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Early Animal Husbandry [and Discussion]

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Early animal husbandry

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Prehistoric man–animal relationships can be studied from both a zoological and an archaeological viewpoint. Despite the considerable degree of overlap between the approaches the interests of the two disciplines are substantially different. It is important that archaeology should develop hypotheses concerned primarily with human behaviour.

Animal husbandry can be viewed as a group of close relationships between man and animals, in which man derives benefit from a dependable and efficient exploitation. Such relationships are not necessarily confined either to the modern farmyard domesticates or to the Holocene period. It is to be expected that the exploitation of species which provided food staples was regulated so as to favour the success of both species involved in the relationship.

Reindeer, red deer, fallow deer, and gazelle were successfully exploited for long periods, in certain cases many millennia. The data at some sites suggest that individual human groups may have been dependent upon particular herds or populations of animals on a year-round basis. The slaughter patterns, where they are known, show a selective pattern of exploitation as opposed to a random kill.

These Pleistocene economies illustrate the difficulty of accommodating archaeological data successfully to the zoological wild/domestic classification. A more appropriate classification for archaeological purposes will be concerned with variations in human behaviour rather than in animal morphology. Such a classification may as usefully indicate the continuities in human and animal behaviour, as concentrate exclusively on a single dramatic change.

The study of prehistoric relationships between man and animals has developed considerably over the last two decades. In particular, a renewed interest in the analysis of archaeological faunal material has led to a great wealth of data relevant to man's past exploitation patterns. An inevitable end-product of this advance, however, has been to highlight the limitations of the current techniques and hypotheses.

The zoological hypothesis

Broadly speaking it can be said that consideration of early animal domestication has taken place within the framework of zoological hypotheses. The definition and nomenclature of domestic animals are usually viewed as zoological questions. This is a point of view appropriate in some respects, but it should be realized that it has important consequences. There is a concentration upon the animals involved in the relationship, the human partner being commonly relegated to a secondary role, if indeed he is considered at all.

The zoological view of domestication classifies animals as either wild or domestic according to a number of criteria, most of which concern morphological divergence between the two groups. This twofold classification is reinforced terminologically, the tendency being increasingly to insist on a nomenclature which stresses the separation of the two groups. In this

way wild cattle, *Bos primigenius*, are distinguished from domestic cattle, *Bos taurus*, in terms of their larger size, differences of skull and horn conformation, and so on.

It is clear that such substantial changes cannot have taken place in the animals overnight. The amount of time sufficient to allow their occurrence is still a matter for debate. Some of the changes involved might in theory have taken place in a few tens of generations, but the actual amount of time will necessarily have depended upon the nature and severity of the selective pressures which caused them. This information is not readily derived from the archaeological record, and the difficulty of accurately dating archaeological deposits hampers the precise documentation of rates of change. It has been the custom to assert that change would have been relatively rapid, being accelerated by a reproductive barrier imposed by man between the wild and domestic populations. The hypothesis of this rigid barrier to gene flow lacks supporting evidence at present, however, and is indeed directly contrary to many historical and modern examples of pastoralist behaviour (Higgs & Jarman 1972). This does not, of course, mean that we may assume that such sexual isolation never occurred in prehistoric times, but it should make us wary of accepting the proposition uncritically as a cornerstone of our approach to the study of early domestication.

At best, therefore, we must accept that a short period would have intervened between changes in human behaviour and the appearance of their zoologically recognizable consequences; while much more likely is the suggestion that we are faced with a period of unknown, but in some cases very substantial duration, in the examination of which existing zoological techniques and theory cannot help us.

An archaeological approach

Let us now examine the question from an archaeological viewpoint. The archaeologist's main interest is the study of past human behaviour patterns. Domestication is a matter of reciprocal relationships, and it is the human aspect of man–animal relationships which is of primary importance. Changes in the form of domestic animals are only of interest in so far as they reflect changes in human behaviour, or in the economic potential of the animals. This realization brings into focus the shortcomings of the zoological approach from an archaeological point of view. The available data and techniques may be able to indicate that a close man–animal relationship was definitely in existence, but cannot pinpoint for us the early stages of such relationships nor tell us how long a period of development the relationship has undergone. The presence of a particular morphological feature may be accepted as evidence of domestication, but its absence cannot be used as evidence that the human exploitive behaviour pattern has not changed.

Recently the recognition of these difficulties has led some workers to employ different criteria for the recognition of early domestic animals. The most significant of these has been the search for evidence of age- and sex-biased animal crops, the argument being that such selectivity of exploitation implies a degree of control which is itself tantamount to domestication. This criterion can yield valuable palaeoeconomic evidence, but it is certainly far too simplistic to use the exploitation of such biased economic surpluses as an infallible guide to the presence of a domestic relationship. Not only do some pastoralist economies lack these strongly biased cropping policies; but, far more important, precisely similar evidence could result from selective hunting such as can be shown to have operated in a number of economies. Indeed,

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such evidence as exists strongly suggests that random or non-selective predation is a rarity rather than the norm, both for man and other predators.

I have suggested that rapid change in the animals may only be expected where human behaviour has also changed dramatically and rapidly. This may have been an exceptional case rather than the rule. As Wilkinson (1972) has pointed out, early animal domestication is likely to have been undertaken for qualities the wild animals already possessed, not with a view to producing new features. The selective pressures on at least some of the animals brought into a close economic relationship with man may well have been little changed relative to those operating on the fully wild population. A prerequisite of a better understanding of early Holocene economies is an enquiry into the nature of those which preceded them.

Animal husbandry

I have chosen to use the term animal husbandry in this paper for two reasons. It is a term which concentrates attention on the behavioural rather than the morphological aspects of the relationship. As Spurway (1955) puts it 'the adjective "domestic" describes human behaviour to the commensal' and the term animal husbandry describes one of the most important aspects of such behaviour. Secondly, in getting away from the rather rigid connotations which have become associated with the term 'domestication' we may be able to discern more clearly the important continuities which exist in the exploitation of animals in the Late Pleistocene and Holocene. The perception of these long-term regularities should afford us a clearer understanding of the development of those recent and complex relationships which we know today as 'domestication'. In particular we should note that, at its simplest, animal husbandry does not require either selective breeding or the availability of a sophisticated technology. It merely requires the regulation of exploitation, and the manipulation of the exploited animals in such a way as to optimise the economic surplus in terms of size, and/or of reliability; while maintaining the exploited population in a condition (both mental and physical) conducive to the long-term success of the relationship.

It is important that in addition to extending the area of enquiry further back in time we should also examine man's exploitive relationship with a wider variety of animals than those which are customarily the focus of attention. It is often assumed that only those animals which are today domesticated will have been so in the past. This is not a justified assumption, and there is indeed considerable evidence to the contrary. Zeuner (1963) posed the question as to why relatively few animlas were domesticated in the past, and answered it by saying that after the establishment of enough domesticates to provide a satisfactory economic basis it would not have been worth the trouble of domesticating more species. It seems likely, however, that when the relevant studies have been done it will appear that close relationships were established in the past between man and a far wider variety of species than the modern farmyard animals.

Important among the modern and historically attested domesticates have been the large herbivores, and it is therefore appropriate that we should study other species of herbivore, with their potential as dietary staples, to see if they may not in the past have been exploited in a similar way to that in which the more recent domestic animals were exploited.

It was mentioned above that the zoological techniques in common use could do little to help us in dealing with early intensifications in man–animal relationships. Unless, therefore, the

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subject is to remain at a totally speculative level we must devise some methods appropriate to the study at hand.

A potentially important category of evidence has already been employed for some time. This is the search for selectivity in the human exploitation of a particular species. This usually appears in the archaeological record as a crop which is biased in terms of age and/or of sex, relative to the inferred natural population. This criterion has on occasion been used thoughtlessly as an absolute index of domestication. While this is inadmissable, the study of cropping patterns can certainly provide valuable palaeoeconomic information. Significantly, the data bears directly on the economic relationship involved; the way in which the population was being exploited, rather than on secondary morphological consequences of such relationships.

A second kind of selectivity, the concentration of exploitation on one or a few species, is also of importance. Here again one must beware of facile correlations of specialization with any specific form of economy. It can reasonably be suggested, however, that circumstances in which a human group was exploiting one or two crucial staple resources would tend to favour the development of close economic relationships which might include a measure of animal husbandry.

The technique of territorial analysis has been devised to relate archaeological on-site to off-site data (Vita-Finzi & Higgs 1970; Higgs & Vita-Finzi 1972; Jarman 1972*a*). Specifically, it provides an index of the economic potential of the area exploitable from a given site. The technique not only allows a more balanced appreciation of the economic data from the site itself but can also provide on occasion the basis for a study of the probable methods of resource manipulation.

A further criterion may be considered as of some importance when studying some later sites. Where the economy practised at a site appears to be based on a substantially modern association of species one is justified in seriously considering the hypothesis that they may have been exploited in a substantially modern fashion. At sites such as Suberde, Çayönü, and Can Hasan III in Anatolia, the resource base seems to have consisted primarily of animals and plants which are now domestic and which are known to have been domesticates in those areas in later Neolithic times. It seems at least as likely that these sites represent a situation where changes in human behaviour had taken place but had not yet led to substantial morphological change in animals and plants, as that they represent communities of hunters and gatherers.

We may now turn to a number of case studies where the evidence seems to support some of the general hypotheses outlined above.

The reindeer

The reindeer has long been an object of speculation by archaeologists and zoologists. Partly because of its apparently unusual relationship with man in some modern economies, and partly because of its great importance in some late glacial economies in Western Europe, varied hypotheses as to the manner of reindeer exploitation have been pursued for about a century. Among others Rütimeyer in the last century, and Zeuner in this, have suggested the likelihood of the Palaeolithic domestication of the reindeer.

Little is known about the early exploitation of the reindeer, however, and the accepted view is that it was probably a relatively late domesticate. The primary argument in favour of this interpretation is the absence of early osteological change referable to human interference.

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Recently a second proposition has been made which tends to reinforce the argument; Burch (1972) has suggested that, contrary to many statements in the literature, it is impossible to follow wild reindeer, as they range too widely, too unpredictably, and travel too swiftly. This clearly would argue against the likelihood of the development of any early reindeer herding or herd-following economies.

As we have seen, the morphology of the animals is not relevant to our present concerns. As regards the argument that the reindeer cannot be followed, the simple answer is that a number of human groups in the Old World do subsist by following reindeer. These are usually termed 'domestic' reindeer, and in some cases they are exploited as providers of milk and traction as well as of meat and hides. At some point in the past certain reindeer became sufficiently habituated to human presence and manipulation that they accepted a closer relationship with man than a purely random or hunting exploitation. It does not solve our problem to demonstrate that reindeer have the capacity consistently to out-distance man, nor to show that in Canada today the reindeer is usually exploited in an inefficient manner.

Recent studies (Sturdy 1972, 1975) have demonstrated a number of points which have an important bearing upon the nature of the early exploitation of reindeer. There is no doubt that reindeer can be managed on a loose herding basis with a minimum of technological sophistication. Use can be made of natural topographic barriers and of the animals' tendency to move away from disturbance. In this way the animals can be broadly restricted to certain ranges. A degree of habituation of a particular reindeer population to a particular human population can permit a controlled selective pattern of exploitation, such that an economic surplus is extracted from the reindeer without either damaging the biological success of the herd or unduly disturbing the animals. Such a situation exists with modern 'domestic' reindeer in Greenland, where the animals are left alone as much as possible. Herders only come into contact with the reindeer at points where topographic features might otherwise encourage them to wander from the territory. Close contact only occurs during the autumn slaughter.

Turning to direct evidence of the prehistoric exploitation of reindeer, a number of lines of evidence point to the existence of similar man–reindeer relationships in the past. As Sturdy has pointed out, sites such as Stellmoor can rationally be explained as autumn to winter sites of people and reindeer which spent the summer much further inland, in the German and Swiss uplands. The most efficient mode of exploitation would have been some form of herd following, whereby a single human group was dependent primarily on a single population of reindeer. The alternative, that the reindeer were exploited by different human groups at different times of the year, would have entailed disadvantages for both partners in the relationship. It would increase the dangers of over-exploitation by the human competitors, and would make it more likely that contact with a crucial resource would be lost due to a change in the habits or pattern of movement of the prey species. The long-term success (several millennia at least) of the relationship makes this an unlikely hypothesis. The seasonal variation of resources in late glacial Europe would be such as to encourage the adoption of these economic adaptations at least in some cases. Whereas groups wintering in the North European plain would have had a choice of summer strategies, including possible dependence on marine mammals, the groups summering in the sub-alpine zone would almost certainly have been forced by snow north onto the plain in the winter. In this way a close relationship with reindeer herds performing the same seasonal movement could have become established.

So much is hypothesis, but it indicates the feasibility of the early development of close man–

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animal relationships under such circumstances. A detailed analysis of the archaeological data does nothing to weaken the hypothesis. Evidence from the antlers supports the seasonal interpretation of human and animal movement. Resources other than the reindeer would probably have been totally inadequate to support a human population when the reindeer were absent.

Two specific aspects of the evidence suggest that a close economic relationship may have been in existence. The slaughter pattern as revealed at Stellmoor is conspicuously non-random and is biased in an economically advantageous fashion. About 90% of the kill is of males, and the overall structure of the slaughtered segment of the population is remarkably close to the recommended slaughter pattern of modern ranched reindeer in Scandinavia. The only significant difference between the figures is in the lower proportion of adult females in the prehistoric crop, a discrepancy which could easily relate to less intensive cropping in that economy, or to greater losses to the herd due to non-human predation. The selectivity of the kill, and the probability that at Stellmoor the animals were killed at close quarters, perhaps by use of the 'Lyngby axe', argue for a close, controlled relationship in which the animals were to some degree habituated to, and tolerant of, human exploitation.

In theory the evidence could be explained by an hypothesis of 'selective hunting'. Most of the sites involved are badly located for the pursuit of a hunting economy, however. Their exploitation territories are generally small, and thus offer poor hunting resources; the sites are not, by and large, located in advantageous 'ambush' positions, but are situated so as to block egress from site exploitation territories and extended territories (Sturdy 1975). In this way control could have been maintained over the bulk of the herd without the necessity of constantly disturbing it. A small number of animals selected for exploitation, a killing herd, could have been separated from the main population and maintained in the vicinity of the home base site.

The red deer

The species which are most likely to have become objects of economic specialization are the large and medium-sized herbivores of gregarious habit. It is no surprise, therefore, to find that the red deer, an important constituent of the European fauna in many areas for tens of millennia, seems to have been exploited in a controlled and rational fashion (Jarman 1972*b*).

The red deer was a staple resource over most of Europe between the beginnings of the postglacial and the appearance of mixed farming economies. In much of southern Europe it was a staple throughout the Upper Palaeolithic period as well. Sites such as Kastritsa in Greece, the Camerota caves in Italy, and Aitzbitarte in Spain document stable economies which endured for many millennia. Such successful long-term exploitation patterns imply that a mutually advantageous adjustment between man and red deer had been achieved; a form of symbiosis.

Data are not yet available which would allow an accurate assessment of the intensity of exploitation, but a number of pointers are available. Territorial studies indicate the probability that individual human groups were associated with individual deer herds on a year-round basis; the seasonal movements of the deer being echoed by those of man. In most cases where evidence is available it is clear that a biased crop is being extracted from the red deer population, and that whatever economic system was in operation it is unlikely to have been random or casual hunting. In Central Italy, Upper Palaeolithic sites showed a concentration on young age groups, while at the Neolithic site of Molino Casarotto about three-quarters of the crop was

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of animlas three years old or younger. Jéquier (1963) showed that at Neolithic Burgäschisee-Süd in Switzerland the red deer crop was biased with respect to both age and sex, as was that at the British Mesolithic site of Star Carr.

In each of these cases the nature of the economic surplus extracted is such as to favour the successful continuance of the relationship, removing from the population individuals which biologically speaking can be spared. In many cases this comes down in practice to the preferential slaughter of young and early-mature males, a majority of the females being conserved for future breeding purposes. Such a pattern, of course, is strikingly parallelled in most simple pastoralist exploitation patterns.

We cannot at present be categorical as to the precise nature of the man–deer relationships which were involved, but the result of such cropping patterns is automatically to produce a herd which is husbanded to some extent. The advantages of a close relationship are such that it is likely to have arisen and been maintained in those areas where the red deer were a crucial economic resource over a long period. Red deer, though they are usually considered typical wild animals, are not difficult to tame or herd. Gilbert White describes how Queen Anne saw 'with great complacency and satisfaction the whole herd of red deer [of Wolmer Forest] brought by the keepers along the vale before her, consisting then of about five hundred head'. Recent projects such as that currently in operation on the Island of Rhum, show that the deer can be habituated to close proximity of, and to considerable manipulation by, man. The recent suggestion of Simmons & Dimbleby (1974) that ivy may have been used as winter fodder for deer in Mesolithic times lends weight to the hypothesis of a highly sophisticated exploitation of deer in prehistory. Such relationships may well have included herding or a degree of control of movement, as well as the selective slaughtering for which there is good evidence.

Fallow deer

The fallow deer is another species which has been of great economic importance in the past, particularly in parts of the Near East. In the Mount Carmel area, for instance, it was one of the staple resources over a period of at least fifty thousand years. There is almost no information available as to the nature of its exploitation during the Pleistocene, but its economic importance and the longevity of the relationship presuppose the existence of a successful adjustment of the relationship between man and deer.

The most interesting data available concern the importation of fallow deer into a number of areas beyond its natural distribution, in particular to Cyprus. Until the early Holocene Cyprus carried a relict Pleistocene fauna which lacked the large mammals typical of the Upper Pleistocene of Europe and the Near East. The Holocene fauna constitutes an abrupt break, with domestic caprines and pigs, carnivores, and fallow deer making an early appearance. These species appear abruptly, and together, as a coherent faunal association. It seems certain that the sheep, goats, and pigs were imported by man, and there is no reason to doubt that this was also the case with the other species.

Significantly, the fallow deer was of great economic importance at many Neolithic sites, its rôle being taken over by the modern farmyard animals in Bronze Age times. It is difficult to arrive at a satisfactory explanation of the evidence other than that the fallow deer was imported as the primary economic animal, to be eventually superceded. It has been suggested (Schwartz 1973) that the fallow deer from Cyprus are generally smaller than *Dama mesopotamica* from the

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mainland. This difference can be explained in a number of ways, but it is worth remembering that size decrease is generally accepted as good evidence of domestication in certain other herbivores.

Similar evidence is available from Crete, where it was the Asia Minor form *D. dama*, rather than *D. mesopotamica*, which was introduced. On Crete, however, the deer seem to have been introduced primarily for non-economic purposes, possibly as park animals or for hunting. They appear on Crete late in the sequence, being absent from the Neolithic levels, appearing in Minoan times; and they never occur in numbers sufficient to imply their use as an important economic resource. It is therefore less likely that the Cretan deer were behaviourally domestic than the economically important Cypriot deer.

Gazelle

Recent work in Palestine has re-emphasized the economic importance of gazelle. Its long-term significance in the Near East was indicated by Bate's work on the Mount Carmel faunal collections (Garrod & Bate 1937), and what has now come into sharper focus is the fact that the gazelle remains a critical resource in the Pre-Pottery Neolithic A period. It has been shown, in addition, that a high proportion of the crop at least at some sites is of immature individuals, and while details are lacking as to the precise age structure it is clear that a biased surplus was being extracted (Legge 1972; Noy, Legge & Higgs 1973).

As with the red and fallow deer, it is known that the gazelle can be successfully tamed and controlled. The art of Dynastic Egypt documents the close control of gazelle. The archaeological evidence cannot be held to demonstrate 'domestication', but it shows that a similar pattern of exploitation was being practised as was with respect to sheep and goats at such sites as Shanidar, Beidha, and Ali Kosh.

Once it is accepted that we may usefully search for signs of early animal husbandry in pre-Holocene times and among species outside the range of the modern farmyard domesticates, a number of profitable avenues of enquiry become apparent. There is good evidence that the elk was probably exploited in a sophisticated fashion in prehistory, including its use for dairy and traction resources. How far back this relationship may have existed is totally unknown. There is suggestive artistic evidence that the horse may have been under human control in Upper Palaeolithic times. The barbary sheep and the bison are two further species for which there is excellent evidence of their critical economic importance for long periods, and it is hence likely that satisfactory exploitive relationships will have been established. Such relationships, as we have seen, commonly include an element of husbandry.

Conclusions

The inadequacy of the existing wild-domestic classification for dealing with the complexity of early man–animal relationships has been pointed out. A palaeoeconomic classification of exploitation patterns might be based among other things upon the degree to which the human partner influences and controls the movement of the exploited species. At one extreme of the scale of intensity would be casual or random hunting relationships, where human contact is limited to the particular period in which a kill or capture is being attempted. The other extreme is provided by modern factory farming.

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Many of the herbivores which were of great economic importance in prehistory will have exploited their range on the basis of regular and predictable seasonal movements. Human behaviour in respect to this pattern of movement can be viewed as follows.

(1) Random predation. The human group makes no effort to control or benefit from the regularity of the animal behaviour, simply exploiting the animal when it happens to be available. As we have seen, from a theoretical point of view this is unlikely to have been a common exploitation strategy as far as staple resources are concerned; being inefficient it would tend to be superseded by more effective and successful relationships.

(2) Controlled predation. In such a relationship the degree of control exerted on animal movement might be quite considerable at particular times, but would not necessarily amount to a general year-round association between man and prey. The control of animal movement in game drives or by corralling are obvious examples.

(3) Herd following. The human group, or a part of it, echoes the animal movements, maintaining a degree of contact with it, such that a given human population tends to become associated with a given animal population. Such a system could easily develop by a series of gradual intensifications to

(4) Loose herding, where more direct control is exerted over animal movement at least at some time or times in the year. The spring and autumn movement, for instance, might be initiated by the herders, or controlled so as to ensure a complete transfer of the stock associated with a particular human population. Many modern pastoralist economies fall into this category.

(5) Close herding. This involves close control of animal movement all the year round, and would probably require constant human contact with the herd, and/or the extensive use of fences. This is the relationship involved in much of Western European commercial livestock exploitation at present, except where it has developed to the stage of

(6) Factory farming. Here, characteristically, the animal is kept largely immobile throughout its life, and is maintained in a wholly artificial environment.

This classification is not the only possible one, and it is to an extent arbitrary, as all other classifications are. In basing it on human economic behaviour, however, rather than on morphological and zoological criteria, it may be hoped that important aspects of the situation which have become obscured may now emerge. Of the six patterns of exploitation outlined only the first need be totally devoid of aspects of *husbandry*, in the sense of an effective long-term economic strategy which will favour the continued existence of both partners in the relationship. Some husbanding of the resources may or may not be present in relationships of the second category, and will almost certainly have been an element in all the others. However one explains the phenomenon, it is striking that the kind of biased surpluses extracted from the deer and gazelle populations indicate sensible economic adaptations which would have resulted in a husbanded resource. Whether or not this was part of a consciously reasoned policy is a matter for speculation.

The classification suggested lays intentional emphasis upon the gradual nature of economic change and the links of continuity between periods of widely differing cultural aspect. Important economic changes may in many cases have been accomplished by the gradual development from such commonly used techniques as burning of the brush and use of temporary corrals for the occasional control of animals, to a more intensive relationship with individual animal groups. It is likely that the provision of fodder or water at the lean period of the year was of the

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first importance in the habituation of animals to human presence and manipulation, and the evidence suggesting the possibility of such a pattern in Mesolithic Europe is thus of great interest.

Continuity in man–animal relationships is indicated by the evidence of site locations, also. Not only are there numerous instances of multiple occupations, spanning many millennia, where a particular species or group of species has been exploited apparently in the same way, but the reoccupation of such sites by people exploiting different species in different climatic or technological circumstances is also a commonplace. In Central Italy, for instance, many sites are occupied in Upper Palaeolithic or Epipalaeolithic times, followed by a re-occupation in Neolithic and/or Bronze Age times. As Barker (1975) has pointed out, there is considerable typological continuity through this period, and at some sites the only important faunal change is the replacement of ibex by domestic sheep and goat.

The technological continuities are most striking in some of the features most directly concerned with the manipulation of animals. Corrals, for instance, depicted in Spanish rock paintings dated to *ca.* 12000 B.P., are very similar to those identified in excavations of Neolithic and Bronze Age settlements in Poland. Equally remarkable is the parallel noted by Pigorini (1877) between the *bâtons de commandement* of the French Magdalenian and similar objects used as cheek pieces of horses' bridles in nineteenth century Sicily.

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Discussion

PROFESSOR GRAHAME CLARK (*Peterhouse, Cambridge*)

While not seeking to question that close symbiotic relations may be established between human and animal groups that fall far short of domestication, I think that in reaching a judgement in particular cases from prehistoric times we need to take account of the total assemblages of archaeological data.

A feature of the artefacts from the Late-glacial (Younger Dryas) site of Stellmoor, Schleswig-Holstein, was the number of pinewood arrow-shafts, some of which still retained the stems of tanged flint arrowheads, which themselves formed a leading component of the lithic assemblage (Clark 1975, fig. 5). Unless we suppose that bows and arrows were used exclusively for human combat, there is no alternative to the assumption that they were used in hunting. Since 650 of the 662 individual mammals represented on the site were reindeer, it would be reasonable to suppose that they were used to shoot reindeer. Examination of the reindeer bones from Stellmoor undertaken at the time of the original reports showed (Rust 1943, taf. 85, 86 and 87, no. 2) that some had been shot through the shoulder blade and the tip of a flint arrowhead was found embedded in a reindeer vertebra (Rust 1943, taf. 87, no. 1).

In the case of the assemblage from the early Neothermal site of Star Carr, Yorkshire, flint microliths of the type found mounted as tips and barbs of wooden arrowshafts in analogous contexts in south Scandinavia (Clark 1975, pl. III) were a main component of the cultural assemblage. The animal bones, of which red deer were a leading component, have recently been re-examined by Nanna Nøe-Nygaard of the Institute of Historical Geology and Palaeontology of the University of Copenhagen who has made a special study of wound marks on animal skeletal material from prehistoric sites in Denmark (Nøe-Nygaard 1974). As a result of her re-examination Nanna Nøe-Nygaard reports by letter that she has observed comparable indications on the red deer skeletal material from Star Carr.

References

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DR CAROLINE GRIGSON (*Odontological Museum, Royal College of Surgeons, Lincoln's Inn Fields, London W.C.*2)

Mr Jarman dismisses the rôle of the zoologist in archaeozoology in a rather high-handed fashion. There is simply no substitute for zoological techniques; one obvious example is the accurate identification of bones – surely basic to any assessment of bones from an archaeological site. I think he is right that zoologists have often provided rather sterile reports that shed very little light on the economic behaviour of early man. I would suggest however that this is not necessarily the fault of the zoologist – the archaeologist frequently fails to formulate the questions that need to be answered. So often the zoologist is sent a box of bones and asked for a report, and there the interdisciplinary communication ends.

Regarding the small size of the fallow deer on Cyprus, Mr Jarman pointed out that zoologists might use this to suggest that fallow deer were a domesticated form on Cyprus. Actually a zoologist

would do no such thing. Reduction in body size can only occur when a population is isolated from animals of normal size. In places where man seems to have been the only isolating factor one might tentatively conclude that domestication was taking place, however, on Cyprus one would have a perfect example of geographical isolation.

A similar case of an island deer population in prehistoric times is the occurrence of red deer (body size not known) on Scilly, about 45 from Lands End.

Dr H.-P. Uerpmann (*Institut für Urgeschichte der Universität Tübingen D-74 Tübingen, Schloss, Germany*)

One argument against the assumption of M. Jarman that there was a conscious husbandry of red deer in prehistoric Europe, is that of human laziness. Especially for the neolithic of south central Europe, we do know that around the areas being inhabited there were larger areas without human population. Even under conditions of exhaustive exploitation of red deer in the settled areas, the vast regions around them would have reproduced the losses without decrease in population size. But we do have evidence, that even in settled areas, deer were not exploited exhaustively. For Burgäschisee-Süd (site and publication being cited by Jarman) there is an estimate of 2 red deer hunted per annum. Even if this number is multiplied by 6 (thereby having multiplied the minimum number of individuals present among the bone finds by 12) which is probably too much, only 1 animal was killed a month. It is improbable that the neolithic dwellers made any efforts towards a husbandry of deer under such circumstances.

In addition to this it must be kept in mind, that reasons for hunting were different in the Neolithic from the Mesolithic. Red deer cause a lot of damage in corn fields and to secure the crops it had to be hunted by the Neolithic farmers. This also explains the distortion of sex ratios in the bone finds. Young males are much more likely to penetrate into the fields than females which tend to be more cautious. The probability of conscious husbandry of red deer in the European Neolithic must therefore be considered as low. For the Mesolithic period, too, there is no convincing evidence of animal husbandry. As long as no new evidence is available, Jarman's interpretation remains less probable than the old-fashioned picture of the 'hunters and gatherers'.

Dr M. L. Ryder (*Animal Breeding Research Organisation, Edinburgh*)

Mr Jarman has presented us with a stimulating development of the idea of incipient domestication, which was first put forward with the reindeer by Zeuner, and is now extended to include other species of deer and antelopes.

But I think that Mr Jarman's theme of husbandry before true domestication needs to be very carefully examined before it receives too ready acceptance by archaeologists as proven, and it is a pity that Jarman did not present more of the evidence that led to his suggestions.

First, I consider that his use of the word husbandry is misleading, since it suggests full domestication. A scientist needs to be precise about what he is talking about, and cannot retreat behind a smokescreen of semantics.

Domestication in its simplest terms is the control of the breeding of animals in captivity. What Jarman describes is more in the nature of the management of a natural resource. It is an extension of the ecological relationship between predator and prey, and only in last week's issue of *Nature* (3 April 1975, vol. 254, p. 384) was it pointed out that a predator, such as a lion,

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takes only a limited amount of its prey. As soon as this becomes depleted, the predator moves on to another species.

What we need to do with Jarman's hypothesis is to determine at what stage man began to manage his prey more intelligently than the lion. But man in some instances has been responsible for the extinction of species. The zoologist has long thought that domestication arose in this way almost as an ecological accident. It was almost certainly not conscious or purposeful.

While talking about zoologists, I must defend Jarman's criticism of the use of morphological criteria. This is only done today when comparing wild ancestors with modern descendants.

The crucial point in Jarman's argument is that the remains found may represent the results of hunting rather than 'husbandry' and the red deer was the most-hunted animal right down to the Middle Ages.

I must admit, however, from my association with the experimental domestication of red deer in Scotland, that it is very easily domesticated. But the question I ask is: why, if deer were husbanded in early times, were they not fully domesticated later? Also what did deer get from man?

This is part of a bigger question that has puzzled me for a long time. My main interest is the coat. Deer, wild goats and wild sheep are all ruminants with a similar type of coat. Why then were only goats and sheep properly domesticated, and why did the coat of the sheep change more than that of the goat under domestication?

In conclusion we must remind ourselves that archaeological theories are difficult to test. But I am a great believer in seeking modern parallels, and so I think that the relationship of Lapps with reindeer must be looked at again before it is too late (see, for instance, T. Ingold 1975 *Man* **9**, 523).

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