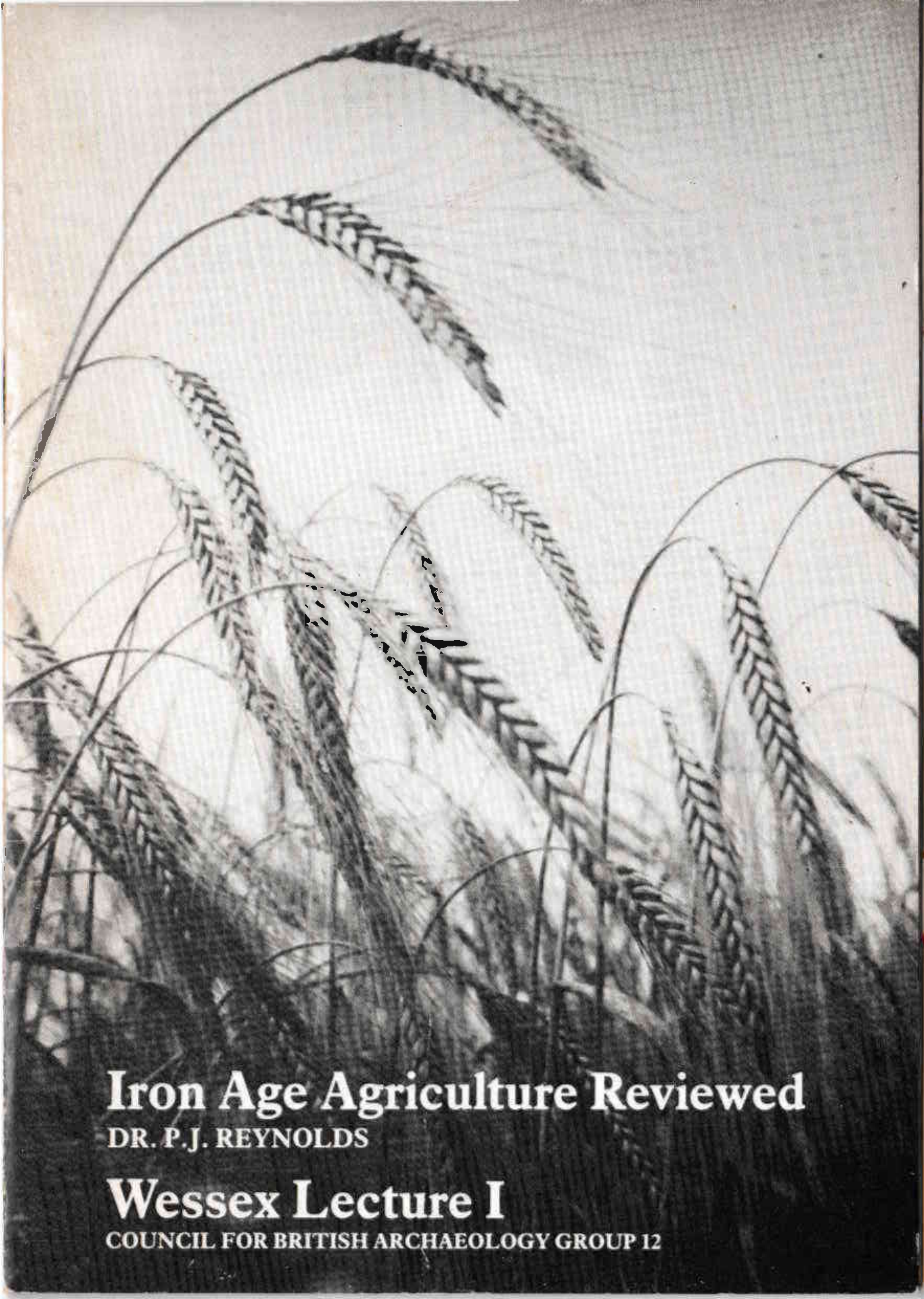
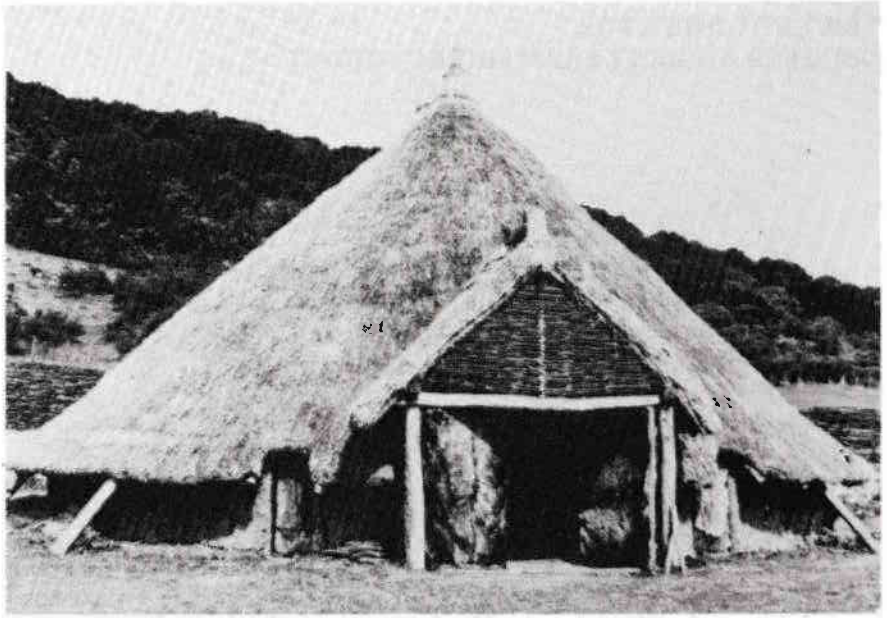



# Iron Age Agriculture Reviewed

**P.J. REYNOLDS** MA PhD FSA
**PROJECT DIRECTOR,**
**BUTSER ANCIENT FARM PROJECT TRUST**

## Wessex Lecture I

**COUNCIL FOR BRITISH ARCHAEOLOGY GROUP 12**



*The Pimperne House.*

## THE WESSEX LECTURE 1983

## IRON AGE AGRICULTURE REVIEWED

To be invited to present the inaugural lecture of a proposed series of lectures is on the one hand a privilege, on the other a daunting responsibility. The burden lies simply in the possibility that the performance and its reception could conclude rather commence the concept. This latter is enhanced in that the topic I have chosen has been the special province of Wessex studies, having received considerable attention from a great number of eminent scholars. Not that I propose to conflict with any of my predecessors since the title is ameliorated by some simple explanation. The term review is used entirely in the sense of 'looking at again' or even 'looking from a slightly different angle'. It is far from my intention to reexamine the archaeological data as they pertain to Iron Age Agriculture. This has been already achieved, notably by H.C. Bowen and P.J. Fowler whose work is of the highest calibre and the greatest use. My objective is rather to consider these data is such a way that functional and validated hypotheses might be made which allow us an insight into how agriculture may have been practised in the first millennium B.C. Naturally within the context of such a lecture many of the issues raised will not be fully substantiated in the test by close-knit argument with regimented proofs on parade. These are, of course, available and if not already in print will shortly be so. Rather the matter is a polemic, one designed to engender thought about practicalities rather than theories about improbabilities. Always it is the intention to allow the data to inspire the hypothesis rather than to claim that the interpretation at least does not conflict with the data.

Perhaps it is wise to begin with this very attitude. In recent years it has become increasingly fashionable to adopt ethnographic examples to illustrate the remote past. We are encouraged to witness trees being felled with stone axes by New Guinea natives, incidentally being filmed, photographed and often rewarded for their labours. The perennial question continuously sidestepped by sociologists who deny this interaction with a subject has a bearing upon the subject's given response. Pottery-making in Turkey, weaving in Afghanistan, roundhouse construction in Africa, all are regularly cited as ways of illuminating and explaining processes and practices evidenced by archaeological data. That ethnography has a value and a role is undeniable. Indeed it is deeply rewarding to study actual processes and to compare the end-products with those excavated material remains, to observe correlations and subsequently to suggest hypotheses. Indeed cases are cited below which potentially enhance our understanding. My fear, however, is not for the tree-felling and home-building but rather for the further transfer of social organisation, hierarchies, kinship and similar forays into the theoretical. It is seemingly illogical to assume that because there exist shared hardware similarities between an ethnographic entity and an archaeological resource that the social organisations should also have common features. To imply one from the other has a spurious plausibility, a plausibility which is signally enhanced by incomprehensible terminology and liberally laced with Marxist theory. Perhaps this approach has value over and beyond the exchange of views and suppositious argument. It is nevertheless in advance of its time since the raw archaeological data is to date imperfectly understood even at the lowest functional levels. For example, evidence for circular structures recovered from Iron Age sites is regularly such that there is a clear element of doubt whether they are domestic structures or fulfil other functions, whether they are domestic roundhouses or open kraals. Indeed even if it is a palpable roundhouse in that the structural evidence present could sustain the weight thrust of a roof, it is still not necessarily a domestic structure in the sense of a family unit. Rather it could be stabling for cattle, horses or goats. Thus the lowest level of the data must assume the highest importance. It is of little value to hypothesise population estimates of settlements whatever theory is used to arrive at a figure, if the basic requirement of that theory, usually house floor areas or house frequency, cannot be indisputably defined.

Consequently, it is my purpose in this presentation to examine a range of data at the lowest level and to discuss the implications of those data specially in the light of empirical research programmes that have been carried out at the Butser Ancient Farm Research Project. At the outset it is necessary to emphasise that one is dealing with, at best, statements of probability which are based directly upon validated hypotheses. That such hypotheses have any relevance to the prehistoric realities is and will remain a matter of judgement. Always there is the requirement to seek more evidence ever more precisely, not so much in the eclective, that is the selection only of those data which are supportive of an hypothesis, but rather in the objective assessment of the totality of evidence. The principle of excavation with a specific and over-riding 'question' is fraught with difficulty in that 'the answer' is too often forthcoming. Rather excavation should be as objective as well as exhaustive as possible. The validated hypothesis itself



is similarly not quite as straightforward as it would seem since it is possible to raise and validate more than one hypothesis upon the same set of archaeological data. This condition is described as the multiplicity of validated hypotheses demanding further selection and therefore increased variability.

The methodology of experiment requires no detailed explanation in this context beyond emphasising that one is measuring a sequence of variables against known constants. Against this background it is of some value to examine the agricultural cycle as it may have existed in the Iron Age. The following observations are based upon not only the archaeological data but their implications as tested against the constants of climate and soil.

## The Arable Cycle

The essence of arable farming can be succinctly summarised under the following heads of fields, fences and faeces. Indeed in England there is an abundance of evidence for prehistoric or ancient fields and nowhere more so than in Wessex. Naturally enough they have received considerable attention over the last fifty years, although to date a field system, a small group of fields or even a field has yet to be excavated. Such examinations that have taken place have often been the result of accident in not initially isolating the settlement site accurately. Occasionally, lynchets have been deliberately excavated but hardly sufficient have been examined to provide any kind of standardised 'norm'. It is not without point to observe that the overriding purpose of excavation should be directed to establishing the normal or usual rather than the more emotional response to seeking the unique and unusual. While the latter undoubtedly achieves headlines or renown, the former are more likely to increase our understanding of process and function. In this regard we will have no weight of evidence which allows us to determine the normal kind of fence or hedge or even if such were actually employed. A patchwork of small rectangular arable fields, bounded by grass covered lynchet banks, may have been the 'norm' although it is most probable that some kind of fencing was used if only to limit the area of each field and to keep out from the growing crops sheep, goats and cattle. The use of manure is generally agreed to have taken place from the Bronze Age onward although even this is difficult to prove positively. Nevertheless the fields are there in the landscape and they argue a most extensive arable system of which the surviving evidence is likely to be an extremely minor proportion. In effect, because these field-systems have survived generally speaking as physical monuments, the areas in which they can be observed have not been subjected to intensive arable working since their abandonment. It would be singularly illogical, however, to assume that what survives represents the original extent. It is much more probable that prehistoric farming embraced primarily the valleys and river terraces and that the exploitation of hill slopes especially on the poor soils of the chalklands represents land-pressure bringing marginal land into production. Indeed a very similar process is in hand currently under the inspiration of the Common Agricultural Policy of the European Economic Community. Today, however, marginal land is drastically transformed with the liberal application of agrochemicals. It could be argued, using Caesar's description of the south-east of England on the one hand and our own knowledge of the soil-value on the other, that Wessex was an agricultural backwater and only exploited *in extremis*. There is a suspicion with many of the field systems that they were actually planned along specific axes rather than gradually growing from a central nucleus or complex. In this context it is important to stress that settlement is a function of farming while farming is not necessarily a function of settlement.

Rather than concentrating upon the broader agroscape of prehistory, it is my purpose to focus upon the field itself and to discuss the almost unlimited variables in such a focus. That agriculture formed the basic economy of the Iron Age is not in dispute but it is absolutely fascinating to attempt to unravel the possible systems and functions of arable farming. In the archaeological sense the most obvious functional traces surviving are the so-called 'ardmarks' now ubiquitously recorded throughout Britain. These scores or grooves carved into the subsoil are considered to have been made by prehistoric plough-types called 'ards'. The basic distinction between a plough and an ard is that the former has a shaped mould-board which turns over or inverts a slice of soil thus burying the plant material on the surface. The ard, of which there are broadly three types (q.v. below), simply stirs the soil. In precise terms the plough turns the soil vertically while the ard turns it horizontally. The surviving ardmarks however present a problem simply because they have survived. Were they the evidence of normal cultivation they would undoubtedly have been self-cancelling. Practical trials with replica ards have actually demonstrated this to be the case.

The problem is open to a solution even within the bounds of the archaeological evidence from rock carvings both from Scandinavia



and Northern Italy in the Val Camonica. The three types of ard referred to above are, in fact, well represented. First there is the rip ard, a stout wooden spike attached to a beam at an angle of about 50° and drawn by a pair of animals, usually cattle. One rock-carving depicts such an ard in operation with attendant labourers armed with mattock hoes. The labourers' task was apparently to break down the clods of matted topsoil ripped up by the ard. An ethnographic equivalent from Spain called *el cambelo* is employed in a seemingly similar fashion. This particular type of ard creates a deep score in the subsoil which correlates exactly with the archaeological evidence. Thus the surviving 'ard-marks' may well represent the initial creation of arable or alternatively the recreation of arable from fallow. The second type of ard is evidenced by actual timber remains recovered from peat bogs in Scandinavia and Scotland. 'Donnerupland and Dostrup type' is a complex instrument comprising a main beam curved like an old-fashioned hockey stick, the handle being attached to the yoke, the curved part being transfixed by three elements, the share which is a simple oak spike, the undershare which is heart shaped, and the handle which moves up and back to form the control. All three elements are held in place by two wedges. The main share actually holds the ard in the soil while the undershare lifts the soil and causes it to flow past the main beam. This ard is used for cultivation and in very lengthy and ongoing trials it is extremely efficient. The third type of plough, named after Hvorslev in Denmark where it was found is generally called a crook ard. It is simply made from the natural state of a curving bough forking away from the trunk of a tree. The bough forms the main beam and the trunk is fashioned into the horizontal sole and share. A handle is morticed into the rear of the implement. A rock-carving from Denmark shows this implement in action where it is clearly being used as a seed furrow ard. Thus the three types of ard provide a full panoply of ploughing implements. They are regularly grouped together and rather disparagingly described as 'scratch ploughs'. In fact, each type is extremely efficient and none more so than the Donneruplund type which creates a most satisfactory seed bed to a depth of 150mm, in practical terms the ideal seed bed for the crops available to the Iron Age farmer. Ironically, modern farming techniques are moving back to this type of shallow ploughing since it has been recognised that such a depth is perfectly adequate. Nor should these ard types be considered as being capable of dealing only with the light soils. Empirical trials have demonstrated their efficacy on heavy clay or loam and further ard-marks have been discovered on such heavy soils as well.

In practical terms all the above variables are subject to continuous trial. Fields are dedicated to specific variable treatments and processes. For example one field, autumn sown, is continuously cropped with wheat cereals Emmer and Spelt without any manuring whatsoever, another examines spring-sown cereals annually manured and non-manured, yet another, crop rotation of spring-sown Emmer and Celtic beans, another, triennial manuring of spring-sown wheat cereals. After a decade of research it is possible to indicate tentatively cropping results and to offer observations upon Iron Age farming technology.

Yet it must be understood that any cropping result can at best be regarded as statements of probability and that only if all the variables employed in the achievement of the result in question are accepted.

In this connection perhaps the most fascinating trial of all must be the field on the Little Butser spur dedicated to examining soil exhaustion. The average depth of topsoil, the typical puffy black friable redzina, is a mere 100mm directly onto middle chalk. From 1972 /3 to the present day exactly the same processes are carried out annually. The field is spade-turned, since the depth denies the possibility of actual digging, in late September/early October. The seed is planted in the second to third week of October at a rate of 56 kilos per hectare, approximately one third of the modern sowing rate. Effectively this means two seeds every 20mm. Sowing is carried out in shallow seed drills approximately 25 - 30mm deep and 300mm apart. The field, 900m$^2$ in extent is divided equally between Emmer (Tr. Dicoccum) and Spelt (T. Spelta). In May and early June the crop is carefully hoed especially between the rows. The objective is to examine the comparative yielding characteristics of these two cereals as winter-sown crops - exactly the same seed stock is sown as spring cereals - since there is a widely held theory that Spelt is a much hardier wheat than Emmer and is likely to have been specifically introduced as a winter-sown cereal. There are, incidentially very few indications of winter sowing and of them this is the most hypothetical. The second parallel objective is to discover for how long the viable yield can be achieved from this process with the criterion of viability being regarded as ratio return of less than 4:1.

Over the past decade, even in the dramatically dry years of 1976 and 1984, viability has been more than adequately achieved; indeed the average yield hovers about 1.5 tonnes per hectare with *maxima* and *minima* considerably above and below this figure. Generally speaking Emmer wheat performs better than Spelt wheat rather suggesting that the hypothesis concerning the latter is erroneous. Each year the field is



infested with a large number of arable weeds including some rare types which have not been deliberately introduced. Of these field pennycress (Thlaspi Arvense) is one of the rarest. Whence it came is unknown. The general range of arable weeds includes all those one would expect in a non-agrochemical regime. Charlock (Sinapis Arvesis) is perhaps the most pernicious since it specifically will choke the germination of spring sown cereals. Very few nitrogen fixing arable weeds like the Vetches (Vicia Sp.) have been recorded in this field. Indeed in the height of the season the field is a positive riot of colours echoing the impressionist painters' representations of cornfields at the turn of the last century. The paintings of Van Gogh are particularly applicable. The reds of poppies, blues and purples of thistles and speedwells, yellows of charlock, sow thistles and corn violets, the list is virtually endless.

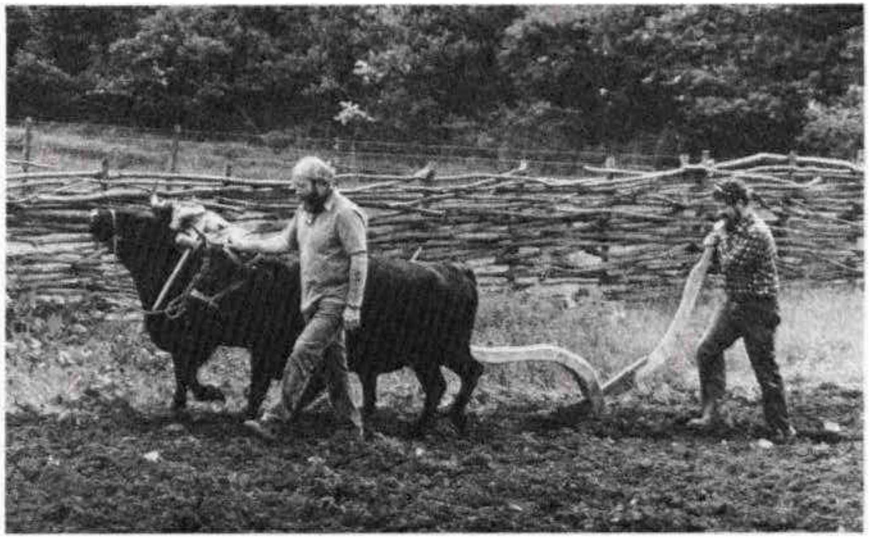
Notwithstanding this romantic picture, the expected steady decline of yield has failed to materialise and therefore some explanation must be offered. The principal answer seems to lie in the method of husbandry. Initially the fields were simply inverted grassland which had been heavily grazed and never subjected to modern agricultural improvement. The percentage of organic material in this soil, therefore, was some 23%. After five years of cropping the organic levels were measured again and averaged some 18 - 19%. Further analysis is scheduled for 1985 but estimations currently suggest this latter level of organic material has been maintained. Given this consistency of organic material there is a steady decomposition continuously in progress in the body of the soil releasing nitrogen, of which a proportion becomes available for the planted cereals annually. In fact, the calculations of the release of nitrogen suggest that there is a steady accumulation of nitrogen annually so,rather than a depletion of nitrogen taking place and therefore a deterioration of resource material from the growing plants, there is an augmentation in train. The variability of crop yield one year to another, since there is not a steady increase in yield as the above argument would suggest, is due to the climatic conditions of each season and specifically related to the rainfall. Water is a key factor in the chemical release and availability of nitrogen. Drought conditions, especially in the period immediately after sowing, (for winter crops in late October and November, for spring crops in April and May) is likely to damage severely the potential yield.
In addition there are free living organisms in this soil like bluegreen algae which actually fix nitrogen although their effect is likely to be but marginal.

The implications of this particular research design are quite remarkable. It would seem that this simple system of crop husbandry has built into it all the requirements for success, given adequate rainfall at critical periods in the growing cycle. Even the hoeing of the weeds between the seed furrows enhances the process since the chopped plants not only contribute to the organic reserves of the soil, their covering of the ground between the rows actually helps to retain moisture in the soil by shielding the effects of evaporation. In the broad context, climatic deterioration which takes place from the drier and warmer Bronze Age to the wetter and cooler Iron Age favours the latter and perhaps explains the agricultural superiority of the later period. Gramineae and its sub-species, the Triticinae, flourish far better in wetter and cooler climes. The improvement can even be seen not so much as the results of technological innovation, of which there is no indication at all from the Bronze Age to the Roman period, but rather as the fortituous circumstance of a husbandry technique enhanced by more favourable climatic conditions.

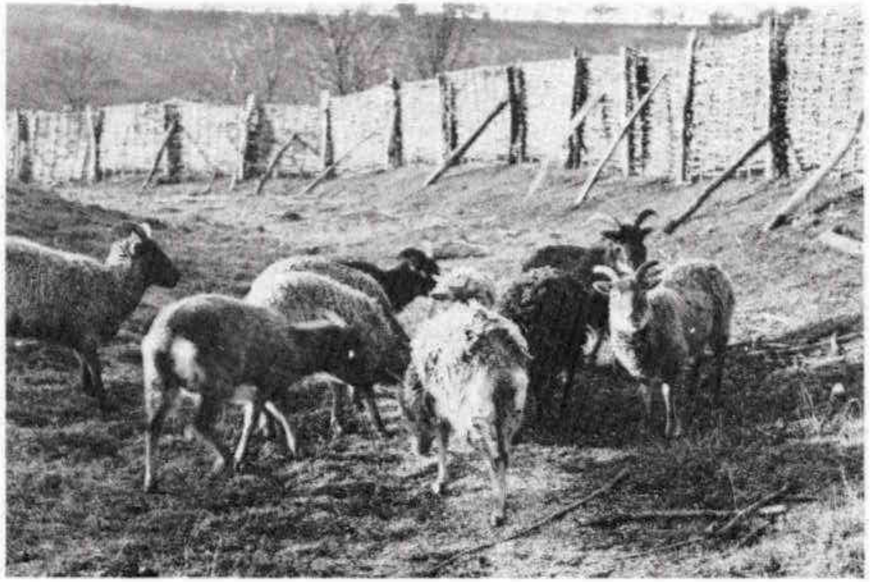
Manuring, the application of farmyard midden material to the fields, similarly does not significantly alter the above situation except that it introduces still more organic material into the topsoil. In turn experimental results show that increased yields are achieved from areas where manure has been applied. Ironically, because the research has been conducted on the base material of middle chalk rather than on the upper chalk,the effect of rainwater has been enhanced. While in ordinary conditions the topsoil is fed moisture by capilliary action from the reservoir held in the chalk rock, because the middle chalk is much harder it is less responsive to water movement by capilliary action and the passage of water soilwards. In effect dryness is much more readily experienced on this type of rock than the more typical upper chalk.

One area which still has to be explored in detail is the inter-relationship of arable weeds and cereals and potentially the inter-cropping of plants which have symbiotic mutual advantages. Mentioned briefly above some arable weeds like the vetches (Viciae Sp.) actually fix nitrogen in the soil via a nodule in their root system. There are potentially other contributions yet to be isolated as, for example, phosphate and potassium trace elements being returned to soil structure. Inevitably some proportion of these is returned in the natural organic breakdown of the hoed-out arable weeds. In all the research programmes to date each field area is monocropped in the sense that only one type of plant is grown in one area. It may well be that a prehistoric field was used for the production of mutually beneficial crops. Nitrogen-users like wheats could have been successfully intercropped with nitrogen-fixers like beans (eg Vicia Faba Minor). In one field the rotation of these two crops as monocrops and the cereal results are regularly better than in non-rotation conditions.





*Ploughing with an Ard.*



*Soay Sheep*

The basic problem which emerges from these programmes of empirical trials is not so much the successful nature of farming in the Iron Age, which is clearly indicated, but rather the increasing number of variables which are raised as each probability is explored. Further, each probability rather indicates an even higher level of achievement.

Arable weeds have a potential in that they may even indicate agricultural practice. Repeating the *caveat* that our carbonised seed evidence has been subjected to secondary if not tertiary phase processing since it is recovered not from the field system but in the settlement areas, the arable weed seed component has to be explained in terms of its presence within an assemblage. If one accepts the documentary evidence that the Celtic practice of harvesting involved the collection specifically of the ears, a number of complex options become open, especially with reference to the carbonised seed evidence.

Both Emmer and Spelt wheats are stable plants and thus differ quite radically from modern hybrid cereals. The spikes or heads fruit at a range of different heights from the ground whilst one of the objectives of modern plant breeding has been to standardise the fruiting height of today's hybrids in order to facilitate combine harvesting. In the field the prehistoric cereals may have perfectly formed ripe spikes as low as 300mm and as high as 1.80m, with an average of c 1.10m. The arable weed infestation regularly averages 600mm in height thus hiding from the reaper a number of ripe spikes. This condition leads to two results. The actual harvest, the collection of ears from a crop, tends to be pure with one or two contaminant arable weeds. The secondary harvest of straw, on the other hand, is full of arable weeds except those which hug the ground like speedwell, scarlet pimpernel and corn violet. It also contains those ripe spikes which were missed during the reaping. The numbers are relatively very few and it is most unlikely that straw sheaves could have been specially processed to recover these 'escapers'. There are now problems of interpretation. The carbonised seed recovered from whatever excavation system, sieving, flotation, soil analysis, needs to be considered in the light of function. Does the carbonised seed represent the pure harvest? Empirically two specific contaminants have been recorded, black bind-weed (Polygonum Convulvulus) and Fat Hen (Chenopodium Album). The former are virtually inescapable since they twine themselves around the host plant and fruit virtually the same time as the cereal; the latter are avoidable during reaping but in practice a proportion finds its way into the harvest. An alternative reason for the presence of Fat Hen is the probability that it may have been a crop in its own right. Alternatively, does the carbonised seed represent some processing of the straw harvest?



The nature of each assemblage needs to be evaluated in its own right. Further, to put quantities of seed into context; from a hectare yielding two tonnes of harvest there are approximately eighty million seeds. A few hundred carbonised seeds can be obtained from tens of spikes. A crude average for Emmer wheat is twenty-six seeds per spike.

From the arable weed flora it may be possible to isolate agricultural practice in another way. One particular, common cleavers (Galium Aparine) has a specific germination characteristic which correlates with the agricultural year. It also has a hard round seed which carbonises easily. Normally germination has two peaks, a minor peak in October, a major peak in late March and April. Assuming a field is winter-sown, traditionally this is done in October. The cultivation of the ground therefore, is likely to inhibit the establishment of common cleavers. By contrast the major peak the following season is likely to be unimpaired except for inter-row hoeing. Actual weeding in the seed furrows would damage the crop itself. On the other hand, if the field is spring sown, traditionally in late March or early April, both minor and major germination peaks of common cleavers are disrupted. That this is actually the case is demonstrated by a spring sown field and a winter sown field at the Ancient Farm where the distance between fields is a mere two metre strip of grassland. In the spring sown field common cleavers is virtually absent, in the winter sown field it is a principal weed. Thus given an abundance of common cleavers in a combined seed assemblage it could indicate the practice of winter sowing of cereals.

Perhaps one of the most depressing aspects of empirical testing is the variability experienced from year to year. The archaeological evidence itself is normally impossible to isolate to a single agricultural cycle. The instance when such could be agreed, the carbonised seed found in a layer within a 'storage pit' is dealt with below. The random non-specific material, however, defies such a singular event. Each season there are changes, sometimes major, sometimes slight, in the distribution and frequency of the weed flora. Occasionally this is caused by the climate. In an exceptionally dry spring, poppies (Papavaracae) germinate abundantly at the expense of charlock (Sinapsis Arvensis). Scarlet Pimpernel similarly flourish in a dry summer. When springs are wetter, charlock flourishes along with sowthistle (Sonchus Arvensis), the Speedwells (Veronica Sp.) and thistles generally. Occasionally the seed flora can be abruptly and dramatically changed by agricultural interference. For example, one field was becoming choked by couch grass to the detriment of the crop. The only course of action was the repeated stirring of the topsoil with the ard and hand removal of as much as possible. Eradication of couch grass is virtually impossible since it propagates rhizomatically.

Even the smallest fragment left in the soil will give rise to another plant. Nevertheless dramatic reduction was achieved which left a new niche which was, for one season only, dominated by chickweed (Cerastium Vulgaris). Of the trial cereals, the modern hybrids grown for comparative purposes were completely overrun. The following year chickweed was comparatively rare in the same field. Such variations are, of course, impossible to see in the archaeology and it is only by this type of testing and field trial exercise that any insight upon the true complexity of the plant communities within a field can be achieved. A disturbing aspect of these observations of the arable weed flora focuses upon those weeds which are either not present in the carbonised seed or are 'inadequately' represented. The latter include those plants whose strategy includes exploding their seeds from pods like charlock or those which depend upon wind dispersal like the thistles. This germination takes place after sowing and their fruition before harvest. Their seed collection in even the straw harvest is unlikely and although they may, in fact, be dominant arable weeds, their presence, if at all, is completely unrepresentative. The other varieties, again often abundantly present in the field, are the ground-hugging plants like the speedwells and corn violet (Viola Arvensis).

The performance of the cereals themselves, however,is quite remarkable. If the parameters of husbandry practice are admitted, the yield results are most persuasive of a successful and stable economy. In unmanured and poor soil the average is 15cwts per acre, on better soil, the hill wash with manuring at minimal levels, this yield is dramatically doubled.

While the emphasis in this section upon arable agriculture has been placed upon the role of Emmer and Spelt wheats, it must be remembered that this focus is somewhat biassed. The evidence we have for other crops, including two further varieties of wheat, four types of barley, possibly oats and rye, is just as persuasive as that for Emmer and Spelt. In addition there are leguminous crops, certainly the bean, probably peas (Pisum Sativum), fibre and oil crops of flax and Gold of Pleasure (Camelina Sativa). The basic point at issue is that the Iron Age farmer had a wide choice of crop and undoubtably an intimate knowledge of the microclimate and soil fertility of his own landscape which allowed him to plant the right crop in the right place at the right time. The demands of each plant would have been known, appreciated and accommodated. The empirical results achieved at the Ancient Farm have, in fact, been gained in the most hostile conditions and poorest soil upon the least yielding type of rock. The scale of those results is such that if transplanted to better conditions even within the chalkland zone, they would undoubtably be enhanced. Similarly, if one



were to conduct the same trials upon the traditional rich wheat soils of South Eastern England, the probable multiplication factor would be at least of the magnitude of two to three. In this context it is much easier to understand the possibility of surplus production allowing consistent export as intimated by the Roman writers. It further stresses the complex nature of Iron Age society and reinforces the principles of production industry on the one hand and service industry on the other. Given surplus food facility, service industries which are by definition non-food producers may thrive as indeed the archaeological evidence indicates.

Within this theme of high argricultural technology one must also consider the aspect of bulk grain storage. In general terms it is virtually impossible to discover how grain was stored in structures or even which structures. The normal theory that the ubiquitous four-post structure bears interpretation as a granary is unchallengeable but only in so far as it is neither provable or disprovable. The ethnographic parallels usually cited of the Spanish *horreo* and the African pot on a platform are helpful but certainly not definitive. There are so many ways and so many types of structure which could have been employed that general argument is of little value. Enhanced awareness at excavation level may yet solve this problem. Of basic importance are the principles of storage. Given the granary, chest, sack syndrome, one is observing aerobic storage with prime requirements of dryness and air circulation.

There is, however, another system evidenced by the archaeological data, that being the storage pit. It has been a normal hypothesis for over forty years to ascribe the function of grain storage to a specific size and capacity range of pits ordinarily recorded on permeable rock types like chalk, limestone and sand and gravel. The principle is one of anaerobic storage. Grain when placed in a sealed container continues its normal respiration cycle, using up oxygen and giving off carbon dioxide as a waste product. Within a short period the intergranular atmosphere becomes heavily loaded with carbon dioxide, at which point respiration slows down to the point of unstable dormancy. The instability is caused by the presence of micro-organisms, bacteria and fungi, which in normal circumstances occur on the grain in the field. Should the new atmosphere become unbalanced, for example, by the admission of water or by temperature increase, the micro-organisims may accelerate their life cycle to the detriment of the stored grain.

The pit acts as such a storage container, the lid or seal being clay or dung. A long series of ongoing empirical trials has shown this to be a supremely successful method of bulk storage of grain. The waste product, sprouted grains at the interface between seal, pit wall and stored grain, represent a loss averaging *c.* 2½% per metric ton capacity, the average size of postulated storage pit. Increased capacity by volume leads to decreased interface and consequently to a lower percentage of loss. Recent work on the debris of carbonised grain from certain pits at Danebury Hill Fort in Hampshire has yielded elegant support for this method of grain storage. Carbonised cereal grains have been recovered which display a cavity where the shoot has been burned away during the disposal of the waste material within the pit.

This method of storage as evidence of the high technological level of prehistoric agriculture is important in itself. However, the real issue is the scale of storage argued by the plethora of such pits. Without entering into the social and economic arguments which are necessarily implied by this processs, it is particularly remarkable in what is normally regarded as subsistence agriculture to observe average storage capacities regularly in excess of a ton and not infrequently, considerably more.

In conclusion it is difficult to understand why the phrase 'subsistence agriculture' pervades the interpretative literature about the Iron Age. The scale of the field evidence alone argues strongly against it and the results of empirical trials simply reinforce the idea of a successful and organised agricultural system whatever the scale of the basic unit may have been. There is, however, much more to be achieved to establish better parameters of probability than those we have at present.

## Pastoral

This second and equally important aspect of Iron Age agriculture, the pastoral elements, is no less exciting and exacting although our evidence is vague and poor. Given the nature of the process, however, this is hardly surprising. That mixed farming was the norm is hardly in dispute although it is likely that in different zones the emphasis changed accordingly. Cattle and sheep country obtained then as now and farmers in the remote parts were as aware as their modern counterparts of the land's potential and its best use. The problem is one of mounting sensible hypothesis on the available evidence or alternatively seeking better evidence in the light of pastoral requirements both in the corpus of material available and by further specific excavations notwithstanding the *caveat* of 'seek and ye shall find'.



Because the vast bulk of the evidence available is drawn from settlement excavation, a problem explored earlier, the livestock husbandry process is argued from the recovery of bones, occasionally bearing evidence of butchery, and must be treated in a similar fashion to the seed-evidence and presence and absence lists since these too have been subjected to secondary and even tertiary processing. Nowhere is one likely to recover sufficient evidence to determine herd or flock structure within the tight parameters of an annual farming cycle or even that of a particular decade. As a week in politics, so a year in farming is a long time. Better perhaps to consider slightly longer periods of three and five-year cycles but these, given present knowledge, deny any correlation with the evidence.

There are a number of inescapable factors which affected livestock management in the Iron Age. The most obvious is the fact that even in the Atlantic climate of the British Isles, let alone the continental climate of Europe, grass does not grow in the winter months and what is left from the summer and autumn growth is of little or no nutritional value to livestock. Any kind of snow cover removes even that option. Therefore we must assume some system of supplementary feeding during the winter period. Indeed the core philosophy of farming is to provide for men and animals a food supply when none is available naturally. A further factor for livestock is their various abilities to reproduce. Cattle, for example, are mature after a minimum of two years, and normally after three. Sheep, while able to reproduce in the first year, more often conceive in the second rather than the first. The same argument applies to goats. Consequently livestock require to be carried through at least one and generally two winters before they become breeding stock. Thereafter cattle can reproduce more or less annually for anything between ten and seventeen years, sheep and goats for five to seven years.

Concerning cattle, one particular observation needs to be made. The bone evidence from Iron Age sites indicates a smaller breed of *bos taurus* than the neolithic cattle which correlate in general size to modern cattle. These small cattle must have been obtained by many generations of selective breeding. The prehistoric farmers of the Bronze and Iron Age periods were responsible for this process, presumably since they had a specific requirement within the farming system. That requirement in areas where arable predominated logically was for draught animals. There has been as yet no clear distinction drawn from the evidence between working cattle and herd cattle. A persuasive hypothesis has been raised for a milking herd in the neolithic but nothing yet for subsequent periods. Certainly the size differential between the large neolithic cattle and the smaller Iron Age cattle is not the result of malnutrition.

Similarly there is no reason to suppose that because the cattle were small they were in some way inferior in quality to larger cattle. Nor should the size factor imply weakness. The modern long legged Dexter cattle and West Highland cattle share the same size characteristics of the Iron Age animals and to describe these as febrile would be foolish. The power of a pair of yoked Dexters is such that they can move several tons dead weight and in a day plough with an ard a hectare with relative ease.

For sheep, the modern Soay which has survived in the feral state on the St. Kilda Islands off the north west coast of Scotland, is argued to be directly similar to Iron Age domestic sheep. Its bone structure equates exactly to the bones recovered from Iron Age sites in southern England and one can be confident that they represent the domestic sheep of the late Bronze Age and Iron Age. Indeed this correlation extends to north-west Europe. The problem posed, of course, is one of management. The feral Soay might share the bone structure but what of the behaviour pattern? Their present colouring from fawn to dark brown with shades between is, for example, not necessarily the typical colouring of the prehistoric sheep. At the Ancient Farm and at Babraham Animal Research Centre in Cambridgeshire, Soays have been kept for a number of years in the domestic sense of being managed on a limited land resource. In both cases after approximately seven years a white spot or patch became increasingly evident in the progeny. Interferance and selection has now achieved predominantly white-wooled animals. There has, of course, been no outbreeding and the white animals are pure Soay. Perhaps these are more representative of the prehistoric domestic sheep than the determined colours of Soays by the breed society concerned. Certainly given the Celts recorded predilection for primary colours, it is impossible to dye the brown Soay wool any bright colour.

Soay, Dexter, West Highland, whatever the modern parallels may or may not be, the problem remains that the livestock in the Iron Age had to be supplementarily fed during the winter. The nature of that fodder needs to be determined ideally from the archaeological evidence. The most probable answer is hay and straw. Others are discussed below. It is relatively easy to hypothesise straw and indeed to determine the evidence for it. The admixture of carbonised cereal and arable weeds combined could well have emanated from



the secondary straw harvest discussed above. Further, the straw of both Emmer and Spelt wheats is less glossy and more palatable to cattle than modern wheat straws while barley straw is perfectly palatable and a normal traditional feed. Dried grass or hay on the other hand is hypothesised.

Some evidence for haystacks may be deduced from solitary post-holes set in a circular dished depression two to three metres in diameter or alternatively in different soil types like gravel, a solitary post-hole set in a circular area bounded by a shallow ditch. In the former case the dished depression has been explained empirically though not definitively. Vestiges of traditional haystacks have survived in remote parts of the country. These were circular in plan set upon a base of branches and twigs, to keep the hay off the ground surface, around a vertical post to give the stack a core on the one hand and a breathing facility on the other. One of the greatest dangers of hay storage is heating in the stack caused through dampness. Fires have been regularly caused in this way. The end-product was a cylindrical stack of hay with a conical thatched roof. At two to three metres diameter and two and a half metres high such a stack contained just over a tonne of hay. The effect of the stack upon the ground immediately beneath is quite dramatic. The plants which hold the topsoil together are killed and the rootstock destroyed as photosynthesis is interrupted. Consequently the soil sinks and erodes beneath the stack and if the same site is used repeatedly over several years a depression similar to archaeological examples is formed. Unfortunately the recovery of grass seeds in this carbonised or waterlogged state cannot really be used as definitive evidence since many grasses are to be found in the arable weed communities in arable fields.

It has been suggested that leaf fodder, a traditional supplementary food utilized in Scandinavia, would not only have caused a decline in certain species of tree but also have affected the pollen production and therefore deposits. The trees concerned are primarily elm and ash. Records also exist of the practice of feeding holly, mistletoe and ivy leaves to cattle. The last, ivy, actually is an astringent and can have beneficial effects although all are regarded with deep suspicion by modern farmers. Oddly enough cattle will seek out ivy leaves for themselves although this cannot be claimed as a mark of overall intelligence since they will also seek out and eat yew leaves which are extremely poisonous. A further alternative for which carbonised seed evidence may be used in the all-purpose plant Fat Hen (Chenopodium Album). Conceivably it was grown as a crop and one of its potential uses is exactly similar to hay. Cut in full leaf, sun-dried and stacked,it is quite palatable as winter feed.

Unfortunately hypotheses become theories or interpretations without supportive evidence and in considering pastoral practice the data are all too few. It is, nonetheless, worth raising hypotheses upon the need to focus attention upon the available data in that they may have an as yet unrealised potential. A case in point is the hypothesis that cattle, at least the traction element of a farm unit, were treated in a specific manner. Perhaps because they were critically important, they were kept inside a roundhouse. The advantages are greater levels of domestication or in other words dependence upon man, closer and more regular inspection and, of course, greater care. The implications are twofold. First this practice postulates a zero grazing system in the exact sense that grass is cut daily and brought to the animals; and second their very containment within a structure means a concentration of urine and dung. The latter is not only important in the provision of dung for manuring, mixed incidentally with bedding materials like straw and even bracken which further enhances the nitrogen input discussed earlier, but also in that the practice provides potential archaeological data. The effects of urine and dung in a concentrated area like the interior of a structure will create an enhancement of the phosphate levels not just in the topsoil but also in the subsoil. In fact in some recent excavations of an Iron Age site, where phosphate analysis has been carried out in a deliberate and planned system, certain circular structures were discovered to have high phosphate levels with low numbers of artifacts in clear contrast to others thus suggesting this very practice. If this practice were to be substantiated generally by phosphate analysis, one could advance further hypotheses of zero grazing, grass cutting and hay making leading toward a 'manicured landscape'.

For sheep and goats we seem to be entirely confined by the nursery rhyme syndrome of 'Little Boy Blue - come blow your horn'. The image of a small boy daily leading his herd or flock of goats and sheep out to pasture pervades our reasoning. Ethnography is full of details of this idyllic scene with or without bells around the necks of the animals in question. Indeed it can still be observed in Spain, Italy, Greece, Africa *inter alia* and recorded on film for interpretative purposes. Yet there would seem to be an alternative hypothesis almost demanded by the actual field evidence. Spreads of ancient fields where they have survived seem to allow little or no provision for patches of general grazing



within the immediate vicinity. The impression one gains is of total landscape control rather than a few fields here and a few more over there. One doesn't deny the use of the higher zones for grazing purposes but pursuing rather the principles of this section which look for livestock control and integration in the farming system, an alternative or complementary function for fields could be promoted. Provided the individual fields were fenced, a system of paddock grazing would be envisaged where stock, both cattle and sheep, were grazed for two-day periods in the relatively small area of the typical ancient field and then moved on. In this case sheep follow cattle in the rotation system principally because sheep graze the grass more closely and secondly pasture recently left by sheep is unpalatable to cattle. The benefits from this system are not inconsiderable. The stocking rate for example can be increased by a factor of three to five, the growth of the grass is continously stimulated in exactly the same way as the typical British lawn and the life cycles of parasites and nematodes which colonise long lush grass are seriously inhibited. Thus a field system may not have been simply a dedicated arable zone but also may have allowed grazing as well. Indeed one can envisage that changing the field was regarded as agriculturally essential.

Finally in any review of agriculture practice in the Iron Age mention must be made, albeit briefly, of the importance of woodland. Today it is generally accepted that woodland was carefully managed to provide the crucial resource of timber with all its obvious uses. Hazel coppicing is evidenced as early as the Neolithic and by the latter part of the first millenium B.C. this method of husbandry clearly extended to other species particularly oak and ash. Such were the requirements for specific timber notwithstanding leaf fodder collection, that tree management was practised for succeeding generations. In general terms it is not unreasonable to suppose that the agricultural pattern is tripartite; arable, pastoral and woodland with each element having virtually equal importance and probably equal shares of the landscape. If we attempt to draw together the threads of all the above arguments, the agricultural system of the Iron Age period was most probably highly organised, sophisticated and successful. The data do not allow a simplistic interpretation of a subsistence economy whatever that may be. The data and the climate together deny the catholic transfer of ethnographic so-called parallels.

The initial purpose in presenting this paper was to consider the evidence available for Iron Age agriculture again, but specifically in the light of practicability and the results of empirical trials at at Butser Ancient Farm. It is my belief that such empiricism is critical in achieving an understanding of the basic data, in effect seeking to establish what, how and why, before any broad review which inevitably must be based on these basic data. A house built on sand is the equivalent to a theory built on surmise. The statement that results is undoubtedly a polemic and from it may emerge a new order of comprehension.

PETER J. REYNOLDS, JANUARY 1984

AUTHOR'S NOTE : The text is uninterrupted by references and footnotes in order that the presentation may follow as closely as possible the spoken word. However, a bibliography of sources is appended below.



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