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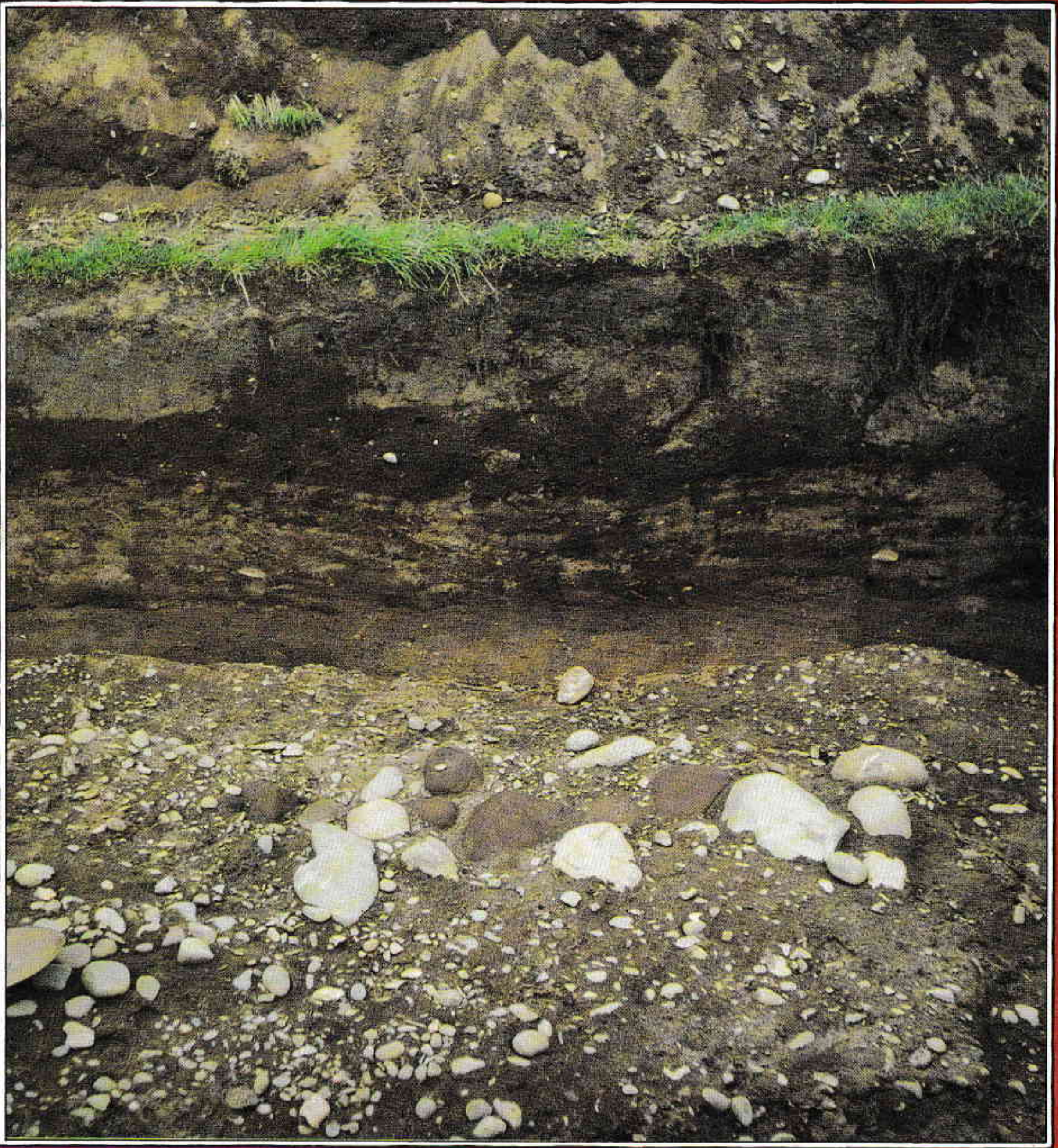


PIT TECHNOLOGY IN THE IRON AGE

by Dr. Peter Reynolds

One of the most exciting and rewarding aspects of archaeology has to be the probable proof of the function of an excavated feature. So often the excavator is faced with a mass of pot-holes and stake-holes, pits and gullies all of which seem to make little or no functional sense. Even with the most sophisticated analyses and computer aided simulations the problems are rarely made less acute. The more remote in time the site, the more complex its interpretation becomes if for no other reason than the differential survival of the material evidence. There is no doubt that excavation is a most challenging and frustrating element of archaeology.

However, given a great enough sample of similar sites excavated, it is possible to recognise recurring types of features and even categories within a feature type. A great deal of excavation to this end has been carried out on the continent, especially in Holland, to isolate house types for different periods. Today it is possible to relate specific house types to specific periods even though a large number of the houses from all the periods share similar characteristics. House plans evidenced by post-hole arrays are one thing, specific features like pits are quite another. Thanks to the attention focussed upon the Iron Age, culminating perhaps in Professor Barry Cunliffe's excavation of Danebury Hill Fort in Hampshire, the pit has been recognised as a recurrent and, indeed, a dominant archaeological feature.

The Iron Age seems to have had a 'pit technology' all of its own. The pits occur in a great range of shapes and sizes from, small shallow pits to huge cylindrical and beehive shaped holes carved deep into the underlying rock. Such variety of pit shapes and sizes have been recovered on virtually every rock type. As a norm they are filled with rubble, occasionally human skeletons, not infrequently horse skulls and bones, rarely carboinised seed. Any determination of function is almost entirely absent. It was during the excavation of Little Woodbury by Professor Gerhard Bersu in the late 1930's that the interpretation of the larger category of pits as grain storage containers was made. This explanation gained ready acceptance in the archaeological world despite scepticism from agriculturalists. In fact, Professor Bersu was clearly drawing his interpretation from well attested African parallels on the one hand and from references in the classical writers on the other. The agricultural scepticism was not directed so much at the system but rather that it could be used in the British climate. The pits Bersu had isolated as potential storage units belonged to the deep cylindrical and beehive shaped pits cut into chalk rock. The argument clearly extends from chalk rock to limestone, sand and sand and gravel in that all rock types are permeable and provided they are above the water table will remain dry. Pits cut into clay or loam turn naturally into wells and would be totally unsuitable.

An earlier interpretation of these large pits born simply of their size and frequency had been that they were dwellings and that Iron Age man was a troglodyte. The grain storage explanation at least brought Iron Age man to the surface! It wasn't until the early 'sixties that this explanation was actually put to the test. Pits were dug into chalk rock and grain was inserted and stored successfully. This experiment, carried out by H.C.Bowen and P.D.Wood, significantly marked the beginning of agricultural experiment into the Iron Age. The following season the writer carried out similar tests but in pits dug into limestone rock. Again the experiments were successful. In fact,the writer has been storing grain in underground pits in different rock types in different locations for the past twenty years with barely a failure.

ABOVE: Danebury Hill Fort in Hampshire during excavation. A lunar like landscape pocked with pits and post-holes.

LEFT: The recovery of a grain storage pit clearly shows how well the cereal has stored. The intrusive pipes and wires are the monitoring equipment by which the atmosphere inside the pit during storage is sampled and the temperatures recorded. After storage the grain is tested for both fungi infestation and germinability.

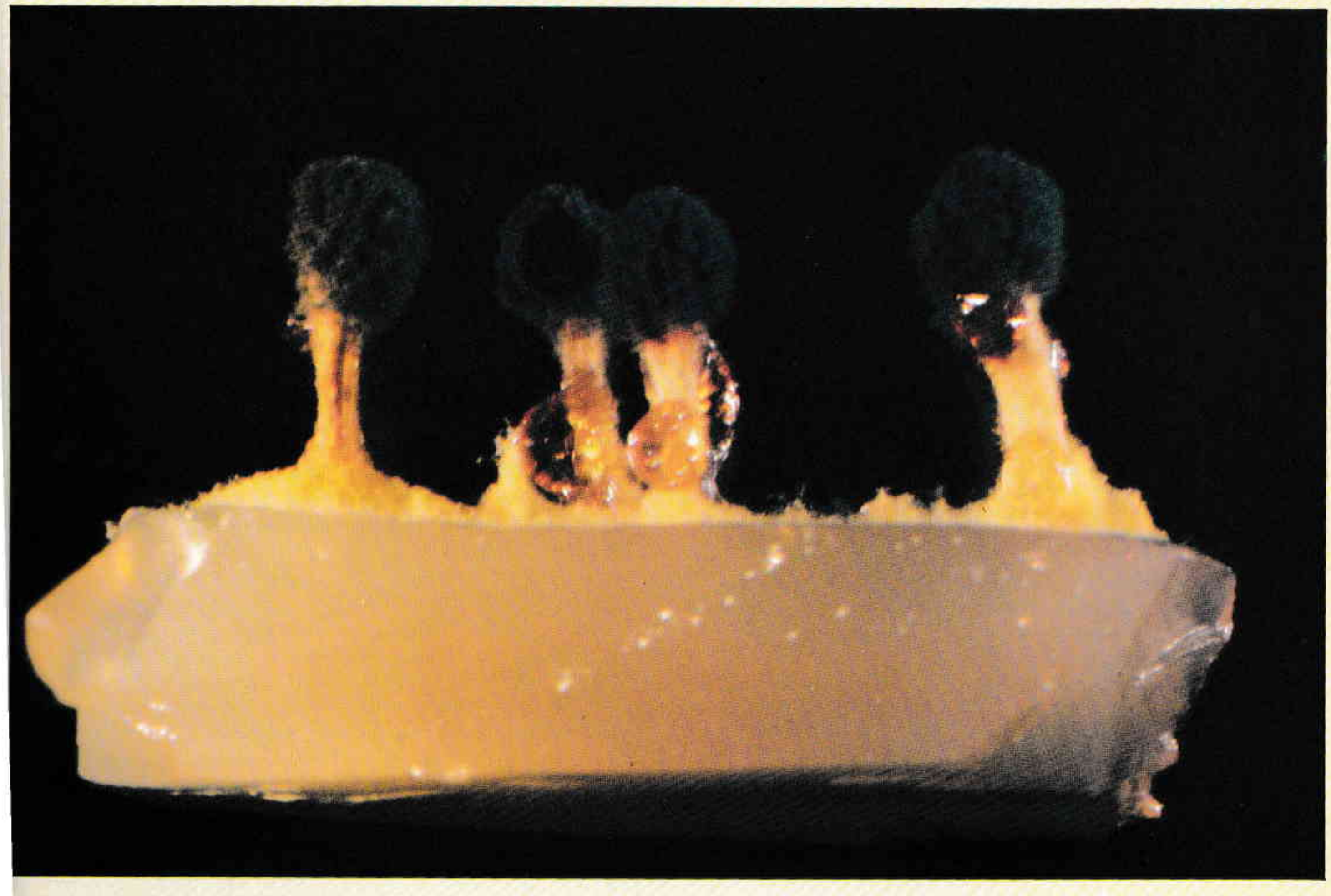
BELOW: An emptied experimental storage pit save for a section of the grain skin which has been left in place. This grain skin represents a loss of less than two percent of the bulk 1½ tons of grain stored. The bigger the pit the greater the volume to wall area and the less the loss.

Pit Technology

The technology of storing grain in a sealed container, is essentially very simple. Grain respires using up oxygen and giving off carbon dioxide as a waste product. Once the atmosphere becomes loaded with carbon dioxide the grain enters a state of unstable dormancy. The instability is caused by the presence of micro-organisms, bacteria and fungi which can maintain themselves in these conditions. However, if the temperature of the storage container is kept below 12 degrees Celsius even the life cycle of the bacteria and fungi is inhibited. Thus the pit is an ideal container. Once it is filled with grain and sealed with a moist clay or dung plug and covered with a layer of soil to keep the clay or dung moist and therefore impermeable to further water penetration, the low temperature is assured by the surrounding rock. Using a moist clay seal actually encourages the germination of the seeds in immediate contact with it increasing the release of carbon dioxide. This gas being heavier than the intergranular atmosphere quickly sinks into the mass of the pit inhibiting any further germination and virtually ensuring successful storage. This is provided, of course, that there is no further water penetration during the storage period. Levels of over 30% of carbon dioxide by volume have regularly been recorded in the

RIGHT: Detail of a pit wall showing the smoothness of the surface brought about by stripping away the grain skin. The scale is in five centimetre units.

BELOW: Penicillium hordei - a typical and relatively harmless fungus of grain storage.



Pit Technology in the Iron Age

experimental grain storage pits. One remarkable result of the experimental programme has been the discovery that after storage in such a simple system the germinability of the grain regularly exceeds 95%. There is, of course, no need to parch the grain prior to storage since this would inhibit the production of carbon dioxide on the one hand and destroy germinability on the other. Ironically the grain is stored at 16% moisture content, a level regarded as 'wet' by modern farmers. The implications for modern farming are fairly obvious but what real proof is ther that this actually was an Iron Age process? The excavated pit is simply a hole cut into the rock in the sides of which tool marks are occasionally found.

Experiment proves that it is a perfectly feasible process. However, the side effects of the process have provided persuasive corroborative evidence. During storage the grain immediately next to the pit wall also begins to germinate but quickly dies as the carbon dioxide levels rise. Yet it forms mat or skin between the stored grain and the pit wall. On emptying the pit, this skin adheres to the pit wall held firmly in place by the intertwined mat of rootlets and sprouts which literally cling to the irregularities in the wall. After storage this skin is stripped away from the wall bringing with it the tiny rough projections from the wall. After a few seasons use the pit walls become smooth and almost polished. This effect can be regularly seen on Iron Age pits and especially where there are traces of tool marks. The edges of these are often seen to be uniformly smoothed out in direct contrast to their original crisp form.

An even more persuasive discovery was made by Dr.Martin Jones when analysing some carbonised grain recovered from such a storage pit at Danebury. There he found a mass of seeds missing the germ area, the seed having been carbonised after it had sprouted. It may well have been the practise to burn the grain skin in the base of the pit after it had been stripped from the walls. What is remarkable is that the average size of these storage pits have a capacity of well over a ton of grain. Although it is virtually impossible to determine contemporaneity of such pits, the implications of a considerable tonnage per annum is inescapable. One popular theory has been to attempt to calculate population figures based upon pit capacity, pit life and grain consumption per capita. Essentially an attractive idea, experiment has provided significant reasons for its rejection. First the functional life of a pit is incalculable because it is but an innocent container. All the bacteria and fungi which would bring about storage failure are on the grain itself. Several pits have been in continuous use at Butser Ancient Farm since 1972 and there is currently no good reason to stop using them. Abandonment of a pit was most likely because there was not enough grain available to fill it. Secondly the high germinability results after storage rather suggest that the stored grain was, in fact, seed grain and in a sense more valuable than food grain.

It is extremely attractive to consider these pits, if indeed they were used for the bulk storage of grain, as indicators of the successful nature of the agricultural economy of the Iron Age when surplus rather than sufficiency was the norm. Similarly there is the implication that such bulk grain storage might have had something to do with export as stated by the classical writers. Yet not all pits were grain storage pits. This is but one explanation for one basic category of pit as revealed by excavation and experiment. There are a plethora of other pit types which need to be explained before the pit technology of the Iron Age can be better understood.

The Butser Ancient Farm is now closed for visitors other than in organised parties by prior arrangement until Easter 1989. Residential Courses for next year will be advertised in these columns in the next issue.

RIGHT: An editorial team meeting took place at Butser Ancient Farm recently. Not only did serious discussion and talks take place but also a very enjoyable tour was organised by Dr. Peter Reynolds. The Editorial Team from left to right: Dr. Peter Reynolds, Malcolm Atkin, Dr. John Bestwick, Richard Bellhouse, Ken Jermy, John Darke and Craig Brisbane.