19 MEASUREMENT OF PLOUGH DAMAGE AND THE EFFECTS OF PLOUGHING ON ARCHAEOLOGICAL MATERIAL

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There has been an increasing awareness of agricultural damage to archaeological sites during the last twenty years (e.g. Drinkwater, 1972). That this damage is largely due to the plough in its many forms is beyond all reasonable doubt. The initial identification of this damage came about as the result of the observation of standing earthworks and the way in which they were being steadily eroded. Further identification has arisen from the large numbers of excavated sites located solely by aerial photography and fieldwalking where all original upstanding features had been obliterated. Few excavations have been mounted with the specific aim of the investigation of plough damage and its extent simply because there is virtually no way of assessing an original situation against which a comparison may be drawn. Consequently, since there is an urgent need to be able to assess and quantify agricultural damage in order to establish guidelines for excavation and conservation, it is necessary to construct some specific experimental situations from which accurate data can be collected. Such data would form the elements of a predictive tool both in relation to agricultural damage taking place and to improve systems of excavation and recovery.

Several experimental situations have been created for other purposes, notably the Overton Down Experimental Earthwork, (Jewell 1963) which was constructed to study the natural processes of erosion movement and denudation of a bank and ditch, and the Butser Ancient Farm Research Project which is designed to reconstruct and operate an Iron Age Farm. The latter, is, in effect, the first open-air scientific research laboratory devoted to prehistoric archaeology and agriculture. In principle both examples quoted are analogues (Reynolds 1976 and 1977).

It would seem that a similar approach, the utilisation of carefully designed and constructed analogues, would be a satisfactory way to evaluate agricultural damage to archaeological sites. The alternative, the accurate measurement and monitoring of damage to standing monuments will not only take considerable time but also the completion of observation will coincide with the virtual destruction of the monument (Figure 40). For artefacts and concealed features there is no alternative to the analogue (Figure 39).

This paper, therefore, sets out several experimental situations which may be of considerable value in the relatively short-term assessment of plough damage. The experiments fall into two clear groups, those concerned with artefacts, principally pottery sherds, their movement and decomposition and those concerned with structures. The underlying principle for each experiment is to set up and minutely and precisely record the situation at the starting point. Unless this elementary step is taken, the results will quite probably be discredited. Thereafter, the monitoring process will be as accurate as is possible given the present state of technology. Since the purpose is to provide an analogue against which archaeological data may be set, it is vital to avoid the basic problem affecting the construction of hypothetical models dragged, often reluctantly, from other disciplines: inadequacy of method and result.

It has been and still is common practice to fieldwalk and to locate sites by distributions of pottery. Indeed many sites are known only by the location of concentrations of potsherds. The practice has traditionally been carried out by amateurs and archaeology as a whole owes a great debt to them. The signal point, however, is that the concentration of sherds over an area is readily accepted as indicative of the presence of a site beneath the ploughsoil. The question, therefore, is how far have these artefacts moved in relation to their original deposition point. This question has been a source of concern for several archaeologists who have plotted exactly in its spatial or three-dimensional position any sherd or artefact recovered. In many cases a correlation has been established between find location and archaeological feature. This correlation alone is enough to discourage the introduction of earth-moving equipment onto a site and the wholesale removal of topsoil employing the now discredited proposition that such material is disturbed and unstratified. Over large areas of England, especially the chalk lands and alluvial river terraces, stratification is rare and such finds as are in the topsoil may represent the vast bulk of material available. Should its location within the topsoil be significant in terms of underlying features, then its abandonment is the wilful disregard of important archaeological data. Should there be no underlying features to explain a surface and topsoil distribution, its abandonment by crude removal would provide a negative result where the opposite was, in fact, the case.

Given the substance of the above argument it would seem to be desirable to establish the range of movement of sherds both laterally and horizontally under normal agricultural activity over a period of time. In order to achieve this the following experiment has been designed.

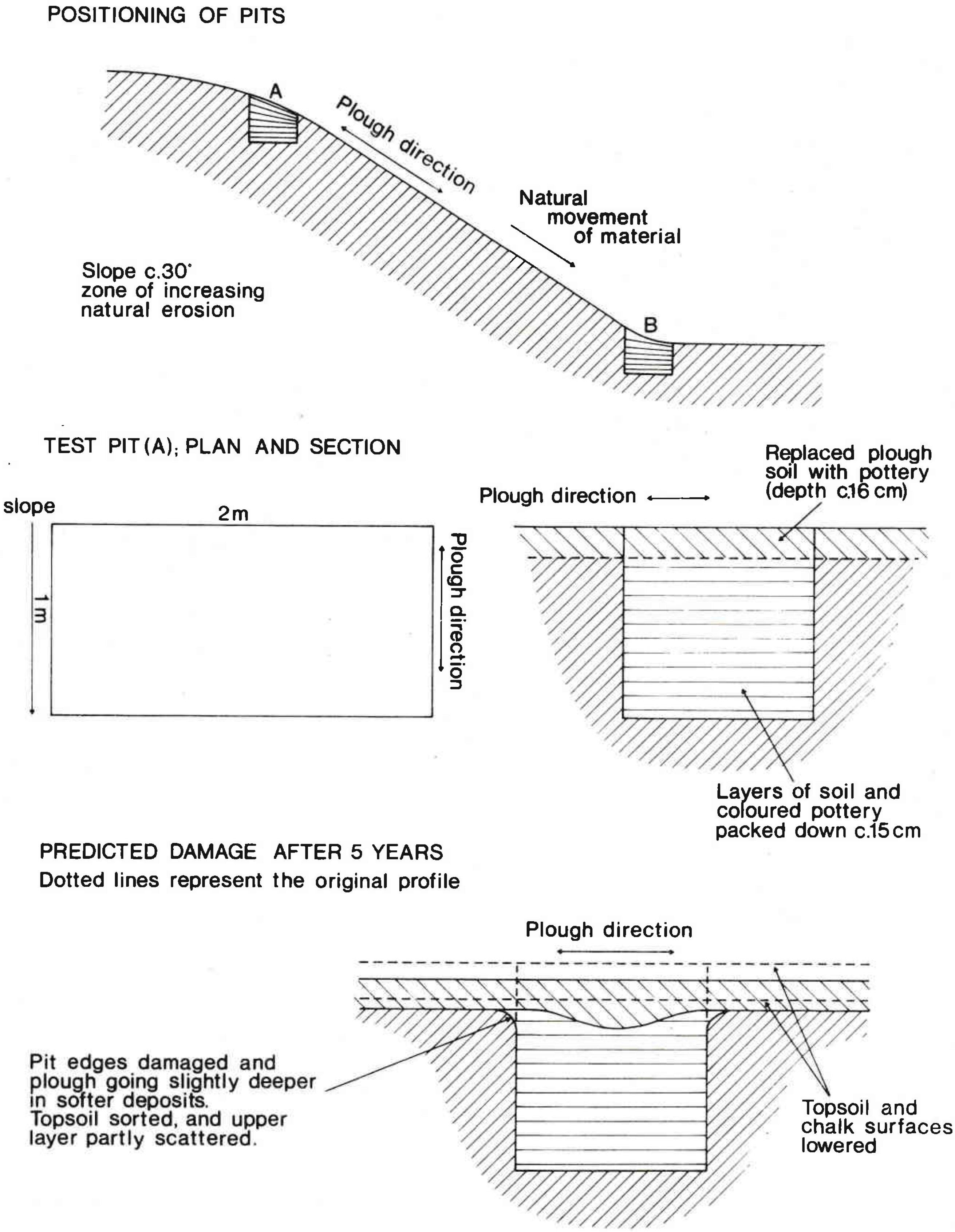

Figure 39 Measurement of plough damage to buried features

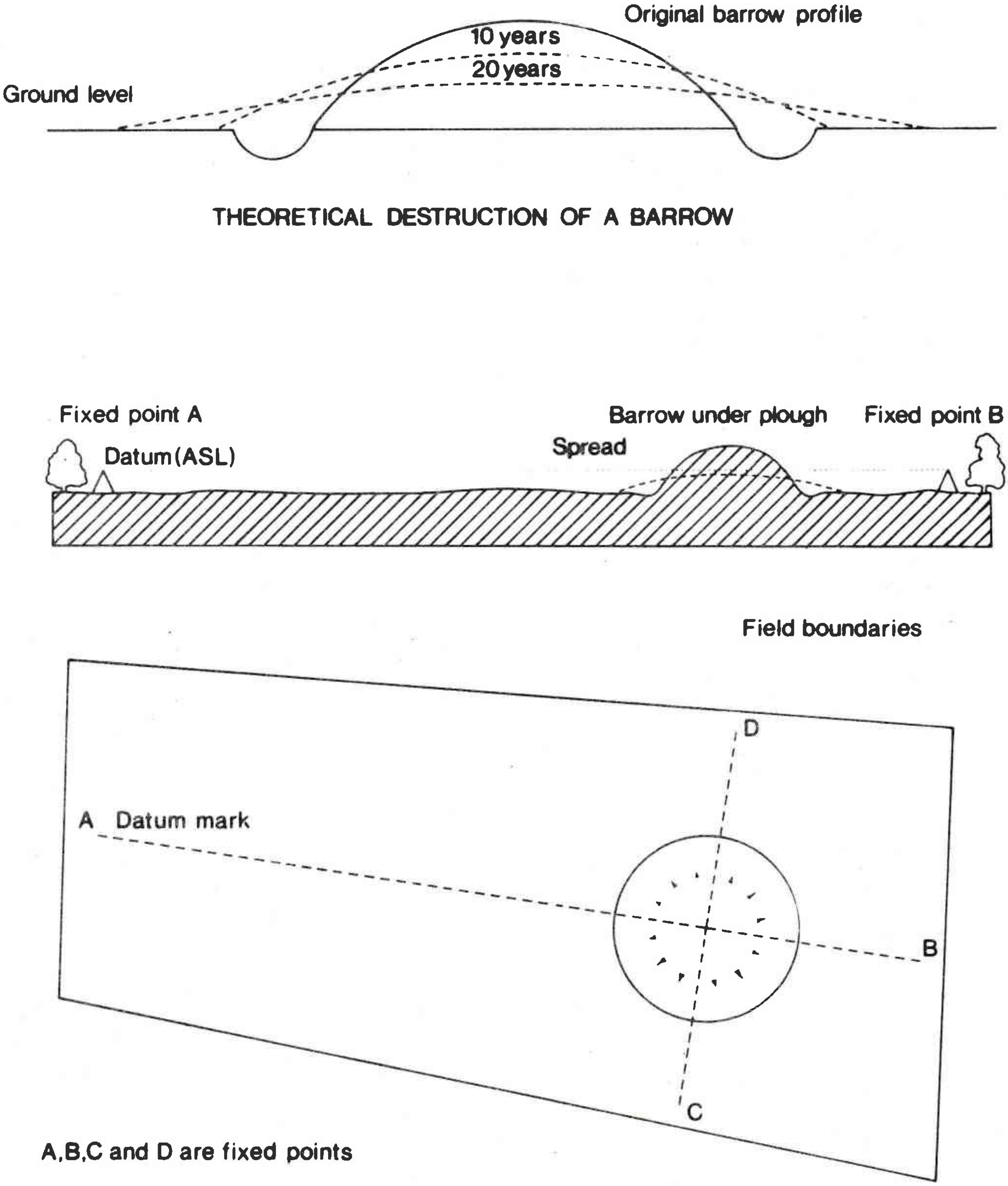

Figure 40 Measurement of plough damage to barrows

In concept a known number of sherds of similar weight and size should be set out on a strictly measured grid at 50cm intervals and surveyed in to 10cm beneath the ground surface (Figure 44). Two grids, one on level ground, one on sloping ground, should be employed. Ideally, in order to accelerate the achievement of results, both grids should be set on ground normally under arable cultivation. After each agricultural process the grids are to be resurveyed, the sherds located and plotted in their spatial context. In this way it will be possible not only to determine sherd movement but also to assess the physical effect of each piece of agricultural machinery employed. As with all the other experiments outlined in this paper, there is virtually no interference with the normal agricultural activity in the sites involved. Indeed one is in the unusual position of actually encouraging that activity.

There are problems involved in the practicabilities of this experiment especially with regard to the nature of the sherds. Initial ideas of using pottery had to be dismissed simply because of the difficulty of finding the sherd when some 10 to 20cm under the soil surface. Further the friability of pottery would be likely to distort the results. Therefore, the design adopted has to overcome these basic problems. A sherd made of plastic resin is both durable and less likely to fragment than most substances. Further, since it is made from a liquid it is possible to encapsulate within it both a number and a small bar magnet. The latter facilitates relocation using either a metal-detecting device or a magnetic anomaly meter such as the fluxgate gradiometer. Its shape, a diamond, is drawn from a general analysis of sherd shapes discovered in ploughsoil. It has two opposed acute angles and two wide angles. Finally its weight, shape and finish are comparable to those of real sherds. (Thus its movement within the soil medium will simulate that of actual sherds.) Preliminary trials with this design have already been carried out successfully.

The grid pattern has been adopted for the deposition of the artificial sherds simply to increase the range of questions that can be asked of the final data. Figure 44 shows the deposition grid and superimposed shaded areas which represent hypothetical features. By seeking, with computer aid, the movements of specific sherds within each shaded area, it will be possible to establish the presence or absence of patterned movements. Should there be patterned movements, the data could well be used as a predictive tool.

One aspect, as yet unconsidered, is the physical nature of the soil, its crumb structure and adhesive qualities. Clearly, once the initial pilot experiment is satisfactorily installed and monitoring procedures established, it is most desirable to set up exactly similar experiments on other soils of different physical types since the resulting data will inevitably vary.

In the above description, two grids are recommended, one on flat ground, the other on a slope. Both are to be considered against the effect of modern agricultural activity. There is a further variable which is also being examined at the Butser Ancient Farm, that of the effect of a prehistoric type of ard as the destructive agent. Experiments with such an ard in Denmark indicate there is considerable soil movement involved (Hansen 1967). From both situations assessment of sherd movement in a modern and a prehistoric context will be possible.

The extremely friable nature of some pottery sherds, especially prehistoric sherds, once disturbed by plough action is cause for concern. It has been observed by the authors that once such a sherd has been brought to the surface by the plough its survival for any length of time is most unlikely. Frost action quickly laminates the sherd and any further movement leads to rapid disintegration. Observation to date has been casual but there is a clear need for more detailed experiments to examine the degradation of prehistoric pottery. The implications of this, especially if there are few clear archaeological features to be recovered by excavation, are the irretrievable loss of further sites. Since at the present time more and more land is being converted to arable to capitalise on the more economically rewarding cereal crops, an intensive fieldwalking programme over all land newly taken into arable is vitally important.

One simple exploratory experiment to examine sherd movement under cultivation has already been set up on arable land near Winchester (Figure 39). In this case a shallow pit, 50cm deep and 1 by 2m was excavated and then refilled with different coloured earthenware sherds in separate colour layers 10cm thick. It is proposed to fieldwalk this area regularly and the resulting distribution pattern and colour determination of the surface sherds will give an observable indication of ploughing effects. The limitation of this particular experiment is in the reliance upon visual location of sherds (Schadla-Hall 1978).

This particular experiment is also linked to investigation of down-slope movement; little work appears to have been carried out on the amount of such movement, whether on chalk or otherwise, as a result of cultivation and natural processes. Observation would suggest the effects could be considerable in certain circumstances, and would have some importance in terms of assessing finds in particular locations, and evaluating levels of preservation and damage. Detailed work would inevitably involve the use of Gerlach traps or similar devices for monitoring on a large scale (Curry 1967). There are already examples of hill slope erosion from the Bronze Age, and the practice, still extant in Wessex and elsewhere until 1945, of carting soil from the bottom of slopes to the top on chalk would suggest that such processes are still active, even if unrecognised (J Vearncomb pers. comm.).

The effect of ploughing on surface soil marks could be further studied using dyes; a high contrast dye, which would need to be non-soluble and non-toxic, spread on the topsoil would allow accurate observation. The authors have already carried out preliminary experiments using dye; small-scale field trials indicated some success, but here again more work is necessary.

The effect of ploughing on subsoil is more difficult to ascertain. On soft subsoil ploughing will erode over short periods of time and on harder subsoils (e.g. chalk) evidence from excavation indicates that increased solution and frost action follow ploughing. Again this conclusion does need detailed investigation. On sites which are already being damaged by ploughing or have been damaged by ploughing (i.e. those producing surface scatters of material) there is a definite need to produce a method of showing whether damage is continuing at a greater depth because of ploughing. One method of indicating this would be to bury below ploughsoil depth an area of high contrast indicator, for example a different soil or dye. If this appeared on the surface it would indicate continuing damage. Recent work has indicated that the surface of occupation sites (as well as the tops of features dug into the subsoil) are highly sensitive to plough damage, and are lost relatively rapidly. It is action of this kind which should affect policy towards excavation of plough-damaged sites. If over a specified period of ploughing minimal movement of material can be shown to take place laterally (as at Bishops Cannings Down) it seems to be important that the topsoil should be treated differently, and not bulldozed off preparatory to excavation.

Linked with the effect of ploughing on subsoil and by implication actual occupation surfaces is the effect of ploughing on the stratification and shape of deep features such as ditches and also of shallow features, for example, post-holes, under plough. Continuous ploughing over long periods will almost completely remove traces of shallow structures. Here again there is need for detailed analysis of the effects of ploughing, and in addition there may well be a case for linking this with aerial photographic interpretation.

The above has dealt largely with the problem of artefacts and their movement and degradation as occasioned by normal agricultural processes. The following section of this paper is devoted to a proposal for an experimental earthwork which is designed to measure the damage upon physical subterranean features, such as ditches, pits and post-holes. The purpose is to establish an artificial standard against which damage to archaeological sites might be evaluated and to provide sound data which will be of value in forming policies of conservation and excavation. The proposition is to make an earthwork which will not interfere with normal agricultural activity but which will simulate the essential features of the vast majority of prehistoric archaeological sites. To this end the earthwork consists simply of a backfilled ditch, the design of which is discussed below. Within that earthwork will be situated a number of pits and post-holes of varying types and sizes (Figures 41–3).

It is vital that such a project should have at least two stages of development; a pilot scheme in which constructional and operational details are finalised and monitoring systems and equipment standardised, followed by full implementation with a number of such earthworks distributed over a range of subsoil types. Provided that the learning potential of the pilot scheme is maximised, the medium- and long-term results should be of considerable significance. The opportunity such an earthwork offers goes far beyond the study of geostructural damage. There is clear facility for the examination of lateral and vertical movement of artefacts, solution and freeze-thaw activity, pollen indicators and their survival and the physical distortion of ditch infill material.

The design of the earthwork need only simulate a prehistoric earthwork in its section; the plan on the other hand needs to offer as many opposed linear faces to the line of ploughing as is possible. Since the normal practice in modern ploughing is to vary the direction through cross and diagonal lines an octagon would provide the minimum number of opposing faces. Thus, for any given field orientation, all plough lines would be opposed at right angles by at least two lengths of the earthwork.

The construction of the ditch presents a basic problem. It can either be a fresh-cut clean ditch immediately backfilled or alternatively, it can be allowed to weather for a short period, for example, one winter. Initially a V-shaped ditch 1m deep and 1.5m wide would seem to combine the general elements of prehistoric ditch types. From observations carried out by the authors on an experimental ditch and bank with a narrow berm, 30cm wide, it would be most valuable to adopt the second alternative described above. During the first winter, given the usual freeze-thaw activity, a V-shaped ditch will change its profile; the narrow berm effectively stops any silting from the dump bank. All the initial silt is derived from the topsoil layer, followed by material from the rock sides of the ditch. The fall is a result firstly of rainfall which principally affects the topsoil layer and is followed by freeze-thaw activity which will attack the topsoil and the bedrock, and thus the initial silt layers will contain material from the original ground surface. The profile of the ditch becomes more U-shaped with a shallow V preserved at the base. (Figures 41–2 and Plate 15). It would be most useful to study the preservation of floral and faunal activity, since the implication is that the first silt layer may contain evidence of the surrounding land area at the time of the initial construction of the earthwork. This method will also allow some closer simulation of a prehistoric earthwork.

FIGURE 41

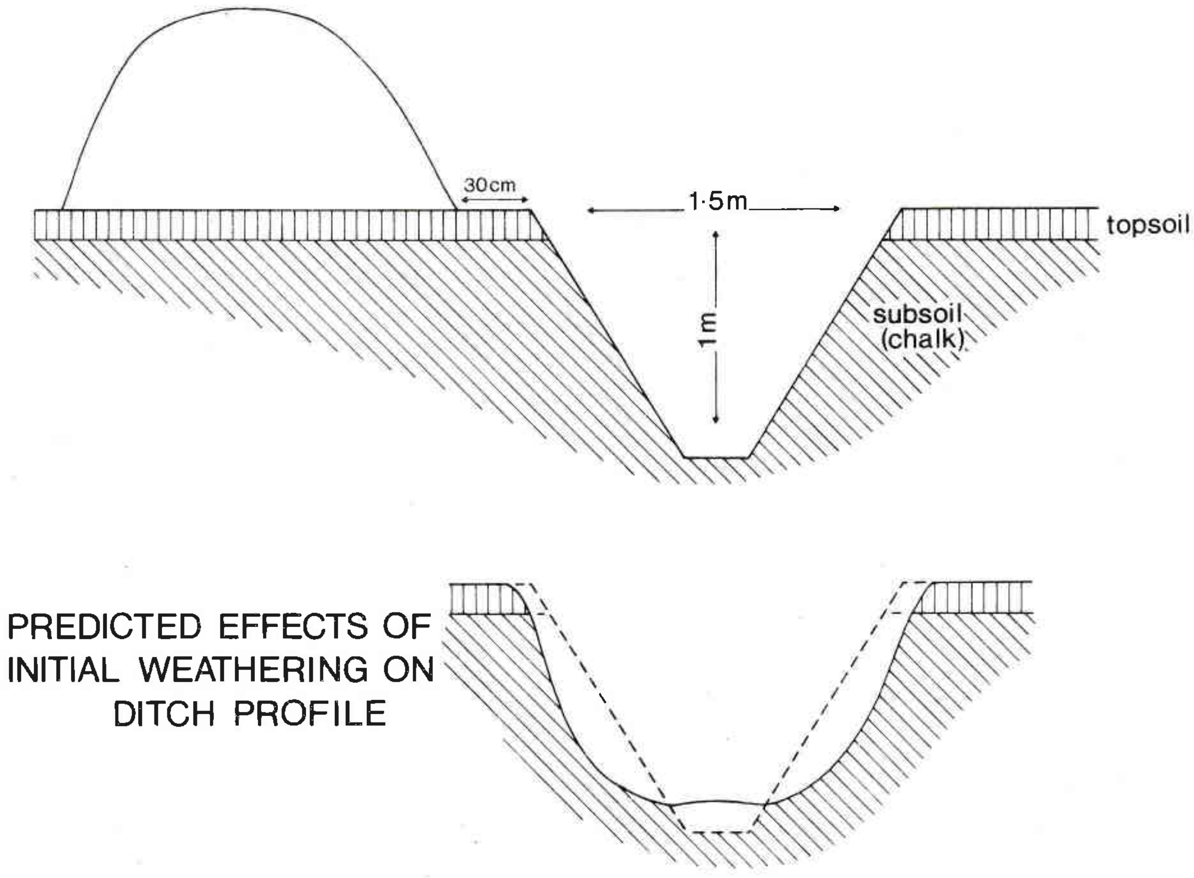

FIG 42

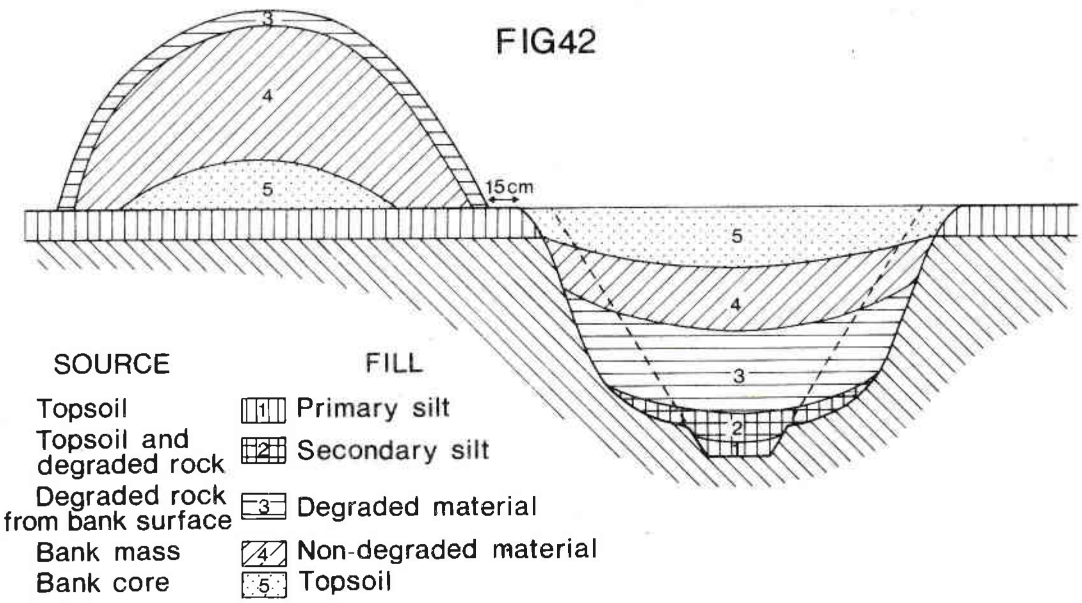

Figure 41 Ditch construction and predicted initial weathering

Figure 42 Predicted ditch filling

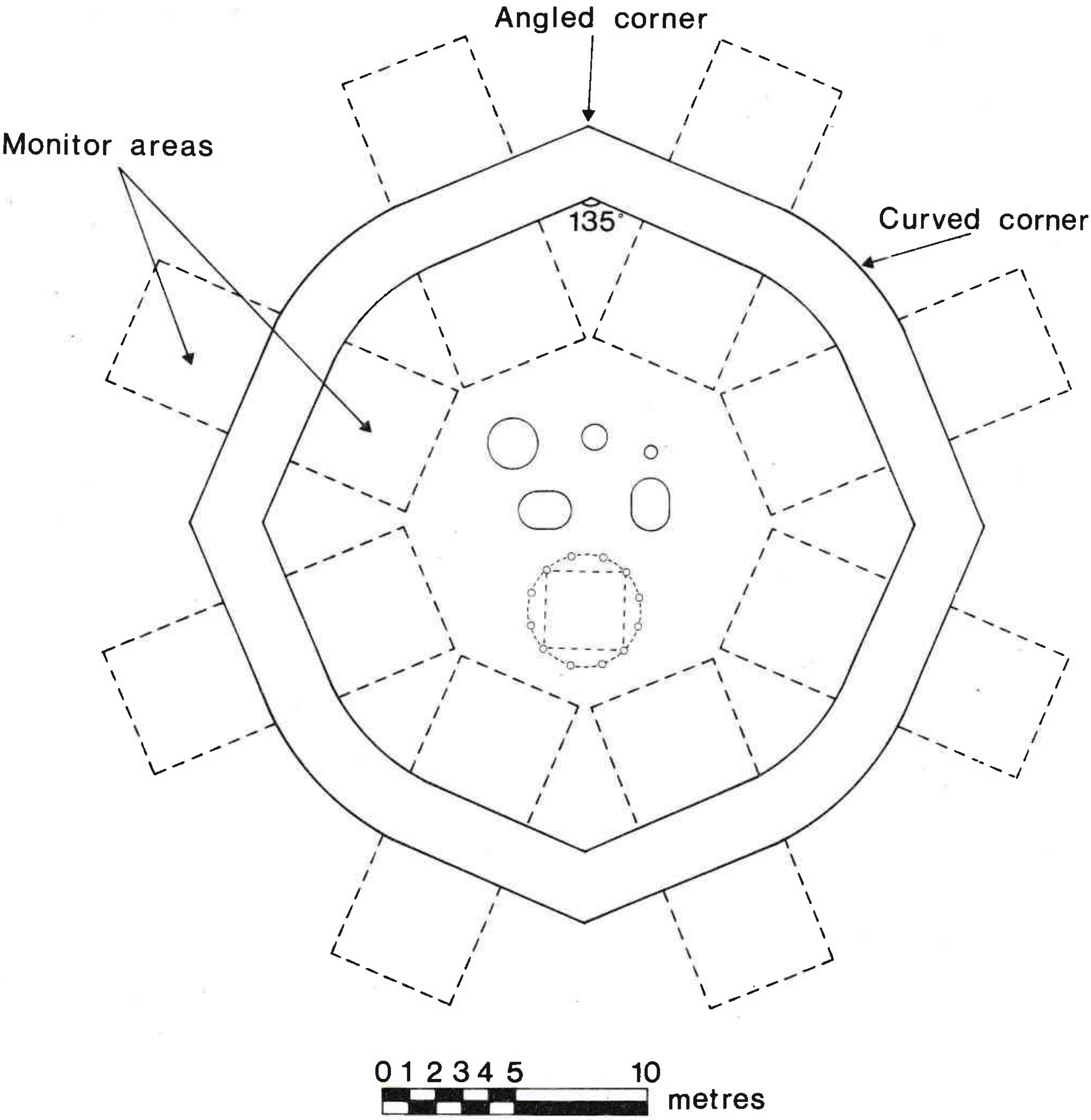

Figure 43 Plan of earthwork

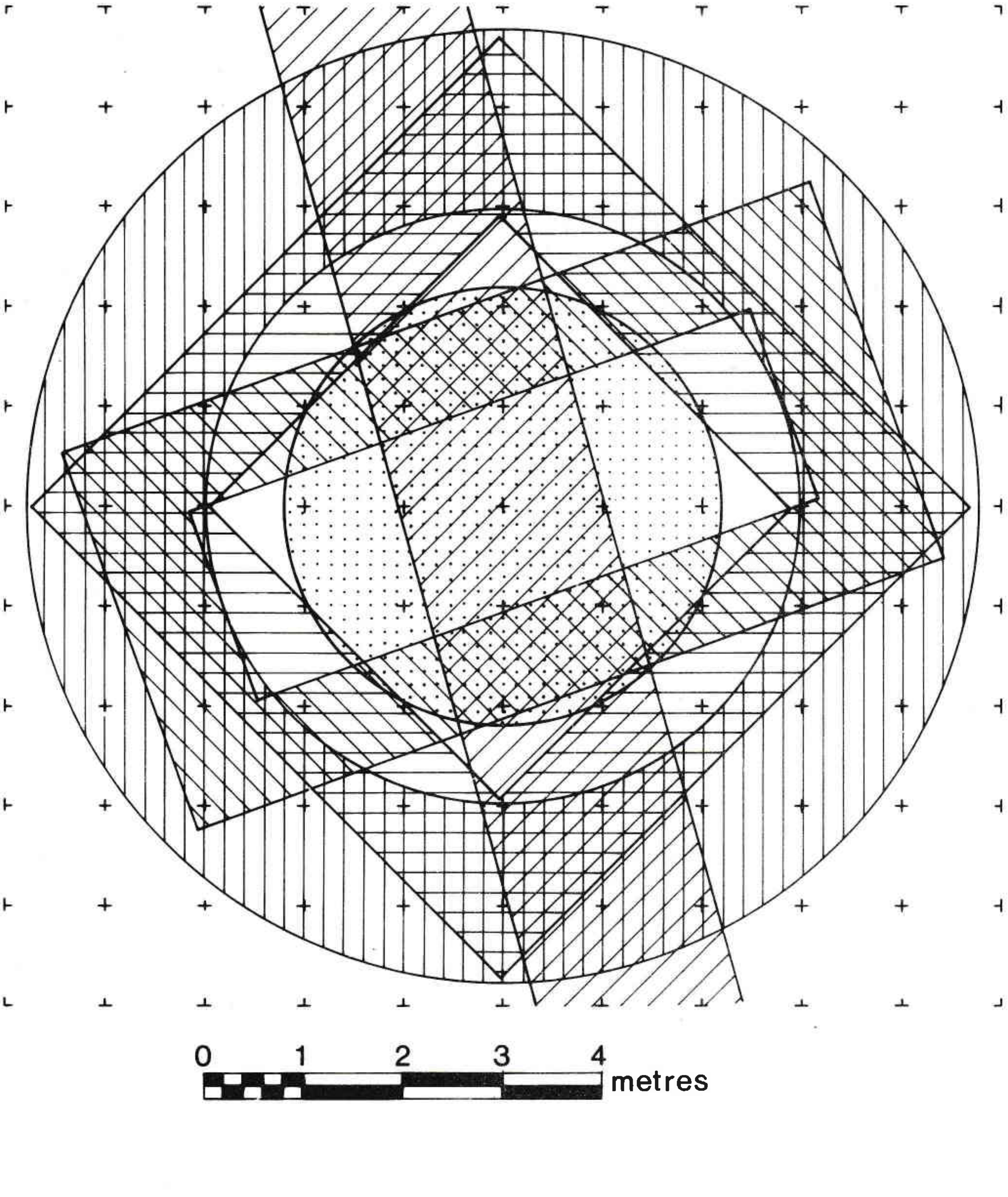

Figure 44 Sherd distribution

Thereafter the proposition is to backfill the ditch with the dump material including specific artefactual material at predetermined positions. This layering will, therefore, be as follows: primary silt drawn from the topsoil, secondary silt, being a combination of topsoil, subsoil, and rock from the ditch sides, weathered material from the dump bank, non-degraded material and original topsoil. The artefactual material should be placed in the top 50cm of fill at specific positions. Possibly modern pottery of different colours at varying depths would be adequate for this purpose. Alternatively locatable artificial sherds as described above should be employed. Ideally this final layer of topsoil should be stained with either non-toxic dye or saturated with some other form of marker responsive to either visual or technical recognition. Provided this can be done, monitoring of soil movement could be achieved with aerial photography, normal or infra-red; such an exercise would be an invaluable aid to the greater understanding of soil-marks. The marking process is of critical importance since the process itself must not distort the structure of the topsoil (Figure 42).

In addition to the construction of the ditch, sample areas of 5m squares on the side of the central points of each of the sides of the octagon are to be excavated to the base of the topsoil level. These areas are to be recorded in detail before the topsoil is replaced. The very minimum record must involve stereoscopic photography of these areas. This would allow accurate monitoring of the damage to the subsoil by agricultural activity on the basis of the regular excavation of 1m wide strips.

The octagon design (Figure 43) would also allow an opportunity to observe the effect of ploughing on both an angled and a curved section of the ditch. The scale of the subterranean earthwork would not be particularly large; each side of the octagon need be no more than 10m in length, thus the whole area required including the subsoil monitoring areas would not exceed 2 500m^2.

The further advantage offered by this subterranean earthwork is the basic one that it will not interfere with normal agricultural activity in any way, indeed agricultural activity would be encouraged.

It is envisaged that monitoring would take place at regular and frequent intervals. After each phase of agricultural activity the site should be photographed from the air and the area fieldwalked, plotting the appearance and movement of planted artefacts. Excavation should initially be on an annual basis to conform with the agricultural calendar.

The implications of this proposed experiment are considerable. It would allow relatively rapid appraisal of the effects of plough damage, subsoil degradation, soil movement and feature destruction as well as the study of the effects of ploughing on features and artefacts below the ploughsoil. In addition the vertical and horizontal movement of backfilled material and planted artefacts can also be monitored. Once the pilot scheme has been evaluated the further implementation of the main scheme embracing a variety of subsoils would yield a valuable standard against which local situations could be evaluated.

This paper is necessarily brief and in no way exhaustive in either its treatment of detail or further experiments which naturally arise from this basic project. The experiments outlined above, at the very minimum level, would provide an adequate working background to the better assessment of plough damage. There is a dearth of good data at present and the widespread and increasing impact of ploughing must argue for the implementation of a swift and coherent programme of such work. There is little doubt that the greatest threat to our archaeological heritage is the plough in all its many guises.