Perspectives in Human Biology (1999) Vol 4(1):1-12
Editors: M Henneberg and C Oxnard

THE ADVANTAGES AND DISADVANTAGES OF BEING DOMESTICATED
(A Keynote Address)

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ABSTRACT

The variety of animals that have been domesticated by different human communities since the end of the Pleistocene include species that supply food, clothing materials or locomotive power; but human association with one domesticate, the dog, was certainly very much older than this, and, it has been suggested, may even be one of the defining cultural attributes of *Homo sapiens*. Most of these domesticated species live in societies, have males incorporated into the social groups, have social hierarchies, are not territorial, are not pair-bonded, have precocial young, can learn, and have undergone parallel changes that appear to be inevitable correlates of the domestication process: size reduction (at least initially), neoteny, increased growth rates, higher fertility and reduced brain size. It is not so much that domesticated animals are less intelligent than their wild ancestors as that they have reduced social and environmental skills: they have suffered a decline of their *Merkwelt* (perceptual world), as Hemmer (1983) has called it.

It has been noticed before that *Homo sapiens* can be characterised in much the same way. Lorenz called it 'autodomestication'. I wonder whether the supposed long association with the dog has more to do with it.

Key words: domestication, dog, wolf, sociality, centre-of-origin

INTRODUCTION

To be domesticated, if you are a large mammal, is to be a survivor. Except for a few non-commercial oceanic species, like the Ross Seal and the Bottle-nosed Dolphin, domesticates are the only large mammals still numbering many millions.

So what is it this domestication? It is the way humans exploit other species; typically it will be for economic reasons, and involves controlling their breeding, providing their food and restricting their movements.

This is not a complete definition, because some domestic individuals, populations, or entire species have managed to slip through the gaps. Pets can hardly be said to yield economic benefits – just the reverse, in fact! – yet they are certainly domestic; maybe we ought to add that domestic animals can serve emotional needs too. The existence of mongrel dogs testifies to the frequent failure of breeding control. Mithan, and often donkeys and camels, are left to find their own food and do not have their movements greatly restricted. On the other hand, zoo animals seem to fit all the criteria except the economic one. And so it goes on. There is really a continuum between domestic and wild, but in the main it is true that we can tell, without problems, which are the domestic ones and which the wild.

What I want to do in this paper is to examine the background and consequences of domestication, and to see what the role of our species has been in it: have we always been the domesticator, or have we sometimes been at the receiving end?

WHO DOMESTICATED THEM?

The widespread and important domesticates are all 'traditional', their origins lost in the mists of time, recoverable only archaeologically. There have been some recent attempts to add to the list, although so far the Eland, the Grass-cutter and the rest have not been overwhelming successes.

"The Centres-of-Origin Theory" of Vavilov (1926), that the origins of cultivated plants could, parsimoniously, be pin-pointed to just a few areas of the world, can be extended to animals. The major animal domestication centres (Table 1) correspond to some of the major plant domestication areas: the Middle-East, India, South China/the SE Asian mainland, Islands of SE Asia, and the Peruvian Andes. Some of the major plant domestication areas figure only in a very minor way (Mesoamerica, West Africa) or not at all (New Guinea) in animal domestication; some areas which provided domestic animals have not provided cultivated plants (Scandinavia, Tibet, Central Asia).

Many will be surprised not to see Egypt in Table 1. Egypt is generally credited with both the donkey and the cat, but I have argued elsewhere (Groves, 1986) that the donkey was domesticated in the Middle-East, and Petzsch (1973) has presented a similar argument for the cat. The Egyptians used domestic animals, of course; they kept plenty of animals in captivity, and obsessively mummified them, but I doubt whether that intensely conservative society ever actually brought any new species into the domestic sphere.

The dog is omitted from Table 1; we will return to it later.

What strikes us about this list is the repetition in it: the pig has been domesticated in several parts of the Old World, and different species of cattle have been domesticated in different regions. Are these entirely independent of one another, or has there been what is called Stimulus Diffusion (whereby an idea is transmitted from one culture to another, but the item itself is not)? There seems no way of definitively answering this, but it does open up another question: why them? Why just those species?

WHY THOSE PARTICULAR SPECIES?

It was Michael Fox in 1978 who made the most concrete suggestions as to the sorts of characteristics in a species which favour domestication. He proposed that a domesticable species lives in large social groups, with leadership and a hierarchical structure, and within which the males are affiliated with the female-young groups. Ideally, the domesticated animals mate promiscuously, not by pair-bonds; males are dominant over females, and their sexual signals are behavioural, not morphological. In addition, the young are precocial, and there is an imprinting period so that the young can be separated from its mother and fostered or hand-reared. They have a short flight distance and are little disturbed by human presence or by sudden environmental change. They are omnivorous or at least catholic in their diets; adaptable; and of limited agility. (The cat, of course, is a notable exception to these. So what else is new?)

Table 1. *Centres-of-Origin Theory applied to domestic mammals.*

Wild ancestor		Domestic descendant	
	MIDDLE-EASTERN CENTRE		
Aurochs	*Bos primigenius*	Cattle (humpless)	*Bos taurus*
Urial	*Ovis orientalis*	Sheep	*Ovis aries*
Bezoar goat	*Capra aegagrus*	Goat	*Capra hircus*
(ancestor unknown)	–	Arabian camel	*Camelus dromedarius*
Wild boar	*Sus scrofa libycus*	Pig	*Sus scrofa*
Wild ass	*Equus africanus*	Ass (donkey)	*Equus asinus*
African wild cat	*Felis libyca*	Cat	*Felis catus*
	Non-mammalian domesticates: Pigeon, Goose?, Honey Bee?		
	INDIAN CENTRE		
Extinct Indian wild ox	*Bos namadicus*	Cattle (humped) = Zebu	*Bos indicus*
Gaur	*Bos gaurus*	Mithan	*Bos frontalis*
	Non-mammalian domesticates: Fowl, Peafowl, Tussore Silkworm		
	SOUTH CHINA/MAINLAND SE ASIA CENTRE		
Arna	*Bubalus arnee*	Water buffalo	*Bubalus bubalis*
Wild boar	*Sus scrofa moupinensis*	Pig	*Sus scrofa*
	Non-mammalian domesticates: Duck, Goldfish, Mulberry Silkworm		
	ISLAND SE ASIA CENTRE		
Banteng	*Bos javanicus*	Bali Cattle	*Bos javanicus domesticus*
Wild boar	*Sus scrofa vittatus*	Pig	*Sus scrofa*
	Domestic pig hybridised with *Sus celebensis* to produce Papuan pig		
	ANDEAN CENTRE		
Guanaco	*Lama guanicoe*	Llama	*Lama glama*
?Peruvian wild cavy	*?Cavia tschudii*	Guinea pig	*Cavia porcellus*
	Non-mammalian domesticate: Muscovy duck		
	Llama hybridised with *Lama vicugna* to produce Alpaca		
	MINOR CENTRES		
Scandinavia:			
Tundra reindeer	*Rangifer tarandus*	Domestic reindeer	*Rangifer tarandus*
Central Asia:			
Wild camel	*Camelus ferus*	Bactrian camel	*Camelus bactrianus*
Horse	*Equus ferus*	Horse	*Equus caballus*
Tibet:			
Wild yak	*Bos mutus*	Domestic yak	*Bos grunniens*
Spain:			
Wild rabbit	*Oryctolagus cuniculus*	Domestic rabbit	*Oryctolagus cuniculus*
Polecat	*Mustela putorius*	Ferret	*Mustela furo*
	Non-mammalian domesticates:		
	West Africa: Guinea fowl		
	Mexico: Turkey		

To assess some of these propositions, let us take the list of species domesticated in the Middle-Eastern Centre and contrast them with related species which are found in the same region but have not been domesticated (Table 2).

Alongside the domestic goat's ancestor, the Wild or Bezoar Goat (*Capra aegagrus*), overlapping slightly with it in distribution, is the Nubian Ibex (*Capra nubiana*). Why was the goat domesticated, but not the ibex? Field studies by Schaller (1977) are available: in Pakistan he observed the Bezoar and not the Nubian Ibex but a close relative the Siberian Ibex (*Capra sibirica*).

Wild equids of any kind are now extinct in Arab countries, but in early Holocene times the Syrian Onager (*Equus hemionus hemippus*) lived there alongside the true Wild Ass (*Equus*

africanus). For this discussion, I will use field studies on Gobi Onager, *Equus hemionus luteus* (Feh *et al*, 1994), and feral donkeys in the USA (Woodward, 1979).

Cattle, sheep, pigs and camels, unfortunately, have no close relatives, but other medium to large artiodactyls of the region, so presumably under potential consideration in this context, are the Arabian Oryx (*Oryx leucoryx*), three species of gazelle (*Gazella dorcas, G.gazella, G.subgutturosa*) and the Persian Fallow Deer (*Dama mesopotamica*). Here I refer to Hall (1986) on the Chillingham feral cattle, Sludskii (1956) on Eurasian Wild Boar, Chapman and Chapman (1975) on European Fallow Deer (*Dama dama*), and a few sources which deal with the exact taxa that are under consideration (see notes to Table 2).

Table 2. *Behaviour of domesticated and non-domesticated Middle-Eastern mammals.*

	Domesticated						Non-domesticated				
	Cattle	Sheep	Goat	Pig	Camel	Ass	Ibex	Oryx	Gazelle	Fallow deer	Onager
Group size	2-3	10	20	6	11	2	9	25,45	<16	10-40	3-6
Hierarchies	yes	yes	yes	yes	yes	no	no	no	no	no	yes
Leadership	yes	yes	yes	yes	yes	yes	no	no	no	yes	yes
Males part of female groups	no	some	some	no	some	no	yes	yes	no	no	yes
Mating type	tending bonds	tending bonds	tending bonds	tending bonds	tending bonds	mainly lek	harem	lek	lek	lek	harem
Flight Distance	short	short	short	short	short	short	long	long	long	short	long
Environmental tolerance	yes	yes	very	very	yes	very	yes	no	no	yes	no
Dietary adaptability	yes	yes	yes	yes	yes	yes	yes	no	no	yes	no
Agility	low	low	fair	low	low	fair	high	high	very high	high	high
Fostering	yes	marked	yes	yes	yes	?	no?	no	no	no	?
Source:	5	7	7	8	4	9	7	1	6	2	3

Note: Sources

1. Abu Jafar and Hays-Shahin, 1988; 2. Chapman and Chapman, 1975; 3. Feh et al, *1994; 4. Gauthier-Pilters and Dagg, 1981; 5. Hall, 1986; 6. Mendelssohn* et al, *1995; 7. Schaller, 1977; 8. Sludskii, 1956; and 9. Woodward, 1979.*

Is group size large in the species that were domesticated? Yes, in most domesticated species group size is large, but not in cattle or asses, and no larger than in the non-domesticated species.

Are their groups structured, with hierarchies? Yes, there are hierarchies, except in the ass, and this is a difference from the non-domesticates except, oddly, for the onager. Were this a necessary criterion, it should have been the onager that was domesticated, not the ass!

Do their groups have specific leaders? Yes again, all of them have leaders; but so do, among the non-domesticates, fallow deer and onager.

Are males affiliated with the social groups? Usually males are not affiliated (cattle, pig, ass), or variably so (sheep, goat, camel). Some of the non-domesticates have such associations, some do not. There is no difference here.

Is mating promiscuous? Usually, yes: most of the domesticated species have what are called tending bonds, where a male forms consortships with several females in turn, lasting anything from a few hours to a few days. Two of the non-domesticates (ibex, onager) live in harems, in which a single male has exclusive mating rights to all the females; oryx, gazelle

and fallow deer have the 'lek' system, in which males set up small temporary or permanent territories, which they defend vigorously against other males and into which they steer fertile females. According to Woodward (1979), some male feral donkeys set up leks, others do not.

Are flight distances short? Flight distance is very difficult to measure, being subject to habituation to some degree: wild sheep and goats advance quite close to human beings, while onagers, oryx and gazelles are incurably timid (except for rutting male *Gazella subgutturosa* and oryx of both sexes, which are extremely aggressive). But fallow deer, both European and Persian, are surprisingly tame.

Are they tolerant of environmental change? Yes, all the domesticates are tolerant in this way; ibex and fallow deer are, whereas the other non-domesticates are environmentally restricted, and in captivity require specialised conditions.

Are they adaptable in diet? This is clear-cut: all the domesticates are adaptable in diet, but none of the non-domesticates are, except the fallow deer.

Are they of limited agility? This, too, is clear-cut: only goats and asses, among the domesticates, have anything like the tremendous agility of, for example, the ibex and onager, among the non-domesticates.

Can the infants be fostered? Again, clear-cut: all the domesticates can be fostered, and, apparently, can be in the wild too; as far as is known, this is not the case for the non-domesticates. Some of the non-domesticates can, however, be hand-reared.

Some of Fox's (1978) criteria survive, some do not. In general, it is true that good candidates for domestication would be large animals, with social groups that are structured into hierarchies, that have promiscuous mating systems, short flight distances, are environmentally tolerant, adaptable in diet, of limited agility, and are capable of being fostered as infants.

Two species consistently violate the criteria: a non-domesticate, the fallow deer, and a domesticate, the ass. The fallow deer is, in fact, a 'nearly-domesticate': *Dama dama* now runs feral in parks all over Europe, and *D. mesopotamica* itself turns up in Neolithic sites in Cyprus, where it is not native, alongside cattle, sheep, goats and pigs (Schwartz, 1973). The ass, however, is very obviously different from other Middle-Eastern domesticates, and, in this light, how it came to be selected for domestication remains a mystery.

WHAT HAPPENED TO THEM SINCE THEY WERE DOMESTICATED?

Table 3 lists changes that have commonly occurred to animals under domestication (partly from Fox, 1978). They became smaller, at least initially: one of the best ways to detect domestication in the archaeological record is to note when the size of the animal starts getting rapidly smaller [for example, Grigson (1989) on cattle]. They exhibit paedomorphic features: short faces, more rounded braincases, with more basicranial flexion. Horns, in bovids, get smaller: the paedomorphic process in different cattle species, and in buffalo, leads to short, relatively thick horns with out-turned tips. In sheep and goats, hornlessness is common in females, and spiralled horn morphs become common. Domesticated animals mature earlier. Some of the behavioural changes (docility, truncation of behavioural sequences) are paedomorphic, but the reduced exploratory behaviour is just the opposite. For Hemmer (1983), this last characteristic encapsulates the entire process of domestication: it is reduction of the *Merkwelt*, the perceptual world, and it is part and parcel of the last and most all-pervasive aspect of domestication: the reduction in brain size.

Table 3. *Common changes under domestication.*

General and External:
Size reduction (at least initially)
Increased colour variability
Changes in texture and distribution of hair
Paedomorphosis

Skull:
Reduced facial skeleton
Shortened tooth-row
Broader skull
Increased kyphosis
Brain reduction

Horns:
Reduction in size
Absence, especially in female
Spiralling

Other:
More docile
Reduced exploratory behaviour and mobility
Reduction of special senses
Higher psychogenic tolerance (eg, crowding)
Behaviour sequences truncated
Earlier maturation

All domesticated animals, except the laboratory mouse, have a brain that is relatively reduced in size. The current best estimates of the exact degree, for each species, taking body size as the standard are listed in Table 4; but they are controversial. One problem is that body weights are unavailable for some wild species, and tend to be unreliable in any case; more reliable and more repeatable estimates are obtained by regressing the cube root of cranial capacity on basicranial length (Hemmer, 1978; Groves, 1989). Another problem lies in identifying the actual ancestor. Hemmer (1976, 1978, 1983) maintains that in the wild ancestral species the actual subspecies which were domesticated were the smaller-brained ones, which were therefore perhaps inherently more domesticable, a view which Herre and Röhrs (1990 and elsewhere) strenuously contest. So in Table 4 three values are listed for the two most bitterly disputed species: the dog and the cat. These values are the original ones, based on generalised wolves and wild cats by Herre and Röhrs (1973); revised estimates from Röhrs and Ebinger (1978); and Hemmer's (1976) estimates of only 10% reduction, based specifically on Middle-Eastern wolves and wild cats. There are also different levels of reduction in different breeds: Siamese cats are further reduced from the general domestic cat level, whereas some dog breeds, such as greyhounds and German Shepherds, have increased their brain size again.

Table 4. *Brain reduction under domestication. Percent reduction of integration constant, b, where brain weight = b x body weight$^{0.25}$.*

Species	Percent reduction	Source
Laboratory mouse	0	Herre and Röhrs, 1973
Laboratory rat: Wistar/ albino	8	Kruska, 1989
Pigmented	12	Kruska, 1989
Mink	5	Herre and Röhrs, 1973
Guinea Pig	13	Kruska, 1989
Rabbit	13	Fischer, 1973
Horse	16	Kruska, 1980
Llama and Alpaca	18	Kruska, 1980
Sheep	24	Ebinger, 1974
Goat	30	Kruska, 1980
Ferret	33	Rempe, 1962
Pig	34	Herre and Röhrs, 1973
Cat		
	28	Röhrs and Ebinger, 1978
	23	Herre and Röhrs, 1973
	10	Hemmer, 1976
Dog		
	29	Röhrs and Ebinger, 1978
	34	Herre and Röhrs, 1973
	10	Hemmer, 1976

Is this reduction genetic? Mainly, but perhaps not entirely genetic: there is some suggestion that cranial capacity is reduced by 5-10% in captive-born zoo mammals, but the evidence is equivocal and, in any case, such a reduction is far below that found in most domestic mammals (Kruska, 1989).

Is it reversed in feral representatives? The answer to this is a surprising, but quite definite, No – to the extent that relatively low cranial capacity has been frequently used to identify, as of feral status, populations which had generally been assumed to be truly wild (Hemmer, 1978; Groves, 1989).

The brain is not uniformly reduced, but differentially. According to Herre and Röhrs (1973), the forebrain and corpus callosum are most reduced, the cerebellum less, the medulla and the midbrain least. Most reduced of all is the limbic system, presumably signifiying reduced aggression.

According to Hemmer (1983), there is differential reduction of sense organs in those domestic species that have been studied (which is not many of them): the eye (including the retina) in dog, pig and ferret, and the ear in dog, cat, ferret and llama.

It seems that domestication really has resulted in, "the decline of environmental appreciation" as the translators of Hemmer's (1983) book refer to it.

THAT SPECIAL DOMESTICATE: THE DOG

It has long been known (Herre and Röhrs, 1973; Hemmer, 1983; Clutton-Brock, 1989) that the dog, as a domesticate, is much older than any other species. The first evidence of domestic dogs (morphological, such as tooth crowding; cultural, such as burial) are late Pleistocene in age (Morey and Wiant, 1992). The dog is far more a part of human society, it has far more distinct breeds, and they vary in colour, size and behaviour far more, than any other domestic species. The social organisation of the dog is totally integrated into human

society, perhaps assisted by the marked paedomorphosis in behaviour, of which other signs are the persistence of play and barking into adulthood.

The behaviour of the wolf, the dog's ancestor, has been thoroughly described in that remarkable synthesis of Hall and Sharp (1978). It violates many of the principles discussed earlier: though a wolf pack varies in size (it can be quite large in cold-climate wolves), it has a bizarre structure, quite different from the herds of domesticated ungulates. In wolf packs, a single dominant male and female do all the breeding, and the other members (generally the offspring of the dominant pair) act as helpers to rear the latest litter. The dominant pair are very definitely the leaders and, of course, the male is a permanent part of the pack. So they do *not* have hierarchies, they *do* have permanent male membership, they are *not* promiscuous and, of course, while adaptable and unafraid, wolves are extremely agile animals. This in itself suggests that their domestication has come about in a different manner from that of cattle, buffaloes, sheep, goats, camels and pigs.

Now comes the startling information (Vilà *et al*, 1997) that dogs have been separate from wolves for as long as different geographic groups of wolves have been separate from each other – and that is a very long time indeed.

Vilà *et al* (1997) tested 261 bp from the mitochondrial control region in 140 dogs (of 67 breeds and 5 crossbreeds) and 162 wolves (from 27 populations), and 1030 bp for 24 of their animals. They found a number of very deep lineages, springing more or less independently from a common origin, as simplified here in Figure 1.

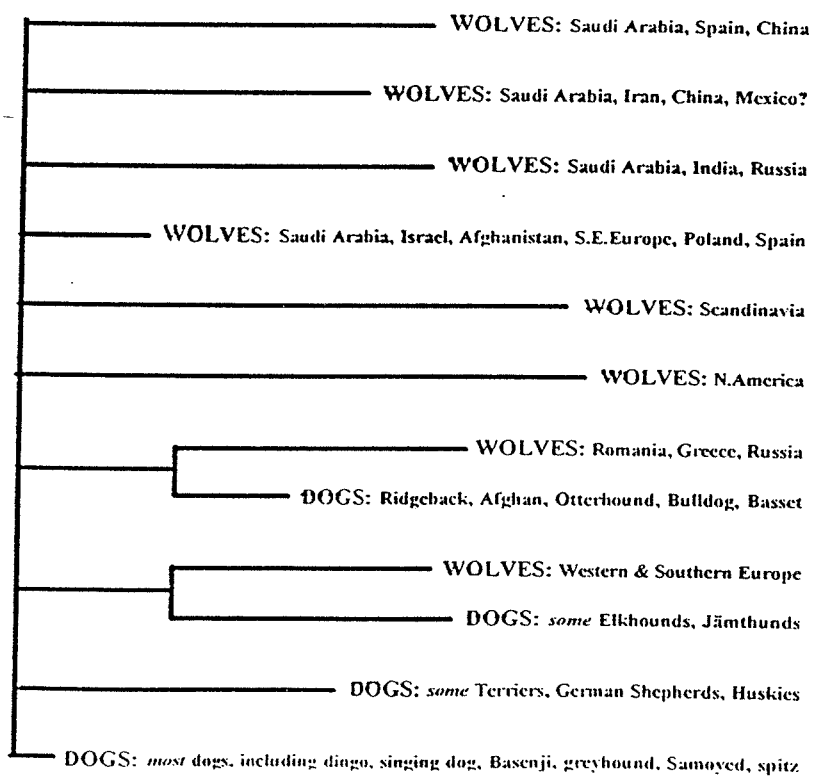

Figure 1. *Outline of dog and wolf evolution (cited from Vila* et al *1977).*

Six lineages contain only wolves, and are well sorted geographically, except that four of them all occur in Saudi Arabia – which is, in fact, a reasonable candidate for the centre-of-origin of the species.

Two lineages contain a mixture of dogs and (European) wolves. The most parsimonious explanation is that the lineages 'belong to' the wolves, and that some dog breeds have received fairly recent gene flow from female European wolves.

Two lineages contain only dogs (one contains most dogs, the other, only a few). This implies that domestic dogs have (at least?) two separate origins from within the wolves.

The authors also tested coyotes and jackals. The sequence divergence between coyote and wolf is 0.075 ± 0.002, whereas the maximum sequence divergence within the major dog clade is 0.010. Vilà *et al* (1997) set the separation time of coyotes and wolves at 1ma, quoting Wayne *et al* (1991); but the most recent authoritative study, including fossil evidence (Nowak, 1979), places their divergence in the Blancan Land Mammal Stage, that is, before about 1.6 ma. If 0.075 represents 1 million years, the major dog clade originated 143,000 years ago; if it represents 1.6 million years, that clade originated 229,000 years ago.

Is it really possible that dogs have existed as a separate entity from wolves for upwards of 100,00 years, perhaps a quarter of a million years? It depends on two contingencies:

1) That mitochondrial DNA evolution is tolerably regular. The arguments put forward by Wayne *et al* (1991) suggest that it is, within limits. To bring the origin of the dog forward to the end of the Pleistocene would require that the normal rate had been speeded up by at least an order of magnitude.

2) That the two dogs-only lineages were not actually part of wolf lineages, so either they have disappeared from wolves (perhaps entire wolf populations were domesticated and became dogs?), or are so rare that they were not picked up by the Vilà *et al* (1997) study.

The case is exactly analogous to that of human mitochondrial DNA evolution: how regular is the DNA 'clock', and have the archaic lineages by chance dropped out of the modern population? Both options seem implausible. The Molecular Clock may not keep exact time, but a variation of that magnitude seems out of the question. Equally unprecedented would be the extinction of a DNA lineage in one branch of a population while it remains overwhelmingly preponderant in another branch of the same population.

We have no option but to take the evidence at face value. The dog, as a quasi-species, really is that old.

HUMANS AS DOMESTICATED ANIMALS

It was Fischer (1914) who first suggested that *Homo sapiens* have the characteristics of a domesticated animal. He claimed that fire, tools and culture sheltered early human populations from natural forces in much the same way as they do for domestic animals, and even went on to assert that the differences between human races parallel those between domestic breeds! The 'self-domestication' hypothesis has been raised by a number of authors since that time, not least among them Konrad Lorenz (1959) who associated it with Bolk's Foetalisation hypothesis, which has more recently been resurrected in the guise of the hypothesis of human origins by neoteny (Gould, 1977).

Herre and Röhrs (1973) were less than complimentary about the concept of human self-domestication. What, they ask, is the wild ancestral species? Humans, in domesticating other species, took particular individuals of them and came to control their lives, but in the human case the entirety of the species is in the same 'domestic' condition. Humans, they maintain, have not selected themselves or each other: deciding which are profitable and shall breed,

which are inferior and shall be slaughtered or turned loose (it is superfluous for me to comment). Certain similar variants crop up (pigment loss, curly hair, size reduction), but close anatomical parallels do not exist. Indeed, and they stress this, human evolution records continuous enlargement of the brain, while domestic animals are characterised by reduction in brain size.

And yet there are parallels. From Table 3, paedomorphosis (including every one of the skull characters) at once attracts attention as being applicable to *Homo sapiens*. As Table 5 shows, some parts of the human brain dealing with special senses really are reduced, relatively or absolutely, compared to other hominoids (Stephan *et al*, 1981). But what of the criticism of Herre and Röhrs (1973) that brain size, so far from being reduced like a domestic animal, has actually increased?

Table 5. *Reduction of brain structures in humans. All values expressed as percentage of volume of medulla*

	Chimpanzee	Gorilla	Human
Neocortex	5,013	4,547	10,461
Cerebellum	750	922	1,428
Visual cortex	252	202	238
Tractus opticus	10.8	8.9	8.6
Lateral geniculate body	6.1	5.1	4.3
Olfactory bulb	4.4	4.2	1.2

Source: *Calculated from figures given by Stephan* et al *(1981)*

Actually, within the species *Homo sapiens* brain size has reduced (Table 6). Cranial capacity, as calculated from the internal cranial module, declined in Europe between Mesolithic and modern times (Henneberg, 1988), and in sub-Saharan Africa decline has occurred from at least the Middle Stone Age to the present day (Henneberg and Steyn, 1993). There appears, in fact, to have been a worldwide trend of reduction in cranial capacity, at least during the Holocene; at the same time, there has been no reduction in body size.

Table 6. *Cranial capacity reduction in* Homo sapiens.

	MALES		FEMALES	
	Stature	Cranial capacity	Stature	Cranial capacity
EUROPE:				
Upper Palaeolithic	174	1544	159	1385
Mesolithic	169	1567	156	1468
Neolithic + Eneolithic	166	1496	154	1373
Late Middle Ages	169	1418	156	1277
Modern	174	1391	161	1210
AFRICA (cranial capacity only):				
MSA (130-30 ka)		1542		-
LSA (30-2 ka)		1467		1329
Iron Age (2000-200 BP)		1359		1278
Modern		1372		1248

Source: *Henneberg, 1988; Henneberg and Steyn, 1993*

So here is my hypothesis. The human-dog relationship amounts to a very long lasting symbiosis (Newby, 1977). Dogs acted as humans' alarm systems, trackers and hunting aides, garbage disposal facilities, hot water bottles, and children's guardians and playmates. Humans provided dogs with food and security. The relationship was stable over 100,000 years or so, and intensified in the Holocene into mutual domestication. Humans domesticated dogs, and dogs domesticated humans.

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