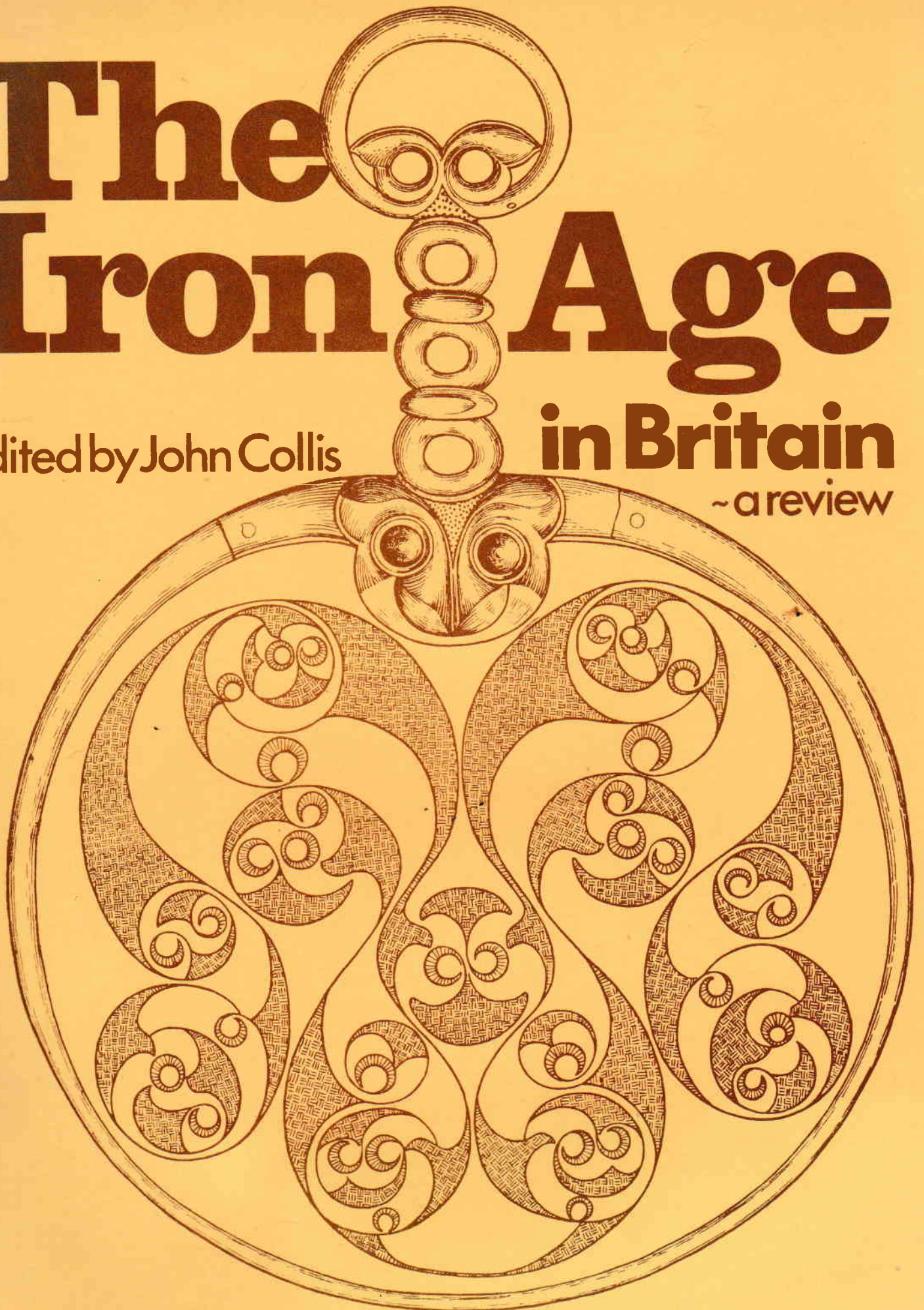


The Iron Age

Edited by John Collis

in Britain
~a review



Department of Prehistory & Archaeology
University of Sheffield 1977

EXPERIMENTAL ARCHAEOLOGY AND THE BUTSER ANCIENT FARM RESEARCH PROJECT

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SUMMARY

This paper seeks to set out briefly the philosophy and implications of experimental work in archaeology today and makes the case that such experimental work is fundamental both to archaeological technique and to improved interpretation. Emphasis is placed upon the need to focus far greater objective attention onto the archaeological material with increased multiplicity of interpretation as the inevitable result. A discussion of the Butser Ancient Farm Research Project presents its aims, objectives and potential scope. A brief survey of the work achieved during the three year pilot scheme is recorded with a detailed analysis of the reconstruction and initial life-cycle of one round-house and the results of two experiments, grass deletion and the proto-phot.

Experimental Archaeology

'The disciplined use of the imagination is the highest function of the archaeologist' (Crawford 1954) is a statement which summarises exactly the work of the experimenter in archaeology. The emphasis is clearly placed upon the word 'disciplined'. Archaeology has, in a sense, reached an impasse. Although more and more settlement sites of all periods are being discovered as the inevitable march of progress extends the sprawl of urbanisation and drives more arterial motorways across the landscape, and rescue archaeologists work around the clock to snatch information from total destruction, the processes of recovery and, therefore, the information recovered are advancing hardly at all. Museums, storerooms, site huts, all are gathering the same kind of material achieved by archaeologists employing the same kind of methods. The frantic struggle to gain this information can be likened to the avarice of the miser who seeks out and hoards money without any clear idea of why he does so or how he might use it.

It is becoming increasingly necessary to pose the questions 'how and why' of the evidence achieved from excavation. It is totally inadequate to be content with the 'what'. The primary need is to understand the information we already possess before these questions can be adequately answered. It would almost be worthwhile holding a moratorium on excavation in order to digest the available evidence and allow specific questions to be formulated along with the development of specific techniques to complement the questions. It is in this respect that experimental work is fundamental to the progress of archaeology because it concentrates attention upon the material evidence.

There is little point in acquiring data by excavation unless the prime intention is to understand that data, both in the immediate issue of its meaning and in its wider implication. The task of the excavator should be essentially quite simple, to recover and record in as objective a way as possible the archaeological evidence and thereafter to offer an interpretation of that evidence employing all the available information to support and supplement the interpretation.

It is singularly without wisdom to present only the interpretation of the evidence from an excavation. This procedure removes completely the possibility of re-appraisal

of the evidence although it does allow the comfort to the reporter of being incontrovertably correct. Unless an objective record is made, there can be no possible way of checking. The archaeologist is in an even stronger position than the doctor who can but bury his mistakes. The excavator should, in fact, play the part of a technician and to the best of his ability and the equipment available present a precise record of the evidence retrieved. The interpretation, in nearly every case thereafter, will need to be multiple in nature.

The experimenter seeks to test interpretations empirically. The testing process may involve the physical reconstruction of replica objects or structures in order to examine their functional practicability, or again, where incidence of a process is required, to seek out the means by which the process may have been achieved. At the other end of the spectrum the experimenter employs theoretical models, systems of locational analysis, computer technology and any other interdisciplinary skill which may have useful applications for the data in question. The results from all these various approaches are vitally significant if archaeology is to progress from mere acquisition of objects to a fuller understanding of human activity and settlement patterns in the past.

Experimental archaeology, however, cannot and does not pretend to provide specific positive answers. It establishes, rather, a series of probability studies, the parameters within which this or that may have occurred. Inevitably it provides a multiplicity of interpretation. Occasionally it can demonstrate a negative. Quite simply, an experiment can prove an interpretation to be wrong and this alone necessarily validates the experiment. Frequently, if not invariably, it demonstrates the inadequacy of data retrieved, often because the excavator did not know what to look for. Sherlock Holmes' admonitory comment to the luckless Watson "you saw but you did not observe" is explanation enough.

Experimental work can be reduced to quite a simple formula especially when applied to the prehistoric period. The starting point clearly is represented by the material recovered from excavation, whether it be artefact or earthwork, structural remain or ephemeral trace. The essential point to be recognised is that the material, whatever its nature, is in its terminal state. For example, the post-hole as an excavated feature is unlikely to represent its original form. Invariably it has a history of deterioration. In this connection it is a salutary exercise to examine modern post-built structures in a farming complex especially where chickens are present. Rapidly, due to their scratching, a 'tailored post-hole' can become a 'post-pit'. Ultimately they are quite capable of causing a structure to collapse by their activity. Certainly they can distort the 'archaeological evidence' since from observation they are rarely consistent concentrating on only one or two posts out of a possible four or six. Thus the archaeologist faced with such terminal evidence, may well misinterpret the evidence. The most important requirement for the formula to have validity is objectively recorded data. Indeed, this requirement alone tends to dismiss a large proportion of the body of archaeological evidence.

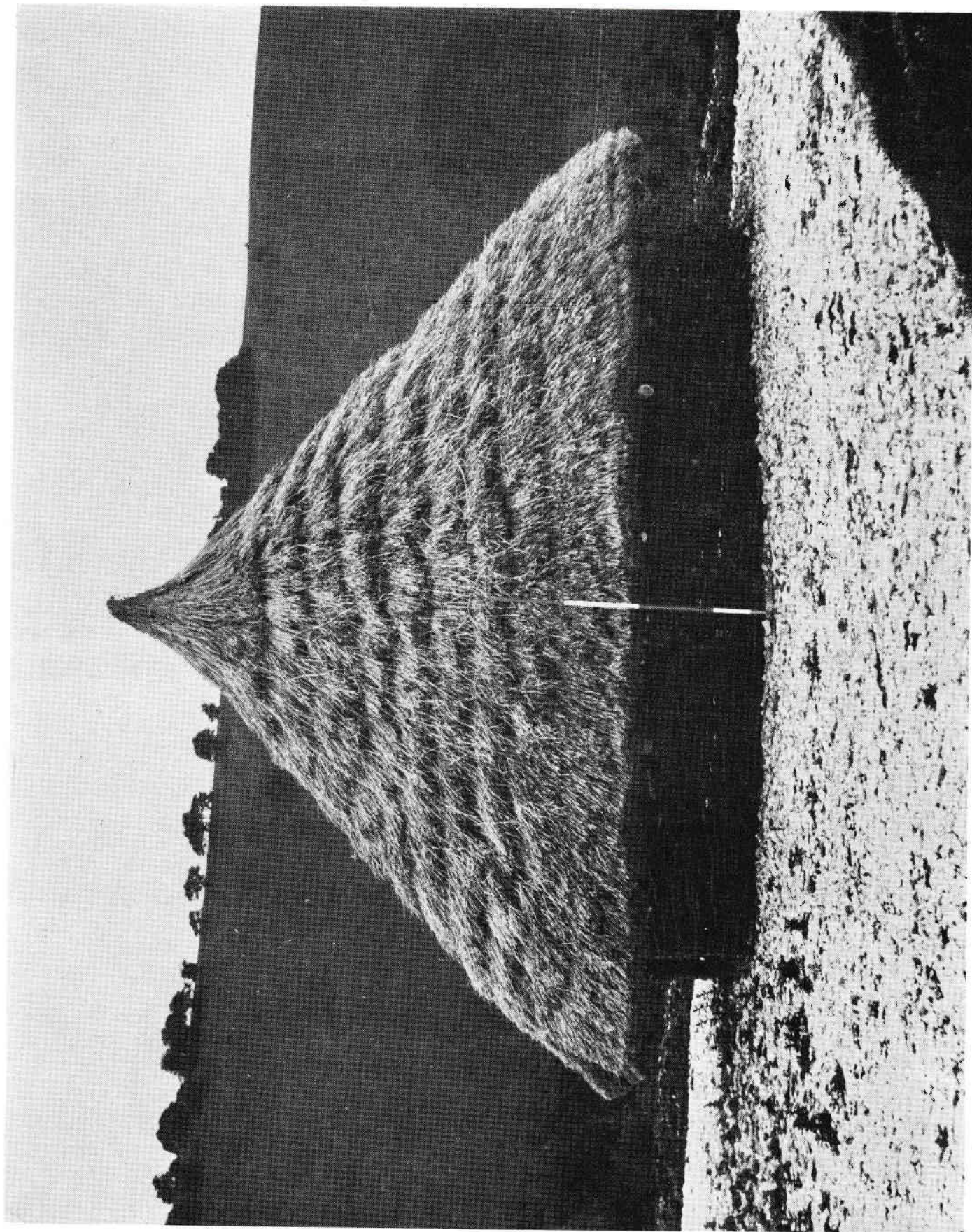


Plate 1. Butser Ancient Farm: The 'Maiden Castle' house nearing completion.



Plate 2. Butser Ancient Farm: the 'Maiden Castle' house, and field and pit experiment areas.

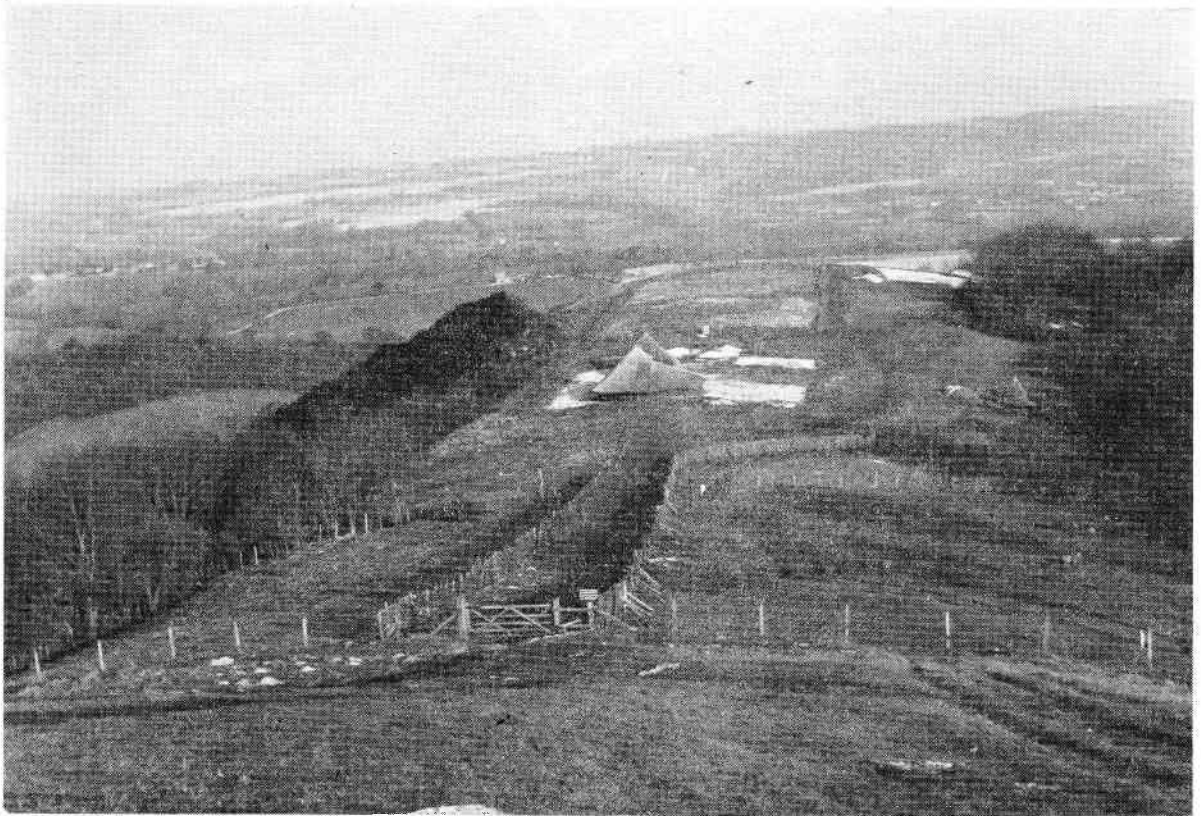


Plate 3. A general view of the Butser Ancient Farm.

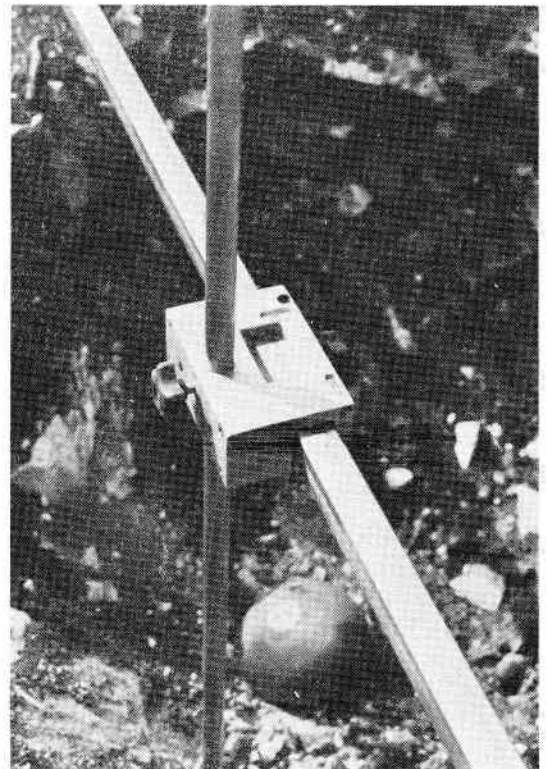


Plate 4. The Protophit.

The second element of the formula is the interpretation or hypothesis suggested by the archaeological evidence. It is a contention of the author that archaeological reports should be presented in two distinct parts. First there should be a precise record of excavation and second, the interpretations drawn from that record. Too often it is the interpretation with its selected supporting evidence which is recorded. However, it is this second element, the interpretation or hypothesis, which is subjected to testing. Specific questions can be asked of the material and experiments mounted to test the question. The experimental testing, the third element of the formula, must be executed with the highest standards of competence and integrity. The experiments will provide answers to those questions, answers which are only valid in the terms of the question. Regularly the experiment demonstrates the inadequacy of the prime question which, in turn, leads to new questions being framed. Similarly there must be built into the question the standards of success and failure. Throughout each of the three stages, the archaeological data, the interpretation of that data and the testing of the interpretation, continuous assessment is of prime importance.

Ideally the formula should be extended in the cases of structures and processes to embrace the subsequent stages of function or usage and destruction. Once this has been achieved it is possible to compare directly the experimental data with the prime data that was recovered in the excavation. The formula, therefore, is cyclical in form with four major elements — i) archaeological or prime data, ii) interpretation or hypothesis, iii) empirical test or experiment, iv) comparison of i) with the results of iii).

The formula is also extremely flexible in that it can be started at any point and provided the principles are closely followed, valid results can be gained. For example, it is reasonable to hypothesise a process which 'must' have taken place in order to support a further process that the evidence proves did take place. The manufacture of charcoal is vital for the smelting of metal. Yet there is little or no evidence of charcoal manufacture from the prehistoric period in this country. By building the process, producing charcoal and monitoring the effects of the process as they may survive archaeologically, data are achieved which can act as comparative source material for the excavator in the field.

Again an experiment may be mounted to answer one question and its execution will provide evidence which suggests an answer to a completely different one. The manufacture of pottery in prehistory is a vexed question and a recent and on-going research programme at the Ancient Farm examining the clamp firing technique resulted in a pit 1 metre deep by 1.50 metres in diameter. The spin-off from this experiment suggested a further interpretation for some kind of pits and offered important implications for other shallow hollows and depressions.

Further, the implementation of the experimental process can provide greater insight into practical implications of the archaeological evidence that have previously been unrecognised or ignored. The operation of a farmstead, for example, is rarely considered during the excavation of a rural settlement yet it is of critical importance for valid interpretation and understanding. A deep appreciation of the practice and problems of small and large-scale farming

is of vital consequence. This last point is of increasing importance as the modern world becomes progressively more urbanised and socially organised. Already rural settlements are being excavated by archaeologists who have no real experience of any rural economy and have little opportunity of either gaining that experience or obtaining access to those who have.

The contribution, therefore, of experimental archaeology is far from being peripheral. Since it is the logical and necessary next step to interpretation, it must be regarded as a central element. The very nature of its philosophy focusses attention upon the critical areas of the archaeological data and its acquisition. Experiment can underline previously unrecognised anomalies and in addition offer improved techniques of data retrieval. This last is already being achieved in minor ways, a good example of which is the development of sieving techniques to recover minute artefactual and carbonised material (Payne 1973). In fact, the success of this particular device in sieving out highly significant material emphasises the general level of data recovery and increases concern over lost potential. The prime data upon which general theories and models are raised are often suspect. It is quite acceptable that a true case may be argued from a false premise and often it is a desirable and rewarding process, but it is far better to argue a true case from a true premise. Experimental archaeology can be a tool which will greatly increase the opportunities of establishing more valid premises.

The Butser Ancient Farm Research Project

The above principles represent the underlying ethos of the research programmes at the Butser Ancient Farm Research Project. This project, unique in British and world archaeology, seeks to reconstruct and work as a full-scale economic unit an Iron Age farmstead dating to approximately 300 B.C. The pilot scheme of this project was set up in 1972 under the control of the Ancient Agriculture Committee, a joint committee of the British Association for the Advancement of Science and the Council for British Archaeology. Initial funding for the project was provided by the Trustees of the Ernest Cook Trust. The land area, approximately 57 acres comprising a spur and adjacent valley to the north of Butser Hill in Hampshire was provided by the Hampshire County Council.

The date, 300 B.C., is in a sense arbitrary in that it represents the main stream of the Iron Age period and the earliest time for which there is adequate evidence for an attempt to reconstruct procedures and structures. It also represents the time when the agricultural pattern was practically stabilised and maintained forward through the Roman period. Indeed it has been suggested that the major Roman contribution to farming in Britain was the villa system.

Butser Hill itself is the highest down in Hampshire and as such has been a focal point in every period of prehistory. The major earthworks present are early Iron Age cross dykes built across each of the spurs. The spur, known as Little Butser, at present the nucleus of the farmstead, was also extensively exploited although the only clear field monuments are a dished platform, which excavation suggests was a house platform, and a 60 metre length of ditch. Both monuments are of indeterminate Iron Age date

but more probably of the later period. However, excavation of certain areas of the spur prior to development and the construction of a field system have provided evidence of considerable use and occupation from the Neolithic to the end of the Iron Age.

The physical purpose of the project is to build a farmstead consisting of a number of round-houses and attendant structures, contained within a penannular ditch and bank with field-systems and paddocks radiating out from the enclosure. Its operation will include the construction of pits for a variety of purposes, fences and stockades, the acquisition, maintenance and training of appropriate live-stock, propagation and cultivation of all the relevant cereal crops with particular attention to potential yield figures, and the implementation of domestic industries.

A better explanation of the concept is to present it as an open-air scientific laboratory researching into archaeology. As a complete exercise the finished farmstead will be the major fundamental experimental project yielding data of an overall nature. Yet each of the component parts, while integral to the whole, will in themselves be specific experiments yielding specific data. For example a field system will furnish information concerning its operation and function within the farmstead but each individual field will be the subject of a particular experiment and similarly even certain areas of one field will represent one specific study which may be isolated from all other studies. Inevitably as with any scientific experiment, replication (repetition of experiments) is a basic requirement. Replication is of even greater importance in agricultural studies in that the major variable of the climate is not subject to control. Therefore, the farmstead is to be viewed as an extremely long-term project spanning a minimum period of twenty years. In addition, because the concept involves the running of a complete farmstead and embraces both the three-dimensional and functional approach new hypotheses for processes and structures previously not thought of, will inevitably be made. The interpretive problem that faces the excavator of a prehistoric rural site is the transference of thought from two-dimensional data to three-dimensional activity. The initial returns even from the pilot scheme of the past three years are so significant that on the one hand they simplify the the initial problems, the other they demonstrate that simplistic interpretations are totally inadequate.

It would be impossible within the compass of this paper to present a detailed record of the work achieved during the past three years and the following paragraphs, therefore, are a brief summary of the major aspects of the farmstead to date. A detailed Triennial Report is to be published in 1978. However, details of the reconstruction of the first round-house of the farmstead are included below.

Before any research activity was commenced a photogrammetric survey of the whole site was made with close contours of a metre interval. Ten fixed survey points were installed again to an accuracy of within 2mm. In addition a basic soil survey of the spur was carried out in order to provide the prime data to monitor the effects of land usage. Finally selected areas were excavated prior to any further development. As far as possible excavation always precedes any reconstruction work in that it is necessary to establish that there will be not interference with any archaeological

data present. Also it is vital to know exactly the nature of the rock surface so that it can become the constant against which the effects of subsequent activity, always closely monitored, can be measured. All excavation is carried out by hand without resorting to any mechanical earth moving equipment. Similarly all layers are photographed in mosaic and stereoscopic pair form. In effect, one aspires to the highest standards of excavation technique and recording.

Pit Experiments

At the outset it was decided to implement a long-term research programme into the question of pit technology, initially concentrating upon the problems of grain storage in underground silos. Since the pit is the major vestige of human activity on a high number of Iron Age sites and clearly represents a particular way of thinking, it is critical that every effort be made to increase our understanding of this feature. Until this is achieved, our knowledge of the Iron Age will remain extremely limited. It is beyond all doubt that there are many functions that can be attributed to a pit and that only one of these, attested by documentary evidence (Pliny, Diodorus Siculus, Tacitus), is the storage of grain. An interim report of the results from the grain storage programme has already been published (Reynolds 1974, see also Bowen and Wood 1968 and Reynolds 1967 & 1969.) The significant factor to emerge from this programme is the possibility of storing not consumption grain but rather seed grain in underground pits. In fact, it is difficult to see from the experimental results how such a system could possibly be efficient for the provision of regular supplies of consumption grain.

This programme was rapidly expanded and now includes research projects into the erosion pattern within pits and how this differs depending upon the orientation of pits. Results from this topic suggest that specific excavation and recording techniques should be employed for pits and in particular, if a section only is to be recorded as is commonly the case on 'rescue digs' then that section should always be on a north-south axis. This is because that major differential effects of erosion caused by temperature extremes can be observed by comparing the north face with the south face of a pit. Indeed it may be possible to establish the seasons when a pit is open and closed or whether it was ever left open to the elements by providing the necessary comparative standards from experimental work.

Also within this pit programme is the topic of silage manufacture in a pit. It is a reasonable hypothesis that some pits were used to produce silage and there is a growing body of evidence which would suggest this to be so. Essentially the evidence is drawn from pit shapes, especially the commonly found bath or oval shaped shallow pits, from pit infills where large blocks of unweathered chalk are found in the lowest layers occasionally sealing a thin dark greasy 'silt' and from pits which have a ledge built in in such a way that it appears to be two pits, an earlier deep pit with a later larger pit set off-centre over the earlier pit. That pit-silage manufacture is an ancient practice is attested by folk lore from the north of Scotland and the Orkneys (personal communication — B. Noddle). That it was a desirable source of supplementary winter feed for cattle is also beyond question.

The research has indicated a way in which it is possible under certain circumstances to prove whether a pit has been used for silage production. The manufacture of silage depends upon the concentration of wilted grass in an anaerobic condition as inside a pit so that bacteria (*Streptococcus lactis*), present on grass in the natural state, will generate lactic acid. This acts as a preservative agent and pickles the grass in the same way as vinegar pickles onions. However, in a pit dug in chalk rock, the lactic acid would react with the chalk and produce a precipitate of calcium lactate. If a chalk pit were used for silage production and after use immediately back-filled so that leaching was minimised or nil, chemical analysis of the pit wall could determine the presence of calcium lactate and therefore pit function. It would be reasonable to schedule for chemical analysis of pit walls as a standard procedure in excavation.

Other aspects of pit technology including the firing of pottery within a pit are being examined at the farm and elsewhere. Perhaps the prime and basic implication from this extensive programme is to underline the fact that a pit is a structure and consequently deserves minute examination and recording of its walls, floor, shape and capacity. The single random section which concentrates upon the fill which rarely indicates its function but rather its final functional phase, is hardly adequate. In this connection it is worth recording that an experimental pit excavated in the autumn of 1972 with a spoil heap less than half a metre away has remained singularly empty with no silting whatsoever.

Livestock

The farmstead has been gradually built up around this central programme with the acquisition of livestock and construction of fields and paddocks. The livestock clearly present considerable problems since apart from the sheep and possibly the horse and chicken, all other breeds are now extinct. The cattle represent an important and fundamental element of the farmstead and in place of the extinct '*bos longifrons*', two long-legged Dexter cows were purchased.

The Dexter cow was originally bred about two hundred years ago from the Kerry cattle and became the traditional Irish house cow. It was introduced into this country from Ireland and has been particularly popular for small-holders and crofters ever since. Occasionally it reverts back to the Kerry breed and this is the case with the farm dexters with long legs. In comparison with the bone evidence from Iron Age sites they conform in shoulder height, body weight and general appearance with '*bos longifrons*'. The supposition, therefore, that they will generate a similar traction power is reasonable.

These animals have been trained to the yoke and in the autumn of 1975 were first used for ploughing. The need for the project to be a long-term exercise is emphasised by such problems like the training of cattle. The construction of a farmstead is not an over-night exercise and anyone concerned with animal training will agree that it is a long and involved process. Nonetheless the implications of trained cattle to provide the basic power unit in a farmstead are extensive. The role of cattle within the farm and even within the social framework is brought into question. Were they maintained during the summer period by a system of paddock grazing, tether grazing or zero grazing, this last being a system

whereby grass is cut by hand and brought to the cattle rather than allowing them to graze freely? In the winter were they fed with hay, silage, cereals or tree branches or combinations of these? Certainly it was and is necessary to provide supplementary winter feed. The principle regularly advocated of wholesale slaughter of stock in the autumn lacks both supportive evidence and common farming knowledge. Bones of yearling animals are most probably representative of culling. Certainly this would be so for horses. All these aspects and allied questions concerning the implements, yokes and ards, and their effects on the ground are the subject of this particular research programme. For example, it will now be possible to investigate the production of ardmarks and the power required to make them against the increasing numbers of 'archaeological' ardmarks found in almost every soil type in this country.

A flock of soay sheep is already established on the Ancient Farm after several years of careful breeding utilising only the stock brought over from the island of Hirta in the St. Kilda Group. (P. Jewell et al. 1974). It is extremely fortunate that the soay has survived virtually unchanged over the last two thousand years since one is fairly certain that this is the domestic sheep of prehistory. The major problem experienced in setting up the present flock has been that of domestication since the animals have survived in the feral state. Their maintenance at the farm is another experiment in that they are kept in paddocks of 'celtic field' size and regularly moved from one paddock to another. In this way it has been possible to sustain a larger number of sheep to the acre than is the normal practice today. The characteristics of the soay are interesting and have serious implications for the interpretation of the Iron Age.

In appearance they are not unlike small goats, they run like deer and can leap over fences 1.50m high when under pressure. Impervious to dog control they exhibit considerably more intelligence than their modern counterparts. They yield approximately one kilo of wool which is plucked and not sheared per annum in late May. It seems likely from their body weight that they would have been kept specifically for the provision of wool rather than meat. Because of the difficulties in controlling the soay as outlined above and because the wool is taken at a time when ordinarily one would expect them to be ranging free over an area it seems more sensible to control a flock in a paddock system and to reinforce domestication as much as possible. Added to which, since there is little evidence for the fencing of arable field systems and the soay is as partial as any animal to the new shoots of a growing crop, some kind of control must have been exerted. While the idyllic picture of shepherd with pan-pipes and flock ranging over the South Downs is attractive, the field evidence, even for the high downs suggests that the majority of the landscape was under arable cultivation and therefore out-of-bounds. Clearly in other areas of the country a different practice may well have been adopted.

The pig, on the other hand, represents considerable difficulties in that one is fairly sure that they were kept domestically but quite how has yet to be established. The area of research that is of particular concern is the production of pig pannage and whether this is identifiable archaeologically. If so, it is necessary to provide for the field archaeologist the required standard for comparison. The animals at present on

the farm are the second generation from an original cross between the European wild boar (*sus scrofa*) and the Tamworth sow, the oldest extant variety of British pig. This particular group of pigs is in no way an attempt to breed back to a postulated prehistoric pig although it is probable that the parent animals are the correct ones for such an enterprise. They are simply to fulfill the role of the pig in the farmstead complex and to be used in the experiment mentioned above.

It is believed that the Exmoor Pony is the modern equivalent of the Celtic horse and one of these animals, a two-year old gelding, is already established on the farm. As with the cattle there is the time problem for training and further the determination of the role of the horse within the farmstead. Its probable function is that of a pack-animal and thus it complements the role of the cattle. That the horse is of great significance as a cult animal has been ably demonstrated (Ross 1967) and for its role in battle Caesar's description of chariot warfare in his Gallic war commentaries (*De Bello Gallico* IV, 33) is particularly valuable. Here the Celtic warrior must be seen as an accomplished acrobat and his skills probably surpassed even those of the American Indians. The description of the modern Exmoor pony is well known but it is worth stressing their endurance and strength. A mature pony is capable of carrying a 12 stone man all day over the rough moorland.

The chicken's presence in Iron Age Britain is also attested by Caesar (*De Bello Gallico* V, 12) and increasingly chicken bones are being recovered from excavations. The bird in question would seem to be the Indian Red Jungle Fowl, a variety which is still extant. In appearance they are like large bantams, the cock bird having a particularly fine plumage. In the wild state they will fly and breed with pheasants and are quite capable of survival. Domestically they need either to have their wings clipped or to be kept within a pen. The latter alternative suggests an interesting interpretation for some four-post structures especially where one or more of the post-holes are seemingly too large to be correlated. Recently the author discovered a 'stick-pen' on an old farm in the New Forest. The pen was used for chickens, conformed to a rough archaeological ground-plan of 2m x 3m, had four major posts with the cage work being made from hazel and willow rods tied with string. The string was a recent substitute for split bramble lashing. The initial attempt to establish the fowl on the farm was thwarted by thieves but a second attempt is proving more successful. Further confirmation of the presence of chicken bones of the species *gallus gallus* has been gained from the Iron Age Settlement site at Skeleton Green, Hertfordshire, (personal communication: R. Ashdown).

Finally, this section on livestock would be incomplete without a brief mention of the bee. Sadly it is impossible to maintain an apiary of the ancient British bee despite the fact that it still survives but in the topographically protected valley of Fountains Abbey in Yorkshire. The 'Isle of Wight' disease virtually wiped out the indigenous bee in the rest of the country. However, an apiary of the gentle New Forest bee is being set up on site utilising the ancient system of skeps and swarming. Honey was of great importance in the ancient world and no less is this so for Iron Age Britain. It was the sole sweetening agent and while it is not suggested

that the modern dependence on sugar be translated into a prehistoric context, honey was used and fulfilled an important element in daily life. Certainly its significance for the brewing of mead can be readily appreciated. The premise adopted for bees on the farm is simply that it is more likely that some control was practiced in the keeping of bees rather than a dependence upon the collection of 'wild' honey. Having accepted this working premise, by studying the literature and material remains of old fashioned bee-keeping methods extant, some archaeological evidence, both physical and artefactual, acquire a new significance. (Report forthcoming). Indeed it is extremely probable that honey pollen will be identified in due course which will add support to the premise of beekeeping in prehistory. The cave paintings which show the collection of honey from wild swarms (Obermaier 1924) demonstrate an awareness that could well have evolved quickly into domestication. In the classical world beekeeping had become an industry (Jones 1973. Virgil.). There is no reason to suppose that the Celtic world was any less advanced.

The preceding passage is but a brief description of the stocking of the Ancient Farm to date and only takes account of the animals so far obtained. Clearly the implications are greater than here outlined and other livestock, like the goat, need to be considered. However, given the present level of stocking, the physical control and husbandry are giving an invaluable wealth of new knowledge and information which would otherwise be quite impossible to achieve. It is only by operating such a functional approach that significant advances in interpretation can be made.

Crops

That this is true is demonstrated from the results of the arable programme. At this time five fields of Celtic size have been constructed on the farm. There is a general study of earth movement and lynchet formation which is applicable to all the arable areas, the results being calculated at regular intervals and based upon the original precise survey and fixed points referred to above. Beyond that there is a complex programme of propagation of rare cereals, the original seed supplies having been gathered by Mr A Eade of the National Institute of Agricultural Botany, and the calculation of yield figures for some of these cereals.

Yield figures are often used in a casual way and with little appreciation either of the cereal in question or what the figures may mean. Generally it is a broad statistical statement which requires both explanation and, on a regional basis, detailed qualification. For example, yield figures achieved in East Anglia will differ greatly from those achieved on a hill farm on the northern side of a mountain in Wales. Indeed, yield figures can differ from different fields and even different parts of the same field on the same farm. The number of variables which affect the yield of any crop are great and the greatest of all is the weather. On the ancient farm, therefore, each field is, in itself, a specific experiment producing specific results to be read against a number of significant and monitored variables. In addition, each field is also a prototype experiment for a comprehensive series of such experiments on a nationwide basis. Only after such a programme has been completed over a long period can reliable statistical results be gained for the cereals in question.

Our knowledge of the cereals of the Iron Age come directly from the identifications of carbonised seeds recovered by excavation. The quantities so far recovered can only indicate the species that were grown. It is unlikely that, were all the carbonised seeds gathered together, they would collectively weigh even one tonne. Consequently it is unwise to speculate beyond the limits of the available evidence.

During the past three years the major emphasis has been directed to the cultivation of both Emmer (*Triticum dicocum*) and Spelt (*Triticum spelta*) as winter and spring sown crops on slopes of different aspect and under different treatments. The results, achieved on soil no deeper than 10 cms, have been startling and indicate the need for a fundamental re-appraisal of the accepted postulated figures. For example, on one field with a south facing slope with no fertilizer applied, the yield for Emmer wheat over a period of three years, two of which are regarded as the most difficult farming years for decades, has averaged in excess of 16 cwts to the acre. In addition the protein levels of both Emmer and Spelt wheat are more than twice that of modern Bread wheat. There is too little space within the context of this present paper to give a full account of the details of the arable programme but it will be the subject of a forthcoming report.

Buildings

The most impressive visual aspect of the research programme to date is the reconstruction of two round-houses which form the nucleus of the farmstead buildings. The reconstructions are respectively based upon ground plans drawn from Maiden Castle in Dorset (Wheeler 1943) and Balksbury in Hampshire (personal communication: G Wainwright). The former is a post-built structure six metres in diameter with interwoven hazel wattle walls. The central post-hole as recorded by the excavator was utilised for a central support for the apex of the roof. That this interpretation of a central post-hole is probably in error is demonstrated by the latter structure which is over nine metres in diameter with an unsupported roof-span. It is always necessary to emphasise that a reconstruction is in no way a replica. Rather it is one possible physical structure which is postulated from the archaeological evidence. It would be quite wrong to think of such structures as being real Iron Age houses. The operation of the basic formula of experimental archaeology can, perhaps, be best seen in this kind of reconstruction work. One is interested specifically in validity and probability judgements.

Each house is given the name of its original site. The Maiden Castle round-house, completed in 1973, has been subjected to a careful monitoring programme with some fascinating implications. In order to construct the house over thirty trees were used, seven tonnes of daub and over one tonne of thatch. This last item, according to the arable research programme, represents the straw from over an acre of land. However, based upon the postulated yield figures for prehistory, this amount of straw would be drawn from over four acres or approximately sixteen celtic fields. Yet this house is representative of the smaller variety. Woodwork was of the simplest kind utilising only the axe-cut friction plate joint with raw-hide lashing. The hides of three modern cattle were required in the construction.

The completed structure has achieved a degree of validity in that it has successfully withstood four hurricanes and, during the winter 1974-5, over a metre of rain. Despite the excessive rainfall, no natural drip trench has formed under the eaves. However, since the house was used for the storage of grain during the winter periods, it became infested with rats which lived under the walls. Their activity has palpably altered the 'archaeological evidence' in that a gully has been created around two-thirds of the circumference of the house producing what might be interpreted as a 'construction trench'. The presence of *Rattus rattus* has been recognised in the Roman levels at York and one suspects that it is only a matter of time before its prehistoric presence is identified. Even failing that, zoologists suggest that the vole fulfilled the present role of the rat before its appearance. One further aspect of the use of the structure has been the creation of a shallow depression immediately outside the doorway. This has been caused by eaves drip and the passage of feet. This last observation has been instrumental in the location of a doorway in the recent excavation of a round-house in Yorkshire.

The second round-house, which has only recently been completed is entirely different in concept and construction. It depends upon the hypothesis of a timber-frame structure utilising sophisticated joinery of neolithic date including mortice and tenon joints, scarf joints and wooden pegs. The roof structure, based upon five major rafters and a pentagonal ring beam supports two tonnes of reed thatch. The major implication of this reconstruction is that a central post is not a necessary integral feature for a house of this size. Mathematically it is possible to span even greater distances. It is worth noting that the ground area of this house with a diameter of over nine metres is greater than the average modern house and yet is still only in the medium range of Iron Age house plans. The round-house with cone-shaped roof is not only an elegant structure but also demonstrates a considerable degree of engineering skill.

Two general observations are inescapable even bearing in mind that these are logical reconstructions based upon archaeological evidence. The first is simply that these structures are not huts by any definition and that this term has implications which are not only irrelevant but also distort interpretation. The second is to deny, beyond the immediate visual impact, any similarity to African houses. If a native African house were to be transferred to this country and erected on a typical Iron Age settlement, it is extremely unlikely that it would survive even a mild winter season.

The work of the Ancient Farm briefly described above will be the subject of a full research report in the immediate future. The selected topics discussed serve to underline the value of establishing 'comparanda' of vital significance to the interpretation of excavated sites. There is clearly a much greater need for the multiplicity of interpretation, the recognition of a number of potential explanations for any particular feature. The returns, even at this stage of development, from the functional three dimensional approach are of such significance that the permanent establishment of the Butser Ancient Farm Research Project is of key importance both as a research centre providing an interpretational

service and as a national and international archive for experimental work and comparative ethnography.

The work undertaken at the project clearly extends beyond the simple construction of a prehistoric farmstead and the final section of this paper is devoted to the problems of data retrieval and presents the results of two research projects designed to alleviate these problems to some degree.

Data Retrieval

It has been stated above that an immediate effect of experimental archaeology is to focus attention upon the raw data, the excavated material and its acquisition. This is perhaps one of the most significant contributions of experimental work for the quality of interpretation cannot be divorced from the quality of the raw material. The study of specific artefacts for their own sake is rather the work of the art historian. The archaeologist, on the other hand, is seeking out a much more fundamental understanding of the material evidence of which art-history is a significant but relatively minor element. In order to pose the questions 'how and why' of the material, it is of vital importance that all the evidence present in the archaeological record be observed and made available.

This principle is clearly difficult, if not impossible, to execute. Instead of approaching a site with one or two specific questions in mind, the excavator is being asked to record all the information whether it seems relevant or not. The decision of selection is being denied for the simple reason that, at this stage of development, there is insufficient available knowledge upon which a selective decision can be based. The proposition is to collect all the data available, the total record, given the limitations of present knowledge, in order that subsequent discoveries may be checked out against prior records. Initially this may seem to be an insupportable proposition, almost impossible to achieve and of little real value if viewed against a 'rescue situation'. Yet it is precisely this situation which paradoxically underlines the inadequacy of present day data-retrieval. A quick glance at the practices of other disciplines demonstrates the value of total records and justifies the time and effort involved. Meteorology is a simple case in point. The detailed mass collection of weather data, each individual piece of information being in itself of little immediate significance, is of vital consequence as a bank of knowledge. The establishment of this bank of knowledge has enabled scientists in many disciplines to isolate patterns of cause and effect, to recognise sequences and trends and to correlate seemingly disparate evidence. Were there a comparable bank of archaeological evidence, experiments whether practical or theoretical would have a far sounder basis and their findings would similarly be of greater value. As it is at present, the experiment is continually in need of more and more supportive evidence which one suspects was observable but was either not observed or not recorded or both. Consequently there is a danger that the experimenter may encourage the excavator to seek specific answers in order to validate a theory. However, the recognition of this danger may well be sufficient to avert it.

If one accepts the above principle of total recording and the establishment of a bank of archaeological evidence, the task of the excavator is made substantially more difficult. The responsibility for both acquisition and recording of evidence is greatly increased with the removal of selective spontaneous

decisions. With site evaluation becoming a distinct post-excavation exercise, the mechanics of excavation technique are of paramount importance. The trowel-face is, as it has always been, the key to the problem. An excavation of any kind should involve the minute examination and recording of each and every cubic centimetre. The ultimate purpose, since excavation by definition is total destruction, is the facility to put back a site into its original three dimensional state from the excavation records. For how many sites that have been excavated in the last twenty years are records available for such an exercise? The most significant work in this field has been achieved at Wroxeter and Hen Domen by Mr P A Barker (Barker 1969) who has demonstrated by careful experiment and application of experimental processes that it is not impossible to achieve these kinds of results. In this country he first advocated area excavation allied to total recording of material evidence. In Scandinavia similar work by Professor A Steensberg at Borup and Storre Valby has demonstrated the same end result. This process included the surveying in of individual sherds of pottery to establish their spatial context and to evaluate their potential significance as the sole indicators of an archaeological layer. In all of the above cases the areas were initially stripped by hand as opposed to the common area excavation depending upon mechanical removal of topsoil. The argument is not so much for large area excavation though this itself is highly desirable but rather for the precise and detailed recording of all the evidence in such a way that it can be totally reconstructed. The concept is essentially simple, it is the practical achievement of that concept which is extremely difficult.

It is in this connection that two specific research experiments have been carried out at the Ancient Farm over the past three years. The first of these experiments was designed to seek a way of excavating directly from the grass surface downwards without the initial removal of the turf line. Increasing attention has been paid over the recent past to the distribution of artefacts in that by recording such distributions evidence of occupation may be achieved.

The basic premise is based upon simple observation. The limits of a building, for example, afford a protected resting place for rubbish. Debris inevitably accumulates against walls of a house. A clear demonstration is the removal of a wooden garden shed. All physical parts of the structure can be taken away and since most sheds are of a box-construction there will be no post-holes or sill-beam slots cut into the ground surface. All that remains is a central void area with a collection of debris around the perimeter, shattered flower pots, stones cleared from the garden and dumped, broken tools, perhaps a large flat stone used as a step into the doorway. Depending on the time the shed has been in position, so there will be more or less debris. The longer the time, the greater the chance that worm activity has succeeded in covering some of the debris which, unless the area is dug out to some depth, is likely to attest permanently the shed's original position. Transfer this simple observation into a prehistoric context and the same potential picture is quite acceptable. Added to which is the research evidence that prehistoric structures can have a life-span not only of decades but also centuries. There is no sound reason for doubting then that an Iron Age round-house should have a lesser life-cycle than a medieval timber-frame building. Indeed the dynamics of the round-house are in many ways far superior to those of rectangular structures.

One particular research experiment into house-construction serves to underline the need for artefact distribution records. In many areas of the countryside in the prehistoric period evidence of occupation is proven only by the presence of artefacts, pits and ditches with no indication of domestic or other structures. Proposing the premise that domestic occupation did occur within such complexes an examination of completely degradable building materials was made. The two most obvious types of building material are turf and cob or an allied compound. The latter has been proposed as the major building material on Hod Hill (Sir I Richmond) while the former was subjected to a particular test. A simple round-house was constructed consisting of a turf-wall a metre thick and a metre high. A central post, in this case inserted in a post-hole but such insurance is not necessary, supported a timber roof over which a cladding of turf was laid. (Details of this experiment will be published in a forthcoming report). As a structure the round-house was extremely successful, in partial collapse it bears direct comparison to a robbed-out round-barrow, in total collapse and subjected to ploughing, all evidence apart from the central post-hole will disappear. In a domestic situation, had the house been used and subjected to ordinary daily life occupation debris would have inevitably demarcated its perimeter possibly both internally and externally. In an ideal situation of technical excavation, the wall position could be identified by the distribution of the debris in two concentric circles with a reserved blank area within. The alternatives to this basic pattern are clear. The experiment indicates that there is potential value in plotting all artefacts not only in their precise position but also in their spatial attitude.

One major variable mentioned above is the incidence of the plough. It is a matter of some urgency to establish within fairly accurate limits the effects of ploughing with relation to artefact movement. That the plough moves such material is beyond dispute but by how much at particular depths and on particular slopes. An experiment is in hand at this time to test the premise that the plough will not randomise an original significant distribution. A second variable also touched upon is the activity of earthworms. The initial important observational survey carried out by Darwin (1881) certainly requires further study and the institution of more observational studies. Worm activity extends beyond the lowest level of plough penetration and if sufficient time is allowed to elapse from site abandonment to subsequent cultivation and if the artefact travels in a vertical plane, significant distribution patterns could survive immediately below the plough damage stratum. The use of an earthmoving machine to take off the 'ploughsoil', a common enough practice, would, therefore, also remove such artefact distributions.

Bearing in mind all the above premises and the shallow topsoil layer commonly experienced especially in Southern England, it is appropriate at least to seek ways of testing such premises by approaching an archaeological site literally from the grass surface downwards. The life cycle of grass depends upon the conversion of sunlight into energy, a process known as photosynthesis. Stop the incidence of sunlight and in due course the grass will die. The experiment is essentially simple. A sheet of opaque black plastic was securely pegged down over an area and left in place for a

period of twelve weeks. During this time the grass died and the roots rotted away. So successful was the operation that after removal of the plastic sheeting it was possible to lift off the dead fibrous material releasing in situ previously root-bonded artefacts. Thus the topmost layer could be immediately plotted. An additional benefit from the process was the texture of the top-soil, soft and light and in an ideal condition to trowel.

The implications of this experiment principally for excavation of rural sites is clear. Regularly a warning period of several months is given even in rescue situations and this time could be utilised to great advantage. One final benefit that comes out of this process is that once the grass has died, it is possible to survey extremely accurately the area to be excavated and thus provide the best possible datum from which to work.

The second experiment, also directed toward the acquisition and recording of the prime archaeological data in the field, was devoted to the manufacture of a measuring device capable of accuracy levels at least equal if not superior to a dumpy level. The motivation for this particular experiment stems from the inadequacy of evidence recorded for pits and post-holes. In order to attempt to reconstruct either a building like a round-house or a process like storing grain in an underground silo, it is critical that all the archaeological information available is recorded in great detail. One is interested in volumetric details, three-dimensional shape and form. A black blob drawn on a plan to signify a post-hole is of signally little value. Similarly, a random section drawing of a post-hole or pit, while an advance, is only a marginal improvement. The need at a minimum requirement level for at least eight section drawings of a pit is discussed elsewhere (Reynolds 1974). For a post-hole the same arguments apply. Its capacity and potential details of manufacture, presence or absence of a post-pipe, disposition of packing material are all factors of greater significance than a crude analysis of its contents. Even this last factor is capable of greater exploitation in that proximity to occupation areas and potential function can be postulated depending upon the frequency of artificial packing material. While one readily appreciates that the critical process is that of the physical excavation of a feature, there is a considerable problem in precisely how it can be recorded.

The tool described below was developed in order to achieve as full a record as possible of any archaeological feature simply and quickly. The basic principles of any instrument to be employed on an excavation are that it should be easy to use and understand, portable, durable, a minimum of moving parts and, above all, accurate. The object is to record horizontal and vertical measurements simultaneously with further provision for sub-terranean horizontal measurements for under-cut features.

The resultant device, provisionally named the 'Protophit' and built as a machine tool by Mr D Chapman of the Farm Factory at Napsbury fulfills all of the above principles. It consists of an horizontal bar supported at one end by a foot and at the other by an adjustable leg. The leg is provided with a universal joint just above the base foot to allow for uneven ground conditions and a collar support for the horizontal bar which can be adjusted vertically and locked into any position. The horizontal bar, marked in

centimetre divisions carries a sliding chuck which is fitted with two spirit-levels. The levels are adjusted for horizontality and verticality. Once in position a vertical measuring rod also marked in centimetres is fixed into the chuck. Locking nuts are provided on the chuck for both horizontal and vertical movement. Operation is simple with co-ordinates being read off at the chuck and recorded numerically. If a tape recorder is used the exercise becomes virtually impervious to weather conditions. In fact, after a little practice, the procedure is quicker than any other system in common use. The data can further be programmed for a computer to produce a three-dimensional drawing of the feature. The accuracy of the protophit under ordinary operation is to within 0.5cm.

A further device, for measuring undercut features, consists of a telescopic rod similarly marked off in centimetre divisions and mounted on a collar with fixing nut which can be fitted to the vertical measuring rod. When it is necessary to move this second horizontal measuring device, the only additional equipment required is a compass. The protophit, therefore, as a machine tool is sufficiently flexible to fulfill all the requirements demanded by precise excavation. In addition it is capable of replacing a dumpy level and staff over small areas and considerably eases the problems of repeated surveying demanded by area excavations.

These two particular experiments demonstrate how the basic formula explained at the outset of this paper can be extended to seek improved methods and techniques for excavation and represent a significant part of any experimental programme. The results of these experiments, far from being divorced from 'real archaeology', are designed specifically to improve and accelerate the recovery process and to be of real value within the 'rescue situation'.

It is important at this point to introduce a 'caveat'. Experimental work is of little value if it is not monitored as exactly as possible. The highest standards need to be applied at each and every stage. The 'ad hoc' and 'wonder if it works' approach is fine but it is not experimental archaeology. To cook meat in a tub of water heated by casting in hot stones is hardly an experiment. Rather it is a simple demonstration of an obvious process. However, the exercise does become an experiment when all the phases are thoroughly monitored, especially since one is concerned with comparing the 'experimental pot-boiler' with the 'archaeological pot-boiler'. With the former one has a precise knowledge of its formation and manufacture, the heat of the stone and the fire, the timber required, the time factor, the escalating water temperature, vapour loss, displacement, the effect of the water temperature upon the stone, the nature of cracking and much more. The prime data, in fact, upon which valid and critical comparison can be made to the archaeological data. It is necessary to distinguish most carefully between demonstration and experiment.

In conclusion, the practice and principles of experimental work are devoted to the problems of excavation, recording and interpretation. The Butser Ancient Farm Research

Project is to be viewed as an open-air scientific research laboratory designed to test empirically hypotheses and theories and to act as a critical interpretation service. By establishing validity and probability boundaries its work is fundamental to the progress of practical archaeology and its interpretation within and beyond the context of pre-historic agriculture.

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