V Waarnemingen aan vuursteen

Microwear on flint:
Some Experimental Results

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Introduction
Before a discussion of the results of the experimental work undertaken at Oxford to provide a framework for the study of the utilization of British Lower Palaeolithic implements, it might be best to get a few definitions out of the way. *Microwear*, which has been emphasized in this project, consist of striations, abrasion and polishes, observable usually only with a microscope, on the surface of flint implements. *Utilization damage* is the *macro*scopic breakages and flake scars, occurring on implement edges that have been used, as a result of that use. *Edge damage* is the term for all such breakages and flake scars, of which utilization damage is a particular type. The use of the term edge damage doesn't beg the question of whether the damage results from use or from other causes.
Because of the necessary brevity of this paper, I will only discuss very generally the particular techniques used in examining implements and some of the more interesting preliminary results of the program of experiments, though I will gladly answer in more detail any questions that may arise out of this. Also, I am not making reference in this paper to the work of others in this field; this is simply a progress report on my own research.

Techniques
Two microscopes are used in my research: a stereomicroscope with a normal range of magnification from 4x to 50x, and a lab microscope with an incident-light attachment with a normal range of magnification from 40x to 400x. The incident-light microscope is more effective for several reasons: 1) light intensity increases as magnification increases, 2) of course, high magnification work is easy to perform, 3) photomicroscopy is simpler than with a stereomicroscope and 4) the particular microscope I posess has a great flexibility of light arrangements: light and dark field illumination, polarization, and various filter arrangements. Its only disadvantage is this close working distance above 200x, but 400x is still obtainable on most pieces. The stereomicroscope loses light intensity as magnification increases, which makes detailed observation and especially photography above about 12 - 20x almost impossible. I have tried using the scanning electron microscope, but the small size of the stage, and the time consumed making carbon replicas, have discouraged further attempts in that direction for the moment.
When you are looking for microscopic features on flint surfaces, care in cleaning those surfaces is particularly important. I clean all my implements in an ultrasonic cleaning tank. The implements, experimental and archaeological, are first washed in HCL and NaOH to remove calcareous and organic deposits respectively. They are then cleaned ultrasonically in a detergent solution and a clear water rinse. At some stage, when dealing with implements that have been handled before, is is also useful to immerse them in white spirit to remove extraneous matter such as finger prints and plasticine. These procedures ensure that the microfeatures seen belong truly to the original surface of the implement and are not something else.

Methodology
So far as I am concerned, the aims for the microwear analyst of a flint industry are these:
1) to isolate genuine microwear and utilization traces from similar phenomena resulting from other causes
2) to interpret such traces - i.e. assign implements showing microwear and utilization damage to a particular use on a particular material
3) to examine all pieces in a suitable condition from a collection or random sample in order to discover a) what percentage of all the implements were actually used, b) what the range of uses and the predominant uses were and c) how various uses relate to the typological and technological features of the implements
4) to compare the data obtained from microwear analysis with other information available from that site (for example: artifact location, associations, ecological data etc.) in order to address more general questions about the behavior of the inhabitants.
Before any attempt at microwear analysis can make progress towards its goals, the analyst must conduct a systematic series of experiments in order to isolate true microwear from extraneous effects and to acquire a familiarity with the various types of microwear and utilization damage. Thus far in my program, I have conducted some 80 experiments of which 60 were actually concerned with implement use, 6 with technological effects, and the rest with natural processes.
From these experiments it seems that most natural processes leave traces on flint implements that are relatively easy to distinguish from microwear and utilization damage because they tend to affect the *whole surface* of the implement, rather than just the working edge, and to be oriented in random directions. However, the most serious source of confusion for microwear analysis, and especially for analysis of edge damage, is *in situ* soil movements. This may not often be a particular problem for post-glacial material, but for most of the Palaeolithic even implements which are apparently very fresh and unabraded, from undisturbed contexts, will show numerous breakages and, more rarely, scratches that seem to be the result of slight shifts and movements after burial. The maddening thing about these is that, while most of the time they are manifested as tiny, shallow scalar scars and step fractures randomly distributed on thin edges, they can be manifested as areas of fine nibbling and step retouches that mimic various types of utilization damage. One clue to soil movements is the presence of white scratches on the implement surface. The more white scratches on a piece, the more edge damage. There are also certain types of striations which are probably the result of soil movement. You will find that from primary context floors where the implements are quite fresh, most, if not all, flints have some form of edge damage, while true microwear traces (other than random striations) are much rarer.For this reason and a few others, I have not emphasized edge damage in my methods but placed the major emphasis on polishes, abrasion and striation, while nevertheless not ignoring edge damage.
Before discussing the prelimary experimental results it might be helpful to mention something about the causes of microwear. One cause is environmental grit, which consists of hard particles which are embedded in, or settle

on, the surface of material being worked or on the implement itself. This grit comes from atmospheric dust, hands, soil adhering to tools and worked material, and the fine silica dust on the surface of freshly flaked flint. This material certainly causes minute striations and may also be involved in the formation of polishes. Often in the course of work, minute breakages occur on the edge of the implement and the flint particles thus detached are dragged across the implement surface or become imbedded in the worked material. These chips cause abrasion and striation. Working some materials such as wood, bone, meat and hide often produces a polish on the implement edge. The causes of these polishes are not known. It is possible that uses which involve much friction between the implement and the worked material produce enough heat to fuse the surface of the flint, perhaps including some elements of the worked material. Flint is a poor conductor of heat, so any frictional heat would not be dissipated and would be concentrated on edge surfaces.

The Utilization Experiments

Of the sixty controlled experiments concerned with use of flint artefacts on various materials, 36 were used on wood, 13 on bone, 4 on dry hide and 7 on meat. The artefacts were experimental pieces made by myself under controlled conditions. The most important discovery from the experiments completed thus far was that the various worked materials seem to produce distinctive polishes (distinguishable at 200x but not at low magnifications) and that these polishes are produced by most kinds of use (cutting, scraping and so forth). It should be noted that these polishes survive *all* cleaning and chemical baths.

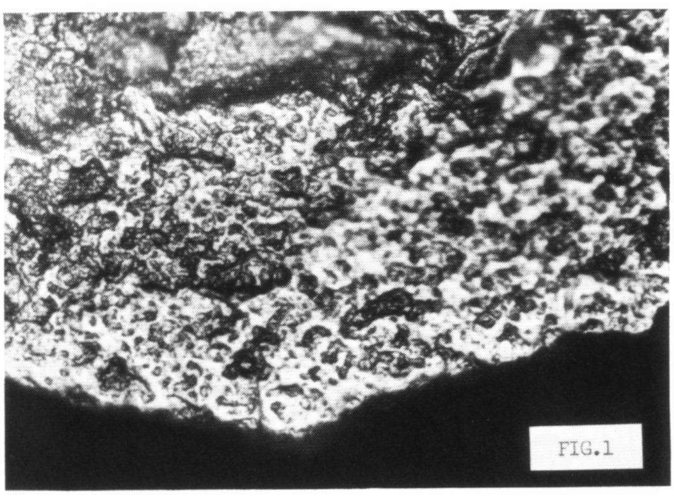

FIG.1

Fig. 1. The edge of a flint implement used for whittling wood showing wood polish. 200x. The normal, unpolished surface of the piece can be seen near the top of the photograph and in the pits and depressions surrounded by the polish.

Wood-working produced a polish that is very bright, smooth and unpitted incorporating shallow striations. It tends to be distributed in a reticulated pattern away from the edge (Fig. 1). This polish was produced in every drilling and sawing experiment and all but one of the 15 whittling/planing experiments. It was produced in 7 out of 10 scraping experiments, but only produced once in each of the two experiments in chopping and wedging respectively. It is important to note that only 22 of the 36 experiment produced recognizable 'utilization damage' (distinguishable from edge damage 'noise' on the edge of archaeological specimens). The form of this damage varied in a bewildering fashion, responding to such variables as force exerted, edge angle, angle of use, thinness of the edge, edge shape etc. As well, on *retouched* edges it was often difficult to distinguish the utilization damage from the smaller components of the retouch. The woodworking polish surveved, unaltered and recognizable, the white patination which I induced on 2 pieces by immersion in NaOH.

Bone-working, while it gave more utilization damage of a more regular kind, also produced a polish which is distinguishable from wood polish at 200x (and sometimes 100x). It is not as smooth or mirror-like as wood polish, but is pitted and uneven often with a 'greasy' lustre (Fig. 2).

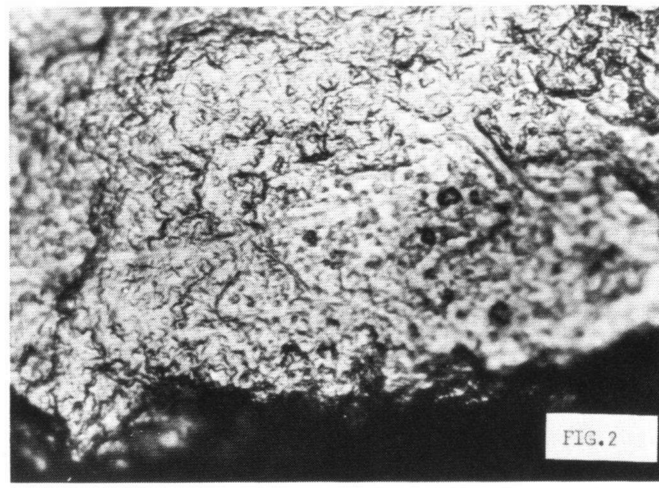

FIG.2

Fig. 2. The edge of an implement used for scraping bone showing 'bone' polish. The normal, unpolished surface cannot be seen in this photo but is similar to that visible on Fig. 1. 220x.

The striations produced are often cut deeper than those produced in wood-working.

Cutting meat does seem to produce a distinctive polish as well. Because of the expense involved, I have not so far been able to use the experimental implements long enough to produce a really clear large area of polish. What has been produced is a matt polish not as pitted and rugged as bone polish, yet it is still distinct from wood-polish, not being as bright nor very smooth. It is rather similar, as one might suspect, to the polish produced in the early stages of hide working (Fig. 3). Some of these meat cutting, experiments were conducted outdoors on the ground, and in these instances a quantity of very minute striations (practically undetectable under 200x) extending into the body of the implement appeared. Until some real butchering experiments are completed, the picture of the microwear traces caused by meat cutting will be limited.

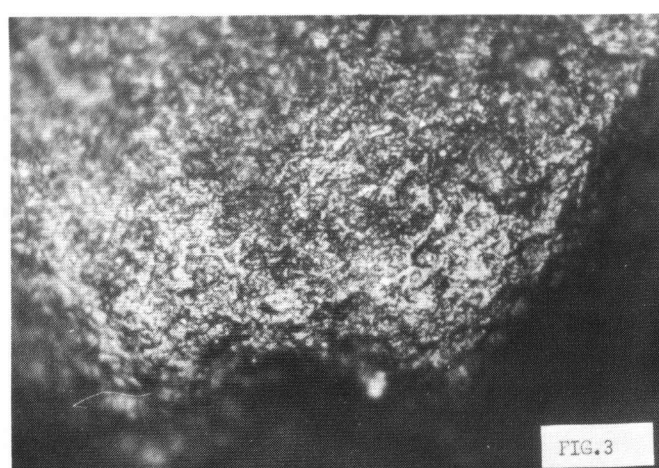

FIG.3

Fig. 3. The edge of an implement used for slicing meat showing attrition of the corners of utilization-damage scars and slight polish. 200x red filter. The unpolished surface (for comparison) can be seen from the center to the top of photo.

The working of dry hide and leather produced a very characteristic microwear pattern. In scraping and slicing, a severe attrition of the edge occurs accompanied by an extensive pitted and matt polish. There are further fine striations in the polish (Fig. 4). There are indications that the working of fresh hide will not produce a polish that could be easily distinguished from meat polish. But other than slicing and cutting, these two materials would tend to be worked in quite a different manner so that the orientation and placement of the traces of use would provide sources for separating meat cutting from hide working.

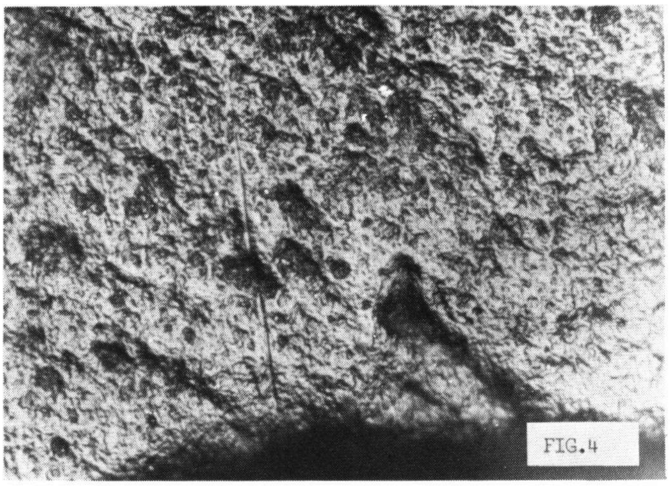

Fig. 4. The edge of an implement used for scraping leather showing leather polish. 200x. The normal surface of the flint can only be seen in the bottom of the pits and depressions surrounded by the polish.

It should be noted that while these different polishes provide some valuable distinctions for microwear analysis, the final interpretation of any implement depends upon the whole pattern of micro- and macrowear: that is to say, the types and quantities of utilization damage present; where the microwear occurs on the piece; the type of polish (if any) present; the type, quantity and direction of striations present. I would also like to mention in passing that, at present, some of my experimental pieces are being analysed at the Research Laboratory for Archaeology at Oxford to see if any chemical or other analytical differences can be discerned between the various polishes which may shed some light on their genesis.

Now, since the features to which I have just been referring have been produced experimentally by me on implements of my making and using, the final question must be, can such effects also be recognised on archaeological specimens? The answer is yes. I have so far identified what are clearly wood, meat and even bone polishes on certain implements from the Lower Palaeolithic sites of Clacton-on-Sea, Swanscombe, Hoxne and La Cotte de St. Brelade. Of course not every piece shows a polish nor is every polish easy to interpret, but in a large number of these cases the interpretation of the polish can be checked against the other macro- and microwear evidence for use. But until the program of experiments is completed and until the chemical evidence is in, it is best to be a little tentative about these polishes as the range of variation in a number of them can hardly yet be said to be fully defined.