IX. *On the Discovery of a Novel Type of Flint Implements below the Base of the Red Crag of Suffolk, proving the Existence of Skilled Workers of Flint in the Pliocene Age.*

By Sir Ray Lankester, *K.C.B., D.Sc., LL.D., F.R.S.*

(Received November 15,—Read November 16, 1911.)

[Plates 14–17.]

Contents.

1. *Introductory.*

The discovery to which this memoir relates was made by Mr. J. Reid Moir, of Ipswich, in the autumn of 1909. He had for some two or three years collected and become familiar with the well-known "almond-shaped" and more elongated "kite-shaped" forms of flint implements as well as the flakes and scrapers from the Pleistocene sands and gravels of the neighbourhood of Ipswich, where they are abundant. It occurred to him, in October, 1909, to examine some large flints which in small numbers were being turned out in a brickmaker's pit at Ipswich, from a bed forming the base of the Red Crag, resting on a well-marked surface of London Clay. The brickmaker's pit is a large one, lying one mile north of Christchurch Park, Ipswich, and belongs to Messrs. Bolton and Laughlin. An escarpment, nearly 300 yards long, has been formed by the removal of overlying strata in order to arrive at the clay used in brickmaking. It shows, at the spot where Mr. Moir found his first Sub-Crag implements, the following beds :—

1. Top sand and gravel, 7 feet.
2. Middle Glacial sands, 15 feet.
3. Decalcified Crag, with casts of shells, 3 feet, resting on
4. An uneven floor of London Clay, in the hollows of which are pebbles, large flints, box-stones and micaceous sandstone.

It was here, in October, 1909, that on the floor described as No. 4 in the above paragraph, Mr. MOIR found a large cylindrical nodule of flint (now in my possession), weighing $8\frac{3}{4}$ lbs. (fig. 38), worked at one end by rough but well-directed "flaking" into a cutting edge (figs. 39, 40). After a year's collecting from this and similar beds in pits in the neighbourhood of Ipswich, Mr. MOIR wrote the following letter to 'The Times,' which was published in that journal in October, 1910 :—

12, ST. EDMUND'S ROAD,
IPSWICH,
October 17, 1910.

To the Editor of 'The Times.'

SIR,—

It may be of interest to the Scientific world to know that, after a series of investigations in the Pliocene strata of Ipswich and East Suffolk, I have managed to find indisputable evidence of Pre-Crag man in the flint implements I have dug out from the base beds of many Crag sections in this district. The first discovery of these implements was from below a thin seam—about 3 feet thick—of decalcified Crag, surmounted by Middle Glacial sands and gravel, in two hollows in the London Clay at Ipswich; the worked flints which were lying on the London Clay were found to be in intimate association with a large number of the usual phosphatic bones and nodules found at the base of the Crag.

In July last the Geologists' Association of London visited my section, and though the flaked flints were immediately accepted as man's work, and the bones lying with them recognised as of Pliocene age, the general opinion was that there was no conclusive evidence that the Crag was *in situ*, and so I began investigations in other parts of Ipswich and the county where undisturbed Crag resting on London Clay could be seen.

These further investigations resulted in my finding flint implements exactly similar as regards method of flaking, type, and patination, at Buckanay, Foxhall, Greenwich Farm (Ipswich), and Thorington Hall, Wherstead, and afforded conclusive evidence that my first discovered specimens were also of Pre-Crag age.

The occurrence of these worked flints on the London Clay below Crag over such a large area points to the conclusion that the top of the clay was an old land surface inhabited by man, whose implements were covered up by the deposition of the Crag following the slow submergence of the London Clay.

My first implements, which have been unhesitatingly accepted by Dr. W. Allen Sturge, Dr. Corner, of Poplar, Miss Layard, F.L.S., of Ipswich, Mr. Percy Martin, and other authorities, though all of Pre-Crag age, can be divided up into at least two distinct types, which, by the difference of their flaking and patination, must be of different degrees of antiquity, and, what is even more interesting, exhibit over their worked surfaces, in many cases, extraordinarily deep and well-marked striations. If ice has been the agent responsible for them, to what glaciation can they be assigned? The implements themselves, one of which from Thorington Hall, Wherstead, has Crag-barnacles attached to the humanly worked surfaces, show large bulbs of percussion and long flaking, also both fine and bold edge-work.

They appear in some cases to have been used in the hand for smashing purposes, having splendidly adapted hand-grips and pointed ends. Split flint nodules with flat bases are undoubtedly rubbers, while the finely worked pieces which occur were no doubt used as skinning knives and scrapers.

My discovery, of course, means that our ideas of the antiquity of man must be somewhat altered, as these specimens, though of such an extreme antiquity, exhibit a knowledge of flint chipping far in advance of any Eolithic work, and the question arises, as this is so, to what period the Eoliths belong.

In conclusion, I would say that my implements, etc., can be seen by any one who cares to examine them, and the various places from which they are derived can most easily be visited and inspected.

I remain, Sir,
Yours faithfully,
(Signed) J. REID MOIR.

A few weeks after the publication of this letter, namely, on November 7, 1910, Mr. MOIR exhibited a large series of his Sub-Crag flint implements at a meeting of the Geological Society, and a paper by him on "The Flint Implements of Sub-Crag Man" was, after being read and discussed by the Prehistoric Society of East Anglia, published in the summer of 1911 in that Society's 'Proceedings,' accompanied by a report on the implements, written by a special committee of the Society. This report is signed by Colonel UNDERWOOD, Dr. ALLEN STURGE, Mr. W. G. CLARKE Miss NINA LAYARD, and Dr. FRANK CORNER, all of them most competent critics. They pronounced absolutely in favour of the human workmanship of the Sub-Crag flints submitted to their examination by Mr. MOIR—39 in number. They give a very minute and careful account of the flints, accompanied by photographs of five of them. They discuss several important matters in connection with the enquiry as to whether these particular specimens are to be considered as owing their chipped condition to human or to natural agency. They briefly refer to the little which is known as to the action upon flint of great heat, and of frost, of torrential water, of glaciers, and of the pressure of superjacent beds of sand and gravel, and they express the conclusion that the sculpturing of Mr. MOIR'S flints is due to none of these agencies, but to purposeful blows delivered by human beings.

Appended to the valuable report of this Committee, the Prehistoric Society of East Anglia publishes a brief but definite report on the geological horizon of the "stone-bed" or "bone-bed" in Messrs. Bolton and Laughlin's pit, from which the larger number of Mr. MOIR'S specimens have been obtained, others having been obtained from the basal bed of undoubted Red Crag resting on London Clay in other pits. This second report is by Mr. W. WHITAKER, F.R.S., Ex-President of the Geological Society of London, and by Dr. J. E. MARR, F.R.S., of Cambridge, also Ex-President of the Geological Society of London. These two geologists, after careful examination of the locality, state that in their opinion the stone-bed in the pit at Messrs. Bolton and Laughlin's brickyard, northward of Ipswich, is the undisturbed base of the Red Crag, and that the sand which overlies the stone-bed (the stone-bed in which the flint implements were found) in the Eastern Channel shown in the pit is, in part, decalcified Crag resting normally on the basement "stone-bed."

The number of specimens of worked flints discovered by Mr. MOIR in the basal bed of the Red Crag, as well as the number of localities in South-East Suffolk from which he has obtained specimens of this age, has largely increased since his publications on the subject. I paid a visit to Mr. MOIR in May, 1911, and examined his collection, and again in September. He has also been so kind as to lend me all the specimens in his possession which I desired to study at leisure, and to have drawn and photographed. I have also visited with him Bolton and Laughlin's pit, the "Back Hamlet" pit, and that of Thorington Hall, Wherstead, and have seen the exact conditions under which the specimens are found. In the

Back Hamlet pit I removed a large humanly-worked flint which a workman who accompanied us exposed with his pick in the stone-bed at the base of the Red Crag.

I may say that I happen to have an intimate knowledge of, and interest in, this stone-bed at the base of the Red Crag, for I was the first to draw attention to some of its special geological features and importance as long ago as the year 1865 ('Geological Magazine,' 1865, p. 104), and subsequently published an account of the "box-stones" of Diestian age contained in it, and proposed for it the name of the "Suffolk Bone-bed" (on account of the numerous fragments of Cetacean bones contained in it) as a parallel to the name given to the very similar "stone-bed" by the Rev. JOHN GUNN, on account of the large flints contained in it, which occurs at the base of the Norwich Crag. The existence of the Suffolk Bone-bed was first recognised by HENSLOW in the fifties, who drew attention to the commercial value of the phosphatised clay contained in it. It is mentioned and its lumps of phosphatised clay are noted by LYELL in his 'Elements of Geology.' The manufacturers of superphosphate manure in the later part of the last century purchased many hundred tons of phosphatised clay obtained from it by digging pits through the surface deposits and superjacent Red Crag so as to reach this basal bone-bed resting on the London Clay. A great area of agricultural land in the south-east of Suffolk was thus "turned over" between 1860 and 1890, and the phosphatised Eocene clay and water-worn Cetacean bones of the Diestian period were removed to be ground up in the superphosphate factories. It was found to exist beneath the Coralline Crag as well as beneath the Red Crag—where the former deposit rests on the old London Clay (Eocene) land surface. When these "diggings" were proceeding, the phosphatised clay nodules were separated by the workmen by sifting and washing away the Crag shell and sand and picking out by hand the large flints and Diestian box-stones dug up with them. Unfortunately, at this time the flints were not examined with any hope of discovering evidences of human workmanship among them. A great opportunity was lost, since we shall probably never again see so many acres exposed of the ancient land surface of South-East Suffolk and the "bone-bed" or "stone-bed" which rests upon it and contains its detritus. The large flints (some very large and unrolled, others of the size and shape of large potatoes) are scattered (not very closely) among the other contents of the bone-bed. They are removed by the so-called "coprolite-diggers" and carted away by the farmers to mend roads. The Diestian "box-stones" were sought after by myself and other collectors, and I was able to publish ("Contributions to a Knowledge of the Newer Tertiaries of Suffolk and their Fauna," 'Quart. Journ. Geol. Soc.,' vol. 26, 1870) a list and figures of several species of Mollusca contained in them, proving them to be the detritus of a Pre-Crag deposit of the same age as the Diestian or so-called "Black Crag" of Antwerp.

Whilst my early familiarity with the Suffolk bone-bed has enabled me to form a definite judgment as to the geological questions connected with Mr. MOIR'S

discovery, I am chiefly anxious in the present publication to place before the reader the evidence as to the human origin of the chipping of the flints obtained from this bed by Mr. MOIR, in a more convincing way than has been possible in the small but most careful and valuable publications which we owe to him and the Committee of the East Anglian Prehistoric Society. The unassailable demonstration of the existence of man in the Pliocene period is a matter of such immense scientific importance that it is desirable at once to employ for that purpose an adequate publication of illustrations by means of trustworthy drawings and photographs of the worked implements which are the evidence upon which that demonstration depends.

I have been able to select from among the worked flints discovered by Mr. MOIR in the Suffolk bone-bed—or basement bed of the Red Crag—a series of one definite shape and manufacture, which carry conviction as to their human origin, when seen and examined side by side in considerable number. To the specialist, a single one of these implements gives convincing evidence of its human history by the character of its "flaking," which can be produced by no other agency than that of fracturing blows delivered with the aid of a hammer-stone by an intelligent being. But a very important and, to many minds, a more convincing evidence of their human origin is the coincidence in a large series of these chipped flints of a peculiar shape given to the flints by fracture. This shape is undeniably that of a definite tool or implement which might be used by primitive man. The shape in question is that of a beak-headed hammer, one end of which is broad and heavy, whilst the other is chipped into the form of an eagle's beak (fig. 1). My purpose, then, is to place before the reader drawings of a series of these "eagle-beaks" or "becs d'aigle"—or "rostro-carinate implements!" I shall also show that flint implements of this form are not as yet known to students of archæology, and I shall discuss some points connected with their probable history and employment. They are the implements mentioned in Mr. MOIR's paper and the East Anglian Society's report as "beak-shaped implements." I have also reproduced here drawings of some other remarkable worked flints obtained from the Pre-Crag horizon by Mr. MOIR—but the full illustration of all the forms (numerous and varied) of humanly-worked flints discovered in this horizon must be the work of later years, when further collections have been made.

2. *The Evidence as to the Provenance of* Mr. MOIR's *Sub-Crag Flint Implements.*

Apart from all the questions which may be considered and discussed when it is once admitted that flint implements of human workmanship have been actually taken out in quantity from the geologically undisturbed "bone-bed" or "detritus-bed" at the base of the Red Crag, in localities where it, the bone-bed, lies beneath a thickness of some feet of undisturbed Red Crag—the important question is, "What is the evidence upon which this admission as to the exact 'provenance' of the flint implements in question is based?"

The evidence is, firstly, the statement of Mr. Moir, that he has himself removed some of the "implements" from freshly-exposed undisturbed "bone-bed" overlaid by Red Crag, that he has seen others so removed by workmen employed by him, and that he has found others in such association with other flints and box-stones thrown out by workmen engaged in digging, as to render it highly probable that they were dug out together from one horizon. Secondly, I am able to add my personal testimony that I removed a large flint flaked by human work from the bone-bed (stone-bed) overlaid by shelly Crag in Back Hamlet Pit. But to this must be added, thirdly, the evidence afforded by the condition of the flints themselves. The "café-au-lait" staining and surface glaze of some of Mr. Moir's worked flints is characteristic, and agrees with that of large flints from the bone-bed, in association with which they are stated by workmen to have been found, and differs from the colour and glaze of flints from higher horizons in the same locality. But not all the exposures of bone-bed present this strong coloration of their contained flints; in some localities they are paler, and have also a "glaze," which is characteristic. The flint implements from that second group of localities have the colour and glaze of the bone-bed flints of the locality. As an example, I may cite the pit at Thorington Hall, Wherstead, which I visited, in company with Mr. Moir, in May last. The flints (both ordinary specimens and implements) found in the bone-bed there have a whitish, cream-coloured surface. The evidence which enables an expert in the flints of various beds and horizons, which he is continually handling, to distinguish the exact locality and horizon from which each comes, is not easy to describe in words. It is not, in fact, possible to enable a reader to recognise such characters by description; specimens must be seen and compared. Mr. Moir has this experience and capacity, so also have the members of the Committee of the East Anglian Prehistoric Society who drew up the report accepting Mr. Moir's conclusions. To some extent, I have this knowledge myself, and I do not hesitate to associate certain of Mr. Moir's worked flints with the unworked flints occurring in the bone-bed at the localities of Bolton and Laughlin's pit, and at the Thorington Hall pit, where they were obtained by workmen employed to dig for them in the basement bed of the Red Crag. Of other specimens and localities I am not able to speak, but I fully accept, as do such experts as Dr. Allen Sturge, Colonel Underwood, and Miss Layard, Mr. Moir's judgment in such cases as we have not personally examined. Mr. Moir had no hesitation in pronouncing the little hooked flint implement (fig. 6) to be not Sub-Crag, but Mid-Glacial, in origin, although it was found in the pit where the Sub-Crag implements occur. He was able to do this by his knowledge of the surface colouring and texture of the Mid-Glacial flints of the locality. It is impossible to submit the fine details of colour and surface—even by means of highly finished coloured plates—to the reader. The only way in which an appreciation of this evidence can be arrived at is by personal examination of actual specimens. It is possible that, at some later day, we may be

able to make such microscopic study of the surface of flints as will enable us to distinguish by definite minute structure of the flint, which can be measured and pictured, the flints of one horizon and bed from those of another, and so enable us to assert on such tangible evidence that flint A comes from the same bed exactly as flint B, and not from the bed which sheltered flint C. But at present we have to make use of differences of colour and glaze and other slight features, which can be depended upon, but cannot be reduced to pictorial reproduction, to measurement, or to intelligible description.

3. *The Geological Age and Conditions of Deposit of the "Stone-Bed" or "Bone-Bed" at the Base of the East Anglian "Crags."*

A full knowledge of the materials which enter into the composition of the Suffolk "bone-bed" or "detritus-bed," of which one element is furnished by the flint implements discovered by Mr. Moir, is necessary in order to arrive at a conclusion as to the age of those implements and the circumstances under which they were deposited in this position at the very base of the Red Crag. It is necessary not merely to have a catalogue of these constituents of the bone-bed, but an account of their proportion to one another, of their variation in different localities, and of the local deposits of Pre-Crag age from which they may have been derived, whilst at the same time we should form a judgment as to the mode and the succession of events by which they have been brought together and laid down as a composite deposit on the surface of the London Clay as the first or basal deposit of the Red Crag.

This problem has been somewhat neglected since the time (1870) when I first drew attention to it, and I am not able to do more than give incomplete observations of my own on the subject. The leading feature of this bed is that it is from 12 to 20 inches thick, though it has sometimes been dispersed by later deposit and becomes either ill defined or lost altogether.

It contains (*a*) material derived from the Chalk; (*b*) from the London Clay; (*c*) from a Miocene land surface; (*d*) from a marine Pliocene deposit (the Diestian sands); (*e*) from the earlier conditions of a land surface which emerged after the Diestian deposit; and (*f*) from later conditions of the same land surface.

The relations of the south-east coastal region of East Anglia to the neighbouring sea have been, since the emergence of the chalk as a tract of dry land, remarkably constant, in so far as this, viz., that the coast-line was formed in approximately its present position in the early Post-Cretaceous period. The sea which is at present the southern portion of the North Sea was very nearly where it is now, washing the shores of a Cretaceous land surface, but shut in to the north by land (now vanished) which extended from Britain to Scandinavia. The sub-litoral deposits of the Lower Eocene (London Clay) were laid down here, and the immediately adjacent land surface was successively raised and depressed throughout the Tertiary period. The

persistent sea was not in continuity with the cold waters of the Sub-Arctic portion of what is now the North Sea, but had a varying extension southwards on the one hand across Central Europe, and on the other hand in the western direction to the Atlantic. A distinctly southern, non-boreal character is shown by the successive deposits (often small and fragmentary in what remains of them) until the period of the Red Crag. It was then that the northern barrier, the land surface stretching from Britain to Scandinavia, was destroyed and the cold waters and Arctic marine fauna invaded the warm area of "the German Ocean." The Coralline Crag belongs to the still warm period. A few of the fine southern Mollusca of the Coralline Crag, such as *Voluta lamberti*, *Cassidaria bicatenata*, *Pleurotoma intortum*, and the Brachiopod *Terebratula grandis* survived for a brief time in the Red Crag period and are found in its earliest deposits but they rapidly became extinct and the higher deposits of the Red Crag assume a more and more boreal character. There is no line of separation, no difference of physical character nor any important change in the molluscan fauna between the great bulk of the Red Crag deposit and those beds which we know as the Norwich Crag.

An erroneous conception as to the age and character of the Red Crag sea was formed by geologists in the middle of last century by the confusion of its proper marine fauna with the remains of Pliocene (and even of Eocene) land mammals and of Cetacea which occur in the detritus-bed at its base, and were not living during the Red Crag period. The close contiguity of the Coralline Crag and the temporary survival of some of the Mollusca which flourished in the conditions proper to that earlier deposit, as well as the washing up of their broken shells into beds deposited later than those during the deposition of which they were living, have assisted in leading geologists to assign to the Red Crag an earlier age than that which is proper to it. The line between Pliocene and Pleistocene should be, I submit, drawn at the commencement of the glacial conditions which set in at the beginning of the Red Crag deposit, and that line should separate the Coralline from the Red Crag. The former is still Pliocene, the latter is the earliest Pleistocene. An important piece of evidence in this matter, proving that the basal deposit of the Red Crag, the bone-bed or detritus-bed of Suffolk, was subsequent to the glaciation of the land surface, is the discovery by Mr. Moir of glacial scratching on the humanly fractured flints found in that basal deposit. The evidence of this most important fact is given below (text-figs. 17, 19, 21, and Plate 17). It comes as a confirmation of a conclusion arrived at by Lyell from the presence in the basal beds of huge unworn chalk flints. He says ('Student's Elements of Geology,' 1874, p. 182):

"The transport of blocks by ice, when the Red Crag was being deposited, appears to me evident from the huge size of some irregular, quite unrounded chalk flints, retaining their white coating, and 2 feet long by 18 inches broad, in beds worked for phosphatic nodules at Foxhall, four miles south-east of Ipswich. These must have been tranquilly drifted to the spot by floating ice. Mr. Prestwich also mentions

the occurrence of a large block of porphyry at the base of the Coralline Crag at Sutton, which would imply that the ice action had begun in our seas even in this older period. The cold seems to have gone on increasing from the time of the Coralline to that of the Norwich Crag, and became more and more severe, not perhaps without some oscillations of temperature, until it reached its maximum in what has been called the Glacial period."

The Sub-Crag detritus-bed or bone-bed, when well defined, is from 12 to 20 inches thick, harder than the shelly Crag above it, and its larger contents are embedded in a fine, often argillaceous, sand, which is frequently (though not always) of a pale yellow colour and not so deeply iron stained as the Crag above it.

The materials found in this bed may be enumerated and their relative quantity and condition noted as follows, in an order which has reference to their mode of arrival in that deposit :—

1. *The remains of a Pliocene deposit anterior to the Coralline Crag and identified by its fossils with the Black Crag or Diestian Sands of Belgium.* These consist of:

(α) Abundant nodules, some almost spherical, others irregular but rounded and water worn, of a glauconitic sandstone, often containing the hollow casts of shells, whence the nodules are termed " box-stones."* These pieces are usually of the size of a large potato. They occur, not closely set together, but in fair abundance. In most localities where the bone-bed has been exposed in the south-east of Suffolk they may be estimated as three or four to the square foot exposed. In many places they are more abundant than flints, but as might be expected their quantity varies in different localities of the Crag area.

(β) Pieces of Cetacean bone, very fragmentary, and not merely water-worn but partly dissolved. They belong to Cetacea which lived in the Diestian sea, and were very abundant. These, and the teeth of Cetacea and of sharks of known Diestian species (Oxyrrhina and Carcharodon), are at the present day about a twentieth of the bulk of the box-stones in an average sample of the bed. Occasionally these teeth and bits of bone are embedded in the nodules of Diestian sandstone.

(γ) One tooth of a pre-Diestian mastodon—a member of the Miocene fauna (not to be confused with a later Pliocene mammalian fauna), which had lived on the land surface and disappeared—has been described (see LANKESTER, 'Geol. Mag.,' 1899, p. 289) embedded in a nodule of Diestian sandstone.

(δ) Rounded, almost spherical flints mixed with the Diestian box-stones, and of size and appearance very similar to the box-stones. They are usually about the same in number as the box-stones.

The elements of the bone-bed just cited were derived from the breaking up, on the spot, of an extensive Diestian deposit. The flints were probably derived from the chalk and rubbed down and rounded by the Diestian sea, but may be due to the action of a *later* beach-forming incursion of the sea. They do not owe their condition

* This term was introduced by me in 1870. See 'Quart. Journ. Geological Society,' vol. 26, p. 493.

to the waters which deposited the bone-bed. The nodular form of the box-stone fragments of Diestian sand is probably due to beach-rolling of harder bits of the Diestian deposit in association with the flints, when the Crag sea (before Coralline Crag times) first invaded this area where the Diestian deposit was already in place. But such beach action was anterior to the deposit of the bone-bed. There is evidence that that deposit was made in tranquil water and not accompanied by beach action.

2. *The remains of a higher bed of the London Clay similar to that of Sheppey*, and containing numerous fossil Crustacea, shark's teeth, Chelonians, etc., and also mammalian teeth (Coryphodon and Hyracotherium). This breaking up of London Clay beds probably took place (as is the case with regard to the materials mentioned in Section 1) *after* the Diestian deposit and in an early phase of the Coralline-Red Crag sea before any now-existing deposit was formed by it. Probably a beach was produced in which an immense quantity of the bones of Cetacea from the broken-up Diestian deposit were associated with slabs and irregular pieces of the Eocene Clay. The bones were to a large extent dissolved, and the dissolved phosphate of lime was taken up by the clay (as occurs elsewhere), forming the phosphatised bits of clay dug for and sold under the name of "coprolite." The clay exposed in this shallow sea was perforated by boring Mollusca (of still living species) and the larger pieces of bone were also to some extent attacked. The total bulk of phosphatised clay lumps in the Suffolk bone-bed is about equal in most localities to that of the box-stone nodules, in some places more bulky. This phosphatising beach and sea certainly preceded the deposit of the Suffolk detritus-bed, and was anterior to the Coralline Crag as well as to the Red Crag. All the materials of the bone-bed underlying the Red Crag so far enumerated, that is to say box-stones, Cetacean bones, round flints, and phosphatised clay lumps, have been found in a similar bed exposed at the base of the Coralline Crag at Sutton.

3. *Detritus from the land surface removed by slow running water and carried seawards by land ice and floating masses of ice*, at a period subsequent to the breaking up of the Diestian deposit and subjacent clay. Possibly, and even probably, the greater part of this action took place after the Coralline Crag was formed. Hitherto its products have not been found in the bone-bed below the Coralline Crag which is otherwise similar to that below the Red Crag. To ice action we owe the presence in the bone-bed immediately below the Red Crag (*a*) of very large flints of irregular, unworn shape; (*b*) of the flint implements of various shapes and sizes which are described in this memoir and are often found to bear characteristic scratches due to glacial action; (*c*) of the enamel crowns of a series of mammals of late Pliocene age (to be distinguished from an earlier Miocene series*), including as the most frequent and characteristic form *Mastodon arvernensis*. There is, it should be at once pointed out, no evidence that the makers of the flint implements were contemporaneous with

* Also present in small number, including *Rhinoceros Schleiermacheri*, Hyænarctos, Hipparion, and trilophodont mastodons. These should have been enumerated as (*d*).

the *Mastodon arvernensis* fauna. It is quite possible that the teeth of the latter were embedded in shallow fresh-water deposits, and that the great mammals from whose jaws they came had ceased to exist before the men who made the Sub-Crag flint implements arrived on the scene, although both the teeth and the implements were carried simultaneously from their resting place by ice and land water and were mixed with its other constituents to form the remarkable detritus-bed or bone-bed at the base of the Red Crag. It is also possible that the makers of the flint implements were far more ancient than the *Mastodon arvernensis* fauna.

It is obviously desirable that a careful geological study of the features presented by this bed where it occurs at the base of the Red Crag should now be set on foot. It is equally obvious that the similar bed at the base of the Coralline Crag at Sutton should be carefully explored, and the conditions of its accumulation determined. Mr. Moir and I have in the past autumn opened up this bed at Sutton close to the spot where I found and described it in 1865.

An account of this enquiry will be published in due course, but I may say that the bed contains phosphatite, many Diestian box-stones, Cetacean bones, and very few flints. None of the characteristic flint implements, no very large flints nor mammalian enamel crowns have yet been found in the bone-bed beneath the Coralline Crag, but Mr. Moir discovered in that deposit, at Sutton, a fragment of a flint flake of creamy colour which he considers to be of human workmanship.

The men who made the Sub-Crag flint implements existed on an extensive land surface which touched the sea line at that spot which is now East Suffolk. Probably they were there during a period of mild climate coincident with the deposit of the Coralline Crag. Whether they were there earlier, whether they ranged far over the land surface of what is now Great Britain, and whether they were contemporaneous with the late Pliocene mammalian fauna, characterised by *Mastodon arvernensis*, or with an earlier or a later mammalian fauna, are matters which remain for further investigation. It seems that it would not be reasonable to put forward any opinion on that point in our present state of knowledge. But one important fact is clear and well established—the men who made these flint implements, and left them on the Suffolk land surface, did so before the Red Crag was deposited.

The time-relations of the Red Crag, and the subsequent glacial series of East Anglia, to the river gravels of the south of England and the north of France, in which flint implements—differing altogether from those of Pre-Crag age—are found, are quite undetermined. But we may expect further information on this subject at no distant date from the able geologists who are engaged in the study of it.

4. *Description and Illustration of the Rostro-Carinate Implements or "Eagle-Beaks"* (Becs d'aigle) *Discovered by* Mr. Moir.

The best way to enable the reader to form a judgment with regard to the human authorship of the rostro-carinate implements found beneath the Red Crag of Suffolk,

is for me to present a diagrammatic figure of the shape of the implement, in a perfected or idealised state of "finish"—a shape at which the prehistoric workman was aiming, so far as we can judge by an examination of many examples of his efforts. This is given in fig. 1. The implement differs entirely from any implement of Palæolithic age hitherto described (with one remarkable exception mentioned below). It resembles a hammer-head with broad posterior region, narrowed anteriorly to a quasi-vertical cutting or chipping edge. Some hammers made for geologists have

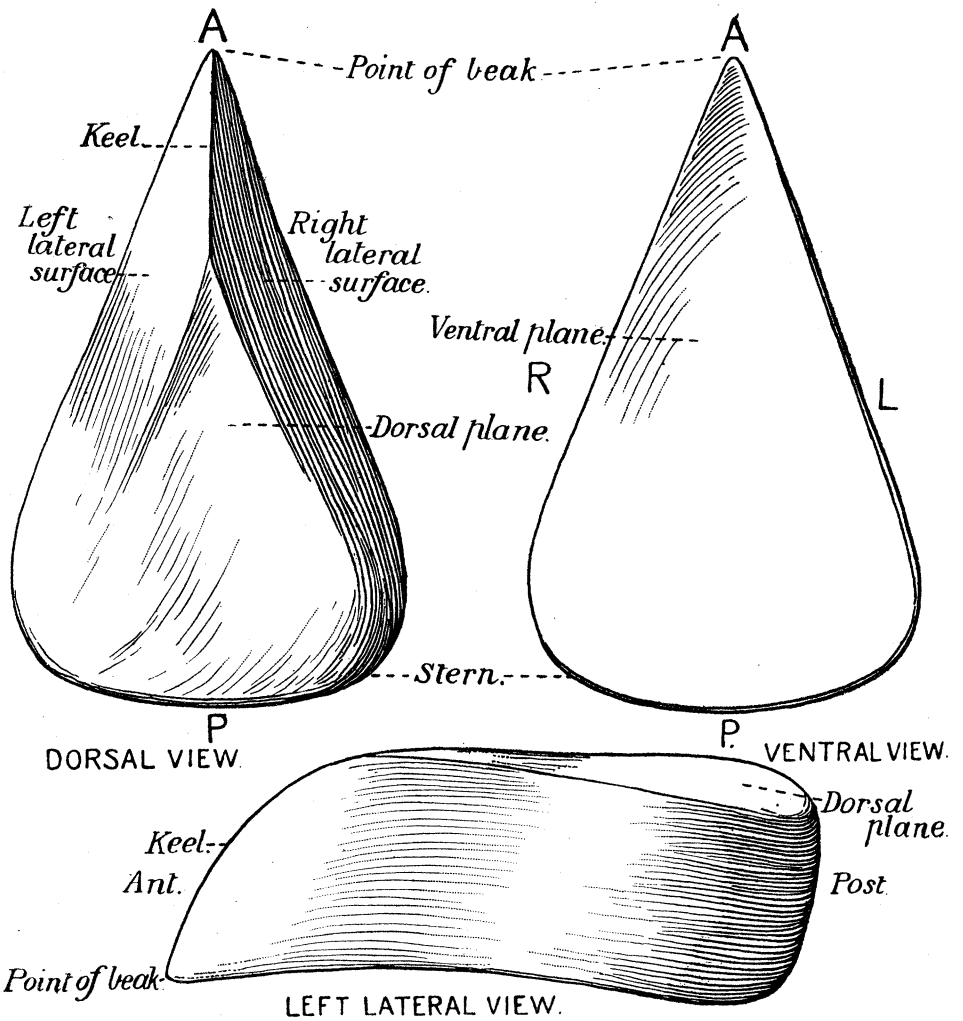


FIG. 1.—Diagrams showing the ideal form aimed at by the makers of the Rostro-carinate flint implements or "Eagle's Beaks" (Becs d'aigle). A, anterior; P, posterior; R, right; L, left.

somewhat this shape, but in them the vertical anterior cutting edge is truly at right angles to the upper and lower parallel faces of the hammer. In the Pre-Crag implements the anterior narrow edge—though tending to the vertical—is strongly curved and gives the implement the form of the beak of an accipitrine bird. The form of this region of the implement may also be compared to that of the prow of a boat (the boat being turned keel upwards). We distinguish (keeping the

prow or beak to the front) an upper or dorsal plane, a lower or ventral plane, a right lateral and a left lateral surface, a posterior surface or stern (P in the figure), usually very irregular, heavy and roughly shaped as though for holding in the hand, and an anterior surface, narrowed to the form of a keel and ending in a beak (hence we call the implement "rostro-carinate") as a consequence of the oblique direction and convergence of the lateral surfaces, which approach one another so as to leave only a narrow keel-like ridge between them. We usually see this keel or "carina" reaching forward from the broad middle and posterior portions of the upper surface of the implement, as a very distinct and leading feature in its sculpture (K in figs. 8, 11, 14, 15, 22, 23). In the most simply worked specimens (for instance that drawn in fig. 22) it is obvious that three blows have been enough to effectively fashion the "eagle's beak" from a specially selected piece of flint of appropriate form. A blow to the right and a blow to the left clear away the flint so as to leave a narrow ridge—the keel separating the two obliquely directed surfaces—a third blow trims the lower face of the flint so as to give one unbroken plane surface (see X, in figs. 9, 18, and in figs. D, G, and I of Plate 15). A little trimming of the edges is all that remains for the tool-maker to do. But many of the implements are more elaborately worked by repeated flaking, so as to arrive more completely at the ideal shape.

Rostro-carinate Implements from Deposits (Mid-Glacial) later than the Red Crag.—The implement B drawn in text-figs. 2 and 3 and in Plate 14, figs. B, B, is the most shapely of the "eagle-beaks" yet discovered. Advantage has been taken (as is so often the case in the most ancient flint implements) of the natural shape of a flint nodule. In this case it was fairly triangular. The workman had only to trim one side and a portion of the other, and to chip out the characteristic curved keel—and then remove a small bit of the anterior lower surface (fig. 3, X). This implement was found in a stone-heap in a Crag-pit at Foxhall and is probably derived from Mid-Glacial sands overlying the Red Crag—a provenance which is certain with regard to specimen C and is also in the highest degree probable in the case of specimen A. These implements—specimens A, B, and C—are accordingly to be regarded apart from those obtained from the Sub-Crag bone-bed. They are from a later horizon, which is nevertheless a very ancient one, older than any of our river-gravels. It is a very remarkable fact that they are of the hitherto unknown "rostro-carinate" form characteristic of the Sub-Crag bed, though more highly finished than the latter and occurring in the same locality.

Last August, I showed this implement to Sir ARTHUR EVANS, F.R.S., who was set thinking by it; and, after a few minutes' search, produced from the collection of his father (the late Sir JOHN EVANS, F.R.S.), of which he is now the possessor, the remarkable implement represented in the text-figs. 4 and 5, and in Plate 14, figs. A, A. It is the only flint implement of this type which was known to Sir John, and I have been unable to discover that any others resembling the rostro-carinate

eagle-beaks of the Sub-Crag deposit of East Anglia are known.* Polished stone hammer-heads of the Neolithic period are known which are perforated for a handle, and have only one end worked to a cutting edge, and that a vertical edge. Several such are figured by Sir JOHN EVANS in his 'Ancient Stone Implements,' second edition, 1897 (see his figs. 125, 127, and 131). They resemble, to a certain degree, the modern geological hammers already cited. The nearest approach among Neolithic implements to the Suffolk "eagle-beaks" is a greenstone imperforate celt—intended for use in the hand without hafting. This is drawn in fig. 83 of Sir John's book; it has a somewhat curved vertical cutting edge giving a keeled or carinate form to the cutting end of the implement, the other end is squared and rough.

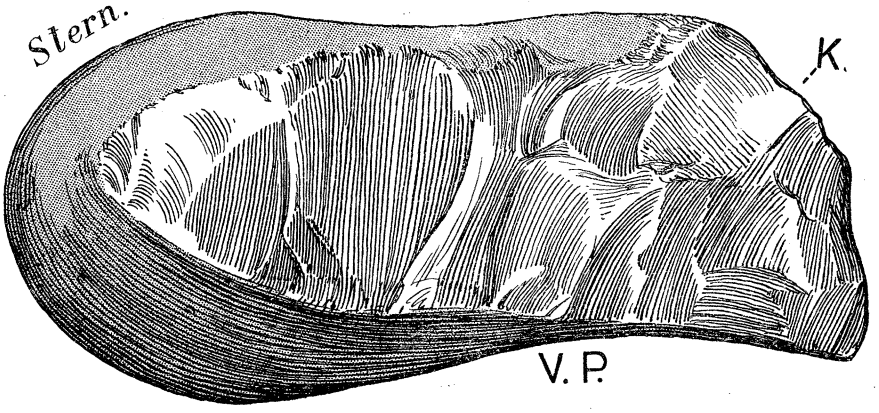


FIG. 2.—Specimen B of the photographic plates (which should be compared with this figure), found by Mr. MOIR not *in situ* but on a heap of flints thrown out from the Foxhall Crag Pit, near Ipswich. On account of its more abundant flaking and 'finish,' as well as on account of its colour and glaze, I regard this implement as not being one of the Sub-Crag implements. I believe it to be derived from sands of Mid-Glacial age, which overlie the Red Crag. Specimen A probably belongs to that age, and specimen C certainly does so. The Mid-Glacial sands of East Anglia are usually regarded as much older than any of the river-valley gravels. View of the right lateral surface, showing much flaking. The parts tinted by a fine mechanical "grain" are the unbroken surface of the flint pebble from which the implement was made. K, the keel; V.P., the ventral or lower plane surface. Drawn of the actual size.

The flint implement (specimen A of this memoir) which was shown to me by Sir ARTHUR EVANS, and has been kindly lent to me by him for further study, is figured by Sir John in fig. 444 of his book, p. 567. He writes of it as follows:—"The curious implement shown in fig. 444, which was presented to me by Canon GREENWELL, F.R.S., was procured from a Lakenheath workman, but it is not certain whether it was found in the gravel near that place, or in one of the pits near Brandon. It differs from all other implements that I have seen from the river-drift in having an oblique hatchet-like edge at the end, so that the side view somewhat resembles that of the iron *Francisca* of Saxon times. A considerable portion of the original crust of the flint remains at the butt-end. Until other specimens of the

* See, however, the postscript to this memoir added in February, 1912 (p. 332).

same form are discovered, it is hardly safe to regard this as furnishing an example of a new type of implement; yet its symmetry and character seem to prove that it was designedly chipped into this form, to fulfil some special purpose." No one, I think, on looking at the figures here given (text-figs. 2 and 3, and A, A in Plate 14) of the Lakenheath specimen, and comparing them with those here given of the Pre-Crag "eagle-beaks," will doubt that the former is of the same type as the latter. The "other specimens of the same form," looked forward to by Sir John,

FIG. 3.—Specimen B. View of the ventral or lower surface. The area tinted by a fine "grain" is the unbroken surface of the flint pebble from which the implement was made. X points to a flat and smooth fracture-surface which is seen in other specimens in this position, just below the beak-like end of the implement.

have been discovered. I regret that this great authority was unable to suggest the special purpose to fulfil which this type of implement was designed—the more so as I have not been able to come to a definite conclusion, myself, on the subject. The Lakenheath specimen is somewhat more skilfully finished, and its anterior edge is better preserved than is the case with any of the Sub-Crag specimens—otherwise it might pass for a Sub-Crag specimen, so far as shape is concerned. The flint is not so deeply stained with iron as are most (though not all) Sub-Crag specimens. It is assuredly significant that this, the only rostro-carinate rough flint implement known

before Mr. MOIR's discoveries, should also come from Suffolk—not more than 35 miles north-west from Ipswich. Though apparently originally discovered in a Mid-Glacial Pleistocene deposit, it is nevertheless possible that it was derived from the old land surface of Pre-Crag age.

Remarkable as this independent discovery of a "rostro-carinate" flint implement is, it is paralleled both by that (specimen B) which led Sir ARTHUR EVANS to call it to mind and by the discovery of another, more highly finished than any yet known, also not obtained from the Pre-Crag horizon. This beautiful little implement (specimen C, text-figs. 6 and 7, and Plate 14, C, C) was obtained by Mr. MOIR from the Mid-Glacial sands which overlie the Red Crag in Messrs. Bolton and Laughlin's pit. It is more minutely chipped than are any of the Pre-Crag specimens, and is of a perfected hook-beaked form, facts which may suggest that it is the work of a later

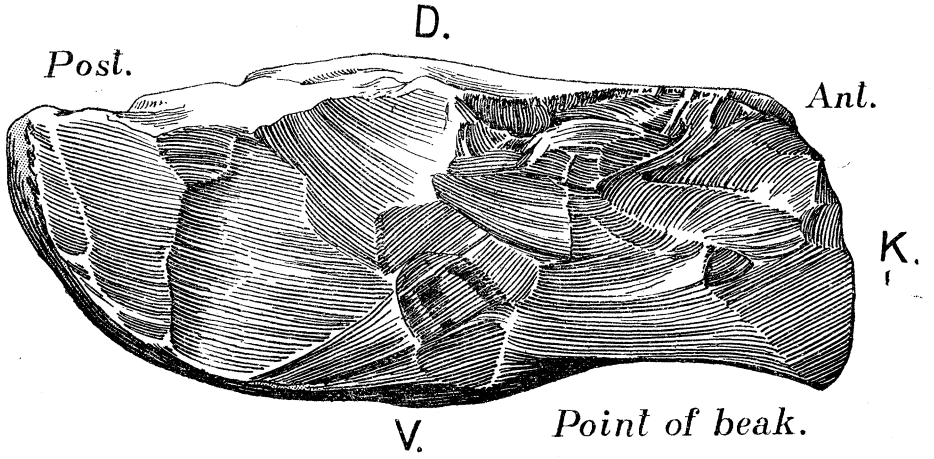


FIG. 4.—Specimen A of the photographs in Plate 14 (which should be compared). Sir JOHN EVANS' specimen from Lakenheath, in the neighbourhood of Brandon, Suffolk. View of the right lateral surface. K, keel; D, dorsal, and V, ventral surface. This drawing is two-thirds of the actual size (linear). The left lateral surface is shown in Plate 14, as also the dorsal surface.

and more accomplished age than that of the Pre-Crag "eagle-beaks." It bears no evidence of having been derived by the Mid-Glacial deposit from subjacent Red Crag, though it may have been swept up from the Pre-Crag land-surface. The occurrence of eagle's beak flints in sands above the Crag, at the very spot where Pre-Crag specimens occur, must suggest the possibility of the persistence of the race of "eagle-beak" makers in this locality from Pre-Crag to Mid-Glacial times. But we are not yet in a position, owing to the newness of the discovery of this type of implement, to come to a definite conclusion as to the history of these implements from the Mid-Glacial sands prior to the day on which they were embedded in that deposit.

The Sub-Crag Rostro-carinate Implements.—The line-drawings reproduced in the text-figs. 8 to 23 and the explanatory remarks which accompany them will, together with a reference to the reproductions of photographs of the six specimens D to I—given in Plates 15, 16, and 17—enable the reader to form a clearer conception of the

rostro-carinate implements from the bone-bed or detritus-bed at the base of the Red Crag than any written description of each specimen. The text-figures are all of the natural size. The adequate illustration of flint implements by means of photographs is an extremely costly thing, involving the production of three or four views of each specimen of natural size. I have therefore presented in the text of this memoir somewhat rougher but effective line drawings prepared by a competent artist, Miss GERTRUDE WOODWARD. They give satisfactorily the form and size of the

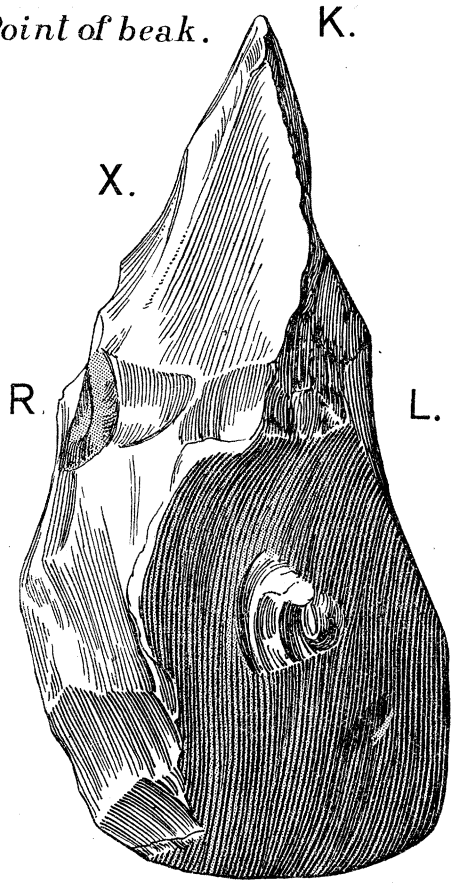


FIG. 5.—Specimen A (Sir JOHN EVANS). View of the ventral or lower surface. R, right; L, left side; K, keel and beak; X, the plane fracture extending backwards from the beak. The "grain" indicates unbroken surface of the original pebble. The upper or dorsal surface is shown in a photograph in Plate 14, fig. A.

implements but the glaze and smoothness of the surface is obscured by the line-work of the drawing, which is liable to be misinterpreted as representing actual striation of the surface of the flint. This misinterpretation is corrected by the photographic plates (Plates 15 and 16), which give views of the same implements of approximately half the lineal measurement of the objects themselves. The fault of the photographs, on the other hand, is that the mottled colouring of the flint often gives an erroneous appearance and obscures the form. It is also impossible to obtain one picture representing the flint in only one play of light which shall satisfactorily catch every

detail of the irregular and often glistening surface. In the fourth plate (Plate 17) I have made use of a third method. Two very careful monotone paintings of specimen H, made by Mr. H. GRONVÖLD under my direction, have been reproduced by the half-tone process. They give better than any other method which I have tried an adequate representation of the details of form of the flint and of the character of its surface. It would have been too costly a business to represent all the specimens in this way. I may here also draw attention to the method made use of in the case of the text-figs. 11 and 27 to 37. The drawings for these have been made upon

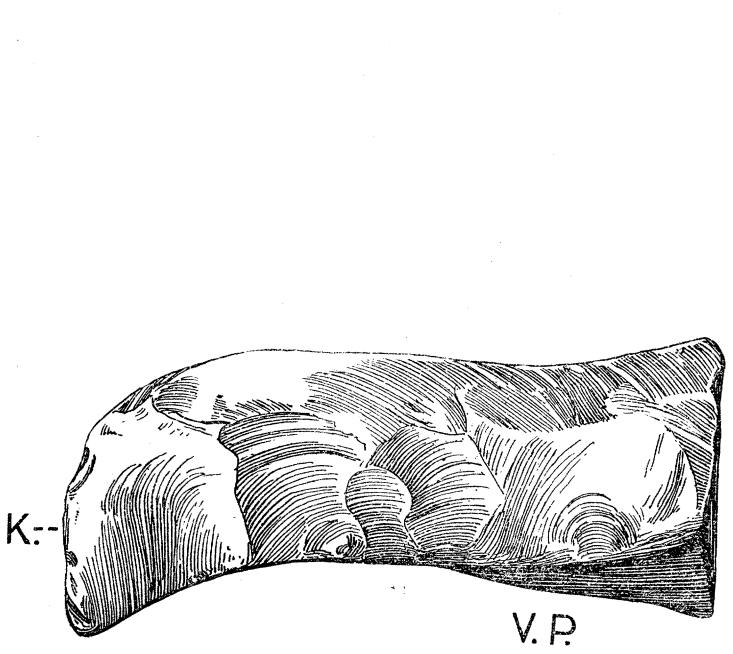


FIG. 6.

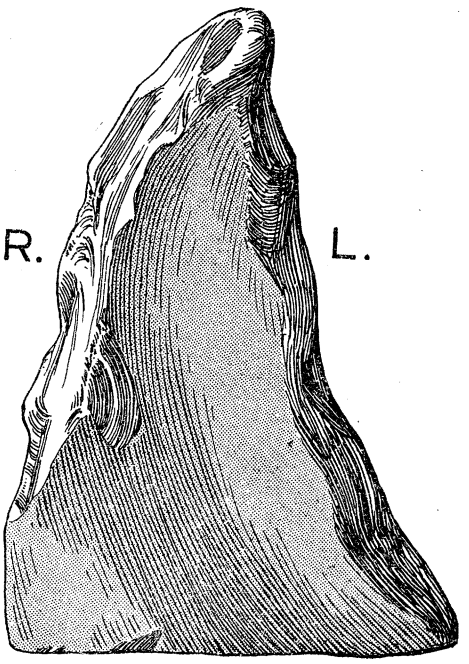


FIG. 7.

FIG. 6.—Specimen C (compare the photographs marked C in Plate 14), from Mid-Glacial sands at Ipswich. View of the left lateral surface. K, the keel; V.P., the ventral plane. Drawn of the actual size. This is the most highly finished of the rostro-carinate implements yet discovered. It and the two implements distinguished as A and B are the only specimens figured in this memoir which have not been taken from the Sub-Crag detritus-bed.

FIG. 7.—Specimen C (compare with the photographs in Plate 14). View of the ventral surface. R, right; L, left side. The fine grain tint represents the unbroken surface of the flint-pebble from which the implement was made. Drawn of the actual size.

granulated paper with chalk so as to resemble lithographs and have been reproduced by the same photographic process as that applied to the line-drawings. They have the advantage of avoiding the possible false suggestion of linear markings on the flints which is the objection to the line-drawings.

The simplest of the implements figured, showing the plan of workmanship in the most obvious way, is that drawn in the text-figs. 22 and 23.

With this preface I now submit the text-figs. 8 to 23 in order. Each specimen which is also figured in the photographic plates is distinguished by a capital letter, as *e.g.* "Specimen D," etc.

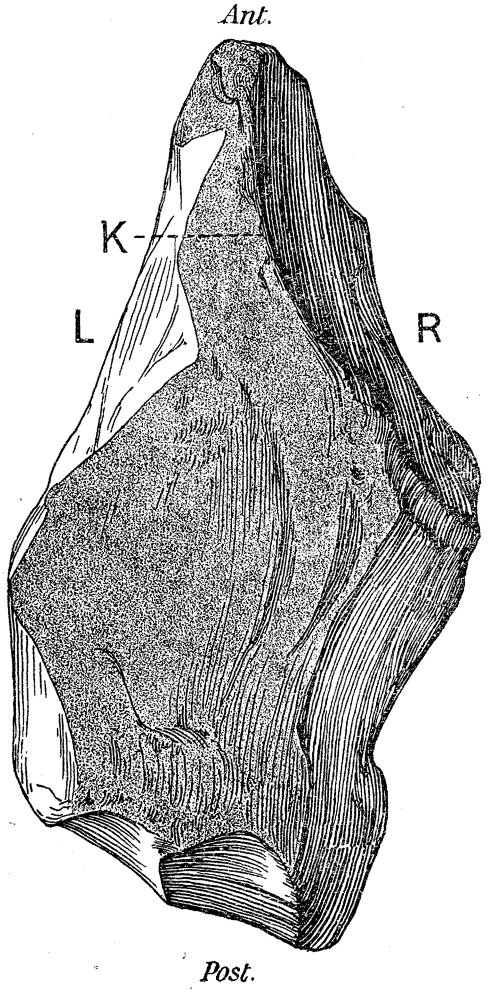


FIG. 8.

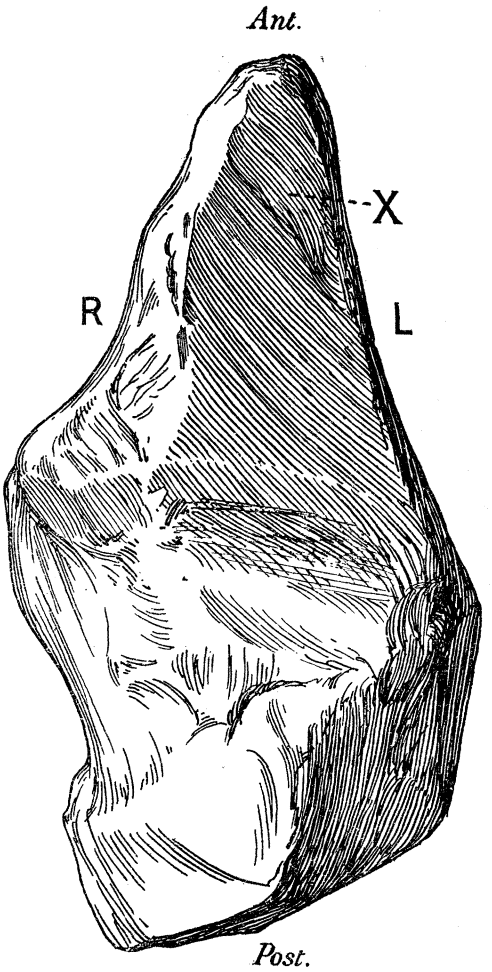


FIG. 9.

FIG. 8.—Specimen D (compare the photographs in Plates 15 and 16). Dorsal view of a Sub-Crag rostro-carinate implement removed by J. REID MOIR from the bone-bed in Bolton and Laughlin's Pit, Ipswich. L, left; R, right side; K, the strongly-marked keel. The fine grain tint marks the unworked surface of the flint. Drawn of the actual size.

FIG. 9.—Specimen D. Ventral view. R, right; L, left side; X, the special flat fractured surface immediately below the beak. Drawn of the actual size.

NOTES TO FIGS. 8 and 9.—This implement has been made by relatively few blows. On the right lateral surface (see fig. D, Plate 16) is a well-marked set of curved ripples made by a concave conchoidal fracture indicating a blow in a direction upwards and forwards from the point R. The rest of the right lateral surface is smooth and bright and almost entirely due to one large effective fracture; numerous glacial scratches are seen on the smooth surface (these are not indicated in the drawing). The left lateral surface L shows one large fracture caused by a blow directed downwards from the crest; its point of application is indicated by the curved ripples of a concave conchoidal fracture; a second similar, but smaller, conchoidal fracture indicates a blow applied in a downward and backward direction a little in front of the dotted line K. There are no glacial scratches on the smooth bright surface of this side of the beak. The ventral surface has been made by two effective blows—a larger one, which has formed the greater part of the smooth surface (obliquely shaded in fig. 9), which is deeply cut by glacial scratches——and a smaller one which has cleared the flat surface in front of X. The point of the beak has been blunted by numerous small fractures, probably due to use.

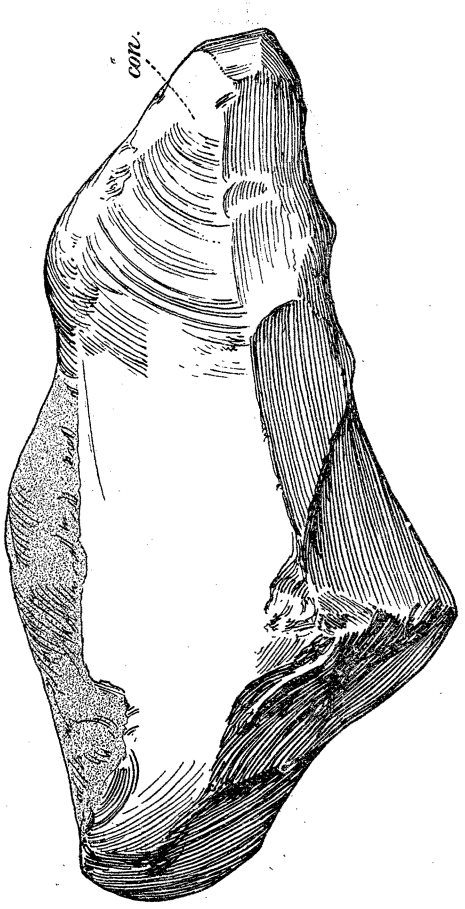


FIG. 10.

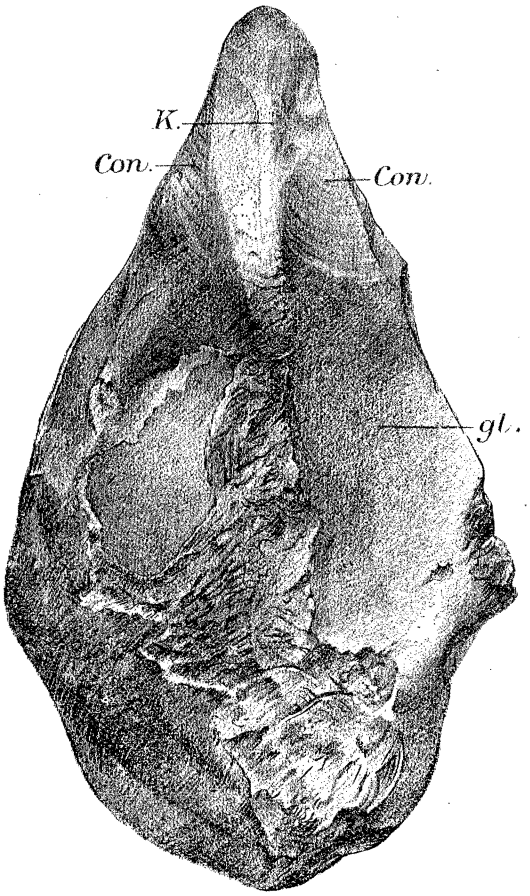


FIG. 11.

FIG. 10.—Specimen E (compare the photographs), removed by Mr. J. REID MOIR from the bone-bed in Bolton and Laughlin's Pit, Ipswich. View of the right lateral surface. This Sub-Crag rostro-carinate implement is richly flaked, showing conchoidal fractures of which one is marked *con.* The grain-tint indicates the unfractured "bark" or surface of the flint. Drawn of the actual size.

FIG. 11.—Specimen E. View of the dorsal surface, showing the strongly-marked keel, K. *Con.*, conchoidal fractures; *gl.*, flat, smooth surface, on which are glacial scratches (not shown in the drawing). Drawn of the actual size.

NOTES TO FIGS. 10 and 11.—A large part of both the dorsal and ventral surface of this implement shows the original bark or cortex of the flint pebble, unfractured. The right lateral surface (fig. 10) shows a well-marked set of curved ripples, due to a blow applied near the beak and directed backwards. This blow appears to have cleared the whole surface to the right of the keel. Behind the ripples the smooth surface is densely grooved by intercrossing glacial scratches. Three distinct fractures have completed the lower part of the right lateral surface. The front one of these shows curved ripples, indicating the upward direction of the blow. The left lateral surface shows three surfaces of fracture, of which the largest was made by a blow applied to the left side of the beak, as indicated by curved ripple marks. The beak-like termination is fractured by small blows, whilst the greater part of the ventral surface (see E in Plate 15) consists of original cortex.

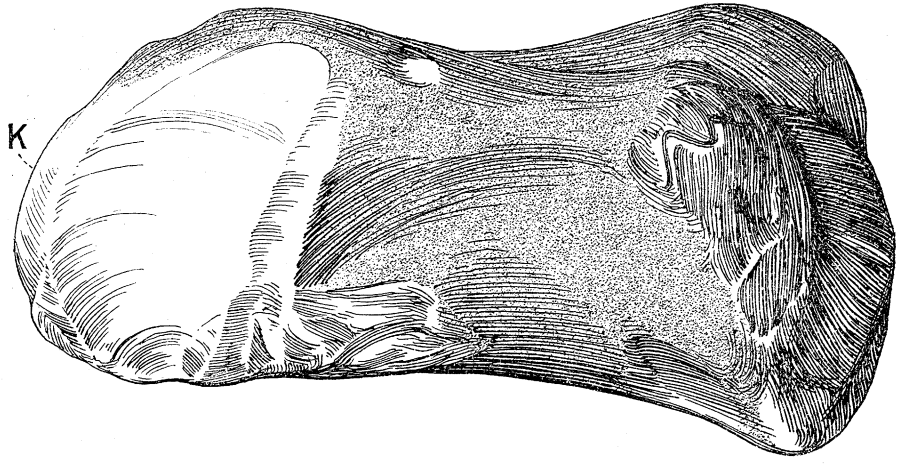


FIG. 12.—Specimen F (compare the photographs in Plates 15 and 16). View of the left lateral surface of a rostro-carinate implement removed from the bone-bed in Bolton and Laughlin's pit, Ipswich, by Mr. J. REID MOIR. K, the keel or "carina." The grain-tint indicates the unbroken bark of the original flint. Drawn of the actual size.

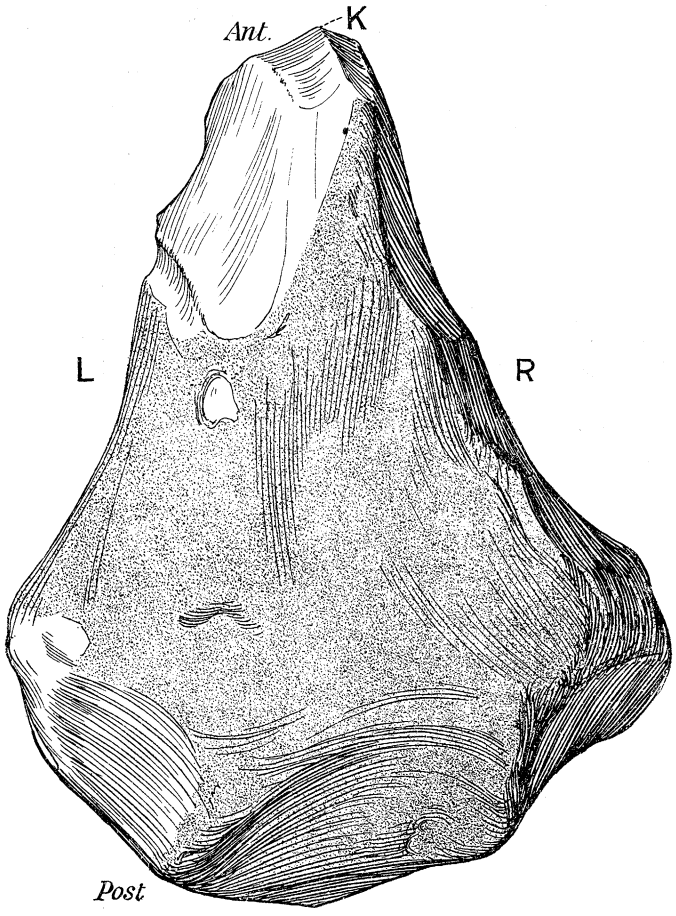


FIG. 13.—Specimen F. View of the dorsal surface. K, the keel; L, left; R, right side. Observe the large extent of unbroken original "bark" or surface of the flint, indicated by grain-tint. Drawn of the actual size.

NOTES TO FIGS. 12 and 13.—A very large part of implement F, both dorsal and ventral, has the unfractured cortex of the flint for its surface. The front region has been worked by two principal blows on the right side and by three on the left (seen in fig. 12), whilst a fourth has formed a narrow smooth area along the keel (to the right of K in fig. 13). All these blows were given from below and directed upwards. The edge of the beak is much broken by small irregular fractures. Just behind the beak on the ventral surface is a smooth plane surface of small area made by a special fracture (see F in Plate 15).

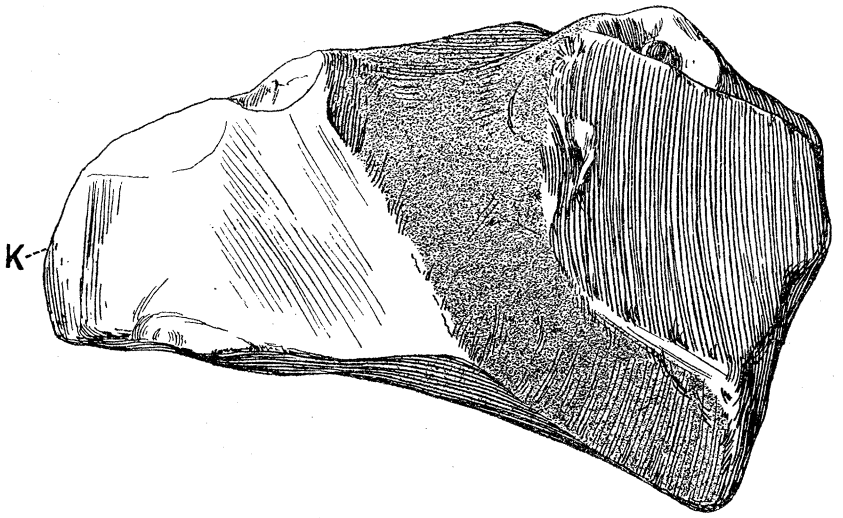


FIG. 14.—View of the left lateral surface of a Sub-Crag rostro-carinate implement, removed from the bone-bed beneath shelly Crag, at Hadleigh Road, near Ipswich, by the quarryman BAXTER. K, the keel. The grain-tint indicates the original "bark" of the flint. Drawn of the actual size.

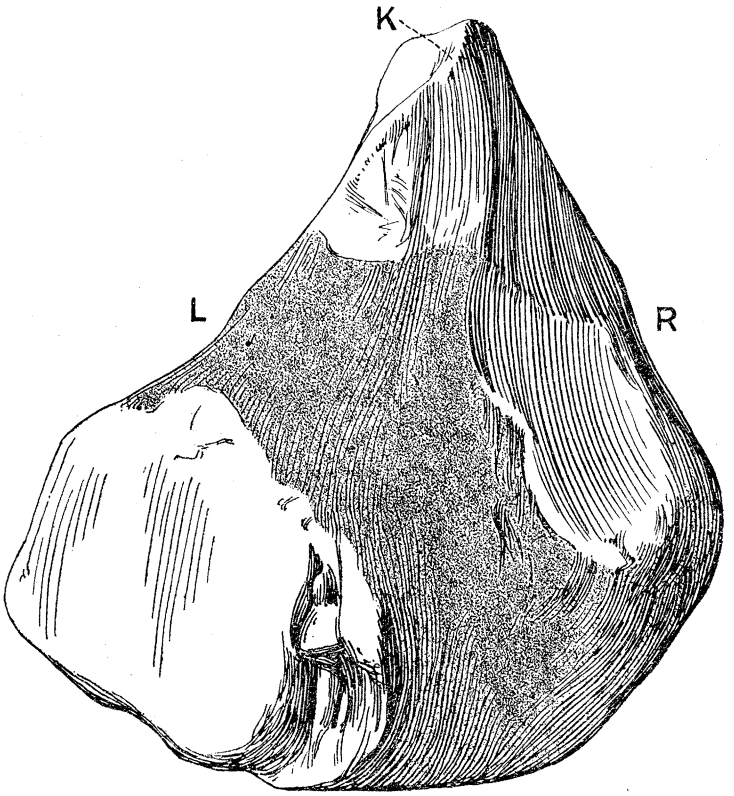


FIG. 15.—View of the dorsal surface of same specimen as fig. 14. The grain-tint indicates the unbroken original "bark" of the flint. K, the keel; L, left; R, right side. Drawn of the actual size.

NOTES TO FIGS. 14 and 15.—This is an implement with an irregular "stern" or hinder region. Like nearly all the eagle's-beak implements, it has a large surface of unfractured cortex. The anterior part of the left lateral surface (fig. 14) has been produced by one principal and two minor fractures; the right side by two principal and some minor fractures. The ventral plane (not figured) is formed by one large flat surface of fracture (scored by glacial scratches) and three minor flat surfaces of fracture near the beak.

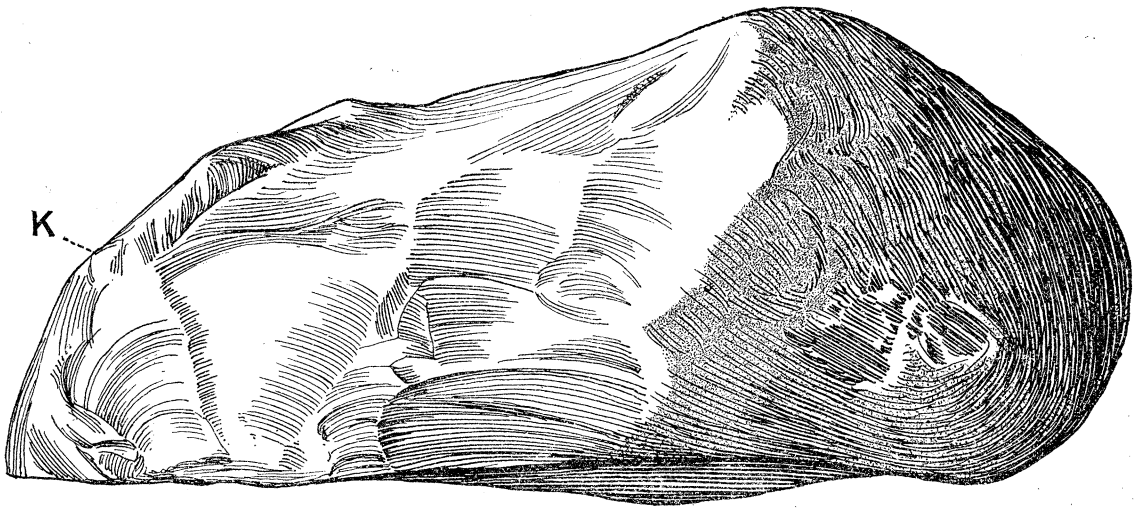


FIG. 16.—Specimen H (compare the photographs). View of the left lateral surface of a large Sub-Crag rostro-carinate implement from Bolton and Laughlin's Pit, Ipswich, dug out from the bone-bed by BAXTER. The grain-tint marks the unworked surface of the flint. K, the keel. Drawn of the actual size.

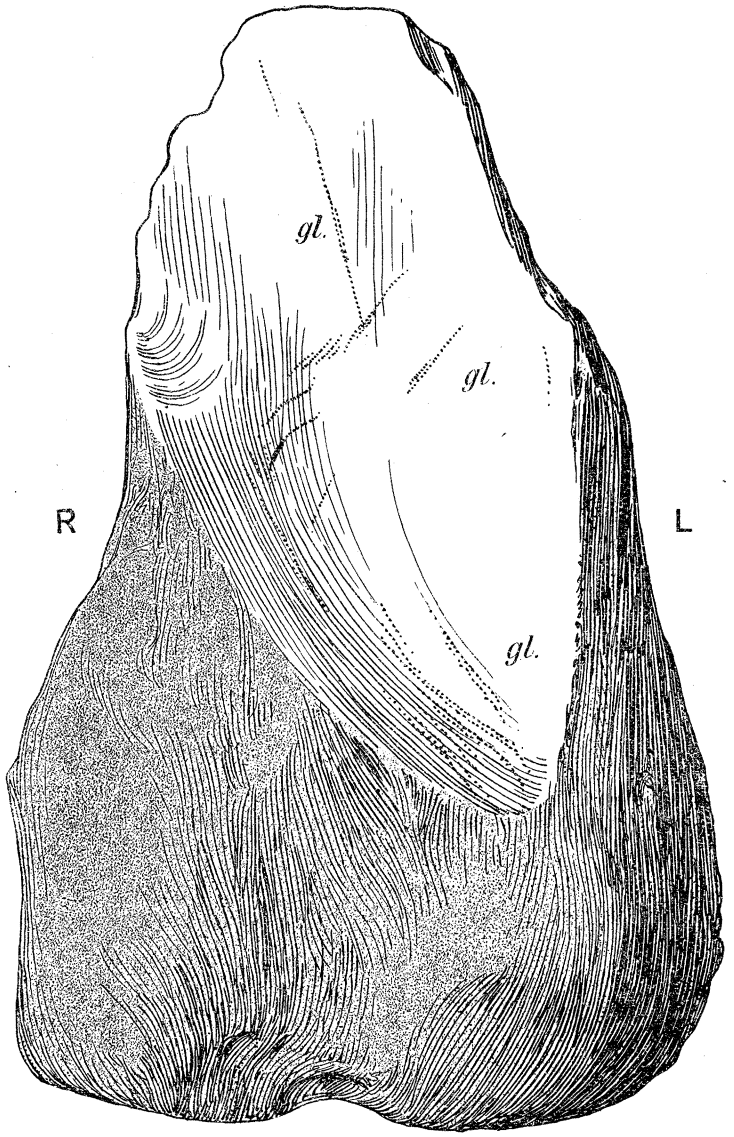


FIG. 17.—Specimen H (compare the photographs). View of the ventral surface. The great smooth surface of fracture (ventral plane) shows strongly-marked scratches due to glacial action, *gl.* R, right; L, left side. The unworked surface of the flint is indicated by a grain-tint. Drawn of the actual size. Compare figs. 1 and 2 in Plate 17.

NOTES TO FIGS. 16 and 17.—This is a large implement of rich coffee colour and a high "glaze" on its fractured surfaces. The greater part of the left lateral surface has been produced by numerous blows directed from below upwards, as shown by the ripples of the conchoidal fractures. The anterior part of the right lateral surface is worked by many small fractures, but the greater part of it (as also of the hinder part of the left lateral surface) is unfractured cortex (as indicated by the grain-tint in the figures). The dorsal surface has been trimmed by numerous blows (for which see fig. 2, Plate 17). One of great power is indicated by very large ripples of conchoidal fracture at the back part of this surface. The beak has been truncated by a clean fracture from right to left below the point marked K. The ventral plane is flat and consists of cortex posteriorly and to the sides, but a large, perfectly smooth and glazed area produced by one blow occupies the front and middle of the plane. This area is strongly scored by glacial scratches (as shown in fig. 17 and more fully in Plate 17).

FIG. 18.—Specimen I (compare the photographs). View of the right lateral surface of a large Sub-Crag rostro-carinate implement removed from the bone-bed below shelly Crag at Thorington Hall Pit, Ipswich, by Mr. MOIR. K, the keel; *x*, the sub-apical plane surface similarly lettered in other specimens. The grain-tint indicates the unworked surface of the flint. Drawn of the natural size.

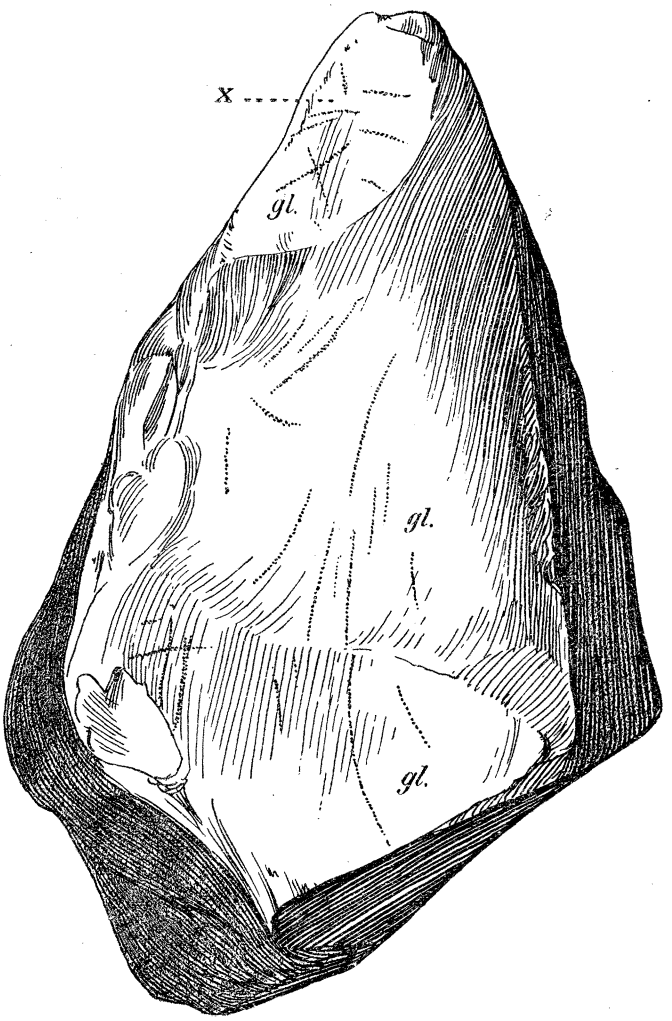


FIG. 19.—Specimen I (compare the photographs). View of the ventral surface of this specimen. The sub-apical plane fracture-surface *x* shows distinct glacial scratches *gl.* The large plane surface behind this, produced by an independent fracture, also shows glacial scratches *gl.*

NOTES TO FIGS. 18 and 19.—The hinder part of this implement is truncated on the left side by one tremendous blow, see fig. I in Plate 15, showing a fine concave conchoidal fracture centering near the mid-dorsal line, showing that this was the point at which the blow was received. This truncatory blow is of the same age as the "trimming" fractures by which the beak was shaped out anteriorly. The right side of the implement is chiefly original cortex until we come to the anterior region. One large fracture (slightly convex) and three narrow ones parallel to and near the keel have sufficed for the shaping of this side (fig. 18). The left side is formed by cortex and a single anterior fracture. The point and edge of the beak are worn down by small fractures. The great ventral plane (fig. 19) is formed by three large fractures giving three very smooth glazed surfaces, to the anterior one of which the letter *x* points in the figure, whilst the hindermost *gl.* marks the hinder, and the middle *gl.* the middle one of the three. They are strongly scored by glacial scratches, which are marked by the letters *gl.*

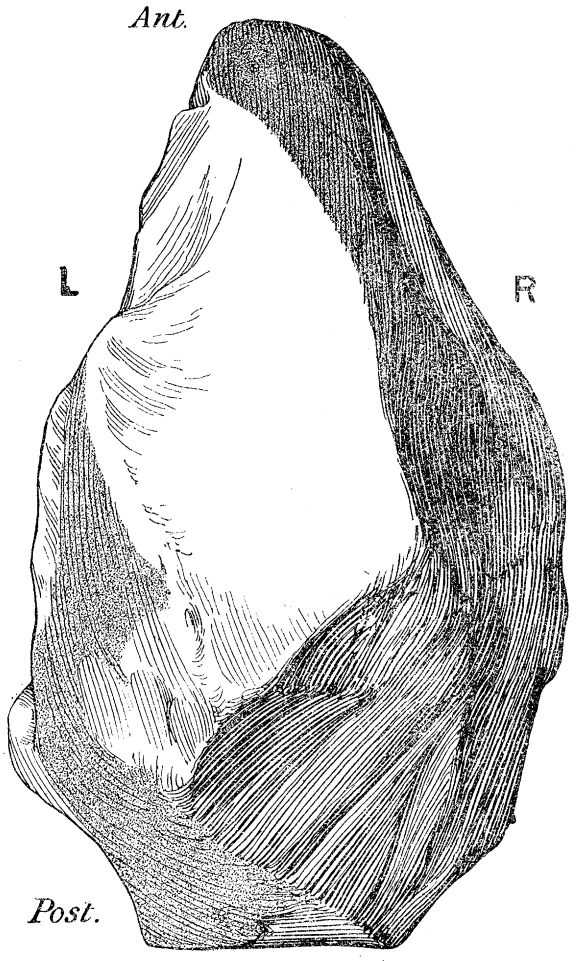


FIG. 20.

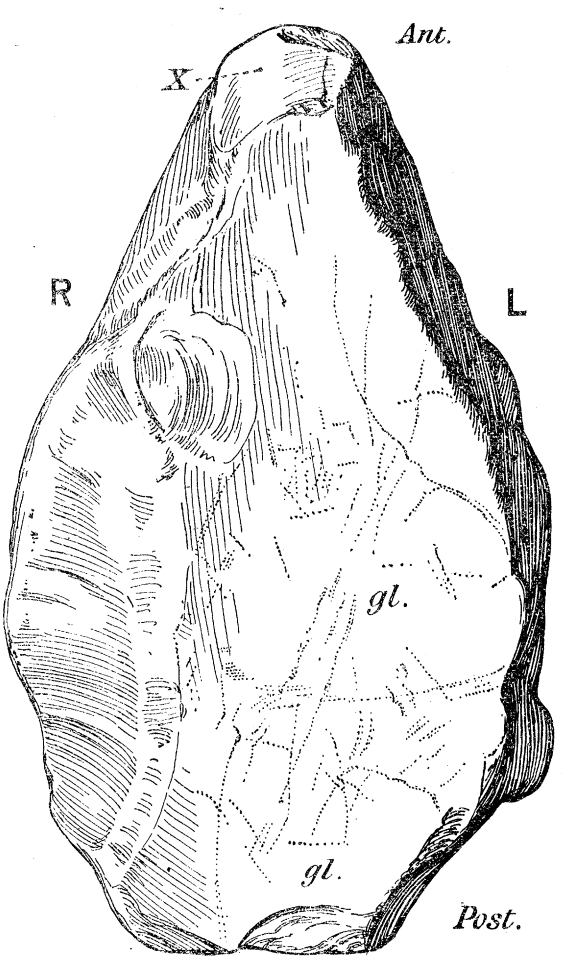


FIG. 21.

FIG. 20.—Dorsal view of a rostro-carinate flint implement from the "stone-bed" below the Norwich Crag; obtained with many others at Whittingham, near Norwich, by Mr. W. G. CLARKE. L, left; R, right side. The grain-tint indicates original unworked surface of the flint. Drawn of the actual size.

FIG. 21.—Ventral view of the specimen drawn in fig. 20. The special flat fractured surface behind the "beak" is shown, and marked X. The rest of the ventral plane is remarkable as being formed in great part by one fracture. It is very flat and smooth, but is scored by numerous glacial scratches, which are marked *gl.*

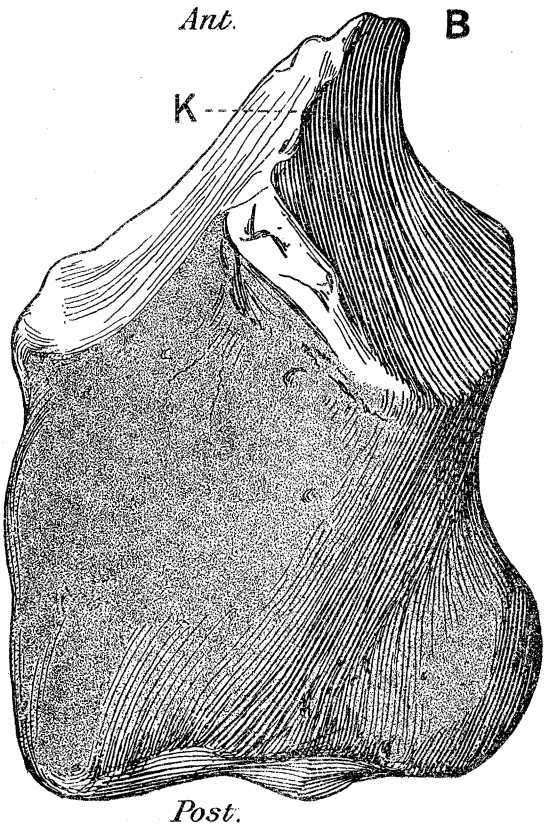


FIG. 22.—Dorsal surface of a rostro-carinate implement dug out from the bone-bed below shelly Red Crag at Hadleigh Road, near Ipswich, by the quarryman BAXTER. It is remarkable for the simplicity of its manufacture—a blow on the right side, one on the left, and three to form the flat ventral surface (not figured) having sufficed. There are a good many small fractures on the "arêtes" or edges separating the three chief surfaces of this implement, due to "finishing" touches or small blows. B, the beak; K, the strongly-marked keel.

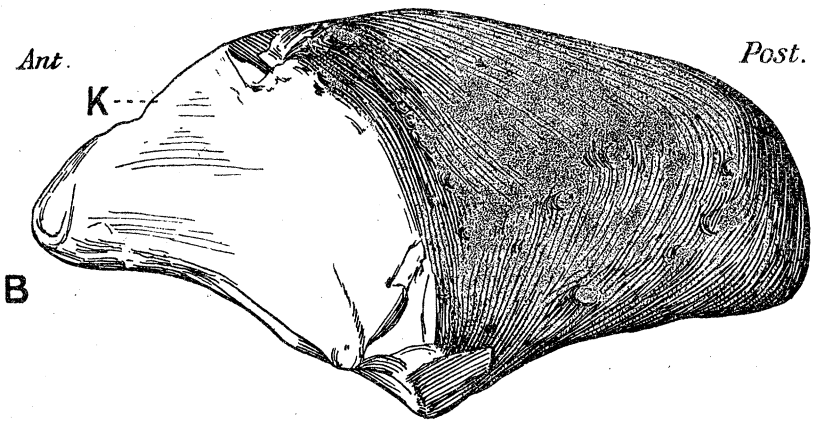


FIG. 23.—View of the left lateral surface of the same implement. K, keel; B, beak.

5. *The Occurrence of "Eagle's-Beak" Implements at the Base of the Norwich Crag.*

The later deposits of the Red Crag sea having a more boreal mulloscan fauna than the earlier beds deposited in Suffolk were laid down to the north of the Suffolk coast-line in the neighbourhood of Norwich and are known as the Norwich Crag. There is the same evidence in this region, 30–40 miles north of Ipswich, as in South-East Suffolk of the existence of the ancient land surface at the date of the commencement of the Crag deposit continuous with that of Suffolk. This land surface was slowly submerged and contributed its detritus to a basement bed of the Norwich Crag which was called "the stone-bed" by the Rev. JOHN GUNN (in 1864) on account of the abundance in it of large flints. The detritus contributed by the Norwich area, and consequently the contents of this basal "stone-bed," differ from the similar contribution made in Suffolk in several important particulars. They are: (1) The land surface was chalk; there was no London Clay in this region; hence we find here no "coprolite" or phosphatised clay in the basal bed, but an abundance of flints derived from the chalk. (2) The Diestian earlier Pliocene deposit which existed in the Suffolk area and furnished the box-stones and the Cetacean bones and shark's teeth to the basal bed of both the Red Crag and Coralline Crag of Suffolk, when broken up by sea which laid down those deposits, did not extend to the Norwich area; consequently, we do not find the Diestian fossils and sandstone "boxes" in the Norwich stone-bed (with possible very rare exceptions). (3) The Miocene terrestrial deposit which contributed the dental enamel crowns of a Trilophodont Mastodon, of *Rhinoceros schleiermacheri*, and of Hyenarctos and Tapirus to the Suffolk bed, did not exist in the Norwich area. Hence this Miocene mammalian element is absent from the basal bed of the Norwich Crag. (4) But on the other hand the submerged surface in Norfolk bore as in Suffolk the remains of a later mammalian fauna, namely, that of *Mastodon arvernensis* and of the mammals associated with it. Hence we find the remains of that fauna in the Norfolk bed. There is, however, no evidence to show that the terrestrial mammals of this fauna were living on the land surface either in Suffolk or Norfolk at the time of its invasion by the sea, and the deposit of the Red Crag and its later local continuation —the Norwich Crag.

The Norwich area of the land surface was even better furnished with the big flint nodules of the chalk than was the Ipswich area, and it is therefore not surprising that eagle's beak worked flints, similar to those found by Mr. MOIR in Suffolk, have been found in the basal bed of the Norwich Crag. They were discovered by Mr. W. G. CLARKE as long ago as 1905. About two hundred "implements" were found by Mr. CLARKE and Mr. RYE at Eaton, near Norwich, in a thin bed resting directly on the chalk, and topped by about 30 feet of pebbly gravels and sands. These topping beds were considered to be "early glacial," and the flints were classed under the vague term "eoliths." Later, in 1908 and 1909, implements of the same

type were found by Mr. CLARKE beneath sands and gravels which were regarded by Mr. H. B. WOODWARD, F.R.S., as "Upper Crag." But little importance had been attached to these flints "until Mr. MOIR's first notification of his discoveries, and then," writes Mr. CLARKE, "I began to suspect that Mr. WOODWARD might possibly be right in his description of the beds as Upper Crag. In October, 1909, I found the same type of 'implements' in the same position at Alderford Common (Swannington), but the 'Geological Memoir'* (East Dereham, p. 15) showed the same divergence of opinion as to whether the overlying beds (Bure Valley gravels) were early Glacial or Upper Crag. Not until April, 1910, when I found the 'implements' at Whittingham, beneath Crag beds (with shells), were my doubts removed. Mr. MOIR had, however, previously authenticated his finds, and I have certainly no wish to reduce in any way the merits of his discoveries, which he prosecuted with far more zeal and perseverance than I did. It was not until his first notes on the subject appeared that the possibility of my specimens being Pre-Crag occurred to me with any force. Specimens of the Eaton 'implements' were placed in Norwich Castle Museum in April, 1909 (Mr. WALTER RYE being the donor), and I have also given specimens to Leicester Museum, Yarmouth Tolhouse Museum, and to various private collectors."

I have only seen a few of these Norwich implements given to Mr. MOIR by Mr. CLARKE, and I figure one here (text-figs. 20 and 21) in order to show the general conformity of shape with that of the "eagle's beaks" found in Suffolk, and also in order to draw attention to the glacial scratches by which the lower flat surface of the implement is scored.

6. *Other Forms of Flint Implements Associated with the "Eagle-Beaks" in the Sub-Crag Bone-Bed.*

I have selected the "rostro-carinate" worked flints or "eagle-beaks" for special illustration in this memoir because they are the most abundant of the forms discovered by Mr. MOIR and because they definitely reveal to archæologists a new type (the rostro-carinate) of very early rough-chipped flint implements, earlier than the so-called "palæoliths" of river gravels. I may remark in passing that the use of the terms "palæolith" and "eolith" should be abandoned as applied to early flint implements. We may still speak of "the Neolithic period," meaning a period later than and contrasted with the preceding vast "Palæolithic" period not merely by its date but by the shape and finish of many of the implements belonging to it. But it seems necessary that separate names should be given when possible to the different shapes of implement found in deposits anterior to the Neolithic period and that their precise geological horizon should always be cited—much as the generic and specific names of an animal or plant are cited. To call a fractured flint, whatever its source, "an eolith" has ceased to have any accepted meaning.

* Of H.M. Geological Survey of the United Kingdom.

Associated with eagle's-beak flints Mr. Moir has found worked flints which may be classed as follows :—

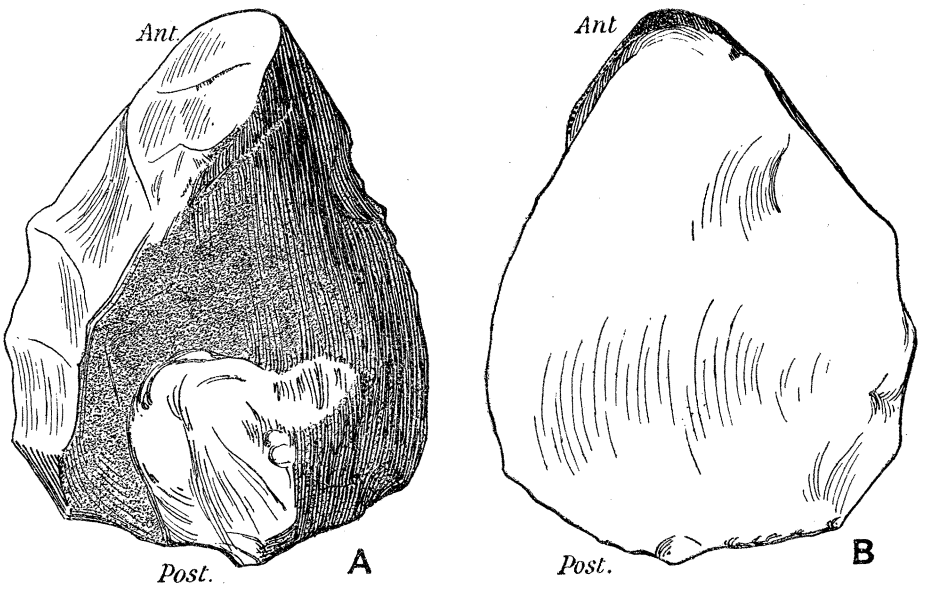


Fig. 24.—Two drawings of the actual size of a "scraper" removed from the bone-bed below shelly Red Crag at Hadleigh Road, Ipswich, by Baxter. A shows the upper surface with several flakes removed to form an edge; B, the lower surface formed by one large fracture.

(1) *Flint-flakes chipped into form as scrapers*, of at least two different types (the "grattoirs" and the "racloirs" of French archæologists). These do not differ from known "scrapers" of Moustierian age, and many are very neatly finished. I figure one here (fig. 24), of a well-known "grattoir" type. Mr. Moir has figured in vol. 1 of the 'Proceedings of the Prehistoric Society of East Anglia' a large implement resembling a Moustierian "racloir."

(2) *Hammer-stones*, of which the most remarkable is the four-sided pyramid, drawn in figs. 25 and 26.

(3) *Heavy one-sided picks*, two of which, showing a most remarkable agreement in shape, are drawn in text-figs. 27 to 34. This type can be derived from the "eagle's beaks" by greatly increasing the "stern" or hinder part (grip) of the implement, giving added weight and hand-hold, whilst at the same time the short "beak" or pointed portion of the implement has been so fashioned as to turn its whole length sharply to the left (assuming that the implement was held in the right hand). These two implements are certainly the most remarkable and novel amongst Mr. Moir's discoveries, their importance being greatly emphasised by the fact that there are two of them, one from Sutton and the other from Ipswich (as yet only two have been found), showing a most extraordinary identity in, not merely general shape, but in details of "flaking." I shall call this type "the massive left-sided picks" or "sinistro-rostrate" implements. One (deeply stained of a café-au-lait brown) is

FIG. 25.

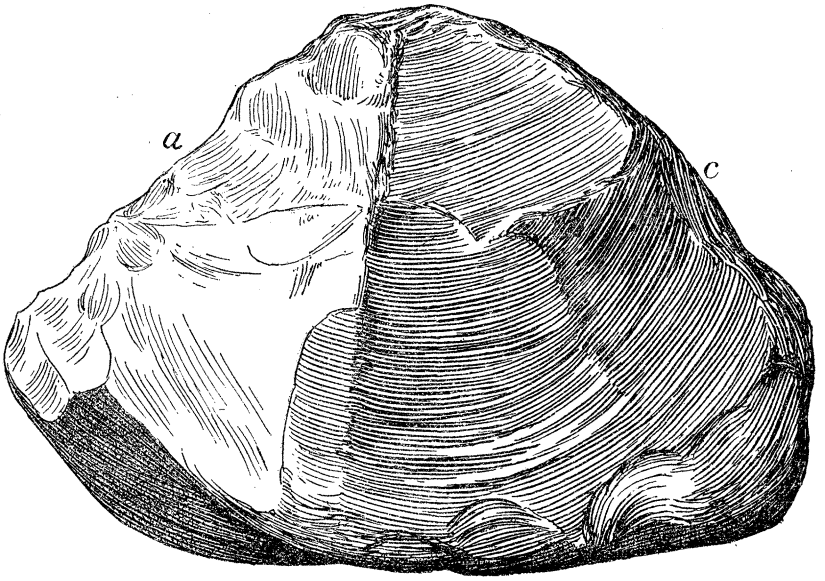


FIG. 26.

FIG. 25.—View of the apical face of a four-sided pyramid of worked flint dug out from the bone-bed in Bolton and Laughlin's Pit by Mr. J. REID MOIR. The point of the pyramid is broken by small fractures, and so is the face *d*. The other faces are smooth and bright and produced by large conchoidal fractures of the flint. Drawn of the actual size. Probably this piece was used as a hammer held in the hand, the apex of the pyramid being the point applied.

FIG. 26.—Lateral view of the specimen drawn in fig. 25. The two surfaces seen are *a* and *c* of the first figure. The conchoidal fractures are shown in the drawing.

NOTE TO FIGS. 25 and 26.—The interest of this specimen is greatly enhanced by the fact that I have received from Mr. EDWARD HERON-ALLEN a hammer-stone of the same shape and workmanship, but twice as big by linear measurement, found by him on the coast at Selsea Bill in a gravel of undetermined age. From the same source I have also received an enormous rostro-carinate flint implement, weighing 5 lbs. 9 ozs., discovered in the same deposit. These are referred to in the postscript at the end of this memoir.—February 1, 1912.

from the bone-bed in Messrs. Bolton and Laughlin's pit, the other (pale yellow and almost white in parts) is from the bone-bed below Red Crag at Sutton, at a spot where it rests on London Clay and where Coralline Crag is absent.

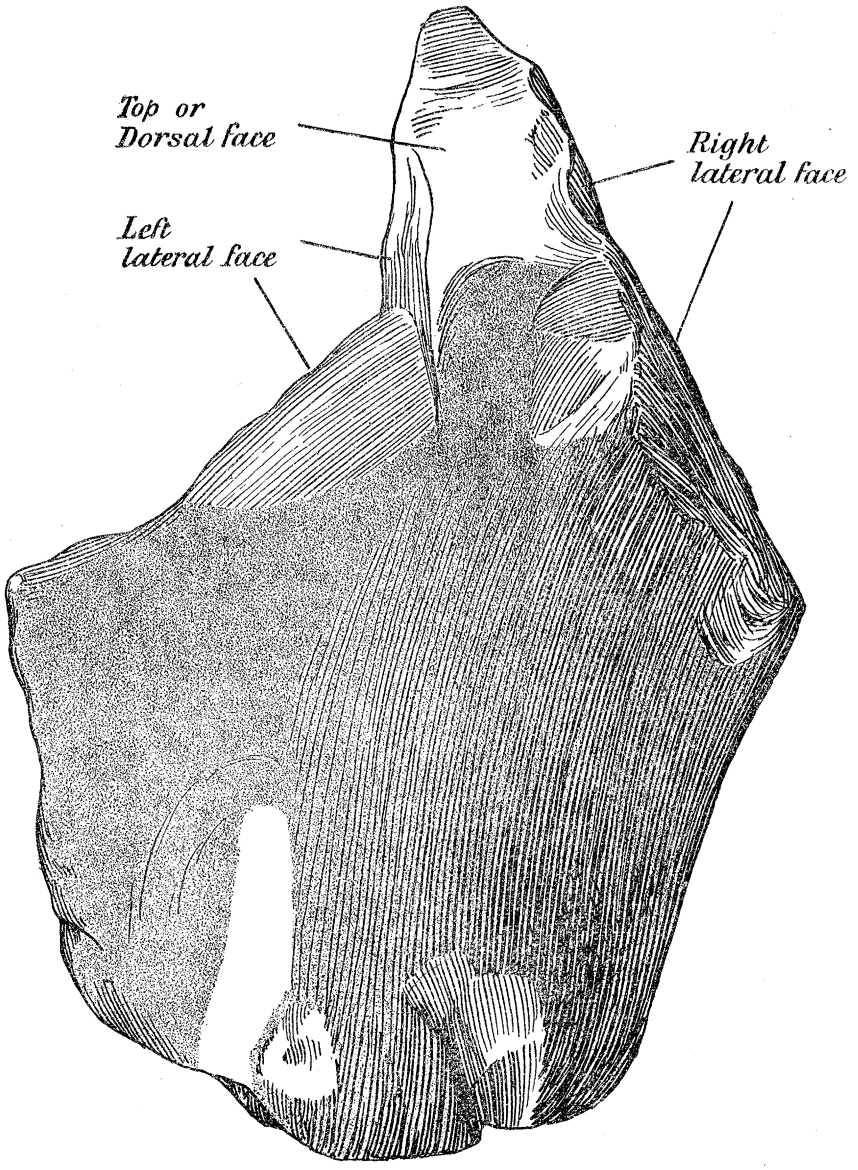


FIG. 27.—"Dorsal" view (that is to say with the beak to the right hand) of a "heavy one-sided pick" dug out of the bone-bed beneath Red Crag in Bolton and Laughlin's Pit at Ipswich by Mr. MOIR. Drawn of the natural size.

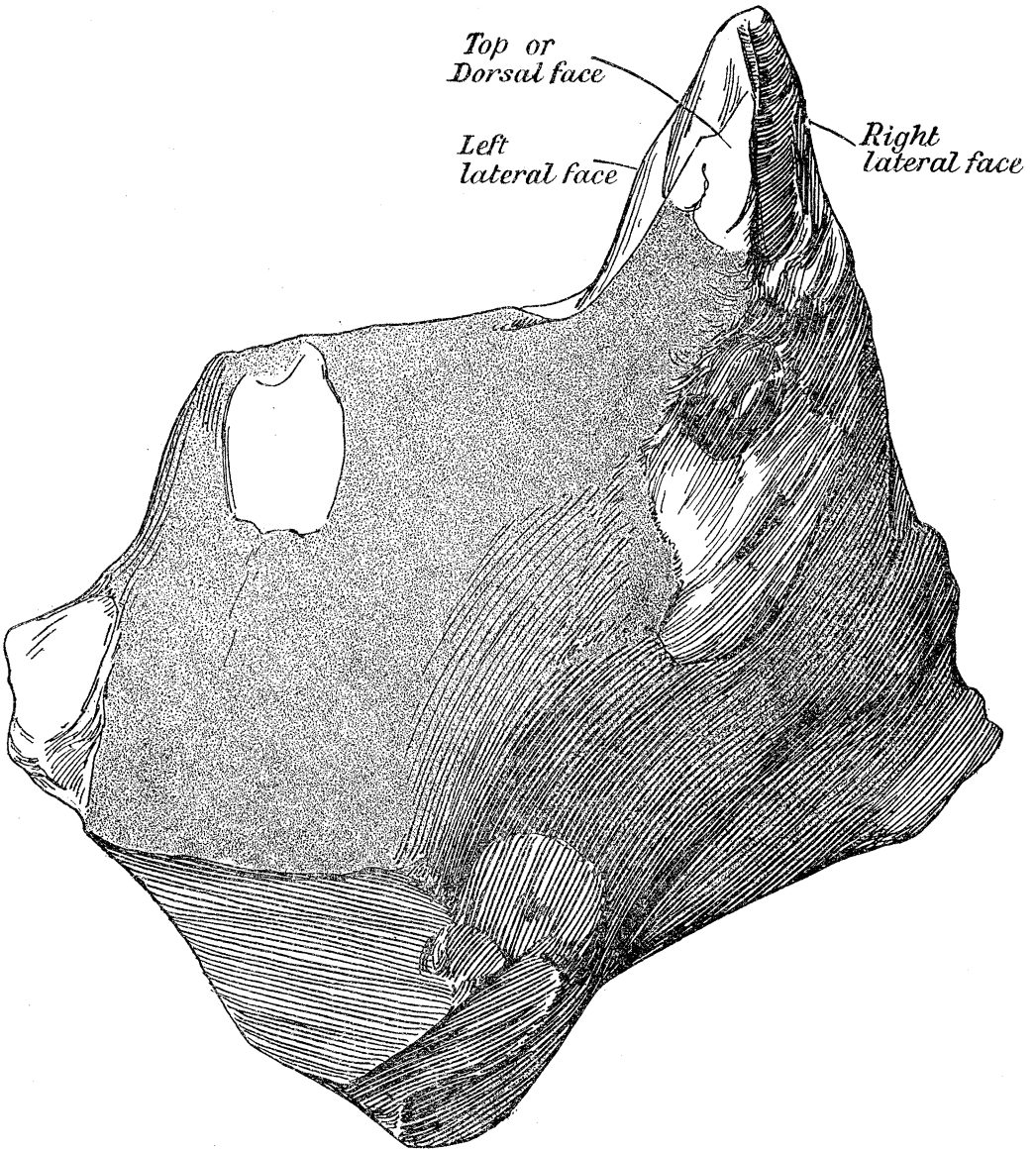


FIG. 28.—A similar view of a flint implement closely similar to that drawn in fig. 27, dug out by BAXTER at Sutton (ten miles from the locality where that of fig. 27 was obtained), from the junction bed of the Red and Coralline Crags.

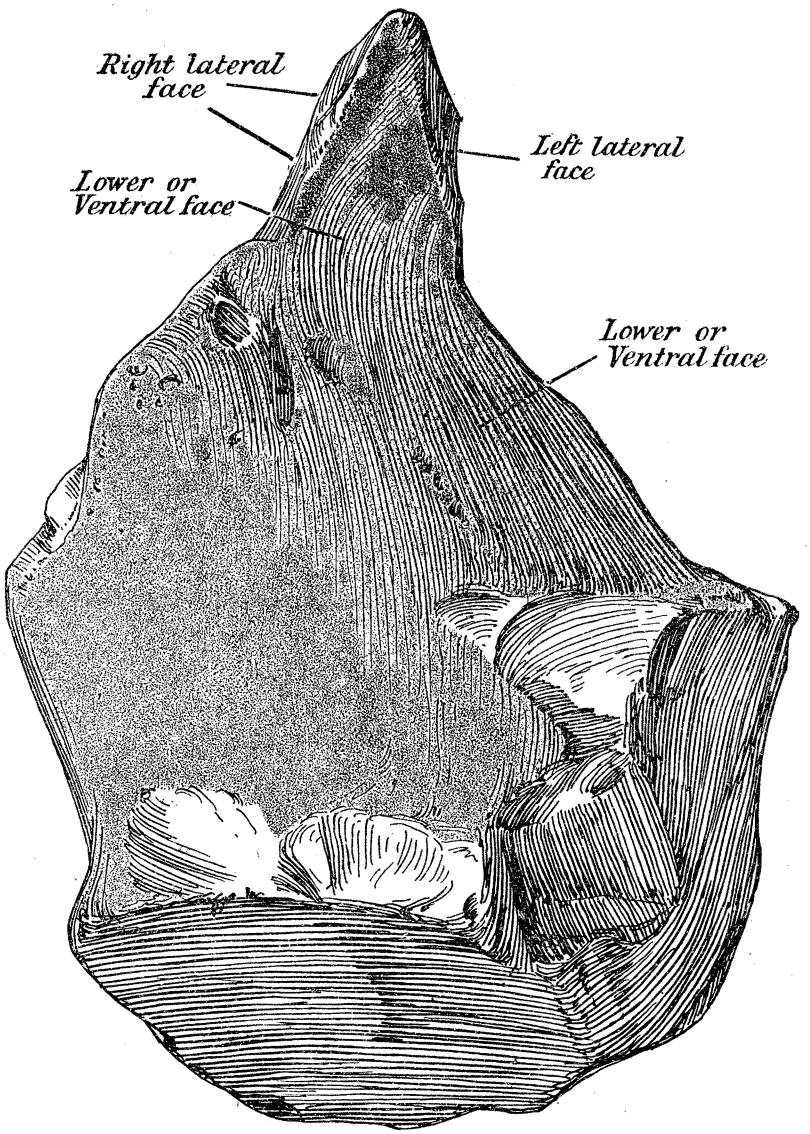


FIG. 29.—The same specimen (Ipswich) as that drawn in fig. 27 viewed from the ventral face (*i.e.* with the beak to the left hand).

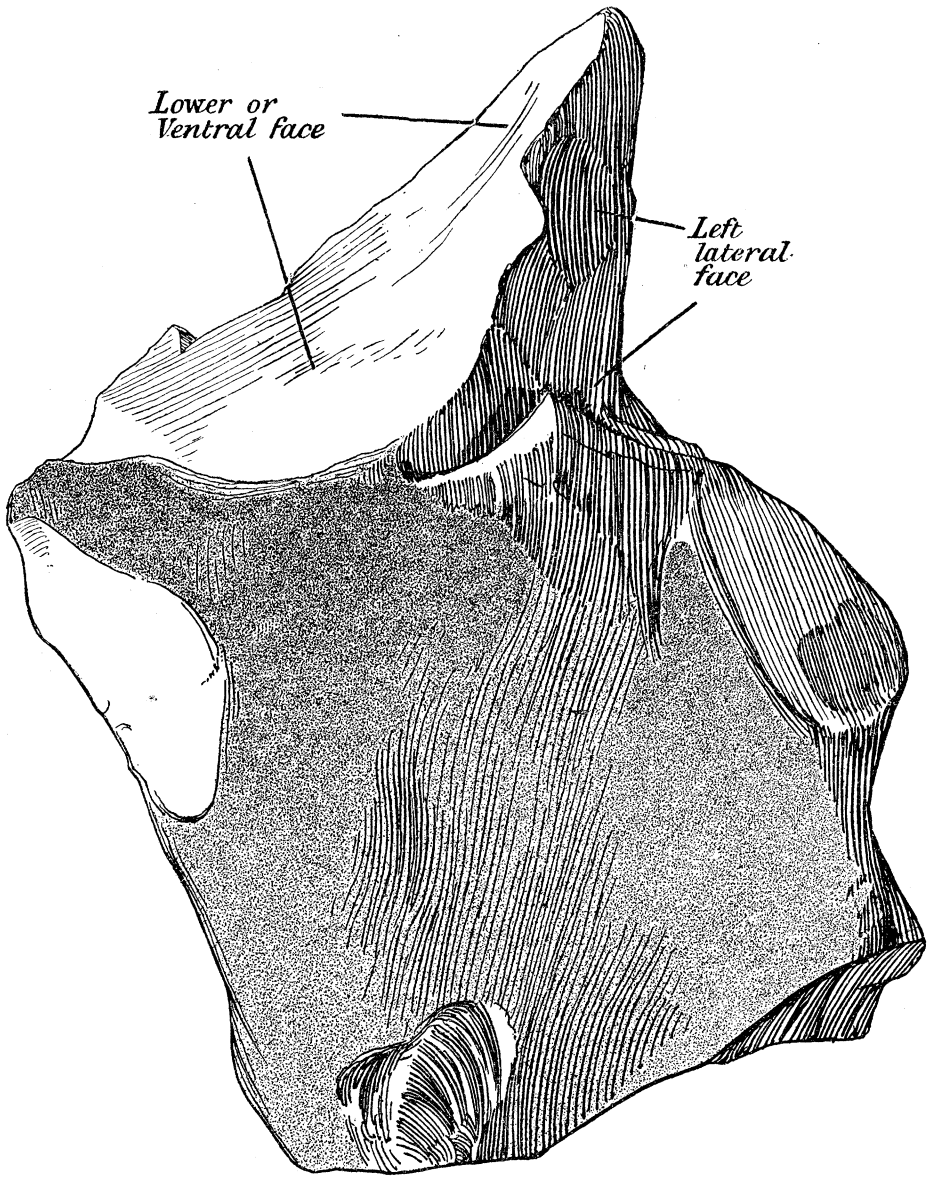


FIG. 30.—The same specimen as that drawn in fig. 28 but viewed from the ventral face (*i.e.* with the beak to the left side).

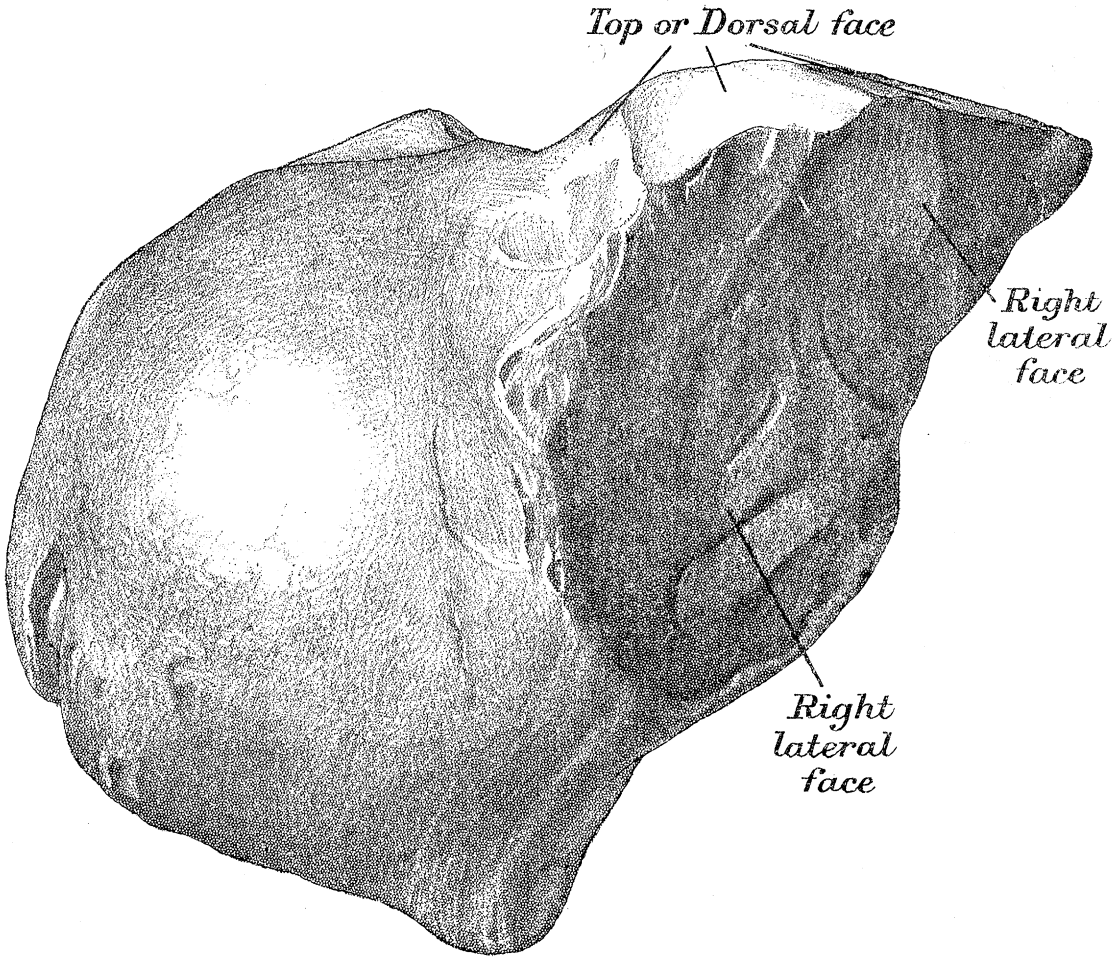


FIG. 31.—View of the right lateral face of the implement drawn in figs. 27 and 29. Natural size.

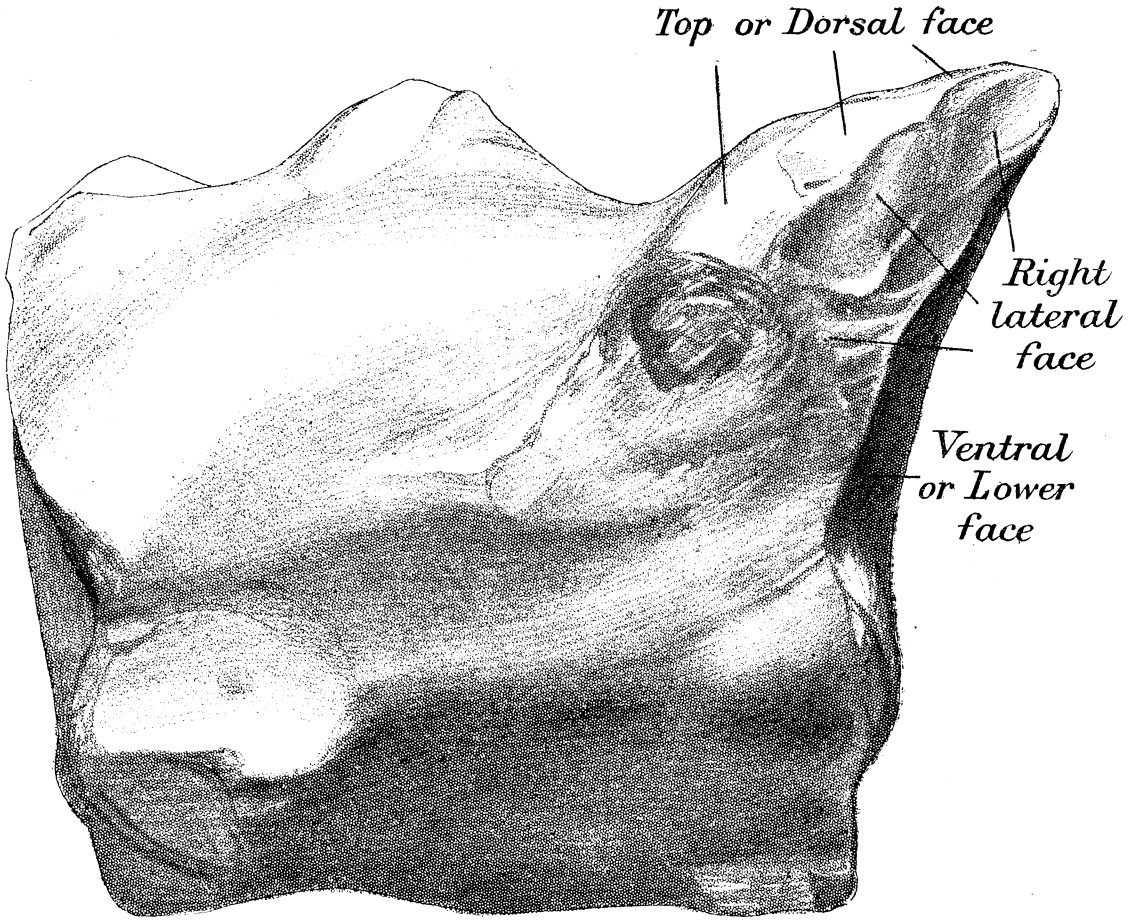


FIG. 32.—View of the right lateral face of the implement drawn in figs. 28 and 30. Natural size.

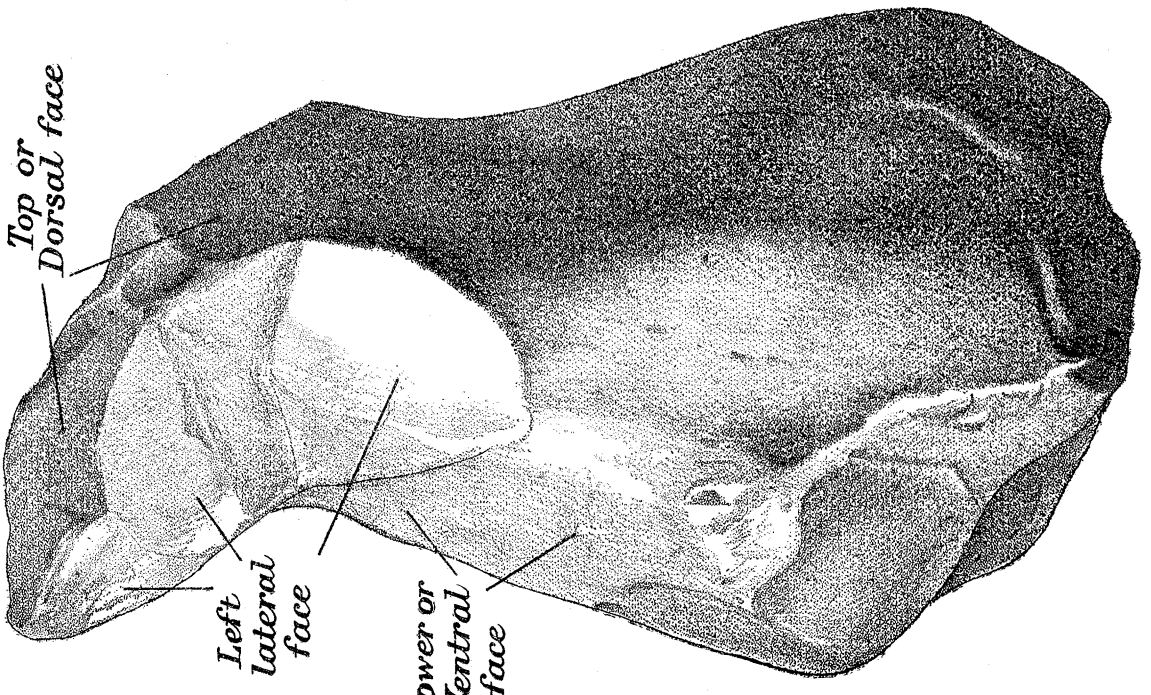


FIG. 33.—View of the left lateral face of the implement drawn in figs. 27, 29, and 31. Natural size.

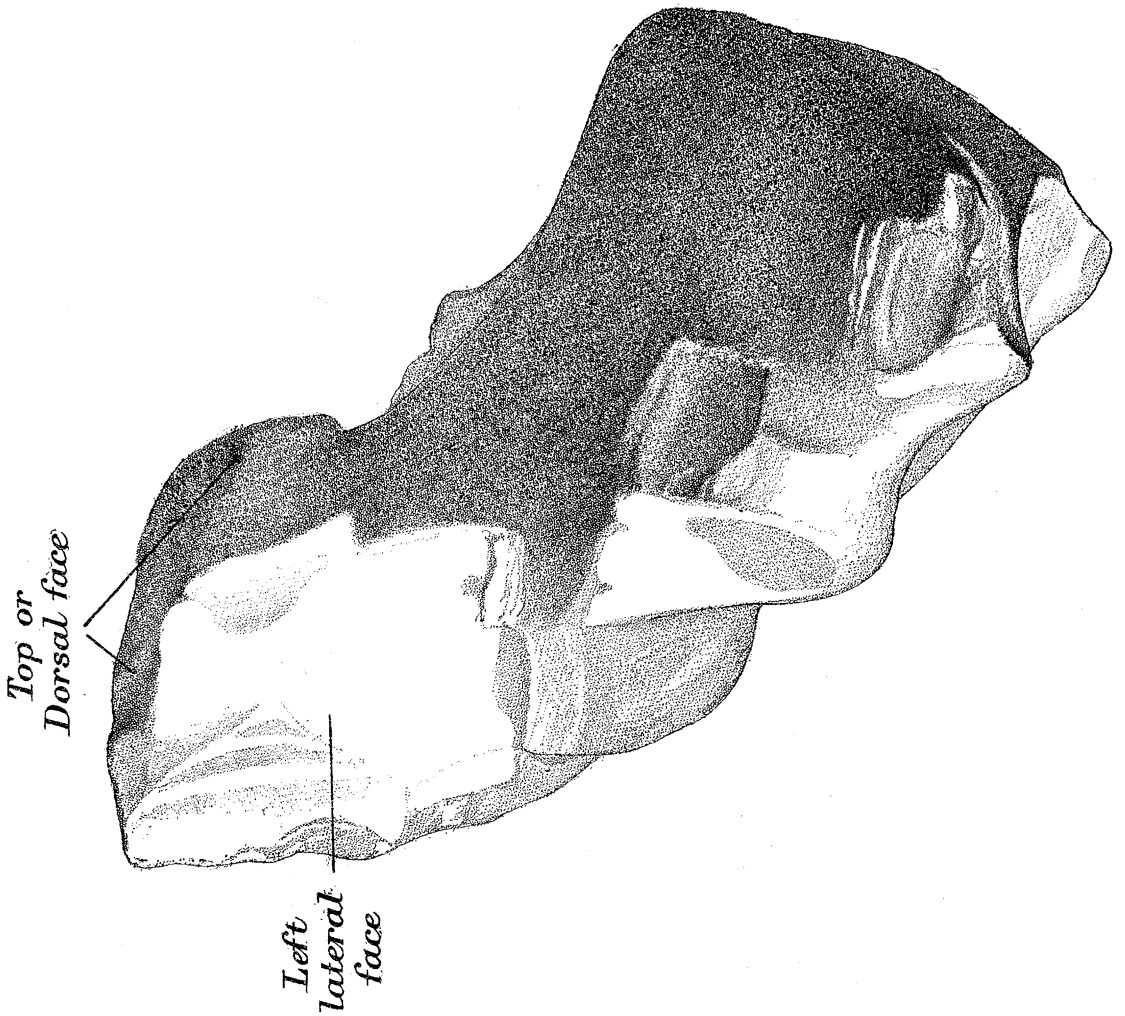


Fig. 34.—View of the left lateral face of the implement drawn in figs. 28, 30, and 32.

NOTES TO FIGS. 27 to 34.—The close general resemblance of form and flaking of the two implements drawn in these figures is remarkable. The chance of accidental coincidence may be at once put aside, since the number of fractured flints in the two localities from which these specimens come is not very large. This is a fact which must always be borne in mind. The chief difference in the manufacture of the two implements is that in the Ipswich specimen (figs. 27, 29, 31, and 33) the ventral surface (as I term it) is formed entirely by the natural cortex (fig. 29), except for the removal of one or two "knobs" at its broader part; whereas in the Sutton specimen the ventral surface has been formed in the region of the projecting beak by a single adroit fracture (fig. 30). In the splendid series of chert implements—most of them of a very primitive character—collected in the Aurillac district (Cantal, Auvergne, France) by Mr. EDWARD WESTLAKE, of Fordingbridge, which I have lately examined, there is a carefully chipped one-sided pick which resembles the two implements here figured. It is one of the most obviously human productions in the collection. In the same collection I noted three implements of the rostro-carinate type (see postscript and text-figs. 44 and 45).

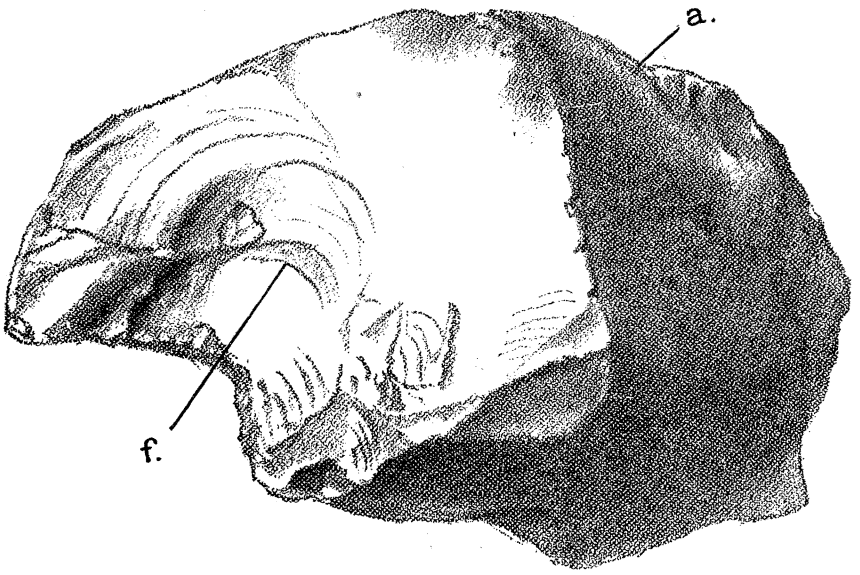


FIG. 35.—View of the left face of a claw-shaped implement, obtained by BAXTER from below the Red Crag, at the Hadleigh Road pit. Natural size. *f*, large conchoidal fracture-surface; *a*, dorsal cortex, unworked.

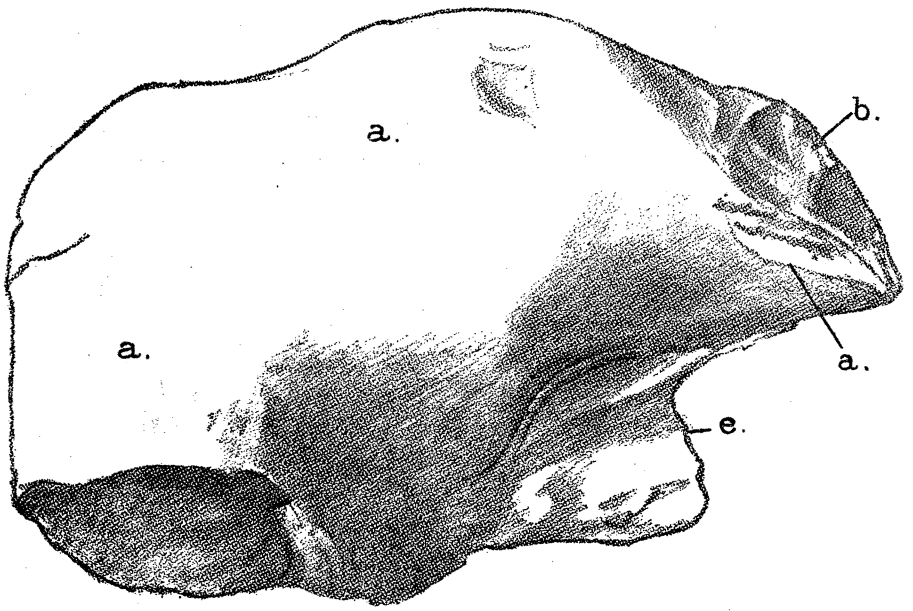


FIG. 36.—View of the right face of the implement drawn in fig. 35. *a*, cortex; *b*, flaking with conchoidal fracture; *e*, flaking.

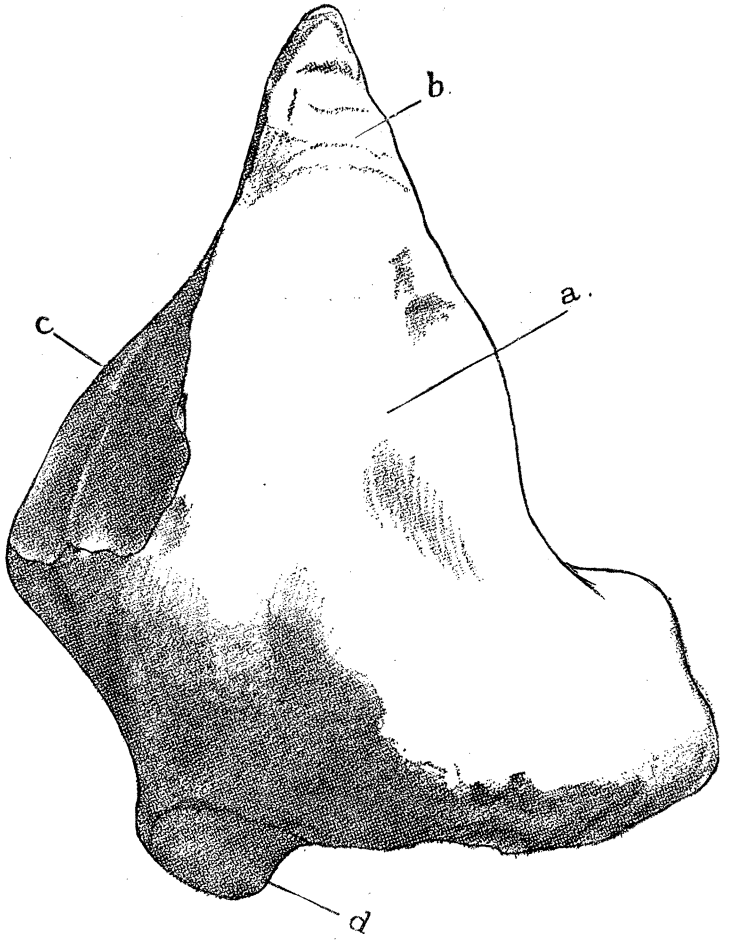


FIG. 37.—View of the dorsal surface of the implement drawn in figs. 35 and 36. *a*, the cortex; *b*, the same flaking as that marked *b* in fig. 36; *c*, the conchoidal fracture marked *f* in fig. 35.

NOTES TO FIGS. 35, 36, and 37.—This implement at present stands by itself among the produce of the Sub-Crag bone-bed. It has the character of a large notched "scraper," recalling those collected at Salisbury by Dr. BLACKMORE from very ancient gravels; but differs from them in the dominance of the definitely "worked" point or beak.

(4) *Massive implements of several shapes;* one is the flint weighing $8\frac{3}{4}$ lbs., the first Sub-Crag implement discovered by Mr. MOIR. It is drawn in fig. 38. It measures $10\frac{1}{4}$ inches in length. The anterior end is fashioned by a few dexterous "flaking-strokes" on both upper and lower surface into a semicircular cutting edge. It is remarkable for the small size of the sculptured area as compared with the large size of the flint, which retains its original chalk-dated bark or cortex and is of a creamy brown colour, variegated in intensity. The small sculptured area closely agrees with the anterior end of many river-gravel flint implements of early Chellian or so-called "Strepyan" age.

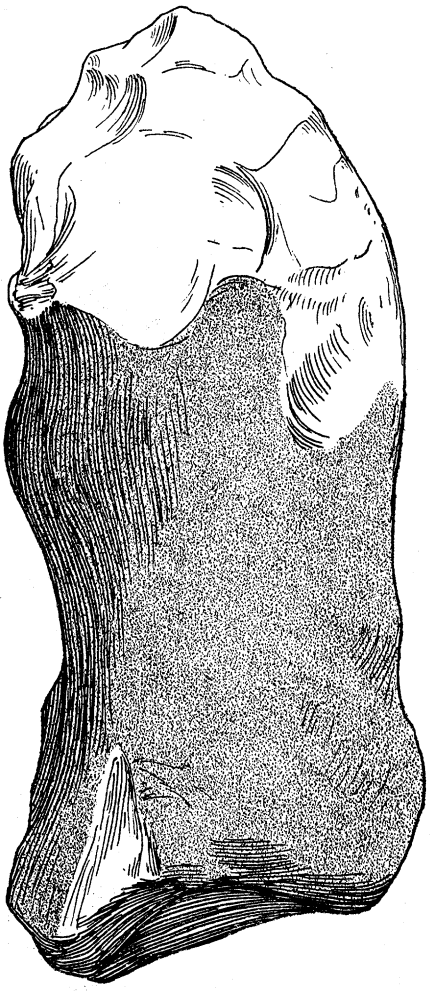


FIG. 38.—Very large flint with flaked anterior region (not of rostro-carinate type). Found by Mr. J. REID MOIR on a heap of flints removed from the Sub-Crag bone-bed in Bolton and Laughlin's Pit. This was the first specimen of human workmanship, from the Sub-Crag bone-bed, recognised by Mr. MOIR. It weighs $8\frac{3}{4}$ lbs., and is $10\frac{1}{4}$ inches in length. The drawing is of half the actual size, linear.

FIG. 39.—Drawing of the actual size of the flaked end of the specimen represented in fig. 38. The concave conchoidal fracture produced by many of the blows applied in the flaking of this surface is obvious. The actual edge of the flaked region was sharp, but has been reduced by minute fractures, as is usual in the edges of flint implements of this shape.

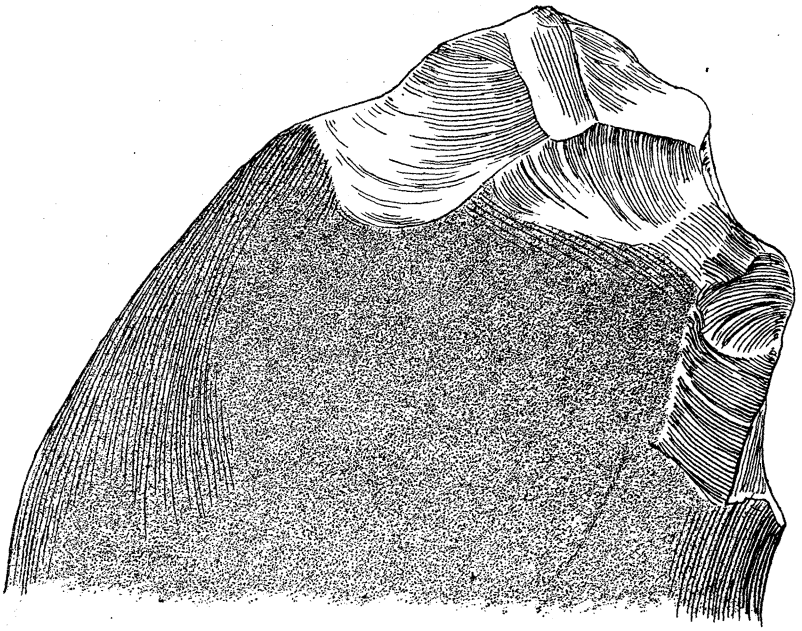


FIG. 40.—The flaked end of the large flint drawn in fig. 38. This represents the reverse side. The flaking on both faces is of Chellian character. This specimen is the only one yet found in the Suffolk bone-bed showing work of the same character as that of the older river-gravel implements. Drawn of the actual size.

Another very large implement (text-figs. 41 and 42), weighing $5\frac{1}{4}$ lbs. and measuring $9\frac{3}{4}$ inches from tip to stern, can be best described as a huge example of the rostro-

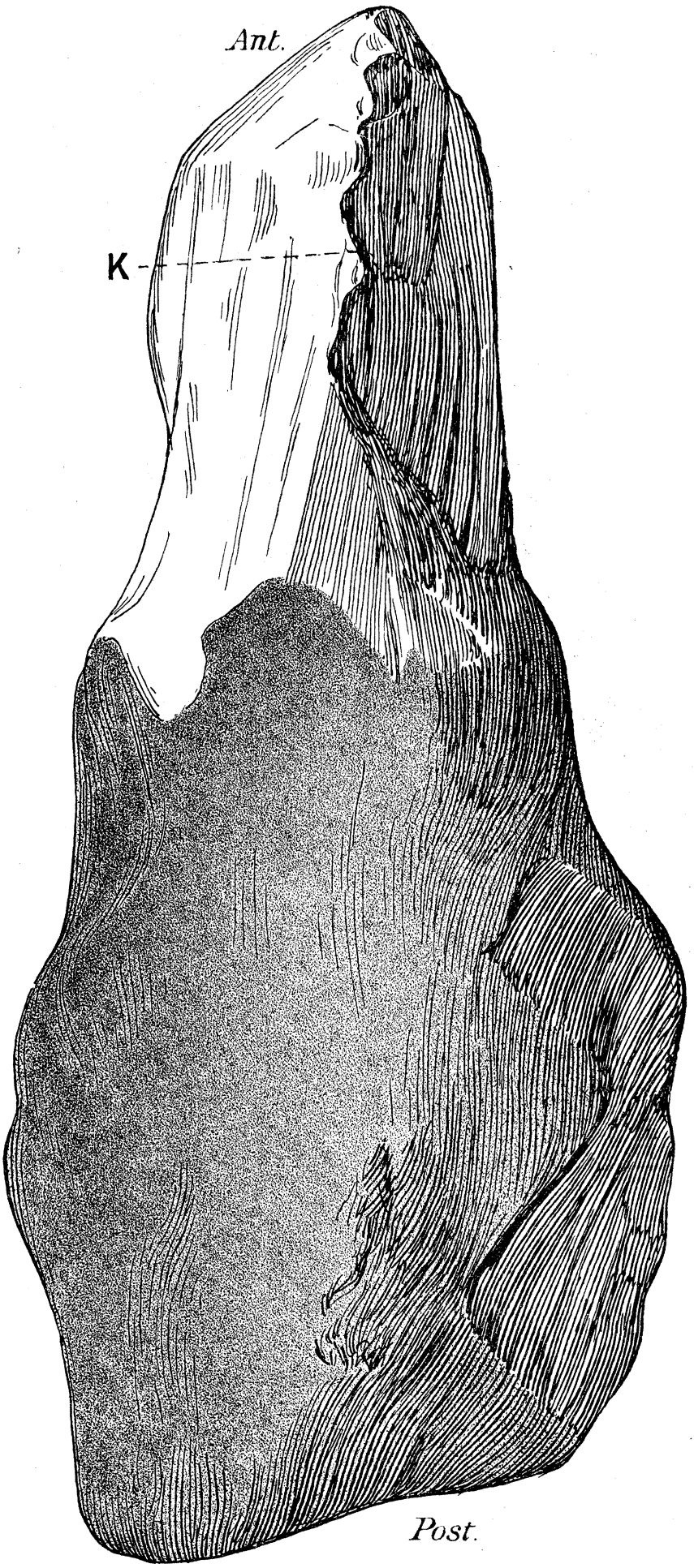


Fig. 41.—Dorsal view of a large implement of rostro-carinate type, dug out by Baxter from the Sub-Crag bone-bed in Bolton and Laughlin's Pit. Drawn of the actual size. Its colouring and glaze are closely similar to those of the large flint drawn in fig. 38. K, the keel.

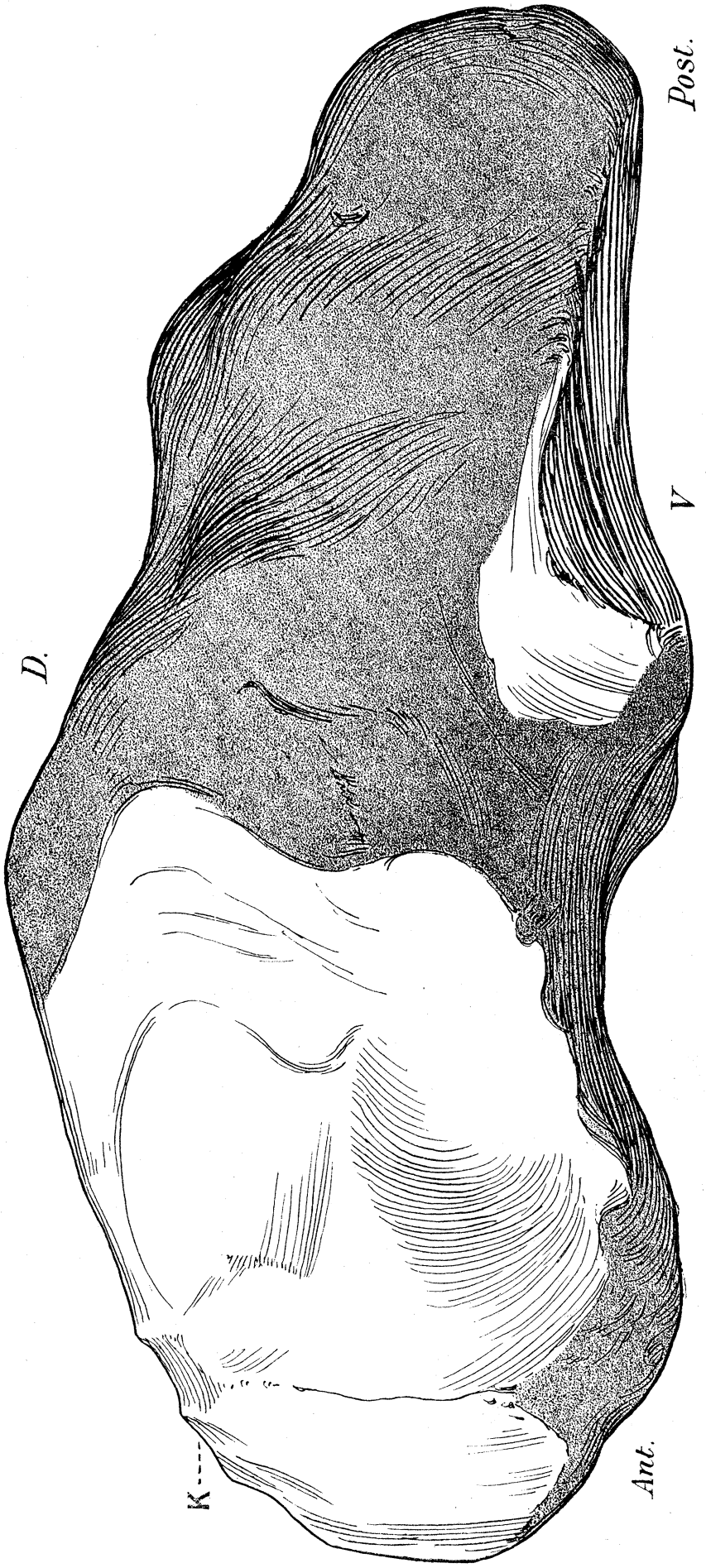


FIG. 42.—Left lateral surface of the same implement as that drawn in fig. 41. D, dorsal; V, ventral surface; K, keel.

carinate or eagle's beak type. It is also deeply iron stained and was found with the last-named implement. A still larger block of flint than either of these is in Mr. MOIR's possession—deliberately flaked and sculptured, but in such a way as to defy at present both description and interpretation. It is remarkable for showing two flat surfaces at right angles, each produced by a single blow of enormous power and without conchoidal fracture.* It weighs about 15 lbs.

(5) *Small borers*, closely resembling those found in the high-plateau gravel of Kent and by Dr. BLACKMORE near Salisbury. One of these is drawn in fig. 43.

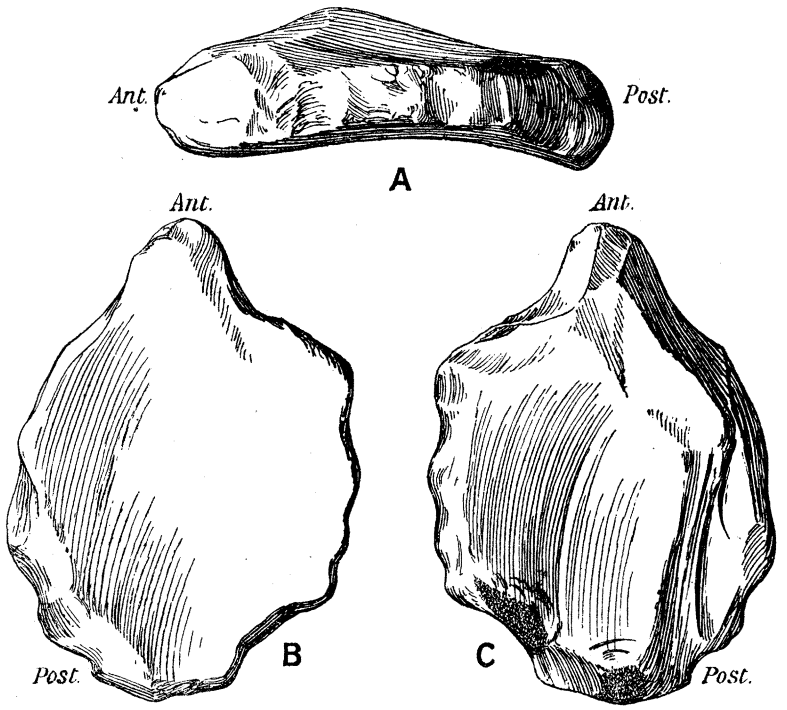


FIG. 43.—Three views of the actual size of a worked flint of the class called "borers," resembling very closely some of the "borers" from the High Plateau gravel of Ightham, Kent, and those from terrace gravels near Salisbury. This specimen was found by BAXTER on a heap of flints at Foxhall, removed from a Crag pit when it was opened for digging so-called "coprolite."

The importance of these small roughly-chipped "borers" is that they tend to bring the so-called "eoliths" of the high-plateau industry into relation with the Sub-Crag industry of East Anglia. They and the two forms of scrapers are the only forms of flint implement already known from other localities which have been found in the Sub-Crag deposit.

* The great size of the fractures, and the consequent tremendous force of the blows which produced them, is a marked characteristic of much of the "Icenian" flint industry. I also desire to emphasize the occurrence of these large surfaces of fracture forming nearly perfect planes at right angles to one another. I have just received a newly found Sub-Crag implement which shows three planes of fracture forming parts of three faces of a cube, the edges of these planes which meet one another being clean-cut, nearly straight lines. Possibly the fine quality of the flint used is accountable, to some extent, for this astonishing workmanship.—*March* 9, 1912.

One of the most important features about the Sub-Crag industry, and in fact one which establishes it as a very independent manifestation of human activity—more ancient than any of the river gravels and similar deposits containing the foliiform "coups de poing" and "amygdaloids"—is the total absence from it of such foliiform (flattened) implements. *The Sub-Crag industry is characterised by the presence of the rostro-carinate or "eagle's-beak" implements, found nowhere else at present, and by the total absence of forms of the lance-head or pick-like Chellian, Acheuilian and Moustierian types and of any forms transitional to or from those types.**

7. *The Purposes for which the Sub-Crag Flint Implements were used and their Relation to Rough-Chipped Flint Implements of other Horizons.*

The very definite form of the most finished "*eagle's-beak*" *implements*—as shown in the figures here published—does not, I regret to say, lead to any certain conclusion as to their use. It seems that the curved edge or keel, rising from the anterior point of the beak, must have had some practical use. A truly vertical chopping or cutting edge was not desired by the maker of these tools. He could easily have given that edge to the tool, had he so wished. Also a clearly significant feature is the production of a *smooth and horizontal lower* or *ventral surface*, in most (but not all) of these implements. Even where a large smooth and flat area (such as that seen in specimens D, E, F, and H, and shown in the figures in Plate 15) is not obtained, there is in nearly all cases a smooth flaked horizontal surface produced by a blow just below the point of the beak. This is marked X in several of the drawings and photographs (notably in figs. 3, 9, 18, 19 and 21, and in the photographs of Plate 15). It seems to me as though the flat "ventral" surface of the tool was intended to glide over some soft substance, and to flatten and smooth it. Stone implements, of one shape and another, are at the present day used by primitive races in the cleaning and "dressing" of skins. And I am inclined to think that this was, at any rate, one of the uses to which the rostro-carinate "eagle's-beak" flint implements were put. They may also have been used in picking and breaking open solid but yielding material—such as wood, bone, the soil, and even ice. But I confess that I could wish to be able to discover a purpose for the peculiar form of these implements more definitely and clearly related to that form. This I must, for the present, leave to others.

The *scrapers* of well-known type were probably used as more delicate scraping and cutting implements in preparing skin and also in shaping wood and bone, and the "borers" similarly.

The *hammer-stones* were used in delivering sharp powerful blows. The apex of that drawn in text-figs. 25 and 26 is much worn by small repeated fracturing. Probably

* I propose to call this the "ICENIAN industry," as the district in which it has been discovered was known to the Romans as the territory of the "Iceni."—February 12.

some of these stones were used in "flaking" other flints—as well as for purposes such as the breaking of the shells of molluscs, bones of animals, and hard vegetable products, in the preparation of food. The use of the heavy *massive one-sided picks* as picks, is obvious. Such picks would serve not only in digging into earth but also in extracting flint nodules from natural chalk escarpments. The massive implements of great size and weight, mentioned above, would serve wherever great weight and strength of blow was necessary. It is possible that their exceptional size may be related to their use as weapons for attacking very large animals, such as the mastodons and rhinoceros, which were contemporary with man on the Pre-Crag land surface.

It seems to be a matter of some importance, in endeavouring to estimate the indications afforded by flint implements as to the culture and habits of the men who made and used them, to take note of the fact that the kind and size of the flint nodules available for manufacturing into implements must have differed very considerably in different localities in ancient days, and that the form and finish of the implements made must often be determined by the greater or less size of the flint nodules available, and also by their abundance. Thus we should be wrong to conclude that large and well-trimmed flint implements necessarily imply that their makers were more advanced in culture than other groups of workers in flint—who, in other localities, made smaller implements of rougher and readier workmanship. The Pre-Crag men of the Icenian area had the finest flints in the world to serve as their material—nowhere else are such huge nodules of fine unflawed flint accessible in such abundance. The men who made the flat amygdaloid and the large triquetro-hastate flint implements (usually referred to by the unmeaning term "coups de poing") of the river gravels of the south of England and north of France probably had access to good-sized flint nodules from the chalk. Though these are not such fine masses as those of East Anglia, the fact that there is no trace in the river-gravel industry of the "rostro-carinate" type of implement, and no trace in the Pre-Crag horizon of the flattened or "foliiform" type, whether amygdaloid or hastate, makes it clear that the men of these two industries were independent and separate. Whether they were separated in place only, or also by geologic time, remains for discussion. We cannot attribute the difference of their types of implement to a difference of material.

When, however, we come to a comparison of the Pre-Crag implements with the industry discovered by Mr. Benjamin Harrison in the high plateau gravel above Ightham, in Kent—which are often referred to by the now useless word "eoliths" indiscriminately applied to all sorts of flint fragments of most varied age and provenance—we have to remember, in the first place, that the age of this high plateau gravel, whether anterior or posterior to that of the Red Crag, or coincident with it, is altogether unknown. And, in any case, we have to take account of the fact that the flint which the Ightham men used was almost exclusively "tabular"

flint, such as is formed in fissures in the chalk. The tabular flint of the South of England is rarely so much as an inch thick, though removable from the chalk in plates of a foot or more in area. The Ightham industry was largely determined in form and character by this tabular form of much of the flint used. Though there is nothing like close coincidence between the East Anglian and Kent Plateau industry, yet in the "borers" and trinacrial (shoulder of mutton) implements of the high plateau gravels, a similarity in design to the rostro-carinate flints of East Anglia, modified by the difference in form and quality of the raw material, can be traced.

On the other hand, we have, in the well-known broad acutely-pointed flakes of the Moustierian period, an example of the prevalence of a comparatively simply worked flint implement at a period succeeding one in which most elaborately chipped, symmetrical implements of large size—the Acheuilian—were the predominant type. It seems to me that this can be explained by the fact that the makers of the finest Acheuilian implements (the great triquetro-hastate flattened forms) had developed too great an artistry in their work. They spent time and skill in the mere pleasure of chipping an implement beautifully and giving it perfect shape. The Moustierian men show a reaction from this. Their typical acutely pointed ovate implements are not over elaborated but struck out with a masterly touch. The whole of one surface is made by a single blow, carrying away the piece required, which is already flaked on its outer face by the previous removal of similar pieces. The point is already shaped at the opposite end to the bulb of percussion. All that has to be done is to notch (in some cases) the very sharp edge of the large flake-like piece by saw-like toothing. Fifty such implements could be made whilst an Acheulian workman was labouring at one of his highly finished large implements. There is, it seems to me, here, at the later period, simplification of workmanship with increased efficiency—a characteristic of *progress* in skill even though it may accompany a disappearance of decorative symmetry and finish.

Probably amongst the ancient flint workers the same order of development obtained in regard to their flint work as in regard to other forms of human handicraft. In the first stage we get clumsy and rough, but bold, workmanship; in the second, careful and decorative elaboration; in the third, conventionalism and simplification in detail, with increased efficiency in regard to either utility or artistic gratification; and, fourthly, relapse into extreme simplicity or nullity of character. And such cycles keep on developing afresh in successive ages. If we apply these ideas to the interpretation of the flint industries of various localities and ages in Western Europe, we shall, I think, be led to the opinion that the "rostro-carinate" implements of East Anglia were possibly connected with the flint industry of the Kentish Plateau, but underwent locally a "perfecting" from rougher to finished work and then disappeared. There is no evidence of any transitional connection of this industry with that which we discover in the river-gravels—the industry of the amygdaloid and triquetro-hastate foliiform (leaf-shaped) implements. Probably

the "rostro-carinate" industry was separated by a great interval of time from the "foliiform." The knowledge as to how great that interval was depends on the answer to the question, as yet ungiven:—"What is the relative age of the Red Crag marine deposit and of the various high and low terrace gravels of England and of France?"

Summary of Conclusions.

1. Flint implements of human manufacture have been discovered in the detritus-bed at the base of the Red Crag in Suffolk and in that at the base of the Norwich Crag in Norfolk. They characterise what may be called "the ICENIAN industry."

2. These implements are of a novel type, "the rostro-carinate" or "eagle's beaks," but include also scrapers, hammers, and large one-sided picks. They do not include any forms resembling the Chellian and Acheuilian ovate implements. The Chellian and Acheuilian and Moustierian types are essentially *depressed* or flattened like a leaf. The Sub-Crag type (*rostro-carinate*) is essentially *compressed* from side to side.

3. They were manufactured at a period previous to one of severe glaciation which set in before the lowest beds of the Red Crag and Norwich Crag were deposited. They characterise a phase of human development earlier than any hitherto known by equally indisputable evidence.

4. The detritus-bed (bone-bed), in which these implements are found, contains the remains of previous littoral deposits, but was itself probably deposited in quiet shallow water—the flint implements and large blocks of flint being carried to it and deposited by ice. They bear no indication of attrition by water-action. The bed in which they are found is not a beach, though it contains derived flints, worn into shape by attrition in a preceding deposit, in which the large blocks of flint and the flint implements were not involved.

5. The rostro-carinate implements were not improbably used for dressing and smoothing the skins of animals.

6. On the land surface from parts of which these implements were moved into the detritus-beds at the base of the East Anglian "Crags" similar (but often more richly flaked) implements remained or were subsequently manufactured, which were embedded in the subsequent deposits of the Glacial period and have been found in a few isolated instances in Mid-Glacial sands and Boulder clay (*fide* MOIR).

7. The Red Crag is commonly regarded as of greater geologic age than its proper fauna would indicate. Its mammalian fossils are derivatives of an earlier age, and the few molluscs of Pliocene character found in its earlier layers are lingering survivors from a warmer condition of the sea. They became extinct at the early onset of the cold conditions proper to the Red Crag sea. The Red Crag should be grouped with the Pleistocene rather than with the Pliocene series.

8. The race of men who manufactured the Sub-Crag flint implements probably lived on the land surface not remote from the sea during the period of the Coralline Crag, but possibly earlier. The period of the Coralline Crag was characterised by a warmer climate than that of the Red Crag and may justly be regarded as marking the close of Pliocene conditions in this part of Europe. The land barrier joining Britain to Scandinavia, which had kept the southern part of what is now the North Sea from the access of the cold northern waters, ever since the earliest Tertiary period, disappeared at the beginning of the deposition of the Red Crag.

9. If these propositions are justified, it remains a question for later enquiry as to whether the men who made the Sub-Crag implements were of greater antiquity than those who made the implements of the high plateau gravels of Kent or than those recognised by some archæologists as the makers of roughly chipped flints found in other localities, but not hitherto generally admitted as of human workmanship.

10. In any case, the implements from the Sub-Crag beds in East Anglia are of a special and very distinct type, and cannot be associated with any of those known from any other locality.

[*Postscript, February* 15, 1912.—Whilst this memoir has been in the press, two important facts bearing on the history of the Icenian industry have come to light, which should be mentioned here, however briefly. The first is the discovery by Mr. Edward Heron-Allen of worked flints, resembling some of those found in the Sub-Crag deposit, in a gravel of undetermined age resting on Eocene clay, upon the seashore of Selsea Bill, Sussex. One of these is a very large pointed rostro-carinate implement measuring 8 inches in length and $5\frac{1}{2}$ inches at its broader end, and weighing 5 lbs. 9 oz. It has the characteristic beak, dorsal keel (shaped by six well-marked longitudinal flakings), and a flat ventral surface. It is broader and heavier than any of the Icenian "eagle's beaks." Little of the original cortex is left; the worked surface is nearly black, scratched here and there by glacial action and a little stained by iron. The edges of fracture are smooth to the touch, not sharp. Another specimen is a very large flint hammer-stone, of the shape of a four-sided pyramid, closely similar to that from Suffolk drawn in figs. 25 and 26 of the preceding memoir. But the Selsea specimen is of twice the linear dimensions of that from Suffolk. Other specimens of a less decisive character have been found. A very striking feature about the two specimens mentioned is their great size and weight. I hope to publish figures of the Selsea Bill specimens at no distant date.

The second newly ascertained fact which I desire to put on record in this connection is the existence of rostro-carinate implements—very similar to those of the Icenian industry—in the remarkable deposit of fractured nodules and slabs of

chert, discovered by RAMES in 1877 near Aurillac in the Auvergne. Mr. EDWARD WESTLAKE, of Fordingham, near Salisbury, has devoted several years to the collection and study on the spot of the humanly-worked chert-stones of Aurillac, and (for the purpose of comparing the two industries) to the investigation of the stone implements of the Tasmanians, having spent some months in Tasmania for this purpose. I have during this winter (1912) been able, by Mr. WESTLAKE's kindness, to examine a large part of his splendid collection, with the illustration and description of which he is now busy. The age of the Aurillac chert implements is definitely fixed by a lava-flow of ascertained Upper Miocene age, which overlies the deposit containing them. The deposit contains teeth of *Dinotherium giganteum*, *Hipparion gracile*, and *Machairodus cultridens*. The chert itself is derived from an anterior Eocene deposit. I was impressed by the similarity of many of Mr. WESTLAKE'S specimens to the worked tabular flints of Ightham (Kent plateau). The chert of Aurillac occurs in tabular masses, larger and thicker than those of the flint made use of at Ightham, and many of the "worked" pieces are of relatively great size. But the fact which I wish to announce here, in connection with my account of the rostro-carinate implements of Suffolk (Icenian industry), is that in Mr. WESTLAKE'S collection from Aurillac are three rostro-carinate implements, identical in character of manufacture, of shape, and of size, with those of Suffolk. I am able to present (text-figs. 44 and 45) rough line-drawings of the dorsal and ventral surfaces of one of these implements, the specimen having been lent to me for the purpose by Mr. WESTLAKE. It seems to me not possible to doubt the close similarity of the Aurillac chert implement and the Suffolk flint "eagle's beaks." Figs. 44 and 45 should be compared with figs. 8 and 9 and with figs. 10 and 11.

I do not intend to proceed without caution to any conclusion on this subject, but it seems to me quite possible that there was a close relationship between the men who made the Upper Miocene rostro-carinate implements of Aurillac and those who made similar implements in Suffolk before the deposit of the Red Crag. The Icenian flint-workers may have been of Upper Miocene age. It is true that, at present, we know of no facts placing them earlier than *some* epoch preceding the deposition of the Red Crag. At the same time, we do not at present know of anything which precludes their having occupied the Icenian land-surface in late Miocene times.

Whilst the facts as to the characteristics of the worked tabular flints of the Kent plateau, and as to those of the worked tabular chert of the Upper Miocene of Aurillac, are so little known (since of neither series has there yet been any adequate publication and illustration), it seems unwise to say more as to the connection of the Kent plateau industry with that of Aurillac than that there is a good deal of evidence, leading one to entertain—at any rate, as a hypothesis to be further tested—the possibility of a community of origin of the Icenian, the Ighthamian, and the Aurillacian industries.

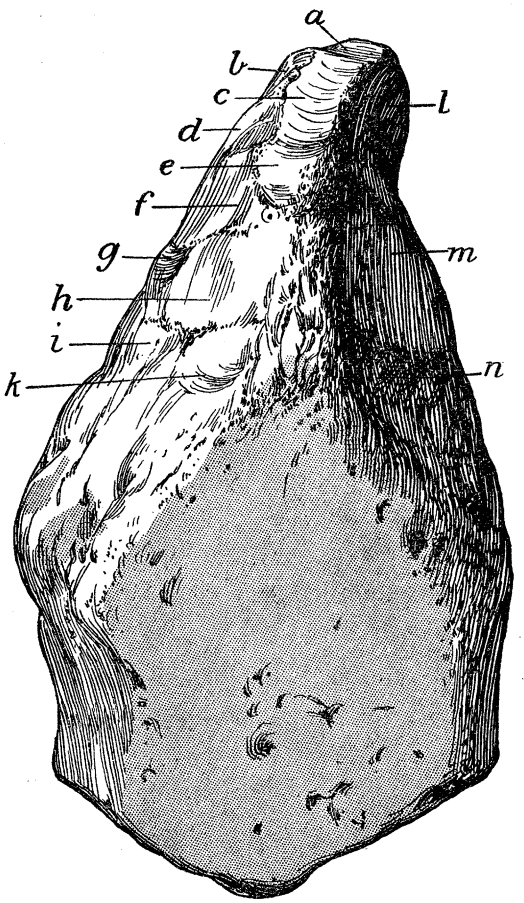


FIG. 44.

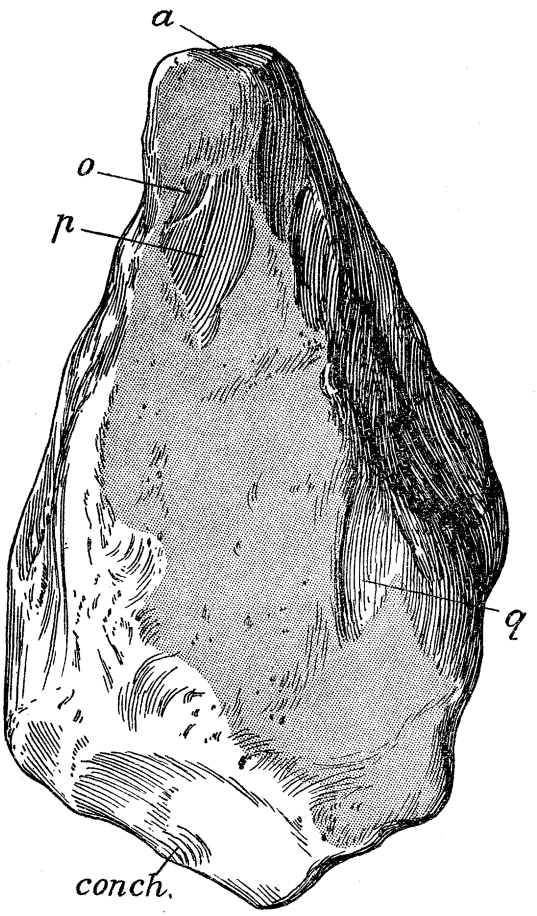


FIG. 45.

FIG. 44.—Drawing (of the natural size) of the "dorsal" surface of a rostro-carinate implement from Queille, Belbex, near Aurillac, now in the collection of Mr. EDWARD WESTLAKE, of Fordingbridge. The broad flat hinder dorsal surface is unchipped, and is indicated by a fine granular tint. From this runs forward to the beak-like anterior end of the implement, a strongly marked "keel" or carina, indicated by the deep shading. To the left of this keel a number of separate "flakings" are shown marked *a* to *k*: some of these show conchoidal fluting. To the right of the keel, three large "flakings" marked *l*, *m*, and *n* are seen.

FIG. 45.—Ventral view of the same specimen. The ventral surface is a horizontal plane, and is formed by the original surface of the chert nodule as indicated by the granular tint. At the spots marked *o*, *p*, and *q*, flakes have been removed showing conchoidal fracture. *a* in this figure indicates the same "flaking" as that marked *a* in fig. 44.

N.B.—I am informed by Mr. WESTLAKE that this specimen and the one-sided pick to which I have referred at the end of the above postscript were not obtained from the implementiferous quartz gravel overlaid by a lava flow at Aurillac, but at a distance of a quarter of a mile from it. The colour and surface-glaze of the specimens from Queille render it highly probable that they are of the same age as those *in situ* beneath the lava. Various questions connected with the geological age of these specimens will be dealt with by Mr. WESTLAKE in a memoir on the subject which he is preparing.

I should add that one of Mr. WESTLAKE'S most finished and obviously "human" pieces from Aurillac is a one-sided pick, resembling in important respects the specimens drawn in figs. 27 and 28 of the memoir, to which these lines form a postscript.—E. R. L.]

EXPLANATION OF PLATES.

PLATE 14.

All the figures are collotype reproductions of photographs of the natural size, taken from the specimens.

All the specimens (three in number) are from deposits of later age than the Red Crag—namely, from the Mid-Glacial sands of Suffolk.

A is the specimen from Lakenheath, near Brandon, presented by Canon GREENWELL to Sir JOHN EVANS, and figured by him in his 'Ancient Stone Implements,' 1897, fig. 444. It is now in the collection of Sir ARTHUR EVANS, F.R.S. See also text-figs. 4 and 5.

B is a specimen found on a heap of flints rejected from the coprolite pit at Foxhall. Its colouring and glaze are similar to those of flints from the Mid-Glacial sands which overlie the Red Crag. It is also more richly flaked and by smaller flakings than one observes in Sub-Crag specimens. See also text-figs. 2 and 3.

C is a specimen obtained in the Mid-Glacial sand overlying Red Crag in Bolton and Laughlin's pit at Ipswich. See also text-figs. 6 and 7.

PLATE 15.

All the figures are collotype reproductions of photographs taken from the specimens and reduced to a little less ($\frac{1}{18}$) than half the natural size.

All the specimens are from the Sub-Crag detritus-bed or bone-bed lying below the Red Crag of Suffolk.

D was removed by Mr. REID MOIR from the bone-bed in Bolton and Laughlin's pit, Ipswich. X in the lower figure points to the peculiar flat surface of fracture beneath the point of the implement. See also text-figs. 8 and 9.

E has the same origin and finder. See also text-figs. 10 and 11.

F has the same origin and finder as D and E. See also the text-figs. 12 and 13.

G is a specimen found by Mr. REID MOIR *in situ* beneath shelly Crag in the pit at Thorington Hall, Wherstead, near Ipswich.

H was dug out from the bone-bed beneath Red Crag in Bolton and Laughlin's pit, Ipswich, by the quarryman, BAXTER. The lower face, which is smooth and glistening over two-thirds of its anterior area, shows glacial scratches. See also

the text-figs. 16 and 17 and the monotone paintings reproduced by half-tone process in Plate 17.

I was removed from the bone-bed below shelly Crag at Thorington Hall Pit, near Ipswich, by Mr. Reid Moir. The figure of the lower or ventral surface shows glacial scratches marked *g'* on the peculiar smooth fracture-surface X underlying the point of the implement. See also the text-figs. 18 and 19.

Plate 16.

The figures in this plate are collotype reproductions, a little less than half the natural size, showing the right and the left surfaces of the same implements of which the dorsal and ventral surfaces are shown in Plate 15.

The capital letters A to I have the same significance as in Plate 15. In figures G, H, I, and D of the right lateral surface, the smooth flat area of fracture underlying the point of the beak is well seen.

Fig. I of the left lateral surface shows well the great conchoidal fracture and its centre of percussion, by which a large part of the left posterior region of the flint was removed at the time (to judge by the state of the surface) when the implement was manufactured.

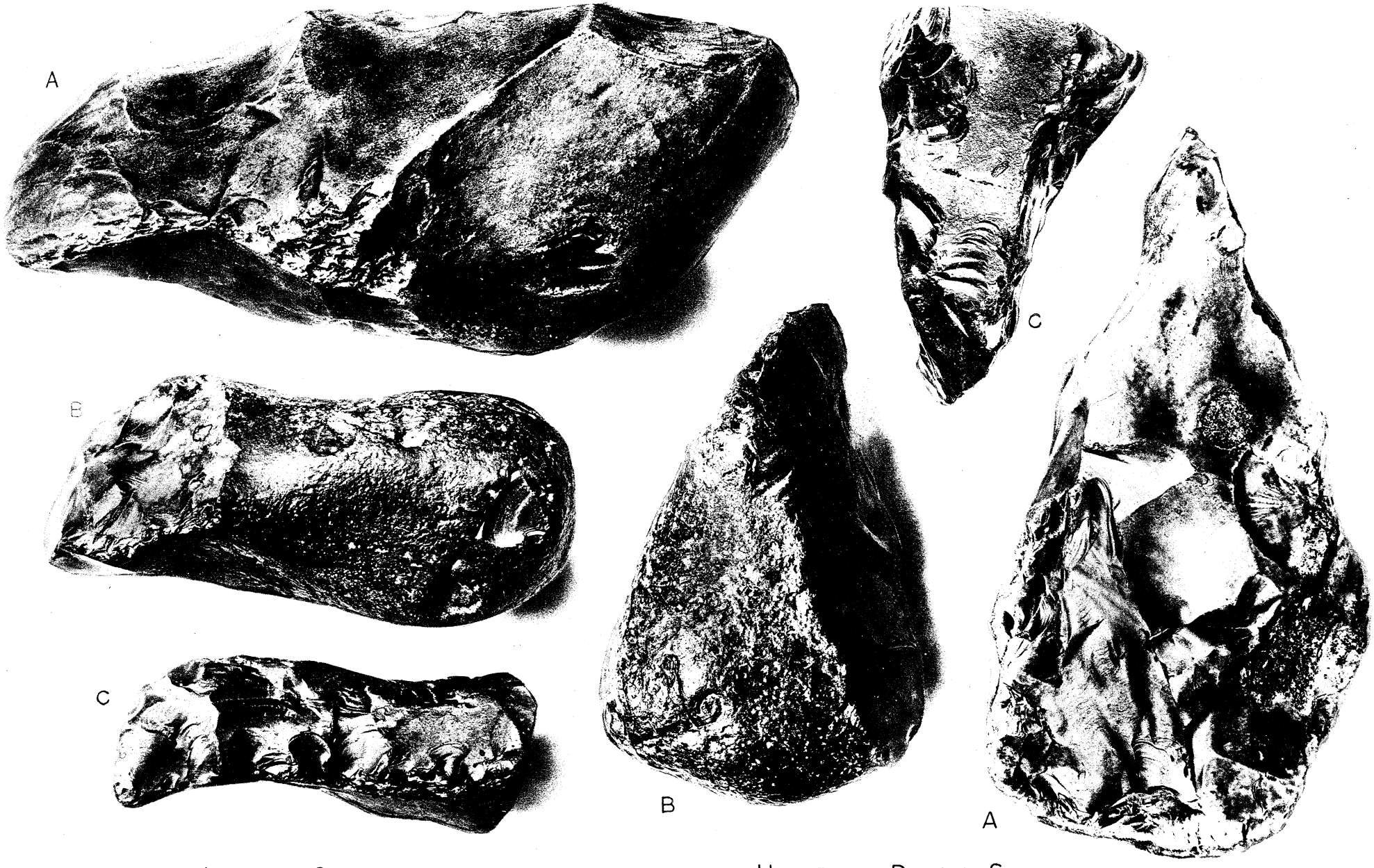
Plate 17.

Half-tone reproduction of very careful paintings in monotone of the large rostro-carinate implement designated in the text and in the other plates as specimen H.

Fig. 1.—Dorsal surface of the specimen H, to show the large conchoidal fracture on the surface of the broad posterior region. Drawn of the natural size. *b* is placed below the curved ridges due to the powerful conchoidal fracture by which the hinder part or "butt" of the implement was shaped. The anterior two-thirds of the surface are trimmed by numerous conchoidal flakings, and fine glacial scratches are seen on the mid-dorsal region.

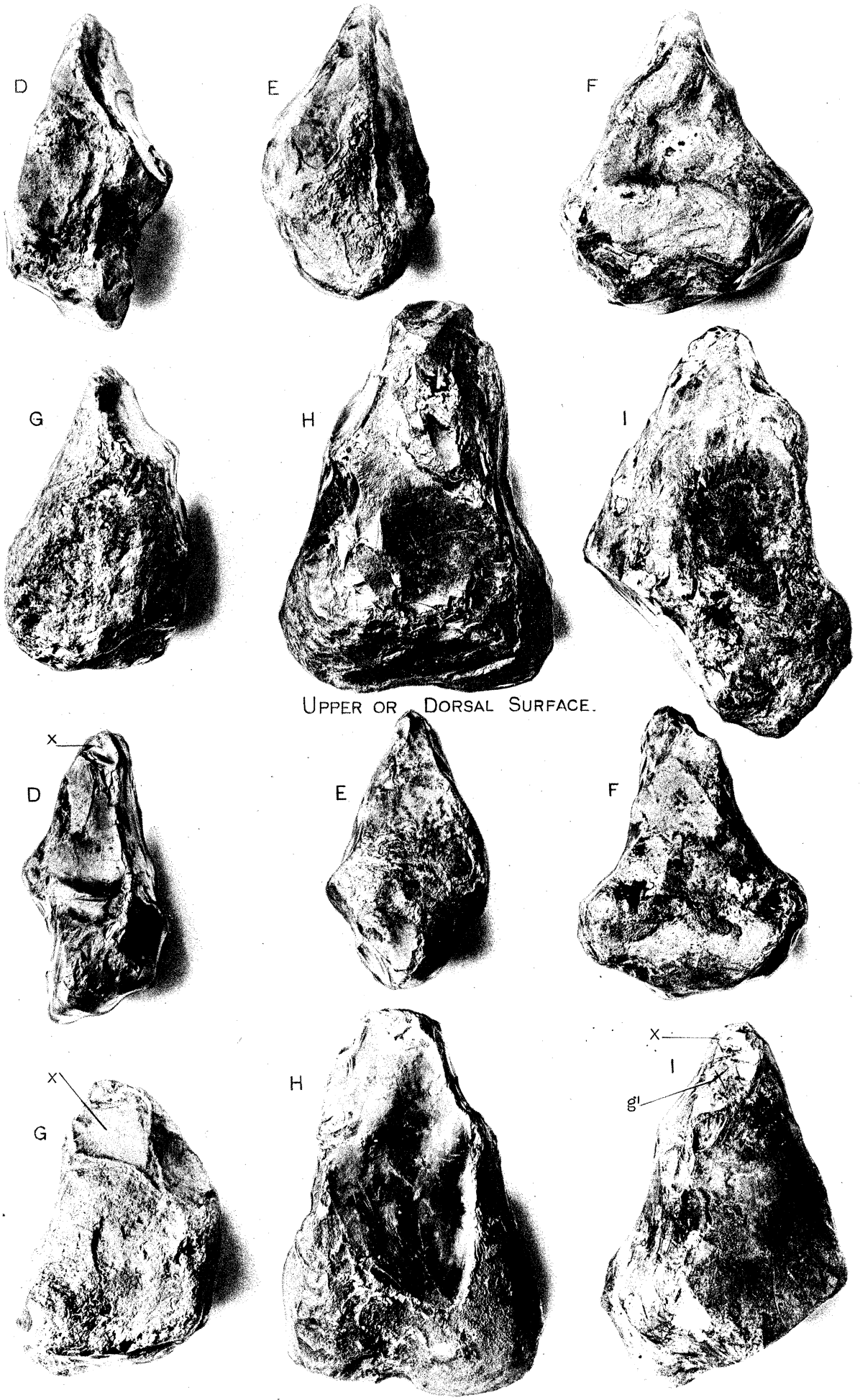
Fig. 2.—Ventral surface of the same specimen (see text-fig. 17, and Plate 15, H) to show the texture of the great flat surface of fracture and the glacial scratches *gl* on various parts of it. Natural size. *a* points to a well marked small conchoidal fracture.

Figs. 3–5.—Drawings of portions of the glacial scratches seen in fig. 2, magnified about 5 diameters to show the structure of the walls of the grooves or canals cut in the flint.



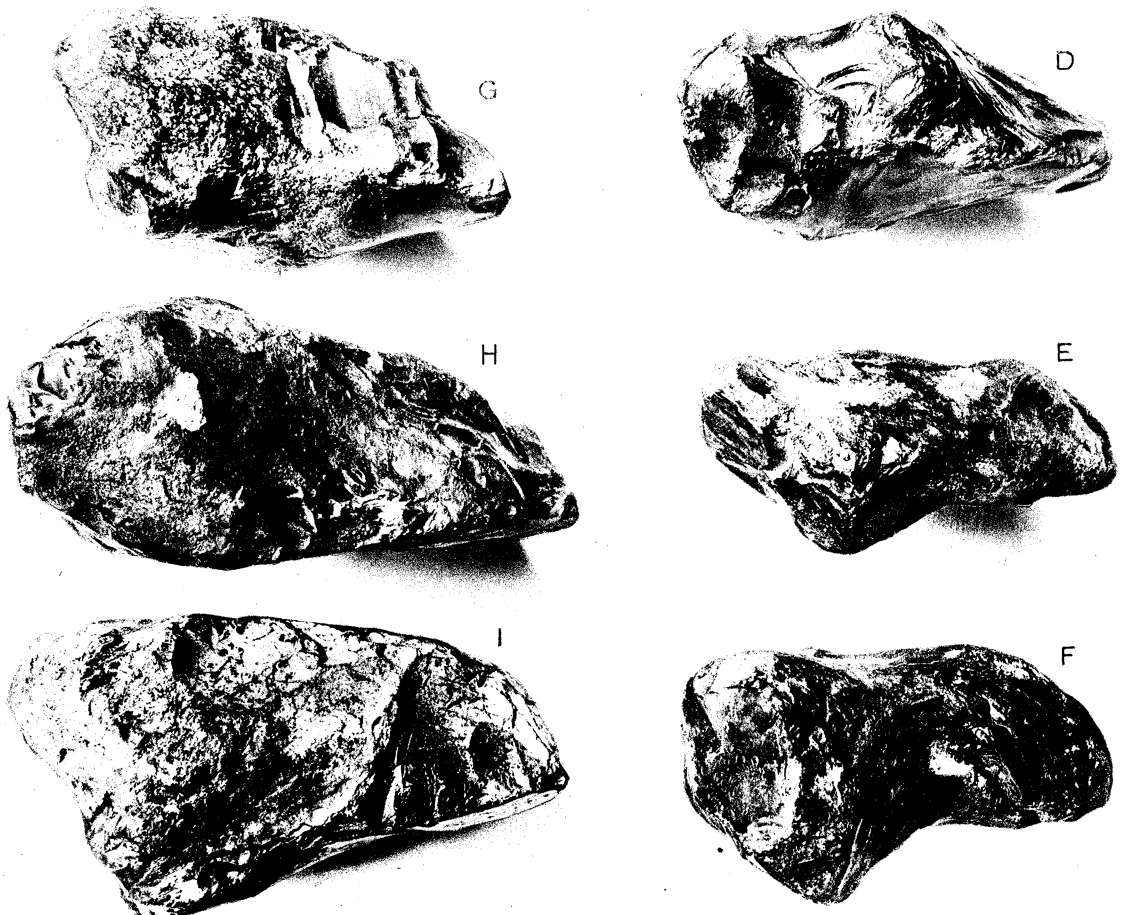
E. RAY LANKESTER dir.

ROSTRO-CARINATE FLINT IMPLEMENTS, FROM MID-GLACIAL SANDS OF SUFFOLK,
OF THE ACTUAL SIZE.



E. RAY LANKESTER dir.

ROSTRO-CARINATE FLINT IMPLEMENTS, FROM THE BASAL BED OF THE RED CRAG OF SUFFOLK, HALF THE ACTUAL SIZE.



E. RAY LANKESTER dir.

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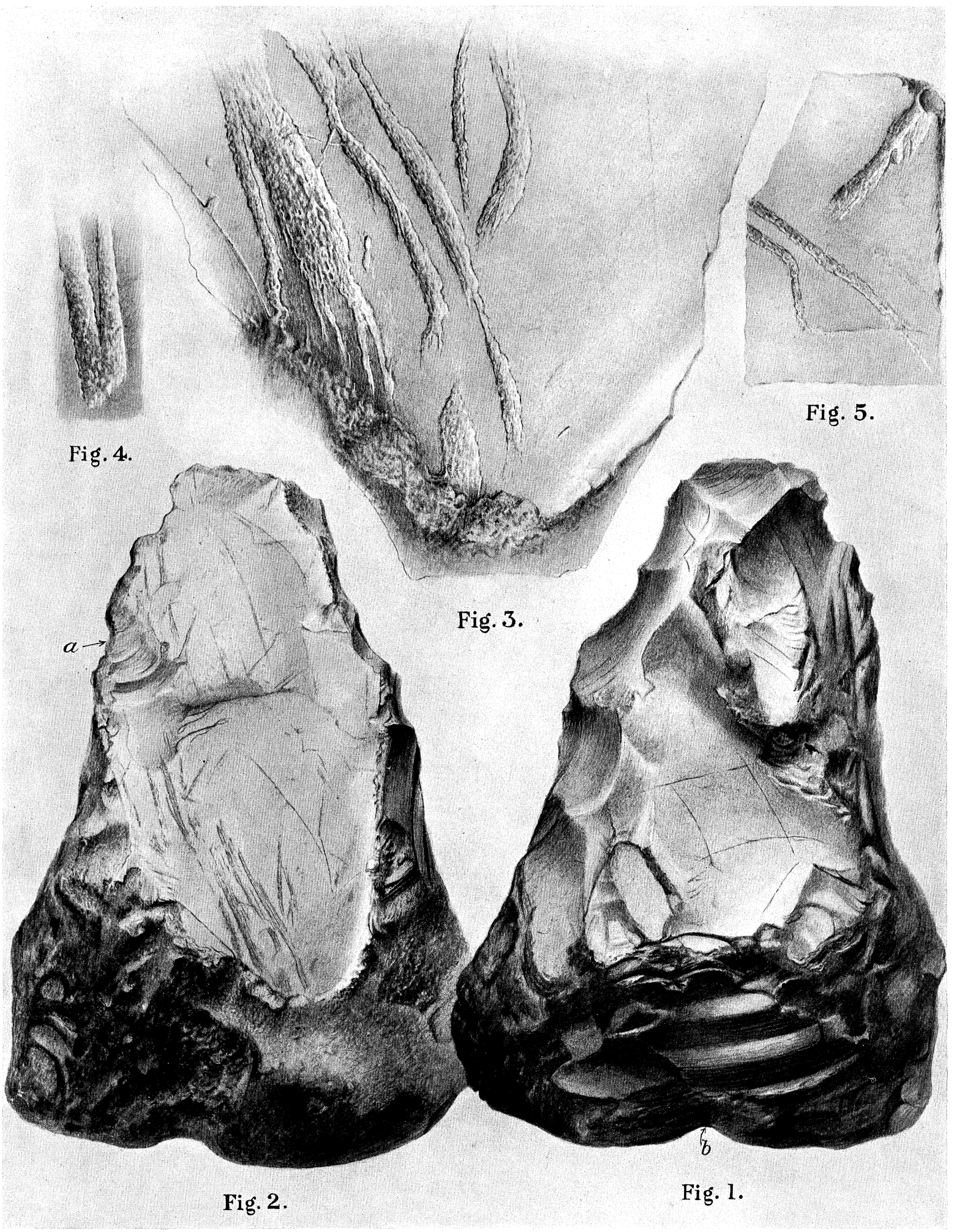
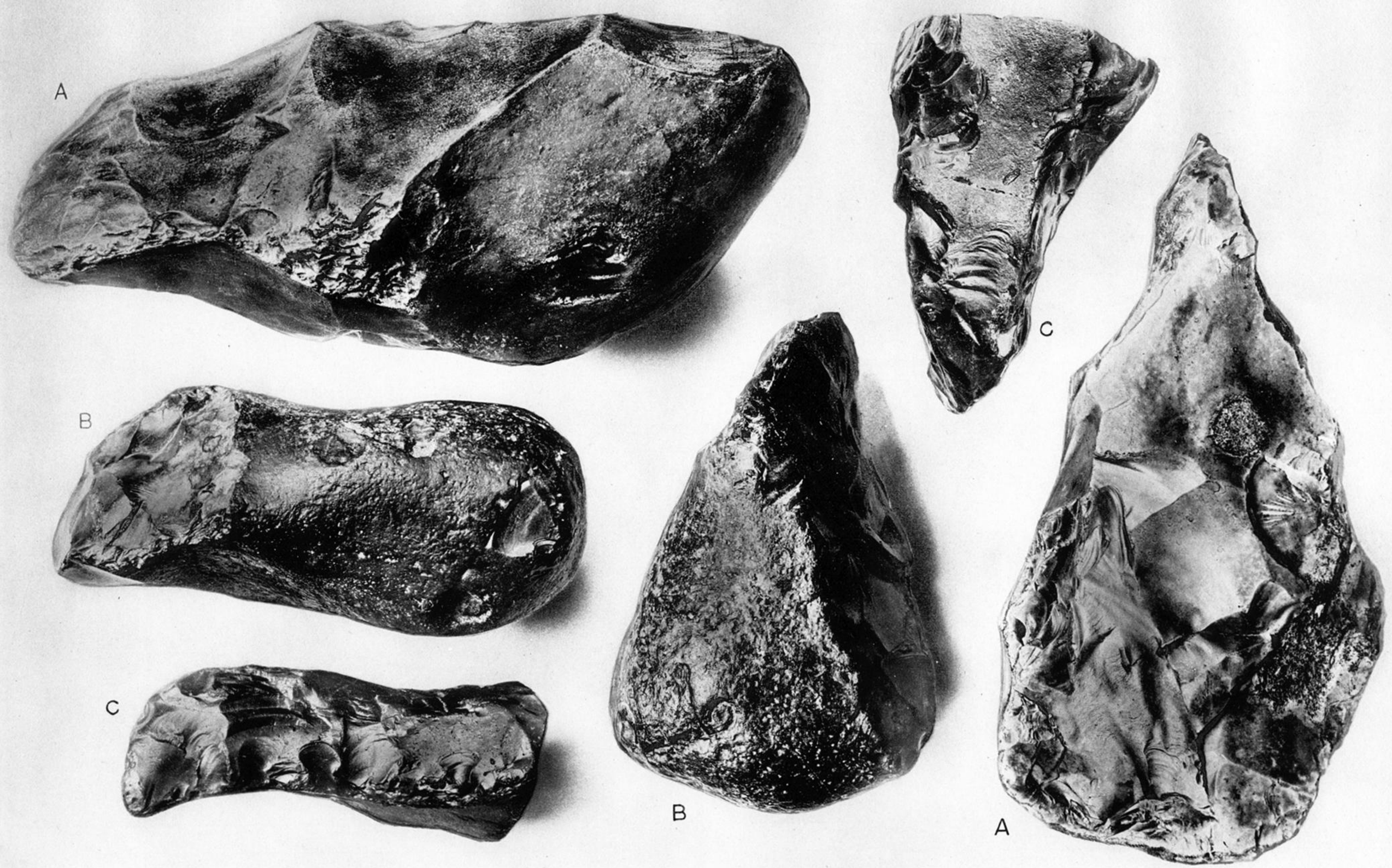


H. Grönvold del.

GLACIATED ROSTRO-CARINATE FLINT IMPLEMENT

FROM BASAL BED OF RED CRAG



LEFT LATERAL SURFACE.

UPPER OR DORSAL SURFACE.

ROSTRO-CARINATE FLINT IMPLEMENTS, FROM MID-GLACIAL SANDS OF SUFFOLK, OF THE ACTUAL SIZE.

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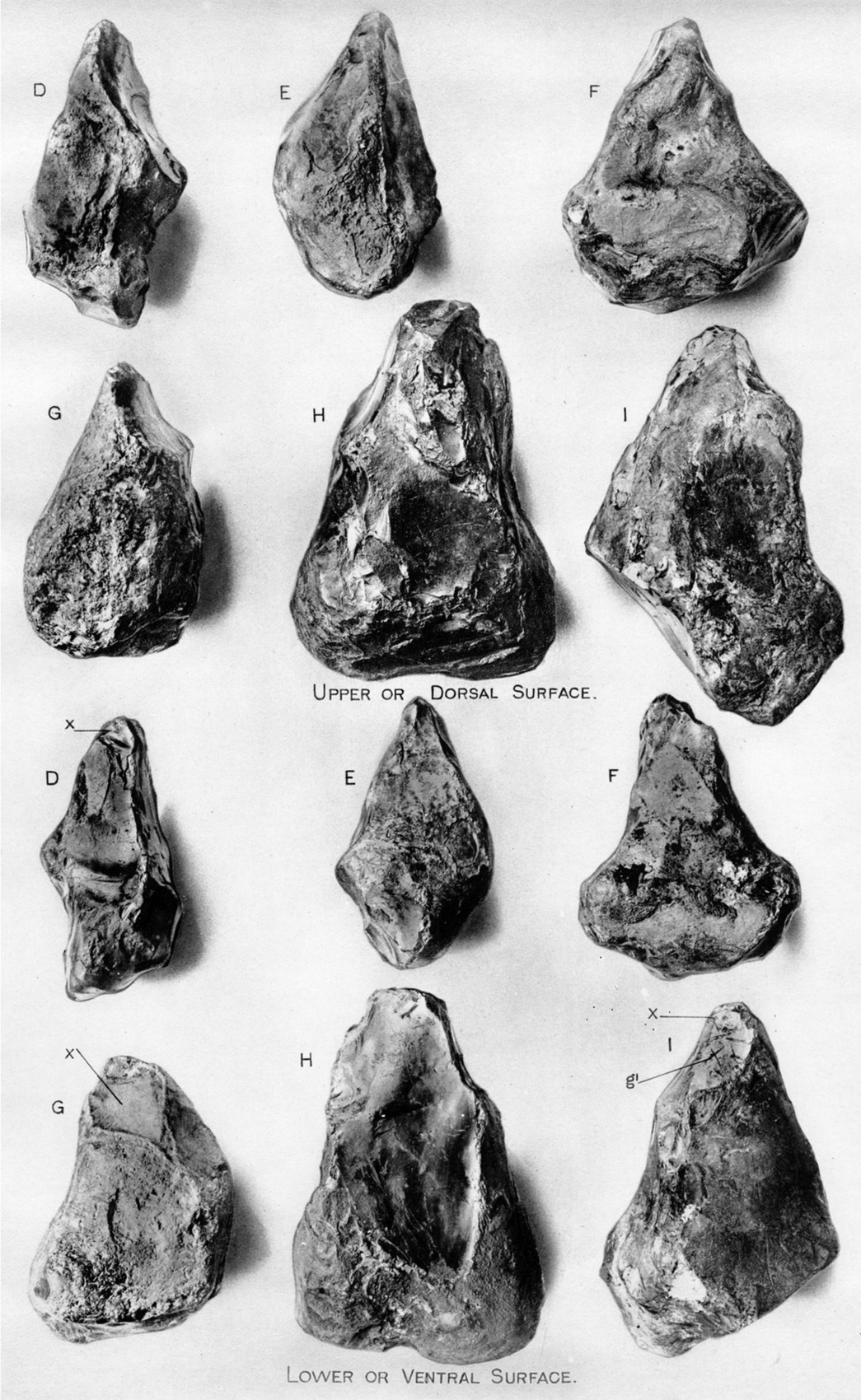

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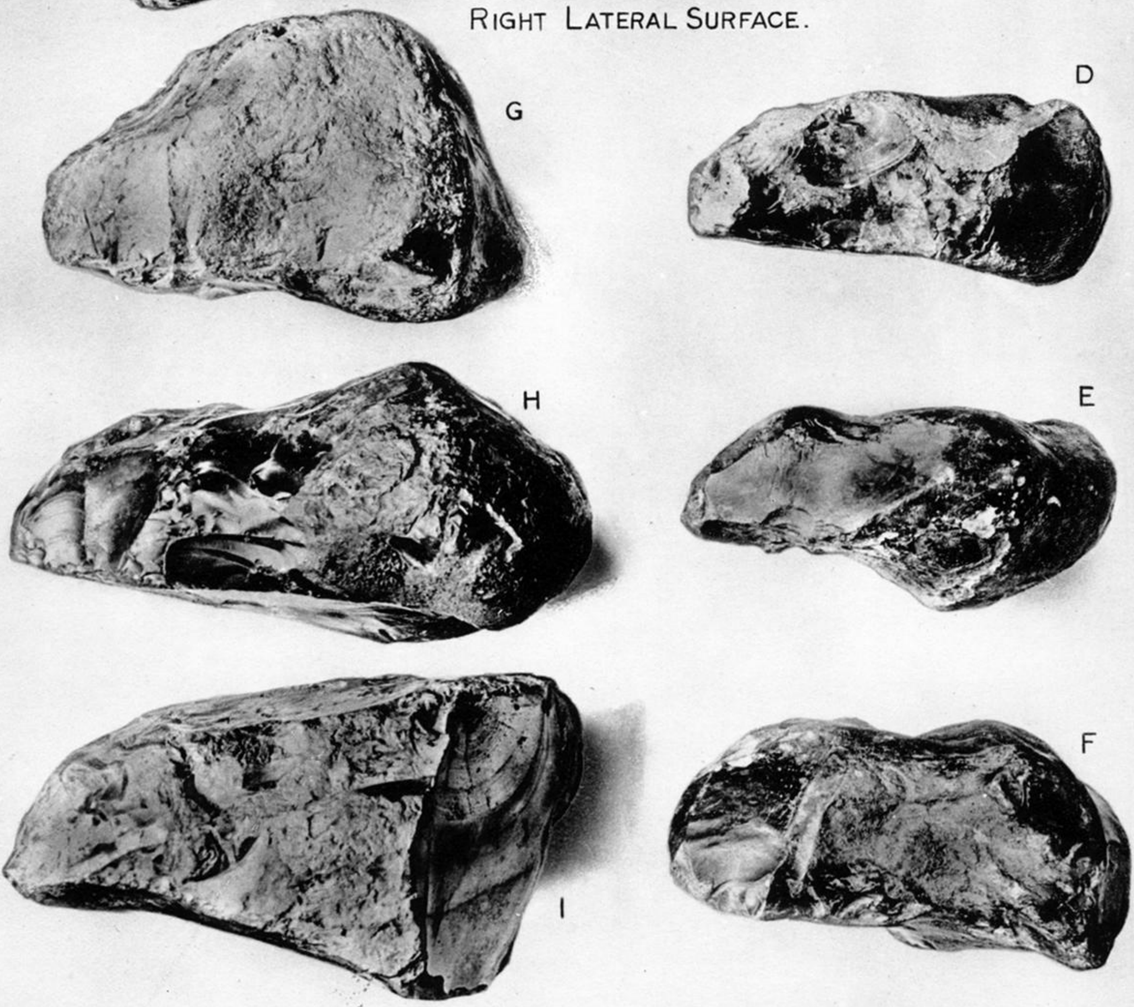
RIGHT LATERAL SURFACE.



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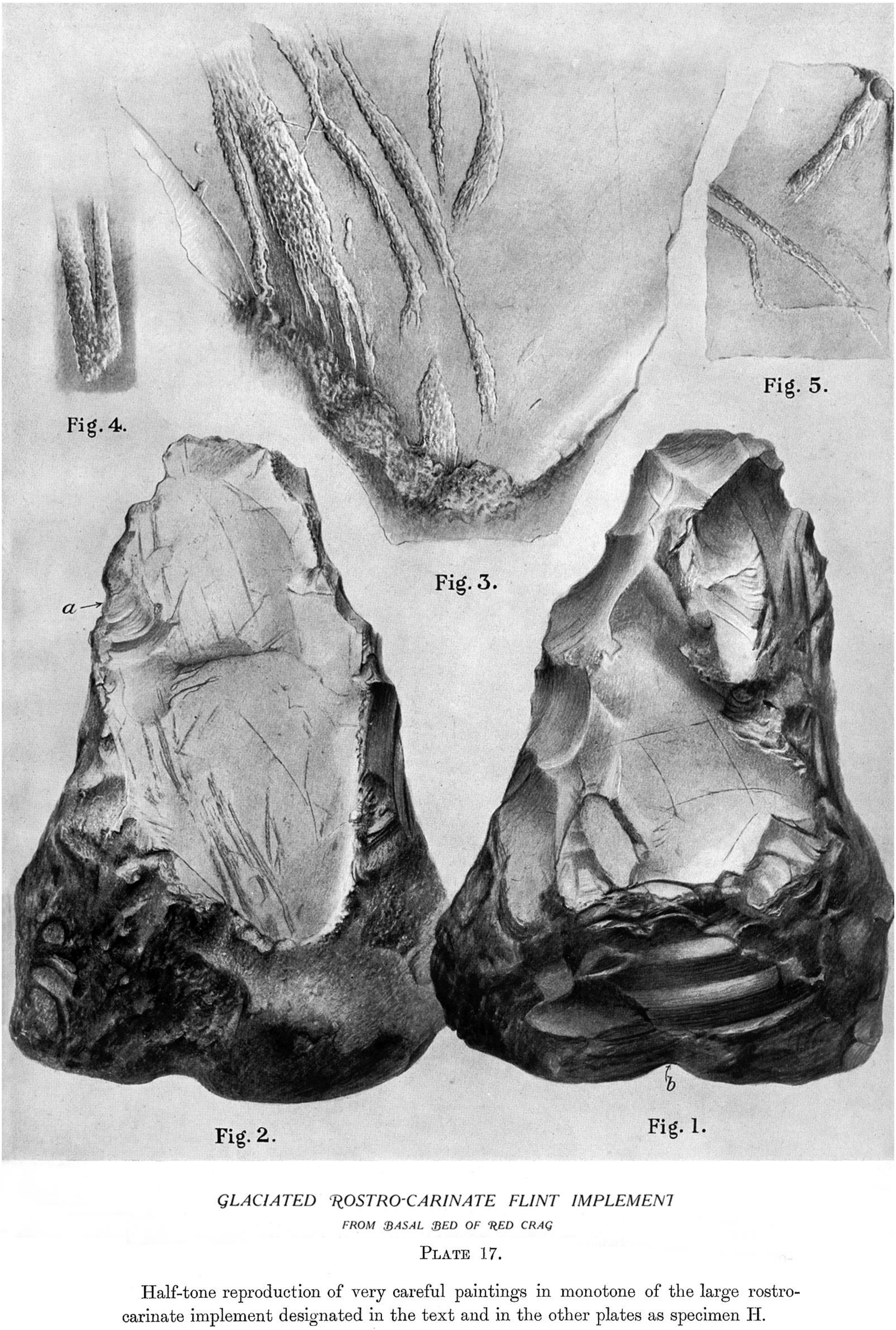
The capital letters A to I have the same significance as in Plate 15. In figures G, H, I, and D of the right lateral surface, the smooth flat area of fracture underlying the point of the beak is well seen.

Fig. I of the left lateral surface shows well the great conchoidal fracture and its centre of percussion, by which a large part of the left posterior region of the flint was removed at the time (to judge by the state of the surface) when the implement was manufactured.



GLACIATED ROSTRO-CARINATE FLINT IMPLEMENT

FROM BASAL BED OF RED CRAG

PLATE 17.

Half-tone reproduction of very careful paintings in monotone of the large rostro-carinate implement designated in the text and in the other plates as specimen H.

Fig. 1.—Dorsal surface of the specimen H, to show the large conchoidal fracture on the surface of the broad posterior region. Drawn of the natural size. *b* is placed below the curved ridges due to the powerful conchoidal fracture by which the hinder part or "butt" of the implement was shaped. The anterior two-thirds of the surface are trimmed by numerous conchoidal flakings, and fine glacial scratches are seen on the mid-dorsal region.

Fig. 2.—Ventral surface of the same specimen (see text-fig. 17, and Plate 15, H) to show the texture of the great flat surface of fracture and the glacial scratches *gl* on various parts of it. Natural size. *a* points to a well marked small conchoidal fracture.

Figs. 3–5.—Drawings of portions of the glacial scratches seen in fig. 2, magnified about 5 diameters to show the structure of the walls of the grooves or canals cut in the flint.