DOMESTICATION: AN EXAMINATION OF THE CHANGING SOCIAL RELATIONSHIPS BETWEEN MAN AND ANIMALS

James F. Downs

Introduction

This paper is the result of an extended interest in the relation of domestic animals to their human masters and the effect of this relationship on human behavior and history.

Over a long period I have been dissatisfied with explanations of the origins of domestication as utilized in anthropological literature, particularly those dealing with cultural development on a broad scale.

In this paper I will attempt to separate the various problems which are part of the general phenomenon of animal domestication. Second, I will attempt to establish a definition of domestication suitable for anthropological investigation.

The literature on domestication, theoretical and purely descriptive, is voluminous, and no attempt will be made to cite all the writers who may have dealt with the subject. What I will try to do is to establish a theoretical framework in which the domestication of mammals by man can be investigated with archeological and ethnological methods. Such an approach is admittedly highly speculative. These speculations are set forth in the nature of hypotheses which may be tested.

My investigation of the domestication of animals began on a rather limited scale; an attempt to create a definition of domestication which would be more useful to archeologists working in areas where domestication was in its incipient or earliest stages. However it became increasingly clear that domestication was not simply the addition of another trait or complex of traits to existing cultural inventories. Examining the use of domestic animals on a comparative level, I became conscious that the introduction of domestic animals often entails drastic shifts in orientation of the culture involved. Domestication often entails a complete change in economic activity, requires the development of new skills and motor habits. More often than not the use of domestic animals affects living patterns, concepts of property and wealth and not infrequently creates new alignments of the society into which domestication has been introduced. These realignments take the form of a new web of social relationships which include both humans and animals. Thus, a discussion of domestication, even for the purpose of defining the condition, is forced to extend itself far beyond the simple question of the presence or absence of certain animals but must devote itself to an examination of what is in fact a process which transforms a culture into a different type of entity.

The discussions in this paper will be presented very much in the order in which the questions developed during the investigation from the most simple and practical to the more general and theoretical problems.

The first part of this paper will be devoted to the problem of defining the term "domestication" so that it may be more useful in anthropological research. To this end we will investigate the definitions which have been used, particularly in archeology, discuss their relevance to anthropological theory and suggest a cultural definition of domestication which I feel will encompass a larger number of animal-man relationships than those borrowed from other sciences.

The primary effort in this part of the discussion will be to establish a definition of a condition which, either in its existence or development, might leave archeological evidence. The major problem in the domestication phenomenon appears to be that of discerning origins of domestication. The presence or absence of domestic animals among modern populations is easily discernible, and with a working cultural definition of domestication, argument as to whether or not such and such a species reported ethnographically is really domestic is largely academic.

Having set up a definition of domestication, an attempt will be made to create a typology of domestic relationships. To this end a classification of hunting methods will be established in order to seek relations between types of domestication and types of hunting methods.

As the different types of domestication appear to be based on the requirements of the culture and the nature of the species in question it would seem that each general type presents a somewhat different problem of origination. Speculative reconstructions of possible origin processes will be presented, along with what evidence presently exists which might confirm these reconstructions.

The first animal type to be treated will consist of those species which live in herds in the wild state and are generally hunted for meat. The suggestion will be made that a specific hunting method, coupled with certain social and cultural conditions might be expected to result in the domestication of herd animals.

Non-herd animals which have been domesticated will be treated in a separate part of the paper and a process of domestication through symbiosis and elaboration of domestication because of a hunting relationship will be suggested.

A third group of animals, carnivores, such as the cat and ferret, will be treated in another section of the paper.

Animals which we can assume were domesticated because of the example set by earlier domestications and the establishment of the domestication pattern will be treated briefly, while the reindeer, because this species appears to have a history distinct from that of other domestic herd animals, will be treated in a separate section.

The formulations suggested in the sections described will be presented in the form of hypotheses. The final section will be devoted to an examination of the archeological evidence which might be used to test such speculations.

Identifying and Defining

There appears to be little difficulty on an ethnographic level in identifying domestic animals, or in describing the relations between living human beings and living animals in observed human situations. The question of exactly defining domestication and how its effects may be seen in cultural activity is brought into sharpest focus in archeology.

One of the recurring questions in the investigation of early occupation sites, particularly in the areas where civilization later developed, is whether or not the inhabitants of the site kept domestic animals. In archeological sites, where domestication was practiced over long periods, the answer is relatively easy. But in sites dating from the far edge of Neolithic time the question is one which seems to be extremely difficult to answer.

As pointed out by Dyson (1953:661), even dependence on the opinion of zoölogists often fails to give a definite answer. While we know that modern domestic animals show a number of anatomical differences from wild animals, it appears that many of these changes did not come about in the initial period of domestication, and that the examination of bones in fact may not give us a clue as to whether the animal in question was or was not domestic. This difficulty leads to two practices which, in part at least, defeat the purpose of asking for zoölogical assistance. Often the zoölogist, unable to determine from the bones he is examining whether or not they represent a domestic species, relies on association for evidence. If the bones occur in association with human artifacts, they may be tagged as "probably domestic," particularly if they are bones of a species with modern domestic representatives. On the other hand, bones of species without modern domestic representatives are generally considered "wild."

The question clearly revolves around a definition of the word domestic which will, in fact, encompass the phenomenon in which, as archeologists and culture historians, we are primarily interested, viz., groups of human beings changing their way of life from hunting and gathering or simple horticulture to agriculture with domestic animals or pastoralism. Domestication, then, from the viewpoint of the anthropologist, is a social or cultural phenomenon. Most definitions of domestication however are based on genetic or zoölogical criteria which have to do with the long-range effect of the man-animal relationship on the genotype or morphology of the animal rather than the cultural and social results of the relationship. Thevinin, for instance, defines domestic animals as follows: "Un animal domestique serait alors, celui qui, élevé de generation en generation sous la survellience de l'homme, évolue de façon à constituer une espèce, ou pour le moins une race, différente de la forme sauvage primatif dont il est issu" (1948:1).

As Dyson points out, this "osteological" definition implies a period of time during which the changes occur. Thus the animal in question may have been domestic, or, more important, the society in question may have been practicing domestication, long before the changes occur. If osteological dissimilarities are used as a sole criteria of domestication our datings of the beginnings in any area are apt to be in error. Let us construct a hypothetical example based on osteological considerations alone.

The African elephant has long been considered outside the pale of domestic possibility. However, in recent years the government of the Belgian

Congo, with the aid of elephant specialists from India, has captured, trained and bred in captivity many African elephants for work (Wagner:1954). Prior to this time the African elephant was considered only as game to be killed for meat, sport or, more importantly, for ivory. This ivory hunting, carried out by Arabs and later by Europeans with firearms, has resulted in a selection out of males with large tusks. The degeneration of tusk size, as well as overall size in male elephants, has been noted by many hunters and naturalists in Africa (Hunter:1954). Let us now project ourselves into future time and attempt to reconstruct the process of domestication of African elephants. Armed with the knowledge that the domestic elephants of 2359 A.D. have generally small tusks when compared with wild elephants or the paleontological record, we could examine archeologically revealed skeletons and would quite probably discover that this diminution of tusk size began in about the eighteenth century. From this information we could postulate that elephants were domesticated some time before that. Our reasoning could be in keeping with respected authorities and zoölogical theory, but our conclusions would be off by at least two centuries. While two centuries in prehistory appears a small period if we consider the cultural situation in the early eighteenth century as compared with 1960, it shows clearly how much actual error such a speculation could contain. Moreover, in the absence of studies which would give some rate of osteological change under domestication for various species, any attempt to infer time depth from osteological differences would be the crudest sort of guesswork.

A second definition, commonly used in anthropological as well as biological circles, defines domestic animals in a manner which is generally not helpful in archeological work and which tends to exclude animals which clearly have an important domestic relationship to human society. One of the more recent usages of this type of definition can be found in Dobzhansky (1955:192). "There is no generally accepted definition of what a domesticated animal or plant is. For our purpose it will be satisfactory to regard as domesticated those forms which regularly reproduce in captivity and whose population is controlled by man."

This definition in a work on genetics and evolution, is satisfactory for its purpose, but when one refers to the list of domestic animals to which Dobzhansky applies his criteria we find two omissions which, from the point of view of the cultural anthropologist, are extremely important--the reindeer and the elephant.

Aside from the problems of definition, another widespread misconception about domestication has, I feel, limited our understanding of the subject and confused our thinking about the origins of domestication. This is the notion that domestication of animals was a "one shot" occurrence; that is, that all "potentially domestic animals" were domesticated within a few hundred or at the most a few thousand years during the transition from paleolithic to neolithic stages of human existence. (Such an opinion can be found in Lowie (1940:37-53) for instance.) This view is not expressed by Dobzhansky, who lists a number of animals under domestication in historic periods.

The next section of this paper will be devoted to an attempt to arrive at a "cultural" definition of domestication (Dyson 1953:661) which will include all mammals which have played a role in changing human behavior through specific changes in their relationship to mankind, and, second, to propose a theory of the process of domestication.

A Redefinition

Without listing additional citations we can say that, in general, domestication has been considered to depend on the criteria of free breeding in captivity. The implication, if not the explicit assumption, of all definitions of this character, is that some species will not or cannot breed in captivity and therefore can never become domestic. An outstanding victim among animals useful to men, of this type of definition, has been the elephant (Dyson:661). The method of utilization of elephants in India has been to allow breeding stock to wander free in the jungle and round these animals up periodically, selecting out the animals suitable for work and then releasing the remaining animals. The reason often given for this pattern is that elephants will not breed in captivity. However, upon investigation this assertion does not stand up. Not only has breeding of African elephants been carried out in captivity, but on at least five occasions in recent years Indian elephants have been bred and born in zoos and circuses in the United States and Europe (Hediger:1954).[2] An examination of the responses of the breeding behavior of the various species brought into captivity in zoos throughout the world suggests that few, if any, species will refrain from sexual activity under captive conditions, if nutritive and environmental conditions are correct, and if some degree of selection is allowed the animals in question (Hediger:1954).[3] Certainly a large number of "wild" animals have been bred in captivity. Perhaps the most exotic experiments of this nature are now being conducted in that capital of unusual human behavior, Los Angeles, where pilot whales are kept in large tanks for the amusement of the citizenry. Other such zoölogical exotica, such as the breeding and training of zebras, the raising of American bison, the raising of alligators, the commercial farming of fishing worms and of ostriches, and the raising of fur-bearing animals for market, suggest that there is no basic barrier to the taking into captivity and breeding of any species of mammal, bird, or reptile, if such action is found to be desirable or necessary to the people involved in the procedure.

What is implied in the statement above is that the term "potentially domestic" when applied to a species of animal is very nearly without meaning. Certainly when applied to animals solely because they are representative of a species on the modern roster of domestic animals, it contradicts known historic events in which certain species have at one time been domestic and are now considered wild.

What is suggested in this work is that the domestic potential in any historic or modern situation does not rest on the psycho-biological make-up of the animal species in question but is in fact dependent on the socio-cultural situation. The criteria we have used in studying this question have been, by and large, biological or zoölogical, when in fact the only justification for anthropological investigation is to determine, not the effect of man on animals, but the effect of a changed man-animal relationship on man himself. Thus criteria which are perfectly valid in a biological context do not fulfill anthropological requirements. In cultural or culture-historical terms the essential element in the question of domestication is that man and animals entered into a new relationship which created new opportunities for cultural development. Our definition, then, should be couched in cultural, not biological terms. What then are the essentials of domestication from the anthropologist's point of view?

To answer this question we can examine the varied domestic usages reported in ethnography and within our common experience. Many of the animals treated in the next few pages will fall into the category of herd animals primarily because such animals appear to have been domesticated early and because of the many degrees of control exercised on such animals depending on the human requirements in a specific situation. In addition, the herd animals are generally held under considerably less restraint than are other domestic mammals.

There have been a number of suggestions as to the original reason that man domesticated animals. Whatever the reason, whether it was a need for meat, milk or fiber, or for pleasure or religious sacrifices, it is clear that he found it necessary to change his relationship to the animal species in question. To obtain whatever he wanted from these animals he found it necessary to exercise some control over them. We have already seen that elephants and reindeer are often excluded from the list of domestic creatures because the control over them appears to be minimal. One suspects, however, that an examination of the degrees of control under which unquestionably "domestic" animals are kept would show that they vary so widely that only very general criteria of control can be established. Let us examine, for example, the case of the pig. In New Guinea much of the social and economic life of the Siane revolves around the possession and breeding of pigs which are used in elaborate festivals and feasts and are the medium of a complex system of exchange and credit. Pigs are owned by individuals, and almost the only method of upward mobility is to enlarge one's pig herd by breeding. Nonetheless, during much of the time the animals roam through the forest unwatched by their owners. It is necessary to build strong fences around garden plots, and it is not uncommon for the men of a village to be forced to hunt down and kill marauding boars in an exciting hunt. These animals, however, generally come into the village at night and respond to calls. But often important feasts are delayed because the pigs cannot be hunted down and driven home (Salisbury:1960). The picture is not much different from that found in rural America, particularly in the South in the recent past, when razorback hogs roamed the woods foraging for themselves, and had to be rounded up for slaughter and marking by specially bred and trained "hawg dogs." This situation may be contrasted with the near-human luxury in which prize-winning purebred hogs are maintained, or to the irrigated pasture, circled with electric fencing and supplied with farrowing pens which is the not uncommon habitat of the market hog today. While the degree of control differs greatly, each is sufficient for the social requirement man has for the pig in question.

A similar picture can be drawn of the operation of the range cattle industry in the days of the open range in the United States as compared with a beef breeding farm or a dairy farm today. It is important to remember that the wire-enclosed ranches of today are not a response to increased difficulty in containing cattle but due to the increased value of cattle and land, and increasing population density which make it necessary to contain beef herds in order to insure profit. Far from being more difficult to contain, today's range cattle are gentle compared with the longhorn of the first three quarters of the last century. The variations in control of beef cattle may be compared with the degree of control of elephants in India where the elephant plays an important role in human life. The jungle corresponds to the range and the drive to the round-up. There would be little efficiency in maintaining breeding herds of elephants which would consume enormous amounts of fodder but would not work. One can conclude that it is more efficient to relegate what must be a

titanic episode of elephantive rut and breeding to the remote privacy of the jungle where damage to human life and property are precluded.

In examining this question of control further, we can look at smaller animals such as the rabbit. Rabbits, although harmless to man, are kept in wire cages when raised commercially. The reason for this is that if allowed to roam at large, rabbits would run away or become prey to predators. Thus, if man is to obtain meat and skins from rabbits in any regular way, the animals must be contained. Although this paper will not attempt to deal with problems of the origin of the domestication of birds, the chicken provides a striking example of varying degrees of control. In the recent past the flock of chickens was often considered the property of the farm wife; it roamed at large in the farmyard, was fed at the kitchen door, and the farm children searched the hayloft for fresh eggs. Increased demands of urban markets for eggs, coupled with increasing restrictions on the maintaining of chickens in urban back yards for family use, has set a premium on high production, and modern poultrymen often place each layer in an individual wire pen, where she remains throughout her productive life. The life of the dairy cow offers yet another example. During lactation she is kept under cover or closely penned, fed, washed and milked daily. With cessation of lactation she is relegated to pasture and left to herself in the manner of beef cattle until her next lactation. Such descriptions could continue indefinitely, but these examples serve to illustrate that the degree of control exercised by man is in response, in large part, to his requirement of the animal, coupled with the nature of the animal.

What these examples suggest is that a domestic animal must be controlled to the degree necessary for man to obtain from the animal in question what man wants, and that any absolute criterion of control is probably impossible to establish; even if such a criterion were possible, it would exclude many animals which are unquestionably domestic. A cultural definition of domestication should, I believe, be constructed so as to include any animal which falls into the generally accepted rubric "domestic." But control is certainly only one factor in the definition of domestication. Hawks used for falconry, and cheetahs used for coursing game are under extreme control, but each new generation must be taken from the wild representatives of the species. Such beasts as these are more easily categorized as tame because their continued use by man requires that the hunting or trapping relationship to the species be maintained.

This of course suggests the second criterion for domestication: the maintenance of the domestic population of the species in question by breeding, which in its simplest form would be that each domestic generation be descended from a domestic generation. Even with this simplest definition man must become involved in the breeding process. Consciously or not he selects the animals which shall remain in the breeding pool. Whether he simply slaughters certain animals for food or withdraws them from breeding to work, or exercises more conscious control over the breeding individuals, such as castration of unsuitable males or deliberate breeding of selected males and females, he is exerting an influence on the genetic history of the animal population under his control. Moreover, having upset the natural situation, he must attempt to protect his beasts from disease and weather, and to supply the food which containment prevents the animal from obtaining independently.

It might be argued that providing food for animals is not restricted to domestic animal situations. The Washo Indians of Nevada cut boughs of trees in

winter so that deer might find food, and even made clearings to encourage the growth of grasses for animal food.[4] This behavior was motivated by a desire to prolong the period in which huntable game would remain within an area, and to attract animals into suitable hunting grounds. A similar practice occurs in the modern United States almost every winter when the Forest Service feeds snowbound deer in order to maintain herds of game animals for hunting, and protect hay crops grown for domestic animals from depredations of the wild creatures. Thus the simple fact of providing food for animals is not a criterion of domestication but becomes such when it is motivated by the fact that the control man has over an animal population precludes its foraging for itself. The provision of food may range from simply reserving grazing grounds by defending them from the depredation of wild species, to the daily feeding of caged animals, the special seeding and irrigating of ranges, the clearing of new land, the slaughtering of other animals to provide food for carnivorous domestic creatures, or the gathering of waste and garbage for feeding to domestic species.

The last criterion (which would be the first to be brought into play in any specific domestication process) is that of a recognized need or desire on the part of man that can only be fulfilled by changing the relationship he has with the species of animal in the three areas outlined above. Much has been written about the first motivations of mankind to domesticate animals. While these theories will be discussed briefly later in this work, it is sufficient at this time to say that man must have a recognized need or desire. I stress the word recognized because so often theorizing about shifts in types of subsistence activity or technological processes of "levels" of culture assumes that all people will see the advantages of certain cultural traits and adopt them if they are exposed to them or if they are conceived of within the culture.

Thus we have four criteria for domestication:

1) Man must have a recognized need or desire which can be satisfied by controlling, protecting and breeding animals.

2) Man must control the animal population in question to the extent necessary to satisfy this need or desire.

3) Man must devote himself, to a greater or lesser extent, to protecting and nurturing the animals.

4) Man must be involved, again to a greater or lesser extent, in the selection of breeding individuals from the population he has brought under control.

It might be argued that these criteria fit lions in a modern zoo. There is little doubt that they do, and little doubt in my own mind that such animals should be considered as domestic. Most circus and zoo lions are, in fact, born of lions which were born in zoos. They fulfill the real, though perhaps not critical, need or desire in our culture to have such animals on display, they are under the necessary control, and man both feeds and cares for them and plays an active role in the selection of breeding individuals. This is not to say that lions are domestic, but that a few hundred or thousand lions represent a domestic population. The fact that many more lions are in the wild state, is irrelevant. If it were a valid argument, we must then conclude that all horses in the world were wild until domestic stock outnumbered wild stock, and at that time all horses became domestic. In fact, modern zoos might be called experimentation laboratories in which a number of species are undergoing

the process of domestication. Some such animals are simply captive wild animals, others are tame wild animals (Hediger:1954) while others are incipiently domestic and others totally domestic.

Potentially Domestic: The Animal Aspect

I have mentioned a number of animals not normally considered domestic, or which are agreed to be "wild" but which have been controlled, trained and even bred by man. The degree to which this control can be carried out with any species or variety might be called the domestic potential of the species or the degree of "tameability" (Hediger, 1954:76-80). It is my position that this element is the least important in considering the possibility of domestication, and that cultural factors play a far more important role. However, to support the contention that any animal is a potential domestic animal when it finds itself in interaction with the proper cultural situation, it is best perhaps to examine some of the examples of animal taming and breeding in the past.

As Zeuner points out, it seems clear that Egyptians experimented with a number of wild animals, including gazelles, antelopes and even hyenas, before settling for the more generally recognized list of animals. Whether or not these beasts were bred by the Egyptians is not known, but that they were kept in captivity and fed for some purpose is proven by wall paintings in a tomb at Saqqara dating from about 2500 B.C. (Zeuner, 1954:340-41). Certainly we are still familiar with the readiness of monkeys to accept the role of assistants to an organ grinder. Even more startling is the story of "Cap'n Adams" who is verifiably reported to have used a number of grizzly bears, taken as cubs, to carry his equipment on his journeys in the Sierra Nevada. Certainly bears in national parks have grown accustomed to human presence to a large degree and display almost none of the characteristics of so-called "wild animals." The onager gives us another example of a supposedly untameable wild animal which was once used by man and later abandoned in favor of more efficient animals. Something similar appears to have happened with certain species of gazelle.[5] The fact that African elephants have recently been captured, bred and trained by the government of the Belgian Congo suggests that the storied elephants of Hannibal were not immigrants from Asia but that the same process occurred previously in Africa. This suggestion is made even more probable by the evidence that the range of the elephant in Africa once extended much farther north.

Drawing on modern history we find many examples of "wild" animals tamed by man. The zebra, according to all accounts, is irrascible, treacherous, spiteful and mean. His general temperament, coupled with a legendary stubbornness, has long placed him on the list of untameable animals. However, we find that in the late nineteenth century zebras were captured in South Africa and used to pull stage coaches (Ridgeway, 1905:53), and in very recent years a zebra was broken to ride by Mr. Cary Baldwin, director of the San Francisco Zoölogical Park.

Ostriches were kept and bred on farms in Florida and Southern California to supply the milliners' demand for feathers, and are still maintained as a curiosity in the latter state. Florida boasts a number of alligator farms where the reptiles are bred, cared for, trained to do tricks, wrestle with men for the edification of tourists, and supply a steady source of leather for the handbag and shoe trade.

White-tail and mule deer that are tame enough to eat out of the hands of tourists, are found in many national parks, and I have seen the park deer of Japan playing the same role in that country, a role which they have fulfilled for centuries.

Advertising in magazines devoted to the trapping and fur trade suggest that there is an increasing demand for exotic animals to be kept as pets, and there appears to be a steady market for raccoons, skunks, and ocelots.[6]

Hediger describes the "taming" of a rhinoceros (1954:77) and, as mentioned earlier, both whales and porpoises have been maintained in captivity and trained to do tricks.

Trained seals, found in circuses, zoos, and the late entertainment medium--vaudeville--serve as another example of an aquatic mammal maintained in captivity and trained to work for man.

In short, it would seem that in any species there are individuals which are more or less amenable to captivity (i.e. involuntary association with man) and which can be trained to perform some service or used to supply some product. This is not to say that all animals are equally tameable. Certainly the rhinoceros, as a species, is dangerous and very difficult to capture. But we must remember that the process of domestication must take place as an interaction between individual men and individual animals, or at least small groups of animals. Certain animals are probably less fierce than others. It will be noticed that in the above paragraphs we have referred to many animals which are considered dangerous. I have not considered the degree of danger (i.e. the willingness to attack humans) as germane to whether or not an animal is tameable. Of course an animal which attacks its keepers at every opportunity after capture is certainly a poor risk as a source of domestic stock. But it should be kept in mind that all large animals are dangerous, and that part of the process of domestication would appear to be that man learn how to avoid or minimize this danger. Many so-called domestic animals are as dangerous as wild beasts. The dairy bull, for instance, requires that his handlers be constantly on the alert, and the yearly toll of farmers killed by this animal is not inconsiderable. In my own life I have come near serious injury or more at the hoofs, horns, or fangs of a "pet" dog, a Black Angus steer, a "tame" deer, a terrified six-month-old colt, a boar and a stallion. I have seen many stallions maintained for breeding which required their keepers to observe more caution than one sees among the handlers of "wild" animals at zoos.

It further appears that if danger were a barrier to cultural change and development, mankind would not have progressed far. Certainly no voyages of exploration and settlement would have been made, nor would mountains have been climbed, wars fought, bridges built, or mines sunk. Nor would many hunting peoples have survived. It is possible that an animal confronted by a given social or cultural situation is too dangerous to handle--the American bison, for instance, in times past when he roamed in great herds and was able to smash his bulk through wooden fences. However, today a ranch in Costa Mesa, California, raises bison largely as a tourist attraction and for the use of motion picture companies, using techniques not too different from those of a regular cattle ranch. Certain aspects of bison behavior must be met, such as the propensity for charging at headlights at night, but the danger of handling buffalo has not

deterred this profitable enterprise. The musk ox, for centuries hunted by Indians in northern Canada, is now subject to domesticating experiments which are, with modern equipment and technique, meeting with success.

Early attempts to contain and breed fur bearers such as the fox and mink resulted in many captive animals killing themselves in attempts to escape, refusing to eat and thus starving, or refusing to breed. However, those animals which did adjust themselves to captive life became the foundation stock of what now are unquestionably domestic animals.

The data offered above are not meant to suggest that there is no difference in response between the various species of animals, but that the difference of response may be met by man's adjusting his behavior to fit it.

Zeuner has pointed out that most of the animals domesticated by man in the shift from hunting to agriculture were gregarious herd animals (1954:326-352). He further suggests that these animals were more apt to form a symbiotic relationship with man prior to actual domestication. These relationships he envisions as an overlapping of the social habits of the two species--man and animal--in which man slowly gained the upper hand. The reindeer, he points out, represents an example of this symbiosis carried to the extent that nomadic human groups are parasites on nomadic reindeer groups. He suggests that the dog may have become domesticated through association with man in mixed hunting packs of men and dogs which formed through the association of dogs, as scavengers, in the camps of men. He points out that almost all domestic animals save the cat are to one degree or another gregarious, herd-going animals. Thus, while supporting the idea of the biologic base of domestication potential, Zeuner interjects social and cultural considerations into the relationship.

Domestication Potential: The Cultural Aspects

Human beings operate in a social milieu which serves as a medium of transmission of traditions, both ideational and behavioral, which we call culture. How might these human factors come into play to make possible the domestication of certain species of animals and the rejection of others? What this question demands is not a general theoretical answer in terms of levels of socio-cultural integration (Steward, 1956) or energy sources (White, 1945) but a discussion of process. By what specific means can certain groups of animals be brought under control, kept and bred for man's use? Before attempting to discuss this point on a theoretical level let us examine two situations from recent history, in an attempt to isolate the influential factors which operated to make what would seem an impossible experiment successful and cause a failure of what seems, now, a situation from which domestication would flow almost automatically.

I have mentioned the enterprises in Southern California and Florida which keep pilot whales in huge tanks, for the entertainment of tourists. These sea animals weigh 2,500 pounds, and are nearly twenty feet long. Although air-breathers, they cannot survive long out of water because the weight of their bodies is so great that they will collapse and strangle if not supported by their normal medium. In addition, they are immensely strong, extremely intelligent, and difficult to locate in a wild state. The task of catching one whale, bringing it ashore, placing it in a tank and keeping it alive is an immense one. Before the hunt could begin, an expensive establishment ashore had to be built.

In this case, a tank some thirty feet deep and eighty feet long was constructed. A complex pumping plant was maintained, supplies of fish secured for feeding, and a staff of men expert in the care of aquatic creatures was retained. What social or cultural factors could bring about such an undertaking, when there appears to be no practical economic reason for the capturing of a live whale in the first place?

Let us examine first, because they appear to me more difficult to isolate, possible cultural factors. The whale has a unique place in European-American tradition. The species finds its way into both Jewish and Christian religious tradition. Its pursuit for whale oil and baleen created great industries on both sides of the Atlantic. In America, in particular, the curiosity and concern with the whale can be suspected when we consider that one of the first classics of American literature dealt with a whale as a central theme (Melville, Moby Dick), that a book about the whale and whaling was recently published as a popular work (Sanderson, Follow the Whale), and that a men's magazine, devoted largely to the relations between men and women, felt a story about a whale to be suitable for its pages (Doyle, Playboy). The desire of the American public to see a whale is evidenced in my own memory when during the early 1930's a regular occurrence in my Southern California hometown was the appearance of a gaily decorated flatcar carrying a preserved but odoriferous whale, owned by a gentleman who affected a seafarer's cap and charged ten cents admission.

Coupled with the national concern with the whale we have the popular zoo tradition stemming from Europe. While kings and potentates of all times and areas seem to have kept menageries or "paradises," the development of the public zoo, and from it the natural science oriented zoölogical park, seems to have reached its peak in Europe and America. Certainly one of the symbols of civic identity in the United States is the maintenance of a zoölogical park. Similarly, the idea that children should be taken to the zoo as part of their education is widespread, and a visit to the zoo is considered by and large an acceptable pastime for adults. This nebulous, but nonetheless real, situation, then, creates some of the raw material of a "need" or "desire" on a cultural level. It is recognized in the United States that people are willing to, and, in fact, seem to want to look at whales. Add to this the fact that within our cultural system making profit is a positively sanctioned activity. Given the situation, that people will pay to look at these sea mammals, and that it is right and proper to make a profit showing such creatures, we have what has been called earlier a culturally recognized need or desire.

How this need or desire has been satisfied requires an analysis of the socio-economic-technical level of development. The complex and rich American society has in its diversified populations specialists who can catch and handle whales, who understand whale nutrition and health problems, who can train whales. Moreover, its technology can take on with relative ease the task of constructing large outdoor tanks pierced with windows for viewing. A complex and efficient system of credit can finance the building of these structures and the operation of the enterprise.

More important, the organization of our society is such that there are many people able to take advantage of the enterprise and visit the aquarium. They can do so because the economic level of the population is high enough to

permit the expenditure of funds on such activities and because of two institutions--the "week-end" and the "vacation"--which are part of our socio-cultural structures. The long mid-summer vacation permits the aquariums to count people from throughout the nation as potential audience.

We may even consider here, briefly, the environmental factors which affect such activities. The weather in California and Florida is apt to be mild during long periods of the year, permitting a financially feasible season during which outdoor entertainment is possible.

While it is not suggested that only under the above conditions would it be possible to contain and attempt to breed whales, it is suggested that, in fact, only under these conditions has it happened and that the above factors have been influential in shaping the enterprise. Certainly other systems of governmental and economic organization could have devoted themselves to such a task, but probably not for the reasons which have inspired the present enterprises.

The example of the whale has been selected because it represents perhaps a most complicated and difficult attempt to bring animals under control systematically, and because, as it is a limited effort, the factors involved appear more clearly. It will be noted that the psycho-biological make-up of the whale has hardly been considered as a factor in determining the success of the enterprise. What has been considered crucial is the ability of a society to create a situation under which whales can be contained, trained, kept healthy and possibly bred.

While the whale appears to be the most unlikely of mammals to add to the list of domesticated species, the quagga, a species of equus until recently extremely common in South and Central Africa, would seem most promising. This animal appears to have been about the size of a small horse, and extremely docile (Ridgeway, 1905:80-85). It commonly joined the herds of domestic horses kept by Boer and English farmers. It was easily tamed and very sturdy. Moreover, it was resistant to many of the diseases which struck down horses of European descent and was more alert and able to evade the African carnivores which preyed upon the domestic stock of Europeans. This one factor made it useful for a time to have a few quagga with a domestic herd, because they were able to warn their less wary cousins of the approach of lions and leopards. Nonetheless, no attempt was made to domesticate these animals systematically, and most farmers looked upon them as vermin, competing with European stock for food, and hunted them indiscriminately until the species became extinct.

Just as we asked under what circumstances can whales be domesticated, we can also ask what circumstances prevented the domestication of the quagga. Clearly there was no recognized need or desire. Certainly an animal which voluntarily joined domestic herds would not have taxed nineteenth century technology or ingenuity to capture wholesale. No extra or different techniques appear to have been called for to maintain the animals under control and use. Apparently, then, the failure to domesticate an animal, which would have been in many ways superior to imported horses and was in plentiful supply, thus eliminating the need to import horses by sea, lies on the socio-cultural level of analysis.

The job of capturing and taming animals classified as "wild" may well have been one which the Boer or English farmer could not include in his own self image as a farmer. Such work was perhaps, in his eyes, the work of an animal tamer or circus performer. In addition, the task of breaking even a relatively tame wild animal could not have been less than that of breaking unbroken horses, a job which has generally, in European and American societies, been relegated to a specialist, the horse breaker or trainer or, in the American West, the bronc buster. On the other hand, both the Boers and the English had a tradition of hunting and readily available, easily huntable animals, such as the quagga must have activated their desire to shoot, particularly in the case of animals they viewed as pests.

Another factor may have been that the socio-economic system within which the European farmers in Africa operated worked in such a way as to block adoption of the quagga. Despite the attrition rate of horses imported from Europe, America or Australia, the supply appears to have been constantly refreshed. Thus, as disease and predators removed a horse from the scene, another appeared to replace it as a result of the interaction between the commercial pastoralism of Australia and America, the network of shipping facilities and international credit systems. This meant that the loss of horses, while it might bring disaster to a single farmer and would, of course, be annoying to any farmer thus afflicted, did not seriously threaten the supply of horses.

On a cultural level both Boers and Englishmen shared the European attitudes which related horses to the status system (Willems:1955) and relegated the mule to an inferior and secondary role, particularly as a riding or carriage animal. The quagga looked not unlike a mule and may have offended the equine tastes of the European conquerors, throwing up another barrier to any serious or systematic attempt to domesticate an otherwise useful animal.

Another factor may well have been the classification of the quagga as "wild," which, in the minds of most of the people who came in contact with the animal, precluded consideration of it as a domestic creature. The South African colonist, particularly the Boer, has proved to be a conservative, fundamentalist in religion, exclusive in racial attitudes and resistant to language changes. He would very likely have rejected as newfangled, radical, or perhaps even unchristian, any suggestion that the quagga be domesticated.

In the terms outlined above, to define domestication and suggest the initial conditions of the process of domestication, the quagga was not domesticated because there was no recognized need for it. There was a need for horses, but the cultural and social systems of the population provided a familiar solution which masked the obvious one.

These two examples suggest, then, that the factors which affect the bringing of a specific animal into a domestic relationship with mankind are extremely varied and complex. Both social and cultural systems are involved and, we can presume, personalities play an important role. This last level of analysis, however, is not germane to the subject of this paper.

What I have tried to develop in the foregoing sections is a view of domestication, not as an incident in human history, but as a continuing historic process. The evidence of the tameability of individuals in an extremely wide

variety of animal species suggests that in general we can assume that within the population of a species there will be found at least some individuals which will adjust to the presence of man, respond to man's handling, and continue to thrive and breed in the new condition.

It seems obvious that all species will not have within their numbers the same ratio of "tameable" individuals. This observation suggests, then, that the domestic potential in an animal species is in fact the proportion of "tameable" animals in a given population. If we assume that this ratio remains fairly constant, we must further assume that the possibility of domesticating this species rests in the willingness and ability of a human group to seek these animals out.

This discussion would lead to a view of domestication very much the same as our view of man's utilization of the metal resources of the earth or his continuing domestication of plants hitherto without use.[7] Metals provide a clear analogy, inasmuch as the first metals to be used, wherever metallurgy appears to have developed independently, are copper and gold, which are easily obtained and worked metals. As knowledge of metals increased and metal working skills expanded, other metals more difficult to obtain and work were discovered or developed. Each of these required, beside a desire for a better metal, a level of technology and social organization which made its extraction possible. Thus copper could be taken "raw" and worked, as we see in the Near East, Mesoamerica, and around the Great Lakes of North America, by peoples with little technological knowledge. Further development of copper techniques and the making of bronze required smelters, forges, and later mining technology, as well as at least some craft specialization.

Skipping over bronze, iron, and steel, we can see that the extraction and use of aluminum required, among other things, sources of electrical energy. This of course required dams, powerhouses, transmission lines, etc., all of them based on the complex scientific and socio-economic organization operating within the value and motivational framework of modern industrialized civilization.

Similarly with the animal resources of the earth; to utilize any species requires a set of conditions of society and culture which make possible the actual change of relationships. Thus, no matter how much a society might need or want a specific animal to supply it with services or products, unless that society has an organization which will support the process, the species cannot be domesticated. It is highly unlikely, in fact, that any "society" as an entity ever sat mooning over animal resources it was unable to utilize. Unless the structural, ecological and cultural systems were such that it would be possible, one suspects that, like the quagga or the eland (Huygelen:1955), animals which a society was unable to capture and control, simply remained "wild" in the minds of men; and only dreamers and mad men, if even they, considered any other possibility.

Types of Domestication

Perhaps one of the stumbling blocks in the way of a clear cultural definition of domestication has been a tendency to see all man-animal relationships save that of obvious captive wild animals or hunter and quarry, as domestic. A cursory examination of the various domestic relationships, however, shows that it is possible to draw up types of domestic usage. This typology could be made extremely detailed and multi-categorical. In this paper, which is devoted to an

examination of the origins of domestication, I feel that such a typology should be useful in examining the initial stages of domestication and have by and large used criteria based on the predomestic condition of the species in question. However, this has not been the only criterion, and archeological evidence, ethnological reports, and the nature of certain species have also been used.

Type 1. Herd Animals

The earliest evidence of domestication (save of the dog in Europe) is found in the Near East and suggests not a single species but a complex of animals (Dyson:662-667). The goat, sheep, cattle and swine appear to have come into domestic relationship with mankind throughout the fertile crescent at approximately the same time. Shortly afterward the complex is joined by the onager, and sometime later there are at least suggestions that experiments with gazelles were carried out. The ass appears on the domestic scene either coeval or shortly after the onager. By the beginning of the second millennium it is safe to add definitely the horse, elephant, camel and water buffalo. In other areas, somewhat remote from the area of origin, the yak and guar appear to have become domesticated. While various sub-species were substituted for the original races domesticated in the Near East, the diffusion of domestication farther into Asia, into Europe and Africa brought no new genus under domestication. The almost tame, well-fleshed eland remained unused save as quarry in Africa, as did a whole host of antelope and gazelles, which were better suited to the environment than were cattle. In Europe the woods bison was hunted to extermination, as were the auroch and the tarpan, despite close relationships to already domestic stock.

One can establish, then, as the first and perhaps most important type of domestic animal, the herd animals. However, there appears to be a distinct difference between the first animals named: goat, sheep, cattle and swine, and later additions. It seems logical to divide this group into those animals which appear to be part of the first domestic complex, as suggested by archeology.

Once these animals had been made the partial basis of a new economic system, and once the techniques of taming and training animals had been learned and specialists developed, the conscious experimentation with other animals followed. Some such experiments were successful, and others failed. It seems that the onager, ass, elephant and camel were suggested as possible domestic animals and were the subject of conscious experiment, while the yak, water buffalo and guar are substitutions of animals in areas unsuited to the original domestic stock. These substitutions may have been made either by indigenous non-domesticators, stimulated by example (Kroeber;1948:368, 691) or by domesticators who, in migration and resettlement, found their original stock unsuited to the new environment. The elephant, for instance, must have been domesticated as a conscious effort on the part of people already well aware of the potential of animals. The magnitude of an elephant drive is such that it can be undertaken only by a society of a size and an economic stability great enough to devote the efforts of several hundred or thousands of men over several months to the capture of animals.

Another difference between these two types--goat, sheep, swine and cattle on one hand, and horses, asses, camels and elephants on the other--is in

usage. The first group essentially supplies food--milk, meat, fiber, wool or hair and hides--and secondarily power. The second group is essentially a power source, with milking a secondary usage in some areas and meat in others. The suggested process of domestication of the first group will be discussed in detail later in the paper. The second we can hypothesize were domesticated through the conscious efforts of people already familiar with animals.(Downs MS).

Thus we have herd animals divided into two types. Primary herd animals, which were first domesticated by man in the Near East, include the goat, the sheep, cattle and swine. The yak, guar and water buffalo appear to be simply adaptations of this first domestic phenomenon and, unless we can find evidence of independent invention of domestication involving these species, will be considered primary herd animals. Secondary herd animals will include all herd animals which have been brought under domestication because of desires motivated by the original domestication, using knowledge developed by earlier domestication. Thus the onager, ass, probably certain gazelles, the horse, camel and elephant would be secondary herd animals. In our own times the musk ox, small populations of American bison, African elephants, and perhaps in the near future the eland as well as elk, if Soviet experiments prove successful, would all be included as secondary herd animals (Knorre:1953).

Type II. Pack Scavengers

The dog, which appears to be the first animal to have entered into a domestic relationship with mankind, is certainly not a herd animal. The species is gregarious and does travel in small packs. This description also fits most wild swine of which we have knowledge. Both of these animals tend to be omnivores, with the ability to use the waste of human occupation areas. These two species appear to be the only ones with a social nature of this type to have been domesticated. Swine present a puzzle inasmuch as they may have been domesticated by a process much different from that which the dog experienced, despite the similar social and ecological conditions of the two species in the wild. It may have, in fact, undergone different domestication processes in different areas, and might be included with type I animals.[8]

Type III. Symbiotic Carnivores

Two carnivorous animals have a long-term domestic relationship with mankind: the cat and the ferret. The relationship of the former appears to have existed under a wide variety of conditions. Almost any urban alleyway is the haunt of cats which live not with, but from, man, scavenging in garbage cans and prowling in his basements, warehouses, parks, vacant lots and back yards for game. At the same time many cats exist in the highest luxury of any domestic animal, with food, health, breeding and living conditions carefully controlled. Their raison d'être may be simply to win prizes in cat shows. Between these extremes are many gradations of pet, companion and co-inhabitant of human habitations. One suspects that this range of variation existed in ancient Egypt as well, with some cats enjoying sacred status and others roaming the streets and alleys of the Nile civilization. Essentially, however, cats appear to live in haughty and independent symbiosis, resisting any attempt to train them, and exhibiting an amazing ability to shift for themselves with or without mankind.

The other carnivore regularly kept as a domestic animal by man is the ferret, which is widely used to control rat populations, and is a sporting

animal in Europe (Camp:66-67). One suspects that the ferret's present situation stems from a symbiotic relationship of the past, and that the ferret and cat can be classed together.

Type IV. Reindeer

This single species has been typed separately because any discussion of the reindeer is apt to lead into so many avenues of speculation and raise so many questions that it seems unwise to attempt to treat it with other types of animals. This situation may simply stem from the fact that the reindeer has received a great deal of attention from culture historians and ethnologists, and the questions about it have thus been aired more completely than have those about other domestic species. However, it appears to me that something more than the accidents of disciplinary history make it advisable to treat the reindeer separately. The nature of the animal and the nature of man's relation to it suggest a separate category and a separate history.

V. Secondary Pets and Exotics

A number of animals kept in recent times as pets, such as ocelots, raccoons, skunks; certain animals recently controlled for specific purposes--commercial or scientific--such as the mink, fox, rat, rhesus monkey, alligator, etc.; and simple exotics such as animals bred in zoos, like the lions mentioned earlier and the spectacular whales, represent types of domestication based on a long tradition of animal usage in our society. The specific reasons for domesticating certain species are as varied as the species themselves. They obviously do not fall into the area of this investigation--that of origins. They are analogous to the development of aluminum in a discussion of metallurgy. They will not be treated further. One species, the rabbit, included in this list, perhaps should receive further treatment, but it will be excluded from discussion for lack of information and because in the overall history of domestication it is a late-comer.

In the paragraphs above I have outlined a typology of domestic animals based on the social nature of the animals, the evidence on hand for domestication, and certain aspects of current domestic usage. This typology can be systematized as follows:

Type I. Herd Animals
- Ia. Primary Herd Animals: goat, sheep, cattle (swine?)
- Ib. Secondary Herd Animals: onager, ass, horse, camel, elephant, and a number of recently domesticated species.

II. Pack Scavengers: dog and swine

III. Symbiotic Carnivores: cat and ferret

IV. Reindeer

V. Secondary pets and exotics: various animals domesticated for specific purposes.

Typology of Hunting Methods

From the ferret to the whale, all the animals listed above have, prior to entering into a domestic relationship with man, been in the position of quarry. While indisputable evidence of Austrialopithecus' hunting is lacking and this hominid may have been the hunted rather than the hunter, other Paleolithic evidence beginning with Chou-K'ou-tien and Oldoway, supports the contention

that man has been the pursuer of animals for food, and probably for fur and leather, through most of his history, and until domestication was developed this was his only relationship with the other animals on this planet. It seems profitable at this point to examine in detail the various ways this hunter-quarry relationship may be expressed.

Before attempting to delineate a typology of hunting methods, I must emphasize that what will be developed will be only an analytical classification stressing elements of hunting technique which appear significant in the present context. What it is actually is an exposition of the logical ways of killing animals abstracted to a degree which will permit inclusion of a number of variations in technique under a single heading. The examples given from ethnography should not be interpreted to mean that the people in question hunted only in the fashion described.

Forde has provided us with an excellent survey of hunting methods based largely on the type of weapon used in the hunt--crushers, entanglers, piercers (1954:155)--a classification which, while useful for some purposes, does not lend itself to examination of the question at hand. The approach I propose is to set up types based on the method used by man to bring an animal into a killing position. I take this position for two reasons: first, the way a hunter approaches his quarry will be decisive in the things he must know about the animal in question; second, his method of approach will shape the skills and techniques he must develop in order to conclude a hunt successfully. The assumption on which this thinking is based is that in certain types of hunting, hunters learn skills and techniques and develop attitudes which can be applied directly to domestic situations, and in other types they do not.[9] Further, I suggest that in most types of hunting it would be impossible to suppose that domestication would develop from the hunting relationship and that in certain others it is logically possible to suppose that it did.

The first and perhaps most common of all hunting techniques is that of stalking. In this technique an individual hunter, using spear, club, bolas, bow and arrow, throwing stick, atlatl or firearm, moves into the domain of the animal with the intention of coming as close as possible to his quarry before he is discovered and makes his kill. He must have an intimate knowledge of game habits, so that he can put himself in the vicinity of game. He may effect his approach by stealth and concealment, lures and decoys, or the use of camouflage. The method may be simply to move quietly through the forest, counting on his woodcraft and eyesight to get him close to animals without disturbing them. On the other hand he may well not expect to take his game before it becomes alarmed, and counting on his skill with a missile weapon, to make a hit before the game escapes. To be a stalker, a man, whether a twentieth century vacation hunter or a Paleolithic hunter, needs woodcraft, a knowledge of animal habits, some ability as a tracker, skill with his weapon, and a great deal of self control.

A most passive method of hunting is ambushing, in which the hunter waits in concealment along game trails, either for the occasional appearance of an animal or more frequently while his companions drive game before them. In modern United States a deer hunter may simply pick a likely spot and wait for deer fleeing from noisier and more energetic hunters. The Eskimo waiting at a blow hole for a seal is another example of ambushing. Patience is perhaps the most important trait needed for ambush hunting, but it must be combined with a knowledge

of game trails, animal habits, skill with weapons, and the ability to act decisively when game appears.

Ambushers often cooperate with a group of drivers, but driving deserves to be classified as a separate method. In this method animals are driven from their haunts by a large group of hunters who follow the fleeing beasts until they are forced into a position where they can be dispatched by their pursuers, such as on a lake or over a cliff. The principal difference between this method and the next one is that the game is taken in number.

On the other hand, trailing puts a number of hunters on the trail of a single beast. It is perhaps the commonest method, other than stalking, for the killing of fierce carnivores. The Masai, for instance, find the spoor of a lion, follow it until the lion turns at bay, and then attack him with spears. Similarly, cougar hunters, bear hunters, or fashionable fox hunters use hounds to locate the trail of their quarry and pursue the animal until it is brought to bay where it can be dispatched. In addition to the skills required for stalking and ambushing, the trailer often must call upon a great deal of courage when facing a large animal at bay. He must have, as well, a great deal of tenacity and a knowledge of animal fighting habits, because, unlike the other hunters, he most often must meet his game face to face rather than kill it while it is unaware or fleeing.

The use of devices which kill, cripple, or capture animals without man's direct involvement in the process is called trapping. Snares, deadfalls, the Eskimo bloody knife, poison, and spring traps are the tools of the trapper. His trade calls for a knowledge of game trails, animal habits and appetites, and a degree of technical ingenuity not required in the other methods.

The final category can be called corralling, a method in which game, invariably herd animals, is lured and driven into man-made or natural corrals where they can be dispatched at will. Corralling requires a knowledge of animal habits and the development of driving techniques which will move animals toward the corral and without unduly disturbing them and causing them to flee in panic. Only in the final stages can the beasts be excited and stampeded into the pen. An example of the method is found throughout the Great Basin of North America where the Paiute and Washo as well as Ute and Shoshone hunted the pronghorned antelope and deer in this manner.

Let us now compare these types of hunting methods in terms of the outcome of a successful hunt. The stalker or ambusher ideally has a dead animal at his feet, taken while it was unaware, or caught in mid-leap by a well-aimed spear, arrow, bullet, throwing stick, or dart. The driver finds himself confronted by animals at a disadvantage, swimming in a lake or struggling, injured and dying, at the foot of a cliff. In either case the animals can only be killed to bring the hunt to an end. The swimming beasts would simply escape if the hunter did not take advantage of his mobility in a boat to dispatch them. The trailer is confronted with a live animal aroused, frightened, and dangerous. Smaller animals such as the fox, coon, or possum could be taken alive but only by risking a severe bite. The stag, auroch, wild boar, lion, bear, etc. must be killed rapidly before they kill the hunters or turn and run once more. The trapper finds himself with individual dead animals. Most trapping methods kill or mortally injure the game.[10] Only the hunter using the

corralling method finds when the hunt is over that he is confronted with a group of animals of all ages, alive and unhurt.

It is not necessary to attempt to reconstruct the thinking of a man long dead to draw from this situation the step which might lead to domestication. Ethnographic material reveals that even the impoverished Paiute often kept the pronghorn antelope corralled for a week or more, killing only a few animals at a time to prolong the meat supply without spoiling. This, it would seem, is a logical basis for experimentation in domestication. It requires no reorientation in attitude toward the game but simply an extension of established patterns for a longer period than is normal.

The obvious suggestion in the foregoing section is that hunting animals by corralling is a necessary precondition of domestication in its original stages. Before the question can be discussed it must be immediately limited. It is the position of the writer that this is probably a precondition for the domestication of primary herd animals in the Old World. Other species, it will be argued, came into domestic relationships with man through other processes, which will be discussed later. At this juncture, however, it seems wise to review the various theories dealing with the origin of domestication which have been offered in the past.

Origins: A Review

In discussing origins it seems inescapable that many, if not most of the world's societies, received domestic animals, or the idea and techniques of domestication from other societies through the processes of diffusion. No purely structural argument can refute the many documented instances of such acquisition in historic times. Nor could any purely structural argument hope to explain the rather limited number of species which have been domesticated by man without recourse to explanations based on the biologic make-up of the animals involved.

Nevertheless domestication did rise independently in the Near East and in the New World and possibly in Southeast Asia (Sauer:1952). Equally important is the fact that in many areas of the New World and Africa, peoples, who must have been aware of the uses to which animals were put by more advanced neighbors, did not domesticate either native animals or animals received from neighboring pastoralists.

This fact is important to keep in mind as we review some of the theories put forth in the nineteenth century to explain the origin of domestication in evolutionary terms. In attempting such a review it is often difficult to cite precisely the writer who first put forth some of the arguments as to origins, because in the ensuing years some of the explanations found their way into the body of popular thought and were repeated without indication of source. Thus citations should be considered as examples of such arguments rather than original credit for developing the idea.

Probably the most widespread of notions is that domestication springs from the practice of keeping pets. Such an hypothesis fitted perfectly into an evolutionary framework, explaining in one simple theory the fact that some peoples had no animals, others had pets, and others had varying numbers of domestic animals. Unfortunately, the idea did not disappear with the framework and can still

be found in culture historical literature (Linton:1955). However, examination of the notion suggests that the fact that most people keep pets of some kind refutes this theory of origins rather than supports it.

First we must ask: if all peoples tend to keep pets of one kind or another, why do we find many peoples who do not domesticate? Examples of pet-keeping can be found endlessly in ethnological literature. The Mundurucú catch, keep, and even suckle peccaries but never consider killing them for food, although they hunt their free cousins (Murphy, R. F.:personal communication). Pets are kept by many other South American peoples. The Australians are reported to keep cassowaries and kangaroos, with no idea of killing them for food or using them for religious purposes, feathers, or anything else save the curiosity of having them (Zeuner:1954, 330). Africans seem to display, almost as a diagnostic trait, a desire to catch and keep young animals of all species. Lowie reports that Crow hunters often brought buffalo calves into camp for children to play with (1935:37). Although he unfortunately does not tell us the eventual disposition of the animals, it seems clear that it was not in domestication.

These examples show pet-keeping in a pure form, inasmuch as the animals are apparently taken and contained with no other purpose in mind than to have them about, as curiosities, companions, or playthings.[11]

Other peoples have kept animals for specific purposes, suggesting a type of man-animal relationship somewhat different from the pure pet-keeping just discussed. The Ainu, for instance, take young bears, maintain them for a period and then kill them ceremonially (Murdock:1940, 188-89). One can scarcely imagine hunting and gathering Ainu with enough food to maintain ceremonial bear farms, and it is safe to postulate here that the subsistence problems of the people would preclude any elaboration of the man-bear relationship into a truly domestic situation. The problem of supplying meat to large carnivores probably is one reason why they have received little attention as objects of domestic experimentation. The Siane of New Guinea keep cassowaries in enclosures so that they may take the prized feathers for head dresses. Such situations are rare (Salisbury has estimated, in conversations, perhaps one village in eight) because the catching of cassowaries is entirely fortuitous and the effort spent to maintain and contain a single bird is considerable. A number of American Indian groups kept eagles for their feathers and South American peoples have been reported capturing and keeping parrots for the same reason. In none of these instances can we find the practice of keeping captured animals for such purposes leading to anything which resembles domestication. It is safe, then, to discard the idea that man's proclivity for keeping pets or capturing young animals and birds for specific purposes has resulted in the domestication of animals except in occasional and minor instances, and was certainly not the origin of domestication.

Another argument would seem to have significance at this juncture. Animals maintained as pets, that is, for the pleasure and companionship of man, are generally endowed with a number of anthropomorphic attributes. Deep emotional attachments between man and his pets develops. Murphy reports that the Mundurucú reacted with horror to his suggestion that they eat their breast-fed peccaries. We know that while dogs are eaten in a number of societies, where they are maintained as pets the idea of eating them is generally abhorrent. Among the Washo Indians dogs are kept as pets in a rather negligent manner, although efforts are made to feed them. The habit of eating dogs reported of other

tribes brings a contemptuous reply from a Washo informant and a vigorous denial of such a habit among the Washo. The predicament of a family buying a Thanksgiving turkey too far in advance of the holiday and becoming fond of it, while probably uncommon in these days of refrigerated eviscerated birds, is still a situation which is recognized as real when presented in newspaper comics or seasonal fiction.

It has been suggested that various non-utilitarian desires, such as the pleasure of ownership, esthetic appreciation of certain animals, or the need for religious sacrifices motivated the first domestication experiments. The Ainu example would support this, as would the practice of capturing eagles by many American Indian tribes. However one suspects that animals taken specifically for killing (or eventual release as was the case with many Indian groups) would probably never be given the opportunity to found a domestic population. In the context of this paper, however, this argument can be accepted as a recognized need or desire as well as could a need for meat or wool or power. My own objection is that the recognition of a motivation does nothing to explain the process. The question remains: once a population decided to keep a supply of animals for sacrifice or to enjoy as objects of beauty, how did it learn the techniques of animal handling without a previous example? This, like the pet theory, requires that we assume that one animal-man relationship will inevitably suggest another and more complex one. All the evidence is that this is not necessarily the case. In the case of animals maintained purely for pleasure it has not been clearly shown that such motivation was the original impetus for domestic experimentation, although such practices are common now.

E. Hahn (1896) has suggested that the original uses to which animals were put by man may not be the use which we might hypothesize today. This appears to be a sound position. This paper, however, attempts to present a framework for thinking about domestication which will not require speculation about motivation to explain the process of domestication. Whether man "needed" domestic animals for beauty and only later saw their value as food sources or vice versa, it was necessary for man to contain a foundation stock, and learn how to handle these animals. This is the process we are exploring.

A third explanation is that offered by, among others, V. Gordon Childe and can be described as one of the many corollaries of the theory of desiccation in the Old World (Childe:1952). This argument suggests that the drying up of the Near East drove both men and wild animals into situations where they were in closer association than they had been in the past.[12] Assuming a development of agriculture, Childe pictured the wild herds existing on the stubble of man's harvested fields and finally drifting into a domestic relationship with man. The paramount objection to this argument is, of course, that we have no evidence of a major climatic change in the past ten thousand years in the Near East. But even if we accept the doubtful assumption that desiccation did occur, Childe's argument is still flimsy. While animals may well have grazed on the stubble of early farmsteads, we can be certain that they were driven away from the planted and growing fields and therefore were not passively accepted by men, but for the larger parts of the year were, in fact, enemies to be frightened, stoned, and killed to protect the human food supply. Moreover, it seems inconceivable that the stubble of early agriculture was sufficient to maintain herds of wild animals for more than a few days at the most. The cold facts of animal units per acre would tend to refute this idea.

Far more sophisticated are the arguments of Zeuner, who draws up a system of degrees of parasitism and symbiosis between men and animals (1954: 332-333). He suggests that some species of animals were able, in fact, to accommodate themselves to man's presence in order to take advantage of man's refuse. This argument may well hold for carnivores such as the dog and possibly for omnivores like the pig. However, the refuse of an early agricultural village would scarcely have provided much subsistence for large herds of animals such as cattle, sheep and goats.

His argument is on much sounder ground as he discusses the reindeer and its dependence on human beings to supply certain minerals and chemicals in urine. He discussed, in addition, the symbiosis between herd animals and nomadic hunters which might possibly lead to domestication. Zeuner's arguments, possibly because they are not couched in evolutionary terms, provide an excellent theoretical framework within which one can examine the problem in greater detail. He does fail, however, to offer explanations for the inescapable fact that some peoples have domesticated animals and others have not, and only partially explains why only certain animals have become domesticated. The importance of Zeuner's arguments to the problem outlined in this paper is that he recognizes the problem of domestication as a question of a changing social relationship between man and animals based on the social relationship prior to the domestication of the species in question.

While I have taken a generally negative position towards the theories outlined in the last section, my objection is not that they are totally incorrect, but that as an explanation of all domestic phenomena each one fails to provide enough room for all the evidence. The pet theory would appear to be the least likely to explain any original domestic phenomenon, for the structural and psychological reasons mentioned above. The arguments against Childe's theory have been outlined, but it should be repeated that in at least some degree Childe uses a single origin theory to explain all domestication. Such approaches implicitly or explicitly must depend on the assumption that the "idea" of the domestication of all animals will spring from a single experiment in the domestication of one species.

Having established what appear to be four logical types of domestic animals and a number of pre-domestic relational situations, let us explore the problems of origins in terms of these four animal types.

The Primary Herd Animals

Primary herd animals appear to have been domesticated independently in the Near Eastern Fertile Crescent of the Old World and in the coastal villages of prehistoric Peru. Evidence from the latter area is as yet so sparse and inconclusive that discussion of New World domestication must be held in abeyance. I have discussed this evidence, much of which is yet to be published, with Prof. John H. Rowe without coming to any conclusion as to whether the hypothetical sequence of domestication which I will present will fit the facts or not. Certain facts appear to parallel Near Eastern evidences, others clearly do not. The speculative sequence, then, will be limited in its scope to the process of domestication in the Old World.

Considering the various types of hunting outlined earlier, I have already suggested that the corralling method of hunting develops in people who practice

it certain attitudes and techniques related to animals which are useful to domesticators. Moreover, the situation at the end of a successful hunt is one which requires only a slight change in the practices of the men involved to become an experiment in domestication. No drastic reorientation either in motor habits or attitudes is necessary. Let us reëxamine corralling for a moment. The driving of a group of wild animals toward a desired location is not far different from herding domestic animals, which requires patience, a knowledge of what may be expected from the animals, a restrained and subdued manner (anyone watching cattle being herded by cowboys must certainly be struck by how little it resembles the hat-waving, yip-yipping motion picture version). The hypothesis which this discussion suggests is that one can expect domestication to rise among peoples who practice the corral method of hunting.

The immediate question is, then: why hasn't domestication developed among all peoples practicing this form of hunting? In reply, it seems that we must rely on the concept of cultural or social potential developed earlier in this paper.

The Paiute, for instance, clearly saw the advantage of keeping animals to be killed as needed. They had a recognized cultural need for domesticated pronghorn antelope. However, the Paiute lived in a none too hospitable region, maintaining a tenuous hold on life by intensive gathering of seeds, roots, berries, pine nuts, and the taking of almost every form of animal life found in their semi-desert home. They lived in small bands without permanent leadership except of the most informal kind. Antelope hunts provided one of the few instances when several bands of these people operated together under any form of leadership--in this case a shaman credited with the power to charm antelope into the corral.

In short, they had neither the resources nor the social structure necessary to support long-term experimentation with domestication. It is doubtful that a herd of antelope could support several bands of Paiute for any length of time. Moreover, to continue a domestication program the majority of the animals must be kept alive to procreate. It seems improbable that a gathering people in this environment could have collected food enough for even a small herd of animals and themselves as well. Thus, despite a recognized need, there was simply no basis for further experimentation in the social structure or the economic resources of the Paiutes.

One might ask why the bison was not domesticated by Plains Indians who used the corralling method regularly, well into the horse period (Lowie:1954, 14-15). Here again the answer lies, at least in part, in the social structure and technology. While bison could be taken in large number in corrals, it is inconceivable that simple agriculturalists could have grown enough fodder for the immense beasts. The animals could not be grazed on the open prairie and there was, in fact, no way of fencing large areas of pasture in which animals could be contained until the invention of barbed wire in the late nineteenth century. It is possible that a smaller, more easily handled animal could have been domesticated by the Plains Indians or the agricultural tribes of North America if such animals had been available. But in the East the deer represented the smallest of herbivorous herd animals. Perhaps the clearest picture of the problems of maintaining whitetail deer in conjunction with subsistence agriculture is painted by Rawlings in her novel, The Yearling. Certainly no people can afford

to devote large amounts of energy to fence-building when planting and hunting must go on to keep the daily subsistence level up to the norm.

From this discussion we may develop a further hypothesis. The initial stages of domestication of herd animals taken by the corralling method must be undertaken with a species which is small enough to be handled easily by one or two men and which will not require expenditures of large amounts of energy to feed. A further block to domestication of the larger American herd animals such as the deer, elk, moose, bison, bighorn, and mountain goat, was, I believe, that all of these animals were too large to be handled with any degree of surety by men just learning the techniques of domestication. The antelope, not a great deal larger than a goat, provided a possible animal of the nature of a goat, but in the areas where hunted regularly, further domestication experiments could not be carried out. And in areas where domestication of an animal of this size is at least conceivable, given the resources and social structures of Plains and Eastern Woodland Indians, the antelope is either not present or not hunted by corralling.

Another hypothesis of domestication is suggested here. For full domestication to arise, as it did in the Near East and possibly in Peru, the distribution of wild animals must include species graduated in size so that men can learn the business of husbandry gradually with animals of increasing size.

A question which has received a great deal of attention in culture historical literature is whether or not agriculture is a necessary precondition for the domestication of animals. My own opinion is that it is, but this is an impression, not a supportable argument. The evidence from the Near East seems to indicate that agriculture did precede by a short period the domestication of animals. The evidence mentioned earlier from Peru is far less clear on this point. Without further arguing the point, let us examine the problems of domestication with an eye to the actual functional conditions necessary for domestication. The example of the Paiute and Washo clearly indicates that in a marginal, refuge environment, such as that in which Europeans found most of the historic hunters and gatherers, herd animals cannot be domesticated, for two reasons. First, the sparse food supply in any one area would not support the foundation stock and the men holding these animals. Second, the demands for food are such that the foundation stock would be slaughtered before it had a chance to reproduce. In short, these people could not remain in one spot long enough, without starving, to allow a generation of animals to be born in captivity. We must remember that these peoples--Basin Indians, Bushmen, Australians, etc.--have been relegated to extremely inhospitable environments. However, we cannot assume that hunters and gatherers in a more favorable environmental situation would be similarly handicapped. The Indians of the Northwest Coast, for instance, were able to maintain large, sedentary villages, complex social structures and a complex of stone-age technology with a subsistence basis of hunting and fishing and minimal gathering. Adequate shoreline resources seem most conducive to this kind of semi-sedentary culture. Thus the argument resolves itself not into a discussion of agriculture or no agriculture, but one in which the significant factor is simply resources and control of resources which would permit concentration of population, development of social organization and technology. These conditions were met in the Near East by the development of agriculture. Certainly the subsistence basis must be such that human energy can be diverted from food production or gathering to the collecting or

growing of food for his captive animals which can no longer forage for themselves.

Let us review, then, what has been put forth as hypothetically necessary conditions for the domestication of herd animals to arise.

1. A society must hunt the animals to be domesticated by the corralling method.
2. A society must control resources sufficient to permit development of social organization, technology and a subsistence basis at a level which allows diversion of human energy from the direct production or collecting of food to domestication experimentation. This suggests extremely favorable hunting and gathering conditions, probably based on shoreline resources, or agriculture.
3. A society must be sedentary to the degree that it remains, or at least portions of its population can remain, with the captive animals until domestic generations have been produced or the taming process is completed and the animals are controllable.
4. The distribution of wild species must be such that among the herd animals hunted regularly there is a gradation of size and tameability enabling man to learn the business of husbandry, gradually expanding the number of species under his control.

With these criteria in mind we can make a speculative reconstruction of the process of domestication in the Near East.

Whether or not early agriculture resulted in an absolute increase in population, the permanent nature of man's habitat would increase the hunting pressure on the animals in the immediate vicinity. That a hunting people can eliminate a species from a restricted area, even without repeating firearms, is shown by the fact that the Shoshone Indians, by the time Lewis and Clark met them, had, according to their own testimony, hunted the buffalo out of the upper Lemhi Valley.[13]

As the hunting pressure increased, the spatial relationship between man and animal changed. Sheep in a wild state are apt to prefer lowland habitat. The American Bighorn, for instance, at the time of contact with white men and firearms, was not uncommon in the foothills and plains adjacent to the Rocky Mountains. Wild goat species, on the other hand, appear to prefer the less favorable highland under any conditions and are able to survive in extremely inhospitable country. Thus, if hunting pressure reduced the number of sheep and wild cattle available in the savannah of the hilly flanks of the Near East, it is likely that the wild goats remained closer at hand in less favorable hill country. It is probable that early farmer-hunters preferred the shorter trip to nearby rough country than the long trek after the disappearing sheep and cattle, particularly in the pre-domestication situation when the kill had to be carried back to the village and the limit of hunting range depended, in part at least, on the length of time the meat could be kept. This being the case, we can postulate a shift from a generalized hunting of wild cattle, sheep and goats, to a greater dependence on goats. It is then understandable why goats appear to be the first domestic species found in the earliest sites (Dyson:1953, 662). Similarly the pig may have retreated into swampy and marshy areas unsuitable for wild sheep and cattle and provided early farmers with another nearby source of meat to replace the dwindling larger animals. Faced with an increasing scarcity

of meat, it is highly likely that the early Near Eastern hunter-farmers attempted to keep their catch fresh by keeping it alive, as did the Nevada Indians, thus setting in motion the process of domestication. Once the practicality of keeping animals was established with the goat, and certain basic skills needed to keep animals were learned, it is logical to assume that the experiment was tried with other desirable animals: cattle, sheep, and probably gazelle and deer. Some of these efforts were obviously successful, while others, such as the gazelle and deer, for reasons already discussed, proved impossible for early farmers to carry through due to a lack of time and resources to contain such leaping animals. One can also hypothesize that deer and gazelle were--as compared with goats, sheep, cattle, and pigs--much less efficient producers of meat per unit of feed supplied by man, and that a group, even relatively successful in keeping these animals, would be at a disadvantage when compared to a group which was keeping the latter species.

Pack Scavengers

It is generally believed that man first domesticated the dog in Europe during the Mesolithic period. This belief is documented by evidence uncovered in Mesolithic habitation sites and by rock paintings thought to be Mesolithic in origin. There appears to be a general assumption, based on diffusionist thinking, that this case represents the ultimate origin of canine domestication. While it is clear that this European domestication of the dog is perhaps the earliest, I question whether we can trace back all domestic canines to this single case. This question is based on obvious differences in attitude toward dogs found in various parts of the world and what appears to be a distinctly different history of the dog in various parts of the world.

In examining the world's attitudes toward dogs, one can almost construct a dichotomy between "European" and "Asian" attitudes. While it would be unrealistic to credit Europeans with any particularly humane tendencies, it is true that the dog has played far more of a role throughout history in this area. Dogs have been bred and trained for hunting, herding, hauling, and the habit of keeping dogs simply for companionship is widespread. This situation may be compared with the commonly reported picture of the pariah dog of the Middle and Far East, roaming village streets, scavenging, fighting, threatening both man and his more useful animals--an outcaste, almost "seeking domestication" (Reed:1957, 991). Reports from Africa and America give us a similar range of treatment from pet-keeping to utter indifference, complicated by complete lack of dogs in some cases and a sporadic taste for dog meat in others (Linton:1936; Kroeber:1941).

When compared, archeological sequences of Europe and the Near East show a disparity in the absence in the latter area of a distinct "Mesolithic" period, the transition apparently being one from nomadic hunting to semi-sedentary agriculture without a long intervening period of semi-sedentary hunting and gathering which characterizes pre-Neolithic Europe. This contrast may have had its effect on the history of the dog in the two areas.

Upper Paleolithic Europeans appear to have depended on the herds of large animals--bison, camels, mammoth, horse, etc. which roamed the plains of late Pleistocene times. Dependence on animals of this type forced a degree of nomadism on man. Moreover, the large, often gigantic proportions of the quarry, precluded the transportation of carcasses to the camp site en toto. Evidence at

Drogone and elsewhere suggests that game was often driven over cliffs and killed in great number. We can safely assume that men either moved to the vicinity of the killing site after a successful hunt or butchered the kill, taking the choice meat and leaving the offal. In either case the residue of these hunts must have been an important source of food to canine scavengers of the time. We can hypothesize that the relationship of man and dog during this period was one in which the dog scavenged the refuse heaps of man's hunting forays. In a spatial sense this relationship was perhaps none too close, as man moved his campsite leaving a haggle of bones and spoiled meat for dogs to feast on, or, if man carried choice portions away from the kill site, the rest was left for the dogs.

However, the changes in the flora and fauna of late Pleistocene and early Holocene Europe brought about changes in the life of man. Subsistence appears to have come from fishing and gathering shell fish in addition to hunting. Hunting itself changed from the harvesting of large herd animals in open country to the pursuit of less gregarious beasts in the new forests which replaced the tundra of the Ice Age. In this period, when the campsites of Mesolithic man became more stable, remaining near sources of shellfish, building up great middens from the refuse of human life, we can say, figuratively, that perhaps the wild dog "caught up" with man.

No longer did wild dog packs feast in the deserted Paleolithic abattoirs or the abandoned refuse of a short-lived camp. Instead, if they were to enjoy the benefits of human wastefulness, they had to operate in man's immediate vicinity as scavengers in occupied camps. From this situation we can hypothesize an initial relationship, not unlike that found today in many parts of the world. Man and dog living together, dog feasting on man's leftovers, but otherwise fending for himself.

It is highly likely that Mesolithic dogs, like modern farm dogs or pariahs of the Middle East, formed packs to hunt down game on their own in the forest. As hunters today watch the movement of wild birds to reveal the location of game, so, probably, did Mesolithic hunters, armed with the bow or spear thrower, follow packs of wild dogs in pursuit of wary forest-living animals such as the woods bison, auroch, elk, and red deer. One can envision, although perhaps never prove, a symbiotic hunting partnership between these wild dogs who located, pursued and brought to bay game, and man who could dispatch beasts effectively with his weapons. In a sense this was an opportunistic exploitation of dogs by man, but it is equally certain that the percentage of kills made in such a way must have been higher than could have been made by either species, man or dog, hunting alone, providing the dog with his reward for having part of his quarry taken from him. It is probable that such an association gave man the opportunity to attribute human characteristics and wisdom to dogs, engaged, as it were, in the same activity. Fierceness and courage when confronting game, the ability to locate animals and follow a trail, tenacity in pursuit vary greatly even in present-day hounds bred especially for these characteristics. We can assume that these variations existed in the semi-wild camp dogs of the Mesolithic. These variations provide a basis for an unconscious selection on the part of man. Dogs displaying these traits to a high degree would be more apt to receive a share of man's food in times of shortage, a place nearer the fire in severe weather. Outstanding bitches might find their litters prized by men until dogs slowly developed at least a partial dependence on man for food and habitat. While this formulation is admittedly highly speculative, it does serve to explain the

difference in attitudes toward the uses of the dog in Europe and northern Asia as compared with the Middle East and southern Asia.

In the Near East, where we have ample archeological evidence, there seems not to have been a clear-cut Mesolithic period (semi-sedentary hunting and gathering). The Mount Carmel evidence on the other hand, suggests that Upper Paleolithic men were approaching an agricultural economy (Bate and Garrod). If the formulation offered as a process of domestication of herd animals is accepted, we can see that among people using the corralling method of hunting, dogs would be of little value and in fact might well be a detriment. This suggests, then, that while the initial stage of man-dog relationship developed in the Near East and probably in China and South Asia, the development of agriculture and the subsequent decline of hunting as a major subsistence factor, did not permit the extended symbiotic hunting partnership to develop and the relationship between man and dog remained on the scavenging level. One piece of possibly significant evidence offered to support the idea that the hunting relationship engenders certain attitudes about dogs, is that, in the Islamic world, despite a general proscription of the dog as defiling, those breeds which have been developed for hunting, such as the afghan and saluki,[14] are exempted and accepted into the company of man (Linehan:1959, 888-89). Further comparative examination of the attitudes toward dogs among peoples who use them in hunting might shed further light on the postulate that this relationship does in fact engender certain attitudes toward canines and thus open the way to a wider use of the species.

The pig offers another variation on the basic theme of domestication which should be discussed briefly. It is entirely possible that wild swine were hunted in the early Neolithic Near East by the corralling method and brought under the control of man in the manner suggested earlier for herd animals in general. However, wild swine in the Old World appear not to live in extremely large herds and quite frequently are solitary animals. The almost universal role of the pig as an eater of refuse, scavenger, and rooter in the forest, has suggested to a number of writers that the pig came into the roster of domestic animals in much the same manner described above for the dog (Thevenin). The fact that swine appear to have little potential utility for man outside that of supplying meat might explain why the role of the animal is not dissimilar in parts of the world which contrast markedly in their use of the dog. There is, however, a further question, if we accept the symbiotic theory, which must be answered. If swine and man developed a domestic relationship through a process of symbiosis where swine utilized the refuse of man's living sites and man in turn slaughtered selected swine, one is forced to ask, why the food-rich middens of shellfish did not attract European wild hogs in the Mesolithic period in Europe? There appears to be no evidence of the domestication of swine in Europe before the introduction of agriculture which, it seems fairly certain, spread from the Near East along with a ready-made complex of domestic animals. This lack of evidence of independent symbiotic relationships between man and swine leads me to support the idea that swine were first domesticated by Near Eastern farmers who still depended on the corral method of hunting for meat and thereby domesticated the common barnyard animals which were adopted along with agriculture in Asia and Europe at a later date. This suggestion does not preclude the idea that perhaps in southeast Asia, where a different species of swine appears to have been the foundation stock of domestic pigs, and a different complex of agricultural techniques developed, the symbiotic explanation of the domestication of pigs holds good.

Symbiotic Carnivores

It seems likely that with the introduction of agriculture and the storage of grains, rodents found man an extremely rich source of food. Wild cats and ferrets must have followed rodents into the habitations of man in pursuit of food. It seems entirely logical that man should protect such valuable allies and in time bring them under full domestication. In the New World the guinea pig offers more of a mystery, largely because of the lack of clear archeological evidence. In historic times the small rodent was raised in close association with man, usually in his home, and provided a regular and inexpensive source of meat. How this association came about is unclear, but one is led to suspect that it developed with agriculture and the storing of grains on which the guinea pig fed.

Reindeer

Perhaps no single animal species has received so much attention from culture historians, archeologists and ethnographers as has the reindeer. Pohlhausen lists ninety entries in his bibliography covering a period from 1872 until 1953 (1953b:64-81), and even this extensive roster does not include all the writers who have submitted significant evidence or arguments. This paper will treat the reindeer only briefly, as one of several domestication phenomena, and a complete survey of all the literature has not been attempted. In the following discussion I depend heavily on a privately circulated paper by Pehrson which surveys the literature prior to 1954, and on subsequent articles in European journals dealing with the reindeer.

Pohlhausen has systematized the ideas about the reindeer's place in domestic history and about the process and time of reindeer domestication (1953b:65-66). I have reduced this system into a series of two-point arguments.

Place of the Reindeer in Domestic History

1. It is the first animal, save perhaps the dog, to be domesticated (in the late Paleolithic or early Mesolithic periods).
2. It is among the last large animals to be domesticated (in Neolithic or historic periods).

Process of Reindeer domestication

1. Reindeer became domestic through a process of symbiosis centering on the species' desire for human urine and utilization of fire and smoke to drive off pests.
2. Reindeer were domesticated through conscious experimentation in which calves were caught and raised to provide foundation stock.

Curiously enough, there seems to be ample evidence to support either side of this dichotomic argument. Such a situation suggests to me that all these statements may well be true and what is needed is an explanation in which all the available facts can be fitted. Such an explanation must consider the total history of the reindeer's relationship to man, again viewing domestication as a dynamic process rather than an isolated historic accident or evolutionary rung.

The reindeer's distribution in its domestic and wild forms is circumpolar. Called caribou in North America and divided into three species of Rangifer, the reindeer is found from the Bering Sea to western Greenland. In the Old World

a very closely related species is distributed in both wild and domestic state from the Bering Sea almost to the Atlantic. The importation of Old World reindeer to Alaska in 1891 and 1902 resulted in crossbred animals which conclusively prove the closeness of these varieties. Prior to the late nineteenth century the reindeer was not domestic in the western hemisphere. However, the attempts to provide a more stable economic basis for Alaskan Indians has now made it possible to include these groups in a list of reindeer herding people (Pehrson:N.D.).

Old World groups which are reindeer herders include:

1. Lapps: Finno-Scandinavian Peninsula and the Kola Peninsula of Russia.
2. Vogul: West of Ob River.
3. Ostyak: East of Ob River.
4. Samoyed: Northern Siberia, extending from Lapland to Khatanga River.
5. Yeniseian Ostyak-Samoyed: South of the Samoyed in the Yenisei River region.
6. Tungus: Scattered from upper Ob to Kamchatka and through Eastern Siberia.
7. Soyot: Southern Siberia in the Sayan mountain region.
8. Yukaghir: Lena to Kolyma rivers in Northeastern Siberia.
9. Northern Tungus: Khatanga to Kolyma rivers in Northeastern Siberia.
10. Yakut: Northeastern Siberia.
11. Chuckchee: Far northeastern peninsula in Asiatic Russia.
12. Koryak: Pacific side of Kamchatka Peninsula, south of the Chuckchee (Pehrson:N.D.).

With the exception of the Soyot these peoples form a continuous belt of reindeer users from the Atlantic to the Pacific. The north-south limit is generally in the taiga and tundra country and the marginal forest separating these two zones. This correlation of environment and economic activity is certainly not without significance, a significance which becomes even clearer when we examine the history of the environment in which the Soyot maintain reindeer.

The details of reindeer usage, however, vary throughout the reindeer herding area as outlined by Pehrson based on Bogoras. Because these distributions were prepared for specific presentations by the writers mentioned, I have summarized them for this paper:

Traits with general distribution among all reindeer herders

A. Ear marking
B. Use of lasso
C. Castration by biting
D. Use of ski
E. Use of urine or salt to attract and tame reindeer

The use of the lasso, the ski and urine and salt can probably be related to ancient hunting methods. Castration and ear-marking, however, are traits which are obviously related to ownership and an interest in breeding which may have developed as wild reindeer herds decreased in number, forcing man to play a role in maintaining the species for his exploitation.

Traits with limited distribution among reindeer herders

A. Milking: Lapps, Soyot, Tungus

B. Reindeer pulling sled: Lapps, Samoyed, Ostyak, Koryak, Vogul, Chuckchee

C. Riding and sled-pulling: Yeniseian, Ostyak, Samoyed, Yakut, Yukaghir, Northern Tungus.

D. Packing reindeer: Lapps, Tungus

Uses of the dog among reindeer herders

A. For herding: Lapps, Samoyed, Ostyak, Vogul

B. For sled pulling: Koryak, Chuckchee

This paper is not oriented to explain the complex history of diffusion and contact which these trait distributions suggest. However, it seems clear that certain traits such as milking among the Lapps, and quite probably among the other milking people, is a result of contact with cattle and goat milkers. Similarly the habit of riding reindeer appears to stem from contact with Asiatic horsemen. The saddle used appears to be the same as that used by their horse riding neighbors.

It does seem clear, however, that there are two distinct types of reindeer herding trait complexes. First, those traits which can be related to hunting practices and those which seem logical to assume have developed in the course of history of the reindeer peoples without necessarily postulating diffusion as an explanation (Manker). Second are the traits which appear to relate to specific contacts with other peoples made by specific reindeer herding groups and subsequent diffusion in the reindeer herding area.

It is theoretically possible to postulate a continuum of man-reindeer relationships from one of hunter and quarry which can be illustrated by American Indian groups and the Kamchadal and maritime Chuckchee and Koryak (Pehrson;N.D.). The other end of the continuum would be logically groups which utilize the reindeer most completely, that is for milk, meat and transportation, and use techniques as much like other domesticators as the nature of the reindeer and the environment permits. The Lapps and several other groups fall close to this end of the continuum. Clearly this does not represent an evolutionary scheme. The Lapps did not take up reindeer herding until well into the Christian era. However, archeological evidence tends to support the idea that as early as 8500 B.C. groups which occupied the Stellmore site in Germany maintained an economic basis of accompanied herds of reindeer during at least part of the year, obtaining two-thirds of their animal food from this source, the remaining third coming from hunting, fishing, and collecting shellfish. While there appears to be no group in exactly this position today, this Mesolithic culture seems to fill a hypothetical vacancy on the continuum suggested.

The reindeer was part of the late Pleistocene fauna which supplied a goodly portion of the subsistence of the Upper Paleolithic populations of Europe. The environment of Europe, and we may assume much of Asia, was sub-arctic tundra and taiga lying below the southern extensions of the glacial ice cap. As the glaciers retreated, many of the upper Pleistocene forms, the mammoth, woolly rhinoceros, wild horse, giant bison and others, began to disappear. The reindeer, on the other hand, appears to have followed the retreating ice cap to the modern area of distribution of the species, which in many ways closely resembles the Pleistocene environment. It seems probable that while some groups of men took advantage of the increasing shoreline resources brought about by the warmer waters of the seas, and learned to hunt the new life forms appearing in the mixed forests which replaced tundra, others continued to follow the reindeer.

An immediate question arises at this point: what circumstances in this progressive shift northward of reindeer and human populations would have brought about a closer relationship between them? The answer lies, I think, in the long observed characteristic of reindeer--a liking for human urine, which keeps them close to man. We must either assume that the species developed this craving in post-Pleistocene times or that it was able to satisfy it in some other way. The latter explanation appears more tenable. We must remember that the reindeer shared the European tundra and taiga with a number of other large herd animals--mammoths, bison, etc.--which must have supplied large amounts of urine. As these herds disappeared and as the reindeer shifted northward, the only other widely distributed large mammal was man, so that it was from man that the chemicals and minerals available in urine had to be obtained. It is also possible that the northward shift left behind sources of minerals in springs, bays, streams or mineral deposits. Thus we can speculate that man began to find reindeer seeking him out, making hunting incomparably easier. In addition, the fires of man aided the reindeer, as they do today, in escaping the intolerable presence of gnats and mosquitoes.

With this new situation it seems possible that individual groups of men and individual groups of reindeer began to relate to each other to the exclusion of other groups so that in an ecological sense we could postulate a symbiotic herd of reindeer and men existing in close association.

A speculative process of reindeer domestication might then be as follows: The retreat of the glaciers and the disappearance of other Pleistocene herd animals forced reindeer north, followed by human groups, and then forced the two into closer association. This close association became a symbiosis between specific reindeer herds and specific human groups. The need for decoys or lure reindeer to hunt other reindeer, plus perhaps the habit of keeping calves, led to a gradually increasing control of reindeer by men. Certain practices developed among these reindeer followers, such as the use of the lasso, and castration and ear-marking.

As domestication of other animals developed in the Near East and spread north, reindeer peoples came in contact with cattle, sheep and horse users, and began to adapt techniques of riding, milking and harnessing reindeer. The reindeer harness in widest distribution appears to be an adaptation of ancient dog-sled harness, but that used by the Lapps is clearly related to Scandinavian horse harness. The milking and riding of reindeer appears to be most developed where reindeer peoples have now or have had contact with horse and cattle users.

Laufer and Hatt have argued the area of origin of reindeer domestication. The former insists that the Sayan mountain home of the Soyot, which we will remember is a discontinuous area of reindeer usage, is the source area. Without recounting the pro and con of this argument it should be pointed out that this discontiguous area seems to have provided the same shift in environment on a small scale as postulated for the entire Eurasian continent, inasmuch as the Sayan mountains were glacier-capped, and we may suppose, being farther south, the glacier retreated somewhat earlier than did the great continental ice cap.

The evidence submitted by Pohlhausen makes inescapable the conclusion that the symbiotic man-reindeer relationship was the basis of certain cultures at a very early time. Further, this evidence suggests that arguments based entirely on present distributions are in error. The reindeer has long disappeared from Stellmore, but the fact that man once lived there following reindeer herds must be taken into account in any history of reindeer domestication. One suspects that one of the key issues involved in these arguments was a different definition of domestication on the part of a number of writers which was never made clear. It seems conceivable that if Laufer meant by domestication the most complex development of reindeer usage, he may have been correct in suggesting a date about the beginning of the Christian era (this, in spite of the fact that his evidence appears to be extremely scant, and his interpretations subject to much questioning). On the other hand, Hatt's contention that reindeer domestication is very old and stemmed from Paleolithic hunting, may also be correct if we consider a hunting symbiosis to be domestication. The development of certain traits among reindeer herders may well be credited to the fact that certain techniques such as lassos and skis stem from the environmental situation. Other traits, on the other hand, can be explained in diffusionistic terms. It seems probable that the original man-reindeer relationship began in immediate post-Pleistocene times and reached its full development about the beginning of the Christian era. The exact place of domestication may not be determined, due to lack of archeological evidence throughout the reindeer area. It cannot be determined by distribution studies because it is possible that it began in some area no longer occupied by reindeer herders. It is equally conceivable that the original symbiosis developed over a wide area of the Eurasian land mass with further developments in this relationship taking place in different times due to diffusion of ideas from one group of reindeer followers to another.

While it is possible that the domestication of the reindeer, or at least a more complex method of using reindeer, may have been the result of stimulation from other domesticators, the reverse proposition seems unlikely.

The nature of the reindeer and its Pleistocene distribution suggests that contact of reindeer herders of northern Europe and Asia with incipient farmers of the Near East in the period between 10,000 and 6000 B.C. is highly unlikely. The lack of knowledge of the northern tribes continued well into the Christian era and it is probable that the early domesticators knew even less of semi-arctic northern Eurasia.

Testing the Hypotheses

Thus far this paper has dealt with a cultural definition of domestication and general historic reconstructions based on this definition, with references only in passing to evidence to support such formulations. It is at this time admittedly impossible to do more than speculate along the lines drawn in this

paper, because the evidence to support these reconstructions does not, in fact, exist. The final section of this paper, therefore, will be devoted to an examination of possible sources of evidence which could be used to support or refute or alter the theoretical formulations outlined earlier.

Osteological and Morphological Changes[15]

As discussed earlier, examination of bones uncovered in archeological sites does not provide us with clear-cut answers as to whether or not the bones are those of domestic animals. On the other hand, we do know that certain osteological changes do occur under domestic conditions, and positive identifications can often be made between modern wild and domestic forms. As Zeuner points out, however (1954:346), the distinction is not absolute, and it is not always possible to differentiate between wild and domestic animals on the basis of a single bone or a few bones.

The skull appears to be affected by domestication, inasmuch as there is often a definite shortening of the facial portion of the skull. This effect is particularly noticeable in the pig; to a lesser extent in the dog. It is not particularly noticeable in the case of the horse, ass, or camel. What these facts suggest is that the alteration of the skull is related to alterations elsewhere, which were perhaps selected for. For instance, wild swine appear to be extremely vicious, and it has been suggested that the reduction in facial portions of the skull is related to a selective process on the part of man to reduce this character in his domestic stock. Thus skull shortening may reflect some connection with the rage mechanism of the animal involved. On the other hand, wild horses and asses appear to be no more vicious than domestic horses and asses, suggesting that when these animals came under domestication, other factors were selected for or against by man; but the facial portion of the skull was not affected. It is perhaps well to remember here that a great deal of man's effective control of these animals is based on his ability to apply pressure on the lower jaw, and that the greater the length of the jaw the greater the leverage which can be applied. Thus it is probable that, rather than selecting for reduced facial contours, man selected to retain the long face of these beasts of burden.

Dentition appears to be affected very early by domestication (Zeuner: 1954, 345). Either a reduction in number, or shifts in the arrangement of teeth due to alterations of the face are common effects. Thus we have at least one osteological test of domestication. If in an archeological site the dentition of a single species alters in a regular manner from the wild form to the domestic form, over time, we can place the beginning of domestic selection at a level prior to the first appearance of the alterations and the first domestic usage at an earlier level still.

There is a tendency for the horns of domestic forms to be smaller than those of wild forms, at least in early stages of domestic alteration. Neolithic cattle, sheep, and goats all have smaller horns than wild relatives, and hornless cattle were known in the Iron Age (Zeuner:354). On the other hand, selective breeding for religious or esthetic purposes has often produced fantastic horns, both in size and shape. It should be remembered that horns of wild animals tend to be fairly uniform in shape throughout the species, which suggests a test to differentiate wild from domestic remains. If horn shape and size

appear unusually varied and exotic, it seems probable that we are dealing with domestic animals.

Skeleton bones from the body and limbs provide us with less evidence of domestication. The pig, however, in a domestic state displays a failure of the end pieces of the longbones to fuse. Generally speaking, domestic cattle show weak muscle ridges. In this last instance one is forced to wonder if these comparisons were made with such creatures as the Texas Longhorn, which seems to display more wild than domestic characteristics.

Another possible bit of evidence is the tendency in some dogs, cats, and swine to develop a twisting tail in the domestic situation. Increased numbers of tail vertebrae are diagnostic of domestic sheep. Some domestic races develop longer leg bones than the wild forms, but, according to Zeuner (1954:346) leg bones are more commonly short and less straight in domesticated animals.

At best, such evidence can only demonstrate the existence of domestication among a people and suggest that the practice was of some time depth. Unfortunately, there seems to be no information on the rates of change in the bones of wild animals coming under domestic conditions. Nor can we be sure that the various degrees of control and usage, mentioned earlier, do not produce different responses in bone structure and in rates of change. Moreover, there is at least a probability that animals gone feral, such as the mustang, longhorn cow, and wild hog will show wild characteristics in their bone structure as a result of the free conditions under which they live. Certainly this is true of the facial structure of swine and longhorn cattle which, compared with tamer breeds of domestic stock, demonstrate marked changes in facial proportion.

Hair, Skin, and Soft Body Parts

Unfortunately some of the most marked changes which seem to occur under domestication are those least likely to survive for archeological examination. With the exception of natural or artificial mummification, it is impossible to determine hair texture, length, or color, whether or not an animal produced wool, or milk, if skin folds existed or fat was stored in tail or hump. However, as representations of animals at least as old as the Upper Paleolithic period can be found, it is possible perhaps to judge some of these criteria from artistic efforts of man.

In cattle, short coats appear to be the norm for both wild and domestic stock, with a tendency for both types of animals to develop longer, shaggier hair in the north. Horses seemed to have developed longer tails and manes. But it must be remembered that horses have almost always been subject to beautification, and roaching of mane and bobbing of the tails may alter the appearance of a horse considerably.

Wool is a domestic characteristic which appears only in an incipient stage in wild animals in the form of a woolly undercoat. Thus, the existence of wool fabric in an archeological site is evidence of domestication. It may, however, be evidence of domestication elsewhere and be present in the site as a result of trade. Moreover, it indicates that the sheep or goat or alpaca from which the wool was taken is the product of a relatively long period of selective breeding, so that the beginnings of animal keeping must be placed in earlier levels.

While the young of wild and domestic species tend to have definite skin folds, in the wild species folds tend to disappear with adulthood. In certain breeds of dog, the mastiff and bulldog for instance, and in cattle like the zebu and Brahma, skin folds tend to remain into adulthood. Thus representations of adult animals with skin folds probably represent domesticated animals. Similarly, pictures or statues of animals with obvious concentrations of fat in the hump, as in the camel, or tail, as in the sheep, or in a more general deposit, as demonstrated by cattle and swine, probably represent a domestic or at least captive animal because unusual deposits of fat in wild animals are rare.

Color appears to be another feature affected by domestication. Piebaldness, according to Zeuner (1954:343), is found in the wild state only in the hyena, but is common among horses, dogs, cattle, and swine in the domestic state. Similarly there appears to be a tendency toward more intense color in certain domestic species; the bright bays, seal browns, and blacks are more common among domestic horses than are the duns which more closely represent wild coloration. There are a number of wild species which display stripes, either in over-all patterns or on parts of the body. This is particularly true among equids. However, among domestic equids, the horse in particular, there appears to be a tendency away from stripes toward solid colors or pie-baldness. In my own experience, however, I have seen purebred Arabian horses with over-all stripe patterns, suggesting at least that if this feature struck the fancy of a horse-loving people, it is a characteristic which could be selected for. It should also be remembered that horses can and often have been painted for beauty, power in war, good luck and a number of other reasons, and such painting might easily be interpreted as natural coloring in an artistic representation.

Once more this kind of evidence, based on changes in the body of the animal in question, is at best only evidence of the existence of domestication, leaving a beginning date to be assigned to times prior to the date of the representation. As this paper is aimed in part at suggesting a method of determining the beginnings of domestication, cultural material which might be available to archeologists and which could provide evidence for the beginnings of agriculture and for the hypothesis set forth earlier will now be discussed.

Cultural Material

If the domestication of herd animals, as has been suggested, is related to the practice of hunting by the corral method, it seems at least possible to find evidence for this technique in relation to sites which later definitely show signs of having contained a domesticated population. Corrals, reported ethnographically, have been constructed of wooden posts, brush, stone walls, and earth walls. Another common method of constructing a hunting corral is to utilize a box canyon. Archeological investigation for evidence of such structures should begin at some distance from the living site, in areas which appear not to have been occupied by man during the early agricultural period. At the same time it seems likely that such structures would not be overly far from the habitation site, in order that animals slaughtered in the pen might not spoil while being carried into the village.

The remains of corrals would certainly not of themselves prove that domestication experiments were in progress. It would, if we accept the formulation introduced earlier, establish that the process of domestication could

have been carried out in the area under investigation. Evidence of the process itself would be difficult to develop, but I think not impossible.

Let us imagine what evidence we would find in a predomestic situation in addition to the remains of corrals used in hunting. Animals of all ages would be slaughtered, and if entire herds or flocks were taken, the distribution of bones in the habitation site in terms of both age and sex should conform relatively closely to that distribution in nature. As slaughtering of penned wild animals would take place away from the living site, we can expect that only the usable portions of the animals would be carried to the village. Thus we should find a higher percentage of certain bones in the village and might well expect to find certain other bones discarded at the slaughtering site.

As the domestication process began, we might expect a change in this evidence. The advantage to the hunter-farmers in domestication would be that animals could be taken from the corrals (which might expand to larger pens or small pastures as the animals became tamer and the husbandmen more expert) to the village alive, thus reducing the spoilage of meat which must have been a part of hunting. Except in the earliest phase, when one might assume that the animals slaughtered would be the adults which were least amenable to control, and therefore dangerous (just as a modern farmer will warn another that a bull or stallion should be killed before it hurts someone), we can assume that the animals taken from the pen to the village were the most easily handled, perhaps the youngest or some of the youngest, and quite possibly the males, which would be less useful in propagation of domestic stock than females. If this is the case, then we should expect a shift from a natural distribution of age and sex in the bones and a preponderance of certain bones uncovered in the site to a heavy weighting in sex and age and toward more total skeletons, since the slaughtering would now be done in the village. Another change from hunting to domestication would be a shift from a general distribution of species to a very great preponderance of a single species. As the domestication process developed over long periods of time, we could expect to see additional species appearing. Evidence available of what appears to be very early domestication, such as that at Belt Cave on the Caspian Sea, suggests this shift from many species to a single species. We should be on guard, however, to treat this material as it appears, not with preconceived notions of what species might or might not be domesticated. It is entirely possible that some groups in the Near East experimented with gazelles on an early level of domestication and abandoned them in favor of other species. Thus a shift from many species to a heavy preponderance of gazelles might be evidence of at least incipient domestication of these animals.

Another source of evidence of domestication in a specific area might well be in an examination of the distribution of species through archeological investigation. The sudden appearance of a species not known in the area under investigation strongly suggests its introduction by man. We must not discount the fact that animal populations do shift periodically and sometimes permanently in response to climatic or other environmental changes; but on the other hand, the appearance of horses in the Near East, for instance, where there is no evidence of their existence in the wild, is definitely an indication that these animals were introduced by men (Le Grain;1948). Similarly, the appearance of any animal, particularly in association with human remains in an area where the species appears not to have been found in the wild, strongly suggests that the animal was domestic. Tracing such remains toward areas where the species was

naturally found, would, I think, be helpful in a search of origin areas of domestication. Of course the wide natural distribution of many of the now domestic but once wild species would tend to obscure the exact area of origin.

Conclusions

We have examined several definitions of the word "domestic" in an attempt to find one which would be useful in culture-historical and cultural studies. Definitions based on biological or psychological criteria were rejected because they fail to cover all the animals which have been important in the cultural history of mankind.

One of the considerations of such a definition has been that domestication is not a single event but is a dynamic process extending over a long period of human history and continues today.

The potential of any species to become domestic has been examined and the conclusion drawn, from the fact that at least individuals of almost every species have been tamed and bred in captivity, was that in terms of the animals themselves almost any species is potentially domestic.

The cultural and social potential, however, was considered to be the important factor in determining the domestic potential in any given man-animal relationship.

We examined the various elements of the human-animal relationship which make up domestication and from them we developed the following definition of domestic.

1. Man must have a recognized need or desire which can be satisfied by controlling, breeding and protecting animals.
2. Man must control the animal population in question to the extent necessary to satisfy this need or desire.
3. Man must devote himself to a greater or lesser degree to the protection and nurturance of the animals.
4. Man must be involved, again to a greater or lesser extent, in the breeding process of the animals he controls.

Having established a cultural definition of domestication, I have described several categories of domestication depending on the various usages to which animals are put, the historic or archeological evidence of their domestication and the nature of the animals in question.

I. Herd Animals.

Ia. Primary Herd animals: goat, sheep, cattle and possibly swine.

Ib. Secondary Herd animals: onager, ass, horse, camel, elephant and a number of recently domesticated species.

II. Pack Scavengers: dog and swine.

III. Symbiotic Carnivores: cat and ferret.

IV. Reindeer.

V. Secondary pets and exotics: various animals domesticated for specific purposes throughout history.

Because I have viewed domestication as a changing social relationship between man and animals, I proceeded to a classification of hunting methods which represent the varieties of pre-domestic social relationships.

1. Stalking
2. Ambushing
3. Driving
4. Trailing
5. Trapping
6. Corralling

The final portion of the paper has been devoted to speculative reconstructions of the original processes of domestication of animal types Ia, II, III, and IV.

It was suggested that Type I animals were domesticated in the Old World when the following preconditions were present:

1. Hunting of herd animals by the corralling method.
2. Control of resources sufficient to permit development of social organization; technology and subsistence basis sufficient to permit diversion of human energy to supporting domestication experiments. In the Old World this would appear to have been agriculture, but it seems probable that plentiful shoreline resources or an extremely provident gathering environment might provide a similar situation.
3. A society must be sedentary to the degree necessary for the production of a generation of controllable animals.
4. Species distribution must be such that a gradation of size and tractability exists so that man can gradually learn the techniques of husbandry.

Pack Scavengers, the dog and swine, it was suggested, were domesticated when human habitation sites became the primary food source for these animals. A difference in the domestic history of the dog in Europe and elsewhere in the Old World was suggested. It was argued that the Mesolithic period in Europe permitted a long time symbiotic hunting relationship between man and dog. Elsewhere the absence of the Mesolithic period did not permit this relationship and resulted in the cessation of the domestic history of the dog in these areas at the pariah level. A similar history was postulated for swine, but with an alternative along the lines suggested for primary herd animals.

It was suggested that the cat and ferret, classified as Symbiotic Carnivores, came into their relationship with man through a pursuit of rodents into the granaries of early agriculturists and that man encouraged their presence as an aid in protecting his own food supply.

The reindeer was the subject of a final section, and a separate process of domestication of this species was suggested. Using archeological, geological and ethnographic evidence, it was suggested that the changing environmental situation at the end of the Pleistocene forced man and reindeer into a closer relationship. This relationship gradually shifted from a simple hunter-quarry one to a mutual symbiosis which developed, among the human half of this symbiotic pair, a number of techniques and traits which are widespread throughout the reindeer herding areas of the world. The full development of reindeer herding, it was further suggested, waited until reindeer herders became acquainted with usages and techniques of other domesticating peoples.

The final section of the paper was devoted to a number of suggestions for possible testing of these hypotheses.

In general, what I have attempted to develop is a view of domestication as a continuing process analogous to the expanding exploitation of metals and plants. The significant factor, as I have presented the material, has been the ability of human beings to adjust to demands placed upon them by changing aspirations or particular historical events.

ENDNOTES

1. This paper was prepared in partial fulfilment of the requirements for the degree of Master of Arts in Anthropology at the University of California, Berkeley. I am indebted to W. Eberhardt, J. H. Rowe and R. Millon for their advice, criticism and encouragement.

2. Mr. Cary Baldwin, director of the San Francisco Zoölogical Park confirms this statement.

3. Mr. Baldwin states: "The problem of breeding is not as big as it once was. By and large there is no trouble if we consider environment, nutrition and adequate selection."

4. I am indebted to W. L. d'Azevedo for this information based on his unpublished field notes.

5. This subject will be touched upon later in this paper but should be discussed at this point. In his article, which was published after completion of this work, Reed (1959) illustrates the common reluctance to accept archeological material related to presently non-domestic species as evidence of domestication even though this same evidence would be treated as a sign of domestication if related to a presently domestic species. Because of the distribution of ages represented by the bones of both cattle and gazelles he questions whether age distribution can be used as evidence for domestication. However he does leave the question of possible domestication of gazelles open in a parenthetical question. My own view is that we must accept evidence as we find it, unless we can show that it is invalid. In this case it seems that age distribution is valid evidence, but that investigators must be prepared to accept it as indicating domestication of any species, not simply a preconceived roster of animals. The case of the gazelle and a number of other facts pointed out in this paper tend to confirm the idea of domestication which the distribution of age suggests.

6. I am indebted to Theron A. Nunez for his description of the current fads in pet keeping among certain classes in Florida and Louisiana, which include both the ocelot and the cheetah.

7. A brief but clear example of this can be found in the University of California Agricultural Publications pamphlet dealing with the domestication of a variety of grass for use on golf courses.

8. W. Eberhardt has suggested, in conversation, basing his opinions on experience in Asia and the Near East, that the pig and the dog might well be

considered as cultural equivalents in many parts of the world. This position appears sound, particularly in Asia and the Near East where the conditions under which both animals exist are similar and may, as suggested, stem from a parallel domestic history. It also permits a functional analysis of the dogs' role in areas such as pre-conquest Mexico where certain races of dogs were bred for *eating and others for hunting, as pets, etc.*

9. Kroeber, in 1901, in a discussion of origins stated: "But no myth, no artistic convention, or any other thing human ever sprang from nothing. It is always from something previous that was similar." The search for origins in this paper is essentially the search for a pre-domestic condition most similar to domestication.

10. The "humane" trap is a development of relatively recent history.

11. It seems clear that pet keeping and domestication are two different phenomena. Pets are often made of domestic animals but on the other hand, pets are also made of wild animals and no domestic species is exclusively a pet (except perhaps in complex, class stratified urban societies of later history). Factors which lead man to keep pets appear to be pan human, but the factors affecting domestication are not.

12. Kenyon's discoveries in Jericho have given new support to the "oasis" theory but as yet shed no light on early animal domestication or incipient agriculture.

13. The civilization of Mexico did not domesticate animals even though it maintained zoos containing animals as large as bison. This may be because the diverse topography of Mexico provided non-agricultural areas relatively close to population centers so that whatever demand there was for meat could be met by hunters and no need for domestic meat animals other than the dog was recognized.

14. W. Eberhardt, in conversation, points out that these breeds are not considered as the same kind of animal as a pariah dog.

15. The greatest obstacles are discussed by Reed (p. 630); lack of interest, a confusion of disciplinary responsibility and lack of comparative materials are among the problems he mentions.

BIBLIOGRAPHY

Arne, Ture J. A.

1943 Excavations at Shah Tepe, Iran; Sino-Swedish Expedition 27. Stockholm, Göteborg, Elander boktryckeri akiebolog.

Bate, Dorothea M.

1928 The fossil mammals of Shukbah. Proceedings of the Prehistoric Society, 8:1-20, London.

1932 A note on the fauna of the Ahlit Caves. Journal of the Royal Anthropological Institute, 62:277-279, London.

1938 Vertebrate remains from Wadi Dhobai, 1938. Journal of the Palestine Oriental Society, 18:292-296, Jerusalem.

Bate, Dorothea M. and D. A. E. Garrod

1939 The stone age of Mount Carmel, vol. 2. Oxford, The Clarendon Press.

Braidwood, R. J.

1948 Prehistoric men. Chicago Natural History Museum, Popular Series, Anthropology 27.

1952 The Near East and the foundations of civilization. Eugene, Oregon State System of Higher Education.

Brunton, G. and Gertrude Caton-Thompson

1928 The Badarian civilization. British Institute of Archaeology in Egypt, Publ. No. XVLI, London, Bernard Quaritch.

Camp, R. (ed.)

1948 The hunters encyclopedia. Harrisburg, Pa., Stackpole and Heck.

Carruthers, D.

1949 Beyond the Caspian. London, Oliver and Boyd.

Carter, W. H.

1923 The story of the horse. National Geographic Magazine, XLIV, no. 5, November, 455-556.

Chard, C.

1957 COWA bibliography, North Asia. Council for Old World Archaeology, Cambridge, Mass.

Cheng, Te-K'un

1959 Archaeology in China, vol. 1, Prehistoric China. Cambridge, England, W. Heffer.

Childe, V. G.

1943 What happened in history. Middlesex, England, Pelican Books.

1952 New light on the most ancient east (4th ed.). London, Routledge and Kegan Paul.

Childe, V. G.

1954 Wheeled vehicles. In Singer, C. et al., History of Technology, I: 716-729.

Clark, J. G. D.

1942 Horses and battle axes. Antiquity 15:50-70.

1952 Prehistoric Europe, the economic basis. London, Methuen and Co.

Coon, C. S.

1957 The seven caves: archaeological explorations in the Middle East. New York, Knopf.

Corner, E. J. H.

1955 Botanical collecting with monkeys. Proceedings of the Royal Institution of Great Britain, 36:258-275.

Dale, I. R.

1955 The Indian origin of some cultivated plants and African cattle. The Uganda Journal, 19:68-72.

Dalimier, P.

1954 La morphologie de la chevre sous l'influence de la domestication. Bulletin Musée Histoire Natural Belge, no. 13, 30:1-12.

Dobie, J. F.

1941 The longhorns. Boston, Little Brown and Co.

1952 The mustangs. Boston, Little Brown and Co.

Dobzhansky, T.

1955 Evolution, genetics and man. New York, Wiley & Sons.

Downs, J. F.

MS. The origin and spread of riding.

Dyson, R. H., Jr.

1953 Archeology and the domestication of animals in the Old World. American Anthropologist, 55:661-673.

Eberhard, W.

1950 The history of China. London, Routledge and Kegan Paul.

Ehrich, R. W.

1954 Relative chronologies in Old World archaeology. University of Chicago Press.

1957 COWA bibliography, Central Europe. Council for Old World Archaeology, Cambridge, Mass.

Epstein, H.

1954 Le dromadaire dans l'ancien Orient. Revue d'histoire des science et leurs applications, 7:247-268, Paris.

Ewers, J. C.

1955 The horse in Blackfoot Indian culture. Bureau of American Ethnology Bulletin 159. Washington, D.C.

Forde, C. D.

1954 Foraging, hunting and fishing. In Singer, C. et al., 1:154-186.

Gejvall, N.-G.

1938 The fauna of the different settlements of Troy, preliminary report, 1937-38. K. Humanistiska vetenskapssm fundet i Årsberättlse, 38: 51-57, Uppsala.

Guman, S. K.

1954 Wild boars being used as bloodhounds. Journal of the Bombay Natural History Society, 53:253-259, Bombay.

Girshaman, R.

1938-9 Fouilles de Sialk pres de Kashan 1933, 1934, 1937. Paris, Paul Geuthner, 2 vols.

Guy, P. L. O. and R. Engburg

1938 Megiddo tombs. Oriental Institute Publications 33, Chicago.

Hančar, F.

1955 Das Pferd in prähistoricher und Früher historicher Zeit. Institut für Völkerkunde der Universität Wien, Wien-München, Verlag Herold.

Hahn, E.

1896 Die Haustiere und ihre Beziehungen zur Wirtschaft des Menschen. Leipzig.

Harker, K. W. and J. L. Taylor

1954 Studies on the habits of zebu cattle. Night paddocking and its effect on the animal. Journal of Agricultural Science 47:44-49, Cambridge, England.

Harper, F.

1945 Extinct and vanishing mammals of the Old World. Special Publication no. 12 of the American Committee for International Wild Life Protection, New York.

Hediger, H.

1955 Studies of the psychology and behavior of captive animals in zoos and circuses. New York, Criterion Books.

1954 Are wild animals in captivity really wild? Scientific American, 190:76-80.

Hill, R. N.

1956 Window in the sea. New York, Rinehart.

Hill, W. C. O.

1953 The elephant in East Central Africa. London, Rowland Ward Ltd.

Hilzheimer, M.

1935 The evolution of the domestic horse. Antiquity 9:133-139.

Huyglen, C.

1955 Elandantilopen en hun mogelijke economische betekenis. Bulletin agricole du Congo Belge, 46:351-366, Brussels.

Jackson, H. H. T.

1958 Return of the vanishing musk ox. Audubon Magazine 58:262-265.

Jettmar, K.

1954 Les plus anciens civilizations d'eleveurs des steppes d'Asie Centrale. Commission International pour une Histoire du Dévelopment Scientifique et Cultural de l'humanité. Cahiers d'Histoire Mondiale, no. 4 1:551-582, UNESCO, Paris.

Jope, E. M.

1956 Vehicles and harness. In Singer, C. et al., 2:537-562.

Kahlke, H. D.

1955 Grossaugetiere im Eiszeitalter. Leipzig, Urania-Verlag.

Kidder, J. E.

1959 Japan before Buddhism. London, Thames and Hudson.

Knorre, E. P.

1953 [Catching, breeding and training of elks] Nasimovich, A. A. ed. Reorganization of vertebrate fauna of U.S.S.R., pp. 191-200. Moscow (in Russian).

Krantz, G. S.

1959 Distinctions between the skulls of coyotes and dogs. Kroeber Anthropological Society Papers, no. 21, Fall, pp. 40-42..

Kroeber, A. L.

1941 Salt, dogs and tobacco. University of California Anthropological Records, vol. 6, no. 1, Culture Element Distribution XV, Berkeley.

1948 Anthropology. New York, Harcourt Brace.

1952 The nature of culture. Chicago, University of Chicago Press.

Lang, E. M.

1954 Über Fang und Eungewohnung Afrikanischer Elefanten im Jahre 1952. Zoologische Garten Leipzig, 20:294-306.

Langkavel, B. A.

1898 Dogs and savages. Smithsonian Institution Annual Report, 1897, pp. 651-675.

Le Grain, L. L.

1946 Horseback riding in Mesopotamia in the third millenium. Bulletin of the University Museum, no. 4, 11:27-33, University of Pennsylvania.

Linehan, E. J.

1958 Dogs work for man. National Geographic Magazine, no. 2, CXIV:190-223, August.

Linton, R.

1936 The study of man. New York, Appleton-Century-Crofts.

1955 The tree of culture. New York, Knopf.

Lowie, R. H.

1935 The Crow Indians. New York, Farrar and Rinehart.

1940 An introduction to cultural anthropology. New York, Farrar and Rinehart.

1954 Indians of the Plains. New York, McGraw Hill.

Lundholm, Bengt

1949 Abstammung und Domestikation des Hauspferdes. Zoologiska bidrag från Uppsala, Bd. 27, pp. 1-287, Uppsala.

Lundholm, Bernhold

1952 Game farming--is it feasible proposition? African Wildlife, 6: 121-128, Johannesburg.

Manker, E.

1954 Zur Frage nach dem Alter der Renzucht. Zeitschrift für Ethnologie, Bd. 79, ht. 2, pp. 175-187, Braunschweig.

Marshall, Sir J. H.

1931 Mohenjodaro and the Indus civilization. London, Arthur Probsthain, 3 vols.

Murdock, G. P.

1934 Our primitive contemporaries. New York, Macmillan Co.

Papashvily, G. and H.

1954 Dogs and people. Philadelphia, Lippincott.

Paton, D.

1925 Animals of ancient Egypt. Princeton, Princeton University Press.

Piggott, S.

1950 Prehistoric India. Middlesex, England, Pelican Books.

Pehrson, R. N.

N.D. Reindeer breeding peoples (dittoed).

Plischke, H.

1954 Das Kuhblasen, Eine völkerkundliche Mizzelle zu Herodot. Zeitschrift für Ethnologie, Bd. 79, ht. 1, pp. 1-7, Braunschweig.

Pohlhausen, H.

1953a Zum Motiv der Rentierversenkung der Hamburger und Ahrensburger Stufe. Anthropos, 45:987-990, Vienna.

1953b Nachweisbare Ansatze zum Wanderhirtentum in der niederdeutschen mittlestien zeit. Zeitschrift für Ethnologie, Bd. 78, ht. 1, pp. 64-82, Braunschweig.

Preshad, B.

1936 The animal remains from Harappa. Memoirs of the Archaeological Survey of India, no. 51, Manager of Publications, Delhi.

Prestwich, A. A.

1950-52 Records of parrots bred in captivity. London (published by the author), 6 vols.

Pumpelly, R.

1908 Explorations in Turkestan, Expedition of 1904. Washington, D.C., Carnegie Institution Publication no. 73, 2 vols.

Reed, C. A.

1957 Review; Vesy-Fitzgerald, 1957. American Anthropologist, no. 5, 6:991-992.

1959 Animal domestication in the prehistoric Near East. Science, no. 3389, 130:1629-39.

Richard, L. R.

1956 Note sur les variation numériques des vertebrates lumbaires chez Equus caballus Przewalskii, Polikow. Mammalia, 20:326-328, Paris.

Ridgeway, W.

1905 The history and influence of the thoroughbred horse. Cambridge, England, Cambridge Biological Series.

Salisbury, R. F.

1960 From stone to steel. Cambridge, England, Cambridge University Press. (in press.)

Sauer, C. O.

1952 Agricultural origins and dispersals. New York, American Geographical Society.

Simoons, F. J.

1953 Notes on the bush pig (Patamochoesus). Uganda Journal, 17:80-81, Kampala, Uganda.

Singer, C. et al. (ed.)

1954-1958 History of technology. New York and London, Oxford University Press, 5 vols.

Sokolov, I. I.

1955 [Biological peculiarities of domestic animals and their ancestors. Why only some animals have been domesticated?] Priroda, 3:48-55, Prague.

Steward, J. H.

1955 Theory of culture change. Urbana, University of Illinois Press.

Thevenin, R.

1947 Origines des animaux domestiques. Paris, Presses Universitaires de France.

Vesy-Fitzgerald, B.

1957 The domestic dog; an introduction to its history. London, Routledge and Kegan Paul.

Wagner, V. A.

1954 Training the African elephant. African Wildlife 8:223-235, Johannesburg.

Willems, E.

1944 Acculturation and the horse complex among German-Brazilians. American Anthropologist, no. 2, 46:153-161.

White, L. A.

1949 The science of culture, a study of man and civilization. New York, Farrar and Strauss.

Van Buren, E. D.

1937 The fauna of ancient Mesopotamia as represented in art. Rome, Pontificum Institutum Biblicum.

Vereshchagin, N. K.

1953 [Trials in breeding new species of fur animals in the Azerbaizhan Republic] Zoological Institute of Azerbaidzhan, 16:158-168, Baku (in Russian).

Zeuner, F. E.

1954 The domestication of animals. In Singer et al., 1:327-352.