in the hill-drifts.

It is also true that there are eolithic types which are contemporary with, and others which are later than, these early palæoliths. The essential claim of the eolithic theory, however, is that the true eoliths are older. In support of this is the fact that the plateau gravel which has been struck in various trial pits has yielded nothing but eoliths. Negative evidence is notoriously unreliable, but at the same time it is perfectly possible that these eoliths, whatever their origin, may be older than the early palæoliths.

With reference to the criticisms of Mr. J. Russell Larkby,|| it is necessary to bear in mind that all eoliths are not of the same character. There are some which (in my opinion) are capable of being formed by water-abrasion. Such especially as the "percuteurs," "retouchoirs," and certain types of "grattoirs," of M. Rutot. These are characteristic of river gravels; and it is to these, as I take it, that the work of M. Boule primarily applies. On the other hand, there are other forms, such as the double notches with point, and those with reverse chipping, which, as Mr. Larkby points out, could hardly be formed by free rolling in a river-bed. Were these types characteristic of deposits where such rolling (and no other geological process) had been extensively going on, it would be favourable to their human origin. But this is not the case. Although they may occur to some extent anywhere, they are only characteristic of hill-drifts, the material composing which has undergone a totally different process, namely, that which I propose to name "soil-abrasion."¶ That is to say, the wear and tear occasioned by the grinding together of stones under pressure, due to the multifarious phenomena

* *Proc. Cambridge Phil. Soc.*, IX., 1896, p. 124.

† *Natural Science*, XI., 1897, p. 332; *Quart. Journ. Geol. Soc.*, LIV., 1898, 291.

‡ *Le Préhistorique, Antiquité de l'Homme*, 1883, pp. 79-96.

§ MAN, 1905, 91.

|| MAN, 1905, 92.

¶ Perhaps the more perfect forms of these types are confined to the drifts that have been subjected to "soil-abrasion."

which may be classed under the general name of "soil-creep," the slipping, sliding, and foundering of the insoluble surface material from higher to lower levels. I hope to go more fully into this question at no distant date.

With regard to the angle of chipping, the Mantes flints have suffered from abrasion, concussion, and pressure. I agree that I should not expect all these causes to operate in Nature under the same conditions, it is therefore necessary to separate their effects, or we get the mixed results referred to.

Mr. Larkby says that the ordinary eolithic flaking angles are from 45 deg. to 72 deg. I think the higher value is somewhat too low. I have some records of Mr. Harrison's, and also of other, eoliths, and, while I have nothing so low as 45 deg., there are several of 85 deg. and 87 deg., even one of 94 deg. While their crushed edges are as high as 102 deg. and 113 deg.

In most of these cases, one has curved surfaces to deal with, and the differences are probably in the methods of measurement. In the case of pressure-chipping, the angles on the same flint, as is seen in the eoliths, are remarkably uniform. I have measured a series of these, and none of them are below 50 deg., and none (except the crushed edges) above 86 deg.

The following may be taken as a typical example of the best effects of pressure-chipping :—The first flaking is at about 52 deg., the next series, truncating the former facets, is at about 70 deg., while the edge is crushed down to about 102 deg. I think these values may also be taken as typical of the best eolithic work. There are, in both cases, large numbers of examples that do not show three sets of facets as above defined. There is often only one set. In all these respects, whatever is true of pressure-chipped flints is also true of the eoliths. It is inconceivable that they can have been produced by a different process.

S. HAZZLEDINE WARREN.

EXPLANATION OF FIGURES.

ARTIFICIAL IMITATIONS OF EOLITHS PRODUCED WITHOUT DESIGNED FLAKING.

Fig. 1. Two notches meeting at a point at a corner of the flint. Cartwheel flaking on a new road.

Fig. 2. Long and narrow flint, flat on one side and rounded on the side shown, found on a new road. A cartwheel, or cartwheels, had passed over the upper (rounded) surface, chipping both side edges by the reaction of the ground; and producing, *inter alia*, a notch on either side. Compare the eolithic type of Sir J. Prestwich, *Journ. Anthr. Inst.*, XXI., 1892, Pl. 19, Fig. 2.

Fig. 3. Tabular flint with reverse notches made from either side, and meeting at a point. This is a flint from river gravel, found upon a new road.

Fig. 4. Tabular flint with notch and chipped edges. Palæolithic Drift of High Down, Isle of Wight. Compare *ib.* Pl. 20, Figs. 4 and 5.

Fig. 5. A differently shaped flint operated on in the same way as above. Note the corresponding difference in its ultimate form. Remarkable parallel flaking has been produced which is best seen in the side view. Compare *ib.*, Pl. 19, Fig. 3.

Fig. 6. Tabular-shaped flint, with chipped end approaching the double notched form. Cartwheel flaking. Compare *ib.*, Pl. 20, Fig. 9.

Sinai.

Petrie.

Note on Semitic Worship in Sinai. By W. M. Flinders Petrie.

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I regret to see in MAN (No. 73) some more theories which seem impossible. The great bed of ashes on the hilltop at Serabit is, I see, not now referred to smelting, but to some undefined use of fire. Certainly any man using fire for warmth or cooking would be in the shelter of the valleys or mines, and not in the bleakest spot of all, in front of the sacred cave on the hilltop, which is distinctly a place for sacrifice. No burnt bones were found; and this is in accord with Semitic usage, as Robertson Smith (*Religion of Semites*) writes of "all the ordinary festal sacrifices, vows, and freewill offerings, of which the share of the deity was the blood and the fat of the intestines, " the rest of the carcase . . . being left to the worshippers to form a social feast."