THE EDUCATIONAL WORLD OF BUTSER ANCIENT FARM

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Butser Ancient Farm

RESUM:

En aquest article es presenta la història, desenvolupament i metodologia de la Butser Ancient Farm durant els últims vint-i-cinc anys. Els arguments per a demostrar les hipòtesis arqueològiques a partir de l'experimentació han evolucionat juntament amb una discussió sobre la naturalesa i valor crític de l'experimentació en sí mateixa. L'Ancient Farm és, de fet, un laboratori obert evocat a la investigació empírica de l'economia domèstica i agrícola de l'Edat del Ferro Tardana i del període Romà del nord-oest d'Europa. No és cap museu ni cap parc temàtic. El component educatiu de la recerca, en tant que s'utilitza per al benefici dels estudiants de totes les edats, s'explora en profunditat. La metodologia per a l'ensenyament mitjançant el mètode dialèctic i la participació física, mètodes pioners durant un període de vint anys, es discuteix en detall. A més a més s'explica, tant l'ensenyament actual com els materials didàctics, amb especial atenció a les necessitats dels alumnes moderns, que cada vegada més, són producte d'una cultura urbana molt més que rural. La interacció de la Ancient Farm amb l'educació primària, secundària i terciària, també s'exposa, incluint l'oferta d'oportunitats per a la recerca individual per nivells universitaris i postgraduats. Tant el programa educatiu com el de recerca són una dinàmica sota una continua reevaluació i canvi.

RESUMEN:

Este artículo presenta la historia, desarrollo y metodología de la Butser Ancient Farm durante los últimos veinticinco años. Los argumentos para demostrar las hipótesis arqueológicas mediante la experimentación han avanzado con una discusión acerca de la naturaleza y valor crítico de la experimentación en sí. La Ancient Farm es, de hecho, un laboratorio abierto volcado hacia la investigación empírica de la economía doméstica y agrícola de la Edad del Hierro Tardía y el peíodo Romano en el noroeste de Europa. No es ni un museo ni un parque temático. El componente educativo de la investigación, en tanto que se emplea para beneficio de los estudiantes de todas las edades, se explora en profundidad. La metodología para la enseñanza mediante el método dialéctico y la participación física, métodos pioneros durante un período de veinte años, se discute en detalle. Además, se explican tanto la enseñanza actual como los materiales didácticos, con atención especial a las necesidades de los alumnos modernos que cada vez más son producto de una cultura urbana más que rural. La interacción de la Ancient Farm con la educación primaria, secundaria y terciaria tambíen se expone, incluyendo la oferta de oportunidades para la investigación individual para niveles universitarios y postgraduados. Tanto el programa educativo como el de investigación son una dinámica bajo continua reevaluación y cambio.

ABSTRACT:

This paper briefly sets out the history, development and methodology of Butser Ancient Farm over the last twenty-five years. The arguments for testing of archaeological hypotheses by experiment is advanced along with a discussion of the nature and critical value of experiment itself. The Ancient Farm is, in fact, an open-air laboratory devoted tothe empirical investigation of the domestic and agricultural economy of the late Iron Age and the Roman period in north-west Europe. It is neither a museum mor a theme park. The educational com-

ponent of the research, insofar as it is employed for the benefit of students of all ages, is explored at length. The methodology of teaching by the dialectic method and physical participation, methods pioneered over a twenty year period, is discussed in detail. In addition, the actual teaching and teaching materials are explained. especially with regard to the needs of modern schoolchildren who more and more are the product of an urban rather than a rural culture. The interaction of the Ancient Farm with primary, secondary and tertiary education is also explained, including the provision of individual research opportunities affered at undergraduate and postgraduate levels. The educational programme as the research programme, is a dymanic, under continuous re-evaluation and change.

RÉSUMÉ:

Ce rapport présente l'histoire, développement et methodologie de la Butser Ancient Farm pendant les dernières 25 ans. Les raisonnements pour démontrer les hypothèses archéologiques à travers de l'expèrimentation ont avancé à coté de la discusion au sujet de la nature et la valeur critique de l'expérimentation en soi même. La Butser Ancient Farm c'est, en fait, un laboratoire en plein air consacré à la recherche empirique de l'économie domestique et agricole de l'Age du Fer Récente et de la periode romaine au nord-ouest de l'Europe. Il ne s'agit ni d'un musée ni d'un parc thématique. Le facteur éducational de la recherche, puis qu'il s'employ pour bénéficier les élèves de toutes les ages, est exploré profondément. La méthodologie d'enseignement à travers de la méthode dialectique et de la participations phisique, des méthodes pionniers pendant un periode de 20 ans, est traité en detail. Outre cela, le rapport explique aussi l'enseignement actuel et les materiaux didactiques, avec une spéciale attention pour les besoins des élèves modernes, produit, chaque fois plus, d'une culture urbaine plus que rurale. L'interaction de la Butser Ancient Farm avec l'enseignement primaire, secondaire et tertiaire est aussi exposée, comprise la provision de chances pour la recherche individuelle pour les niveaux universitaire et post universitaire. Le programme educatif aussi bien que ce de recherche sont une dynamique se reévaluant et changant constanmment.

HISTORY

Butser Ancient Farm was set up in 1972 specifically as a programme for research and education. Its remit to study the agricultural and domestic economy of the period c.400BC to 400AD has remained largely unaltered. The time span embraces the late Iron Age and early Roman period. The overall objective was, and is, to create practical working research programmes based directly upon the archaeological evidence as interpreted from excavations.

During the last twenty-seven years, the Ancient Farm has occupied three locations. The first site on Little Butser, from which the farm draws its name, was a northerly spur of Butser Hill in Hampshire. The base geology of the site was middle chalk overlaid with a shallow friable rendzina soil just 100mm deep. Given its geology and aspect it offered a worst option scenario for the proposed research programme but in its defence it once supported a Bronze Age/Iron Age farmstead the occupants of which cultivated the valley to the north and east. The primary advantage of a worst option lies in the immediate acceptability of the data in the sense that the results of the experiments, especially those which depend upon a combination of soil and climate, have not been enhanced by pre-selecting optimum conditions. This site was in continuous operation from 1972-1989.

In 1976 a second site was developed in the valley bottom on Hillhampton Down on the southern slopes of Butser Hill. This shared the same geology but with a deeper (300mm) soil cover of friable rendzina, clay with flints and chalk granules. It was operated as a research site in conjunction with Little Butser but its primary purpose was as an open-air museum open to the public and available as an educational resource for schoolchildren. Given the independence of the Ancient Farm from any statutory funding, either national or local, it was necessary to develop a sustaining source of income. On both these sites the infrastructure comprised research fields and stock areas, animal paddocks, and an enclosure within which were built constructs based upon specific archaeological data. The livestock maintained at the farm comprised five breeds of sheep (Moufflon, Soay, Manx Loughton, Hebridean and Shetland), Old English Goats, Dexter cattle and Old English Game Fowl. Occasionally Tamworth/European Wild Boar cross pigs were also kept. The differing natures of both sites allowed direct comparisons to be drawn between the different bioclimatic zones. The major advantage of this second development was a redefinition of the binary purpose of the Ancient Farm as being a research and an educational establishment. The planning phase for the development of the second site rather explains its primary purpose - it was called the Butser Ancient Farm Demonstration Area (BAFDA) and by most was regarded as a separate entity from the first site on Little Butser. It was here that the methodology and the results would be shown to a visiting paying public and a full educational service could be offered to schools.

At the beginning of 1991 both these sites were vacated and a new site developed at Bascomb Copse near Chalton. The underlying geology is upper chalk with a loamy soil averaging 350mm deep. This new location offers the typical option of the chalk downlands of Southern Britain as exploited in all periods of the past. This site has the same resources but with the added bonus of potential further development. Indeed, the research now extends into the Roman period with the of a construct of a Roman building including a major research programme into the problems of a working hypocaust. The site also combines the twin focus of research and education in one location. As with the previous sites the objective is to carry out a 1:1 scale empirical trials to elucidate the archaeological data.

METHODOLOGY

"If it disagrees with experiment, it is wrong. In general, we look for a new law (model) by the following process. First, we guess it. Then we compute the consequences of the guess to see what would be implied if the law (model) is right. Then we compare the result of the computation to nature, with experiment or experience, compare it directly with observation, to see if it works. If it disagrees with experiment, it is wrong. In that simple statement is the key to science. It does not make any difference

how beautiful the guess is or how smart you, who made the guess or what his name is – if it disagrees with experiment, it is wrong." Richard Feynman 1964 in John Gribbin 1998 'Almost Everyone's Guide to Science.' Wiedenfeld & Nicholson, London.

From the inception of the Ancient Farm in 1972, it was realised that for this approach, full-scale empiricism, a basic methodology was critical. Without a strict system which applied to all aspects of the work, the results would be incompatible and not allow any form of ultimate integration. It had been envisaged, even in the early seventies, that, given a large enough data base rigorously acquired over a long enough period, computer simulation could be employed to extend the data to embrace far greater regions than those to which the research was manifestly restricted and to respond to questions not originally formed at the beginning of the programme.

The resultant methodology is essentially cyclical in form. The archaeological data, the evidence recovered by excavation along with whatever documentary sources are available and reliable, form the base or prime data upon which the archaeologist/prehistorian mounts an hypothesis. The testing is in the form of a physical experiment which by definition requires replication. The conduct of the experiment must be consistent from start to finish. An experiment which is changed or modified during its course immediately invalidates the original question and the experiment itself. Given adequate replication, usually a minimum of five replicates, the data from the experiment can be compared to the original data upon which the hypothesis was raised. If there is agreement between the sets of data the hypothesis can be tentatively accepted as valid but with the caveat that several different hypotheses raised on the same date can also be validated, a condition referred to as the `multiplicity of hypothesis validation'. If there is no agreement the hypothesis is not merely invalidated but actually proved to be wrong. The value of this methodology lies especially in the seemingly worst case situation. By building an experiment the prime data is subjected to extremely close scrutiny in order to execute the experiment, a process which emphasises aspects previously unconsidered or even unrecognised. Even after the committal of an experiment, it can be readily seen that there are fundamental errors which are further focused upon during the course of the experiment. The resultant negative correlation allows greater insight into the original data and the ability to construct a second or even a third experiment leading to a validated but different hypothesis.

THE NATURE OF EXPERIMENT

Necessarily experiments vary in nature in direct response to the type of hypothesis. Broadly experiments fall into five categories, not that these categories should be seen as mutually exclusive, rather they are a convenient set of explanations. The first and perhaps most obvious category is that of structure, the creation of constructs based upon patterns of post-holes and stakeholes. The word reconstruction is to be eschewed since, for prehistoric buildings where virtually nothing material survives, it is totally inaccurate. The vast majority of buildings evidenced from pre-history and proto-history survive only in the form of negative evidence, the position where posts and stakes once stood. Consequently the term "construct" has been chosen to underline the deductive process and avoid semantic confusion. Reconstruction is properly applied to the putting together and restoration of buildings of which adequate remains survive. The second category of experiment involves process and function where trials are mounted to examine the effects of usage on archaeological features like pits or objects like ploughs or alternatively the effect upon tools in the execution of their hypothesised purpose. Within this category one must place technological resources like pottery kilns and furnaces in the sense that experiment can determine the limits of their performance as well as their efficiency. The third category of experiment is devoted to simulation trials. In this kind of experiment one seeks to discover how an archaeological feature reached its ultimate state as recovered by excavation. Perhaps the best example is the experimental earthwork or ditch and bank. Excavation discovers buried ditches which reveal deposition layers within them brought about by natural erosion processes. The layers are normally irregular and asymmetrically deposited. In order to gain an understanding of both the irregularity and asymmetry the only course of action likely to yield a valuable result is to construct a `new' version which can be studied against climate and time. The Ancient Farm is currently conducting a major research programme of simulation trials involving octagonal earthworks on different rock and soil types.

The fourth category of trial, described as eventuality trials, is in a real sense the logical extension of the first three categories. In such a trial one seeks to establish, within closely defined parameters, probable outcomes or results. Inevitably such results have to be viewed as eventuality statements very much defined by the constants built into the experimental procedure. The best example of a eventuality trial is the growing of prehistoric type cereals in order to establish potential yield factors of these cereals within the probable technology available within a specific time period. Within such trials, the variables of weather and soil type can be regarded as semi-constants provided they are recorded in detail. More significant in terms of eventuality are the presumed constants of treatments, sowing rates and management. Also within this category of experiment fall deductive hypotheses and their testing. The use of this type of trial relies upon data supported validated hypotheses which could not be unless a prior unsubstantiated process or activity had taken place. For example in Britain there is no evidence of threshing or threshing locations yet cereals had to be threshed before they could be processed into food or prepared for storage. In effect it is a function which had to have taken place for without it there would be nothing - *sine qua nihil*.

The fifth and final category of experiment is best described as technological innovation. Within this category fall the initial application of machines or trials which seek to improve or enhance archaeological practice. Particularly is this the case with prospection machines like fluxgate gradiometers and soil magnetic susceptibility meters, ground radar and even X-rays borrowed from other disciplines. The examination and testing of these devices to assess their potential value are, in fact, experiments. Similarly, monitored field trials can be used to facilitate the understanding of recovered archaeological data. For example, a long series of trials have been conducted by the writer to determine artefact movement within the modern and the prehistoric plough zone in order to assess the value of the soil as an archaeological layer which deserves the same detailed analysis as those layers arguably undisturbed by subsequent activity.

Naturally all these five categories should not be regarded as being mutually exclusive. Often an individual experiment can embrace several categories simultaneously and, logically, a probability trial is entirely dependent upon the three previous types of experiment. In reality, separating the experimental process into these categories is only for the convenience of explanation rather than any purpose of definition.

All these categories of experiment have been pioneered and extensively practised at the Ancient Farm. The one important factor which has been deliberately excluded from the nature of experiment is the human. As far as possible the experiments are scientific trials with variables being measured against constants with emphasis being placed on replication and predictability of subsequent trials. Data whenever possible is expressed numerically. No importance has been attached to `time taken to achieve' since the variable of human motivation and skill are impossible to evaluate or calculate. Similarly `living in the past' forms no part of the scientific work of the Ancient Farm. Such activities are signally instructive to the participants and may or not be character forming. There is undoubted value and profit to gain from some forms of re-enactment in the field of education and interpretation, but there is little of scientific worth likely to extend our knowledge. In a very real way, the mental impedimenta which unavoidably burdens modern man precludes any true understanding of his historic counterparts let alone his prehistoric ancestors. The objective from the beginning of the Ancient Farm has been to work within the constraints of the above methodology, concentrating upon the problematic archaeological or prime data. Each of the three sites have been managed in such a way as to seek to integrate all the different experiments so that not only can the individual experiments be studies *per se* but also foreseen relationships between the experiments can be evaluated and unforeseen relationships might be identified.

CORE RESEARCH PROGRAMMES

Cereals

The primary focus of the research has been upon the agricultural economy of the later Iron Age. From 1972, growing trials have been carried out with the typical cereals of the period, Emmer (*Triticum dicoccum*) and Spelt (*Triticum spelta*) on a range of soil types in different bioclimatic zones. Other cereals have been incorporated into the trials including Club Wheat (*Tr.compactum*), Old Bread Wheat (*Tr.aestivum*), Einkorn (*Tr.monococcum*), and Barley (*Hordeum vulgare*). For treatment variabilities, the legumes Celtic bean (*Vicia faba minor*), peas (*Pisum sativum*), and vetch (*Vicia sativa*) have also been cultivated. Field aspect, soil type, manuring and non-manuring, crop rotation and fallow rotation are all incorporated as variable treatments. An important element of these cropping trials has been the study of arable weeds, in terms of their presence and absence and their value as irritants or benefits.

Cultivation experiments utilising different types of cattle drawn ard have been conducted, examining both the efficiency of the ard as a tool on the one hand, on the other the effects of its use on the ard itself. Associated observations within the cultivation programme include the monitoring of lynchet formation on field boundaries and dishing within field areas. Trials with the magnetic susceptitibility meter across manured and non-manured zones within field areas, along with lipid analysis of treated soils, suggest a positive method of determining manuring activity. The cropping trials have also afforded opportunities to carry out pollen rain catchment along with the development of a new pollen rain trap.

Grain Storage

The second aspect to the cropping programme has been an intensive programme of grain storage in underground silos. A large range of variables have been examined over a period of twenty years yielding significant results. Grain can be stored very successfully in simple pits in chalk, limestone and sand rocks both short and long term. After short-term storage of about six months, the grain has a germinability in excess of 90%. Germinability, though not necessarily edibility, deteriorates the longer the storage period. Critically, a pit has an indeterminate life span. No sign of souring was observed during 15 years of trials. The implications of these storage experiments demand a re-evaluation of their currently accepted economy and use.

CONSTRUCTS

A parallel research focus has been upon the houses and structures of the late Iron Age. A large number of different round-houses have been built on each of the three sites, each house being a specific construct based upon the best available excavated data. It has always been a particular aim to project and test a structure within the constraints of the archaeological evidence. A generalised or composite structure has never been built at the Ancient Farm. Two significant constructs have yielded the greatest reward to date. The Pimperne house construction allowed a real distinction to be drawn between constructional and structural evidence and, on its dismantlement in 1990, it was found that a building of 13m (42ft) diameter could adequately exist beyond the life of its structural post-holes, implying that dating evidence found within the post pipe did not necessarily indicate a time after its destruction. An even larger construct based upon an excavation at Longbridge Deverel Cowdown, Wiltshire, 15.4m (50 ft) in diameter built in 1992-93 has demonstrated that a free span of some 13m is relatively simple to achieve.

A construct of a Roman building was started in 1996. This is based entirely upon the results of an excavation at Sparsholt, near Winchester in Hampshire, England. The focus is upon the northern section of the building which includes a channelled hypocaust. The long-term objective is to test the functioning of such a hypocaust.

Earthworks

Since the early 1980s, a major research programme into experimental earthworks has been carried out involving the construction of simple V section ditches 20m long, 1.50m deep and 1.50m across with dump banks with built in variables of berms and no berms, turf retaining walls and turf cores based on an octagonal plan. The plan is dictated by different weather patterns experienced from the major points of the compass. The research design entails the study of erosion and revegetation through time against recorded climate. The programme at present has four major earthworks on upper, middle and lower chalk and aeolian drift. The proto-experimental earthwork built at the Hillhampton Down site in 1976 and excavated in 1981 showed startling rapidity of vegetable colonisation and stabilisation as well as a totally unexpected skew of the deposition layers.

In addition to these core research programmes, subsidiary programmes have researched into metallurgy and kiln technology. Further programmes are run in conjunction with other institutions both here and abroad. Several of these have involved the testing of prospection devices and their research applications with special reference to magnetic susceptibility.

Experiment, however, by its very nature focuses upon ancient technology and it is this which provides such a rich source for education. While it is unlikely to be able to carry out meaningful experiments within the school context, if for no other reason than the lack of time and resources, it is perfectly sensible and deeply rewarding to exploit ancient technology. It is in ancient technology that fundamental principles were worked out and employed to a remarkable degree of sophistication and achievement, to have direct relevance from their original application to the present day. The learning opportunities and experiences are virtually without limit. In addition, there is the inestimable attraction, not to say value, of cross-curricula studies.

The primary issue, that the Butser Ancient Farm is an open-air laboratory devoted particularly to researching the agricultural and domestic economy of the late Iron Age and Roman periods, does not in any way deny its role as a unique open-air classroom. Here, all the curricular subjects are covered from the sciences through mathematics to the humanities. Further, given the need to record information or data, computer technology is significantly involved.

The study of the Ancient World is normally dealt with in the early stages of school education, depending upon the national criteria laid down by each country. As a general rule, it is dealt with before the student reaches the secondary stage of the educational syllabus. Usually the prehistory of each native country is cursorily dealt with in order to impart a sense of heritage, to explain national beginnings. Thereafter, especially in Europe, the early civilisations, usually Egypt, Greece and Rome are studied thus providing a foundation for modern history to be covered at the secondary stage of education. This study of the history of mankind, partial as it might be, can be both sterile and instantly forgettable. Drawing pictures of pharaoh in his chariot against a background of pyramids hardly does justice to ancient Egypt, nor does the rote learning of 'I came, I saw, I conquered' (*veni, vidi, vici*) give any insight into Roman culture. Similarly, the certain knowledge that the Greeks (Athenians) invented democracy, however it might have been unlike any latter democracy, barely acknowledges the actual grandeur that was Greece.

It is in this broad context that the Ancient Farm has pioneered a different approach to education. Given that its early remit was a programme for research and education, the original concept of 'education' was the teaching of the methodology and the finding, not to school children but to students in the tertiary levels of education - students at colleges and universities. However, as the work progressed in the early years, the creation of fields and fences, livestock and plantstock and, especially, the building of constructs of Iron Age roundhouses, so the site became known through television, radio and the media generally. While university undergraduates remained the initial focus, there arose a growing demand from schoolteachers to know more about the programme and, in particular, to visit the site with their pupils. This was accommodated as far as possible but quickly demand escalated beyond our ability to respond. With the construction of a second open-air laboratory in a different bio-climatic zone, it was decided to include in the overall design a special schools programme and to appoint an educational assistant to administer it. The programme necessarily depended upon the facilities provided by the research experiments in train and those completed. But of more importance was the philosophy of the education itself.

At the outset, it was decided that written pre-prepared questionnaires were to be avoided completely. There is no worse a sight than a crocodile of children each clutching a clipboard and pencil, being traipsed around a site and paying no more attention than the desire to complete a list of questions by ticking the appropriate boxes or scribbling nonsensical sentences. The overall objective was to make children look and see what they are looking at – there is a gulf of difference between the two activities – but most importantly to think about what they see. In a positive way, this is the first stage of scientific inquiry – to observe and then to guess. If the children were to maximize their experience, the other senses, touching, feeling, smelling and hearing, had to be involved. For this to happen, the children had to be engaged in doing things. In other words, there had to be 'hands-on' activities involving the children creating objects from natural materials. Similarly, they should be involved, at least in witnessing, the magic (science) of material change.

The critical approach was that of question and answer – the dialectic method. The audience of an inquisitor whose questions are randomly directed will always concentrate more, and indeed remember more, than that which receives a statement, however it may be delivered. With younger children, this is even more pointed, driven as they are by peer pressure. Thus the philosophy of the educational programme was determined. The dialectic approach allied with hands-on experience.

In the beginning, it was realised that such a programme was not to be completed within an hour or even two. To execute the programme, a whole school day of about four and a half hours had to be set aside for each group. In addition, given the normal attention span of this age group, no inquisition, no activity and no demonstration should exceed thirty minutes from start to finish. Lastly, all the elements of the programme should combine together as a cohesive, comprehensible and memorable whole.

At this time, the primary focus of the research was the prehistoric Iron Age. Site facilities included all the elements of a prehistoric farm with the attendant implements and tools. The centrepiece was a construct of a large double ring roundhouse set within its own enclosure surrounded by a ditch and bank surmounted by a wattle fence. In addition, there was an area specifically devoted to experimental smelting of metals, smithing and charcoal production. As a teaching resource, it was unparalleled.

The programme itself was carefully designed to be completely flexible and capable of dealing with a minimum of fifteen students to a maximum of one hundred. This range, in fact, accommodates a single class of special needs pupils to a full single age school year group. Because the evidence from the Iron Age focuses upon the use of natural materials, the programme's requirements of hands-on activities were relatively easily fulfilled with a minimum of instructional teaching.

The pattern of a typical school visit invariably followed a set plan. The introductory session, a dialectic, was held inside the great roundhouse. For the atmosphere to be as real as possible there was always a fire in the hearth, the focal point of the home. Thus the children are thrust into an entirely alien space, their senses assailed by strange sights, sounds and smells. Such a place concentrates their minds and sharpens their perceptions far more successfully than any regular classroom with its formal chairs and tables. More than any other aspect of the day, this moment, the entrance into the great roundhouse, makes the programme work. From just another outing into the familiar, this space virtually demands, even commands, the children to ask questions. The dialectic, prefaced by a brief introduction of where and when, inevitably succeeds. The underlying objective is always to make the children deduce from what they can actually see.

Thereafter, the children were divided into small groups of ten to fifteen, and sent to one of five activity zones. These activities are discussed below but the intention throughout was for the children to 'do', to become involved in using materials, to touch, to feel and, inevitably, given the nature of the materials, to become dirty. Each group rotated around the activity zones through the day. The final session brought all the groups together again to witness molten bronze being poured into an open stone mould. For health and safety reasons, they could not participate in such a dangerous activity, but they could see how a liquid turned into a solid and once the object, a sickle or dagger, had cooled, they were able to handle it. This concluded the day significantly without any final discussion session. The purpose here was for the schoolteacher to be able, subsequently, to progress the matter of the day into the classroom.

This format, with some minor modifications, still obtains today.

TECHNOLOGY AND NATURAL MATERIALS

Effectively, the activities provided for the children are directly allied to the site itself. The significance of the prehistoric period in particular is the way in which natural materials were exploited. The educational purpose is to change the way in which children view the natural resources of the landscape around them. A tree is no longer a tree but a huge resource – the stem or trunk is a potential building post, branches can be plough beams and shares, waste wood is firewood, twigs are kindling, leaves, once dried, can be animal fodder. A hazel shrub or willow tree can become a fence, a wall or basket. Bramble can become a lashing agent. A field of wheat doesn't just supply grain to be ground into flour and baked into bread, it also supplies straw for thatching rooves, bedding and food for livestock. Clay can be made into pots and dishes and even into toys, mixed with earth and cow dung it becomes walling material. Animals don't just provide meat: for example, a sheep can be milked and, from the milk, cheese can be made, its fleece provides wool to be spun into yarn and woven into cloth, the bones and horns can be made into tools and handles for tools, the sinews can be made into thongs and the skin can be cured and made into clothes and shoes. The fundamental message is 'nothing is as it seems'. Clearly the potential hands-on activities are considerable. However, the constraint is always a combination of time and complexity.

Given that the intention is to involve not only the mind but also the senses of the children, the activities are carefully selected to span as diverse a range of materials as possible. In addition, the activities ideally involve the element of completion. It has proved possible on occasion to offer the teachers a choice of activities to fit into their classroom strategies but generally the activities are fixed.

The first activity involves building a length of wattle fencing. The children weave hazel rods into a line of fence posts unconsciously learning about opposing tensions and the flexibility of some materials, the inflexibility of others. Completion here means the construction of a fence they can't physically jump over. The next activity involves the manufacture of daub in a pit. The mixture of water, clay, earth, cow dung, straw and grass always engenders reactions of joy and horror - but jumping about in a pit is a primaeval pleasure. Plastering a section of a wall of a roundhouse provides the completion. From daub to making pots, but using natural rather than processed clay. The children first wedge the clay and then make thumb and coil pots. These they take away with them. From pots to wool with instruction given in using the drop spindle to make yarn and then the practice of weaving on an upright warp weighted loom. The last activity is to grind grain on a quernstone, make a flour dough and bake bread which, of course, they can eat.

The approach is, essentially, simple, the activities, in a way, obvious, the participation fundamental, but the implications of conscious and unconscious learning are unquantifiable. Because the system has run for so many years, adults, who as children experienced the Ancient Farm, return and speak of the significance of their visit and of the impact it had upon their subsequent education. The principal observation that they make is that it made them look beyond the obvious. On such occasions, this educational programme is entirely vindicated.

TECHNOLOGY AND NUMERACY

Setting aside the actual involvement of children with natural materials, the educational potential of the Ancient Farm embraces both technology and numeracy, those two most feared subjects in any curriculum. It is generally true to say that the apprehension is primarily within the educator but it is quickly and often irrevocably transferred to the pupils in their care. Discussions with teachers exploring this fear regularly reveal spectres of computers and calculators, mathematical formulae and incomprehensible laws of physics. There is little doubt that these fears of the present day educators were inculcated by their educators before them. Words are psychologically more friendly, if infinitely less precise, than numbers and, by definition, it is easier not be wrong with words than numbers. Additionally, the pace of technological development, especially computer technology, over the last thirty years and the acceleration over the last five years, engenders an awesome, if not aweful, reaction. It is virtually impossible to teach and maintain any kind of parity with the developments. In consequence, it is feared and avoided despite government demands that it be taught.

There is, however, a compounding of this fear perceived by the educator which, in fact, should be viewed as an amelioration. The major change in the children's world of today is the manipulable electronic gadgetry which is happily accepted by them as normal. Pressing buttons on hand-held computer games naturally graduates to increasingly complex machines without any real educator input at all. Rather it is driven by peer pressure and competitiveness. Their acceptance of ever-changing nature of electronic wizardry is a remarkable phenomenon of the late twentieth century and is a natural result of growing up in this particular time period. The educator's difficulty lies entirely in having to adapt from a non-electronically motivated childhood to an adulthood where electronics are the norm. Notwithstanding this reality of electronics, one needs to question whether this is the sum of technology or simply one singular aspect. The dictionary redresses the balance dramatically. "Technology – the application of practical sciences to industry or commerce" "the total knowledge and skills available to any human society for industry, art, science, etc." "Texum (Greek) means skill, art." (Collins English Dictionary 3rd Edition 1994). This definition immediately opens up a world of practices and skills which are eminently teachable throughout a child's education from the earliest to the latest stages and are fundamental for a successful perception of the world both past and present.

The basic skills of technology developed in the remote past are as true today as they were when they were first developed. By the same token, they are as much in use today as they ever were. However, given the specialisation which is the hallmark of complex societies, many basic skills are deliberately shrouded in mystery lest their simplicity become common knowledge and, therefore, common practice. Craftsmen, as a general rule, conceal and protect their skills by working in private and developing their own vocabulary. This facet of technology is exemplified by the rough stone mason whose job it is to build dry stone walls. There are but three basic rules to be learned for building a dry stone wall. 1). One stone must never be placed upon one stone, always on two or more stones. 2). Every third stone in a wall face should be a through stone locking back into the wall. 3). The mason never picks up the same stone twice, there is always a place where it will fit into the wall within reach. This example is deliberately chosen because dry stone walling was developed and used in the depths of prehistory as it is to this very day. The product is the same, the rules are the same and, with the rules along with practice, anyone can build a dry stone wall. However, it required an apprenticeship of some five years to become a qualified rough stone mason This rather begs the question of what technological skills one should teach since remarkably few modern schoolchildren will ever be faced with the need to construct a dry stone wall. Not that this alone is a reason for not understanding the principles and methods.

Considerable attention has been focused upon this problem of what technology to teach at the Ancient Farm, especially bearing in mind that everything has to be accomplished within a single day comprising a maximum of four and a half hours of actual contact time. The philosophy of the Ancient Farm is that the driving force is the research itself and that the educational programme uniquely springs from the research. Therefore, it was decided that 'gobbets of technology' would be taught, ideally within a thirty minute time unit. The technology itself would have to stem from the technology practised within the research systems on the Ancient Farm. Since our remit encompasses the late Iron Age and Roman periods, albeit localised to north-western Europe, this would furnish the technological source material. As a direct counter-balance, the Ancient Farm also utilises a great deal of modern technology ranging from meteorological equipment through data loggers to computers and information systems. The whole presents a paradox in that one seeks to analyse and quantify, in a completely modern manner, the products from ancient technology. Ironically, it is the adult generation which feels least comfortable with this approach, the younger generation somehow expect it and would genuinely be appalled were it not so.

The current research programmes at the Ancient Farm are listed above. The educational programmes feed off these. Thus the 'technological gobbets' are inspired. For example, for the past three years, a major ongoing research programme is devoted to the construction of a section of a Roman building based upon the excavations of Sparsholt Roman villa. The building itself is probably some kind of estate office. It is a rectangular structure, some 30m x 8m, having a corridor running the full length of the building with a central reception room graced with a fine mosaic and a suite of rooms either side of it. Concentration has been made upon the northern section which has a room furnished with a channelled hypocaust. At the present time, the hypocaust has been completed and the walls, made of flint and mortar, stand to a height of c. 1m. The intention is to complete this section, including the roof of stone tiles, and, thereafter, to carry out experiments with the channelled hypocaust. The research programme drives the educational practice. Using the structure as the inspiration, and dialectic, question and answer, as the method, various 'technological gobbets' are taught.

The obvious, and oddly enough the most complex, is the praefurnian arch over the stokehole. The 'how?' of arch construction is demonstrable in the building itself where regular tiles are separated by segments of mortar, the whole having been built over a former. Using a former and wooden blocks carefully shaped to mimic the masoned stones of the standard Roman arch, including the critical keystone, the children physically build an arch and then remove the former. The test of its strength is the queue of youngsters walking over it. The final question is always 'how do you make the arch stronger?' – the answer, sought and achieved by standing as many children as possible upon it, is quite simply 'to increase the weight it sustains'. The knowledge transfer from this particular gobbet is crucially important because the student for the rest of his life will understand the nature and the use of an arch in architecture through time and place.

From the arch to its component elements, large blocks of stone emerges the next technological gobbet – how are large blocks of stone physically moved? Hence the use of a fulcrum and lever. Much amusement has been derived from presenting a group of computer literate children with a block of stone they cannot move, a pole and a large log. The solution, once given if not deduced, is akin to a revelation. Various glosses are added by increasing pole lengths and fulcra. The typical conclusion of this particular gobbet is the introduction of Archimedes and his claim to be able to move the world with an appropriate fulcrum and an adequate length of pole. Inevitably, within a process dominated by dialectic, lifting heavy weights ensues with the introduction of the tripod and double pulley. The mathematics hold no place here, only the technology or skill of doing.

Still using the Roman building as the inspiring force, the next technological gobbet comprises surveying skills. This is frequently introduced by playing a numbers game. The children stand in line and 'number off' from the left and the right and from lowest to highest and highest to lowest. Then they are asked to do it all again but using Roman numerals. Although an enjoyable game, it is critical for the gobbet itself. The building is rectangular but how do you construct a corner at a right angle quickly and accurately? The groma, constructs of which are crucial teaching aids, is the tool. Along with half a dozen poles per group of five students, it is possible to understand and practice laying out perfect right angles. With tape measures, initially metric but thereafter graduated in *passus, pedes* and *unicae*, it is also possible to lay out the building plan of, say, a Roman temple. Again, there is the added advantage of discovering how to build a wall vertically by transferring the plumb lines of the groma to the standard builders plumb board.

This last exercise introduces numeracy in a relatively painless way. Indeed, the numbers game - while accuracy has to be encouraged, it's no good intending a rectangular structure to be built on a rhomboidal plan - can be further re-inforced by introducing the students to wax writing tablets and the stylus. Measuring is of little value without recording and, of course, records can be checked. In this operation, there is no inter-group competition, solely the competition with the design in order to get it right.

The final element of this introduction to technology is the problem of levels. The Ancient Farm land area is entirely set upon a shallow slope, a fact which is readily appreciated when attempting to build prehistoric or Roman structures. For a roof to sit comfortably and securely upon its foundation, walls or timber substructures must be level. The question posed is how can this be achieved without resorting to modern technology? It is remarkable how, with little or no prompting, the answer of water is quickly reached. Again, one agrees the principle but questions the method. Various aids can be provided ranging from a bowl or a box to a pipe filled with water. However, the real *deus ex machina* is the water level or *aqua libra.* The Ancient Farm possesses a construct of an *aqua libra* based upon literary descriptions and various artefacts recovered from excavations. It comprises a vertical column, its verticality ensured by using a plumb line, surmounted by an horizontal arm, six Roman feet long, centrally pivoted on the column. This is fitted with a glass tube along its length. At each end of the glass tube there is an upturned section. When the column is vertical, the arm is basically, but not accurately, horizontal. However, when the tube is filled with water so that the water surface is just below the ends of the glass tube, looking across the surfaces of the water an horizontal field of view is achieved. To complete the equipment, a measuring pole is needed. This is graduated in Roman measurements and fitted with an adjustable target disc. By sighting across the water surfaces to the target disc, it is possible to record the ground undulations over a planned area. While initially complex, because the students are actually using the equipment, both the principle and the practice are soon grasped. The best moment in this technological nugget is when the student realises that 'the measurements are the wrong way round' – that is when the measuring staff goes uphill, the measurements are less, when downhill, they are greater.

As a purely gratuitous aside, the *aqua libra* is an extremely accurate device. Also, it is possible to buy modern water levels which comprise a length of rubber pipe into each end of which is inserted a graduated glass tube. Technological persistence is a subject well worth investigation.

The above educational activities are only a selection of those practised at the Ancient Farm. Others include the use of balances, weighing with a steelyard, weights and measures, the chemistry of quicklime mortar, natural building materials – the list goes on. Common to all these activities is student participation and learning by doing. The acquisition of knowledge of gobbets of technology within such short time slots is extremely effective and all the more memorable because it is not inside the formal classroom situation but outdoors where the technology is directly relevant. The added bonus of applied and, therefore, sensible numeracy only enhances the exercise.

As a final observation, the whole of the above and more have been tested across the age range from seven to seventy with great success.

ARCHAEOLOGY

One extremely successful extension of the schools programme has been the introduction of archaeology itself. Inside virtually every archaeologist there is a treasure hunter seeking to escape. The discovery of an artefact which no-one has seen or touched for centuries has an excitement, a magic of its own. The intention of the archaeology programme is to arouse this excitement on the one hand, on the other to impart the simple disciplines of a careful excavation and accurate recording. Inevitably, because of time restrictions and the requirement of physical participation, it is the briefest of introductions.

It is achieved by creating an excavation area. This is a straightforward shallow pit, some 5m x 2m x 0.3m, filled with soft earth. Real artefacts (unprovenanced), pot sherds, coins, bones and miscellaneous objects of many periods are secreted beneath the surface. The area is divided into metre squares, strung out with elastic (children are both excitable and clumsy) rather than string. Two children are allotted to each square – one is the excavator who is issued with trowel, brush, hand shovel and bucket, the other is the recorder who is equipped with a recording sheet on a clipboard, a pencil, a tape measure, finds bags and a finds tray. Both are briefly instructed on what to do. Then the excavator carefully excavates the earth surface to a depth of 50mm until something is found. The object is measured in three dimensions by the recorder, both children attempt to identify it and then it is given a number and description on the record form along with its co-ordinates and finally put into its own find bag with its number and consigned to the finds tray. At half time, the children swap roles. Within half an hour, at the very least the children get an idea of both discovery and discipline - and once again numeracy has sneaked into the system!

In fact, the pit was specifically designed for a half-day school because at its base there is a maze of post-holes and stake-holes waiting to be found and planned. To date, only one school has elected to excavate for the full half-day which was completely successful.

SECONDARY EDUCATION

The pattern of dialectic and participation can be perfectly well sustained for older students with the added advantage of increasing the time allotted to each element and thus bringing in more detail. However, because of the range of the research programme at the Ancient Farm and the underlying methodology, more schools are electing to pursue a single topic as a field day experience to be followed up with further work in the classroom. In a positive sense, the field day is used as a data-gathering programme allying observation and quantification for future qualification and analysis. Such a day requires quite specific preparation since the matter is eclectic. Interesting examples of this field day approach over the past three years include groups of pre-university mathematicians, geographers, botanists, meteorologists, archaeologists and even artists. It is noteworthy that historians do not feature at all in this list to date. The field day is a preferred educational exercise simply because of the greater depth of study involved. However, it is often impossible to fit such an exercise into an already overcrowded curriculum. In consequence, most secondary schools opt for a student lecture tour of the site with or without special emphasis.

TERTIARY EDUCATION

With regard to this level of education, the Ancient Farm is both pro-active and re-active. In the former case, practical and theoretical day schools as well as five-day residential courses are offered. Subject content ranges from the philosophy and methodology of experiment in archaeology to specific topics like prehistoric metallurgy, pottery and kilns, flint knapping, pollen analysis, prehistoric and classical agriculture, experimental earthworks, domestic architecture, etc. In the latter case, the Ancient Farm is regularly approached to provide specific courses which are closed to a single group. Often these are for archaeological specialisms like prehistoric cereals and plant communities, practice with prospection tools like the resistivity meter, fluxgate gradiometer and magnetic susceptibility meter, animal bones, metallurgy, etc. Equally frequent visiting groups are trainee teachers, usually for primary schools, who require an introduction both to the resources and the teaching methods of the Ancient Farm.

Included in this section are historical and archaeological societies which normally comprise interested but not necessarily academically motivated individuals. Usually these groups require a site lecture tour and little more. Occasionally these visits can be thematic, when a group could be studying the impact of man on the landscape for example, or only be interested in the agricultural research or in the Roman building. Here the Ancient Farm can only be re-active and respond to specific demands.

Within tertiary education must be included undergraduate and postgraduate students who use the facilities at the Ancient Farm in order to complete theses and dissertations. Sometimes these can actually be based upon the core research programmes but generally the student is afforded space and resources within the confines of the farm.

While not necessarily an educational activity in the strictest sense, the Ancient Farm also offers other institutions the facility either to conduct their own research programmes or, alternatively, to feed off long term core research programmes already in place by asking ancillary questions of these programmes. This is especially true when these supplementary questions involve both skills and equipment outside the competency of the Ancient Farm. One typical example has been the long-term sampling and analysis of soil samples from specific structures and processes.

CONCLUSION

This paper has sought to present the educational world of Butser Ancient Farm. The primary focus has been upon educational services offered to schoolchildren where an educational methodology of dialectic and participation has been pioneered over the last twenty-five years. There is, of course, a hidden agenda, an underlying purpose, to this methodology. The Ancient Farm with all its 1:1 scale research programmes, ditches and banks, fields and fences, livestock and plantstock, houses large and small, various structures, processes and functions in train through time, is a unique operation and, therefore, a unique classroom. Because the Ancient Farm is a three-dimensional reality, it is perceivable through all the senses. The perception that any one person of whatever age might achieve will be necessarily an individual one depending upon the previous knowledge and experience of that person. A schoolchild's perception will obviously be entirely different to that of a professional archaeologist, prehistorian or agriculturalist. In the former case, the perception will be innocently multi-layered and range from the conscious to the unconscious, the unconscious being there to be triggered at a later date. In the latter, prejudice will inevitably affect perception, positively or negatively. But for all who come into contact with the educational programmes of Butser Ancient Farm, the hidden agenda is to make people think, not to agree or disagree but simply to think. Abject failure is for a student to be untouched.

SELECT BIBLIOGRAPHY

Reynolds, P.J., 1967. Experiment in Iron Age Agriculture. *Trans. Bristol Glos. Arch. Soc.*, 86, 60-73.

Reynolds, P.J., 1969. Experiment in Iron Age Agriculture, Part II. *Trans. Bristol Glos. Arch. Soc.*, 88, 29-33.

Reynolds, P.J., 1974. Experimental Iron Age Storage Pits. *Proc. Prehist. Soc.*, 40, 118-31.

Reynolds, P.J., 1978. *The Experimental Storage of Grain in Underground Silos.* Ph.D. Thesis Leicester University.

Reynolds, P.J., 1981 In *"Farming Practice in British Prehistory"* ed. Roger Mercer, Edinburgh University Press,1981.

Reynolds, P.J., 1988. *Arqueologia Experimental: Una perspectiva de futur,* Eumo Editorial, Vic.

Reynolds, P.J., 1992. *Crop yields of the prehistoric cereal types Emmer and Spelt: the worst option. Prehistoire de l'Agriculture: Nouvelles Approches Experimentales et Ethnographiques,* Monographie du CRA no. 6. CNRS.

Reynolds, P.J., in Green, M.J., (Ed) 1995 *The Celtic World.* Routledge, London, Rural Life and Farming, p. 176-209

Reynolds, P.J., 1997. Mediaeval Cereal Yields: an Empirical Challenge. *Acta Mediaevalia,* 18, 495-507. Barcelona.

Reynolds, P.J., 1998. *The Mediaeval Fence.* Experimentacio Arqueologia Sobre Conreus Medievals a L'Esquerda 1991-1994. Universitat de Barcelona.

Reynolds, P.J., In Press. *Butser Ancient Farm: History and Development,* World Archaeological Congress, Delhi, India, 1995.

Reynolds, P.J., & Langley, J.K., 1979. Romano-British Corn Drying Oven: An Experiment. *Arch. J.* 136, 27-43