CONTES DE MA MÈRE L'OYE: AVICULTURAL NOTES

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ABSTRACT: This paper is an essay on aviculture. It presents general information on the keeping of gallinaceous birds and waterfowl with an emphasis on the relationship between man and the avian subjects of his interest. The reasons for keeping rare decorative birds are often an economic nature. The scale of reproduction in captivity may result in the change of an ornamental species into a culinary species. The subsequent use of a domestic animal may very well deviate from its original taming in prehistoric times, for instance from an offering to bio-industry production. The rearing of a species may also be connected with the re-stocking of shoots.

Propagation of birds in captivity may ensure the survival of a species. Still the re-establishing of species in nature by means of specimens raised in confinement tends not to be very successful.

The relationships between certain goose species and man is treated in greater detail and based upon observations on such birds in the author's own menagerie.

KEYWORDS: Aviculture, gallinaceous birds, waterfowl, conservation, domestication, bird behaviour, ethology.

1. INTRODUCTION

This paper is a report on my interest in aviculturalism, a form of animal husbandry; it is an essay rather than a thorough study. It is based upon my own observations, which resulted from a hobby and were not my main task as a scientist which especially concerns archeobotany. Throughout my life I have kept thousands of animals ranging from pedigree Belted Cattle to tiny Bladder Snails. Still I do not think that I would have written about my interest in animal keeping and archaeology if I had not read Janet Kear's book on man and waterfowl (Kear, 1990). I was impressed not only by the information on domestication where waterfowl are concerned, but especially by Kear's description of historical goose keeping in Britain. She informs the reader on the omnipresence of geese, their economic importance, the peculiar drives and many other interesting facts. Reading the chapters on geese, one realizes how important geese were also in folklore, in the tales of Grimm and Andersen, how important gossards were in literature, for instance in Selma Lagerlöf's *Nils Holgersson*. In 1729 Perrault's tales *Contes de ma Mère l'Oye* were translated by Robert Samber, starting the Mother Goose legend in English-speaking homes (I. & P. Opie, 1974). The last time I saw a goose-girl, in a chequered apron, a long twig in her hand, herding twelve geese, was in Jutland, Denmark, during a palynological meeting at the castle of Løvenholm, 1982. However, she only took the birds to a fenced meadow at some distance from the farm, where they had been confined for the night, protected from foxes.

The reason why Janet Kear's story is so important is that she makes clear that we overlook what happened yesterday, while painstakingly investigating what happened the day before yesterday. Her book is not only of interest to archaeozoologists but is a must for all people dealing with Northwest-European archaeology. Various disciplines may supply us with information on the history of the domestication process. Interest in this process comes mainly from the archaeological side. It is therefore self-evident that osteological remains found in archaeological excavations form the basis for investigations into the history of domestication. Nevertheless, it is clear that many other disciplines supply essential information on this bioarchaeological process. Behavioral ecology forms one of the important but underrated parts of the study of domestication. The fact that domestication took and still takes place is more than evident from the living results. The domestication process is a matter of two participants: man and a particular animal species. In this interaction a large number of factors play a role. There are scholars who have pointed out important aspects, for instance Juliet Clutton-Brock (1989) in *The Walking Larder*. Norbert Benecke too treats other subjects besides just bones in his book *Der Mensch und seine Haustiere* (1994).

Some archaeozoologists, especially Anneke Clason, have turned their attention to rare domestic breeds, which are of interest to archaeology because they may form a link between prehistoric breeds of which only bones are found and the modern stock of industrial farming. These remnants of country life may still be the primary source of survival in remote areas, but in Europe they are mostly the agricultural

leftovers rescued by private people who know a great deal more about animal breeding and keeping than do scientists. Since the FAO has been issuing first pilot studies and subsequently a journal on 'Animal Genetic Resources Information', we are informed about a tremendous wealth of rapidly disappearing domestic animal breeds, which are of great interest to the bio-archaeologist.

The domestication of various animals and plants (Roberts, 1989) took place at different times and places, from the Late Glacial onward. Yet this does not mean that these processes have ended. Modern domestication processes can be very informative, although one has to realize that they are taking place under circumstances differing from, for instance, those of ten thousand years ago in the Fertile Crescent. In this respect the study of modern domestication processes resembles anthropology; it is equally important for explaining past processes.

Among the large number of gallinaceous and waterfowl species, a number are not suitable for domestication, while others live beyond the reach of people. Obvious species were selected and other potential domesticates were missed. In this paper I will pay attention to the history of wild birds caught and kept primarily for ornamental reasons.

2. AVICULTURE

Keeping birds for ornamental reasons has a long tradition. Such may be concluded from wall paintings in Early Dynastic Egypt, in which Egyptian Goose (*Alopochen aegypticus*), Pintail (*Anas acuta*), Red-breasted Goose (*Branta ruficollis)* and other birds are depicted. The methods of collecting, keeping and possible propagation in early aviculture are not known. It is suggested that some animals and birds in Egypt were bred or caught from the wild and force-fed to serve as offerings to the gods. Only later were they used for more worldly purposes.

In the course of time, avicultural interest could turn into a culinary one, as happened for instance with Guinea Fowl (*Numida meleagris*) or Bobwhite Quail (*Colinus virginianus*) which was developed into a breed called 'Wisconsin Jumbo'. These species were turned from ornamental pets or shooting birds into domestic fowl. Pet-keeping, as found for instance in South American hunter-gatherer tribes nowadays, may closely reflect early prehistoric man-animal relations (Serpell, 1989). However, propagation is hardly if at all stimulated and it is remarkable that animals, after being taken from the wild, are raised in captivity and subsequently simply released. Some will stay with their foster parents in the settlement, others will disappear. One wonders to what extent the keeping and breeding of avicultural species in modern society resembles pet keeping in hunter-gatherer tribes. This petkeeping resembles the now disappearing rural tradition in the northern Netherlands to raise a Jackdaw and keep it for several months until the bird disappears.

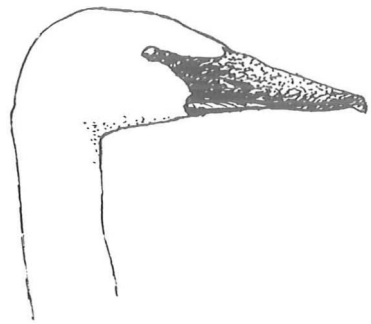

Fig. 1. Trumpeter Swan (*Cygnus buccinator*).

Seventeenth-century Dutch collections (*Rariteitenkabinetten*) included rare exotic birds acquired by the owners, often rich marine merchants (Brouwer, 1954). Such birds can be seen in paintings by Melchior d' Hondecoeter, Albert Cuyp and Jan Steen. It is only in the 19th and 20th centuries that mere collecting developed into keeping of all kinds of wild birds, often with the aim of reproduction. These aviculturalists had agents all over the world or even sent special collectors abroad to obtain rare parrots, ducks or pheasants. In the early days, birds were also bred in zoos that kept birds under suitable conditions. For instance, Frans Ernst Blaauw was an important aviculturalist in the Netherlands at the beginning of the twentieth century. Dressed like a Prussian cavalry officer, he rode on horseback around his estate Gooilust near 's Graveland where his collection comprised 102 species of animals and birds, especially cranes and ducks. He repeatedly bred the very rare Trumpeter Swan (*Cygnus buccinator*) (fig. 1), offspring of which were even sent back to the United States, where they came from, particularly to the Kellogg Bird Sanctuary (Delacour, 1956; Brouwer, 1954).

An important aspect of pre-war bird-keeping was that information on aviculture became available through journals, such as *Ibis, Condor* or *Bulletin de la Société d'Acclimatation de France*.

There was no great economic incentive force to breed birds in times when they could be caught abroad in large numbers and shipped to western Europe. However, when the country of origin decided to protect the dwindling wild stock, the species concerned could considerably increase in price. The Russian export ban on Red-breasted Geese some decades ago made the price of a pair go up from 800 to 2200 Dutch guilders. This price increase enor-

mously stimulated propagation in captivity, resulting in a growing population of captive birds, whose price dropped to about 300 Dutch guilders a pair by 1996 (1 US $ = c. 2 HFL). After 1945, aviculture developed enormously in several European countries, including eastern Germany (Kolbe, 1972) and in the United States. It was no longer the privilege of estate owners, and large numbers of people from various social strata took up this hobby. Most of the trade in ornamental birds went along normal channels, submitting laws and regulations. When a species was present in large numbers and easy to obtain, prices were comparatively low. Some species were rare, which made them very expensive and put them in great demand. Scarcity often meant rarity in the wild. This was the case with for instance several parrot and macaw species, which were strictly protected in their country of origin. Prices would amount to tens of thousands of dollars, and breeding such birds became a professional business. Such birds in particular would be smuggled from their original distribution area where they were protected in vain.

3. SCIENTIFIC INTEREST IN MODERN AVICULTURE

Several European countries have their own branch of the European organization *Aviornis International* which issues a journal in which practical aspects of aviculture are discussed. Very helpful in the dissemination of knowledge in general are the descriptions of species, extracted from literature. This magazine and the backing organization can be compared to the avicultural journal *Gazette* published in Salt Lake City, U.S.A. All the more remarkable is the general lack of 'aesthetic' or 'scientific' interest in these birds displayed by the average 20th-century Dutch aviculturalist. In Britain discussions in the periodicals point to a somewhat different attitude. The interest seems also low among shooters in the Netherlands with their specialized decoy-flocks of White-fronted (*Anser albifrons*) and Taiga Bean Geese (*Anser fabalis fabalis*). Instead, they (the catchers or the shooters) judge the birds in terms of their practical value or their value in money. Although the shooters highly valued good decoys (Bottema, 1989) they nevertheless sold their birds immediately after the authorities forbade the use of decoys. This is quite remarkable because some shooters or goose-netters had a strong bond with their birds. Anecdotal stories about such ties are told. An old Frisian catcher was said to have his leading decoy, an old White-front gander, sleeping beside him in the old-fashioned box-bed.

Today the decoys mentioned above have no value since their use in shooting is prohibited. Their only remaining use is in netting for banding purposes. Since wild specimens of White-fronted and Bean Geese can easily be obtained by catching, be it illegally, prices are low and interest is negligible. From an avicultural point of view this is remarkable, especially since this absence of interest in Europe is shared by the waterfowl keepers in America, who do not keep Bean Geese or Eurasian Whitefronts. Thus the value of waterfowl for most aviculturalists, at least in the Netherlands, is directly defined by their economic value. Available numbers generally define the price, but demand for coloured birds or birds with striking patterns tends to exceed that for rare but dull-coloured birds. Town parks especially want conspicuous birds like Shelducks.

An aspect of interest to the archaeologist or anthropologist is that the breeders rank themselves according to the birds they keep and the birds' value in money is the direct basis of this ranking. To belong to the in-crowd of waterfowl keepers in the Netherlands, the criterion for a long time was the possession of Red-breasted Geese. When the price of a status-conferring bird drops too much, other species take over. It is obvious that these new 'status species' belong to the category of birds that are difficult to obtain or to keep and which are invariably expensive. In 1997, one's collection should include a pair of Long-tailed Ducks to demonstrate one's status. Rare and interesting birds like the Trumpeter Swan never achieved such a status because too few of the waterfowl fanciers could afford the large ponds and large pens that are required to house these swans.

4. NOTES ON GALLINACEOUS BIRDS

A group that has the interest of a large number of breeders is that of the Galliformes. In this group the Golden Pheasant (*Chrysolophus pictus*) and the Lady Amherst Pheasant (*Chrysolophus amherstiae*) (fig. 2) have been kept in western Europe for centuries; the first record of the Golden Pheasant in England dates back to 1740. This keeping resulted in the spoiling of both original species by crossing. At a certain time crossing even caused the disappearance of the true wild form of the Lady Amherst Pheasant in captivity. In the case of the Golden Pheasant the genetic mix-up was even more confusing because a series of new colour forms were developed, in which the amount of Lady Amherst Pheasant blood could only be guessed at. A very attractive variety of the Golden Pheasant is the Yellow Golden, perfected by Professor Ghigi from Bologna (Wayre, 1969). By 1865 a true-breeding melanistic form had appeared and nowadays several variations, including white, are shown at exhibitions. Pure wild types, showing no red in the yellow crown, are very rare in captivity and have to be caught in the wild or can be seen for instance in the San Diego Zoo where pedigree is

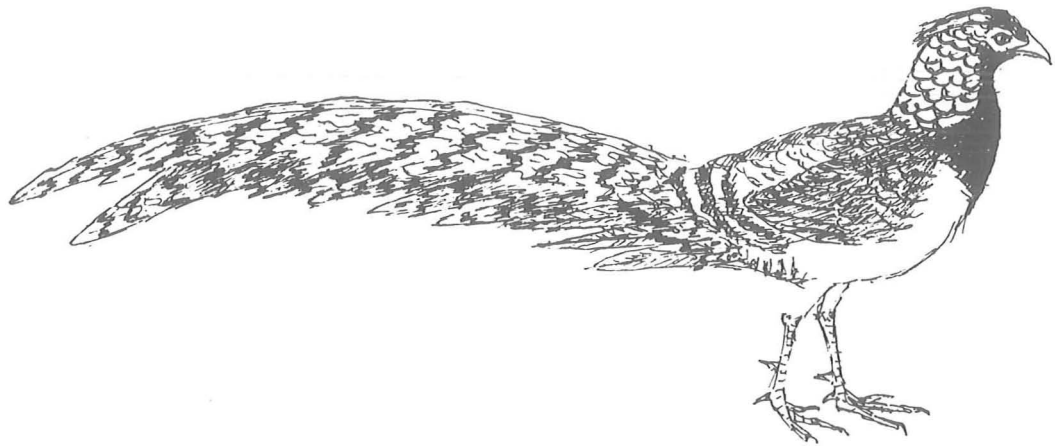

Fig. 2. Lady Amherst Pheasant (*Chrysolophus amherstiae*).

maintained carefully. The history of pheasants in captivity and the narrow genetic basis of many species in such conditions, are described by Chick Driscoll in the San Diego Zoo Pheasant Program (*Gazette*, March, 1988).

Within the large group of Galliformes the genus *Phasianus* has long historical contacts with man. Martialis (100-40 BC) reports that Jason, returning from his trip with the Argonauts, brought with him a gallinaceous bird from the stream valley of the Phasis in Colchis. He took the bird to Greece and called it Phasianos, bird of the Phasis, after this river. This must have been the Black-necked Pheasant (*Phasianus colchicus colchicus*) which was reported by Aristophanes (250-180 BC) as being kept by prominent Greek families. Most evidence from Roman times comes from cookery books by Martialis, Aelian, Palladius and Apicius. Pictorially the pheasant widely featured in mosaics and so it appears in Roman-period Trier in the Rhine area, although it is not clear whether the bird occurred there, in captivity or even released into the wild. Roman mosaics from Thysdrus in North Africa also show pheasants but there the birds were not established in nature. In other parts of Europe, pheasants were possibly spread by the Romans but it is not clear whether this reflects their being kept in captivity for a culinary purpose or their release into the wild. The first appearance of a certain species does not imply its immediate establishment in the area. In Denmark, the pheasant is described from 1562 on but a wild population in that country developed only after 1850. We could compare this to the first appearance of Egyptian Geese in seventeenth century Dutch paintings, whereas a wild population in the Netherlands did not develop until after 1960. The original feral population of the pheasant will have been of Black-necks and we may imagine that this population was reasonably uniform. Still there are early Roman images that already show birds with white neck-rings, for instance in a Roman mosaic in Britain. A bird with a white neck-ring is also shown in a Flemish gobelin tapestry dating from 1520. That date is still too early for Central or East Asian imports and we must conclude that the Cholcic strain may have contained this trait to some extent.

The genus *Phasianus* includes 35 subspecies, all occurring in Asia (Glutz von Blotzheim, 1973). During the 18th-20th centuries only some of these subspecies were of influence on the original Black-neck population in the Netherlands. These would be the Chinese Ring-necked Pheasant (*Phasianus colchicus torquatus*), the Mongolian Pheasant (*Phasianus colchicus mongolicus*) and to a lesser extent the Versicolor Pheasant (*Phasianus colchicus versicolor*). The original distribution of these subspecies can be found in Glutz von Blotzheim (1973); it should be noted that the subspecies *mongolica* is not found in Mongolia but in the Altai. It is remarkable that the successive input of different blood into the population has led to a fairly stable breed that developed its own character and a colour pattern that was new and not found on any of the ancestral breeds. From ornithological observations on the development of the pheasant population (Allen, 1953) we may draw the conclusion that the existing population is far more important for reproduction in the field than the large numbers of birds released for shooting. The latter category is very heavily preyed upon by local predators, whereas the feral population is mostly responsible for the propagation in the wild.

In short, various subspecies from Central and eastern Asia have been brought to Europe and America, first to be kept in captivity but subsequently released for shooting. In this way clearly distinct, beautiful subspecies have been spoiled by mixing. The original Cholcic form with its black neck soon became mixed with strains of diverse feather patterns, especially white neck rings. Large numbers of pheasants were reared for shooting and this presented an opportunity to observe the appearance of colour and

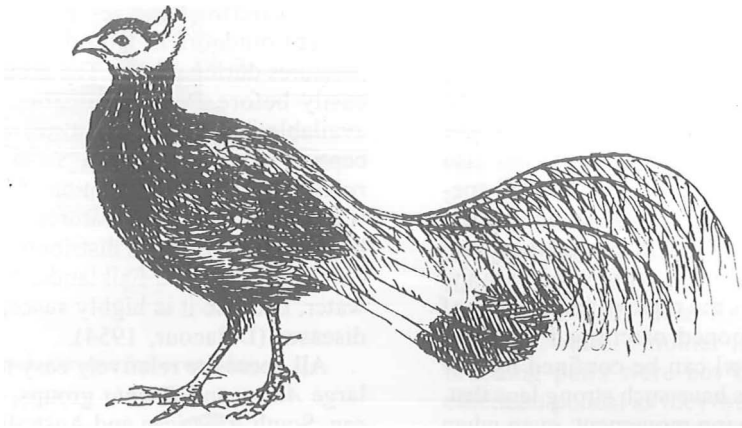

Fig. 3. Blue-eared Pheasant (*Crossoptillon auritum*).

size variation. In captivity a melanistic form '*tenebrosus*' appeared that was also used for shooting. To supply restaurants, pheasants were bred directly for the table and 'broiler' and 'giant' types developed. To give an idea of the importance of this game bird, Durwood L. Allen (1953) is quoted from his report on the island of Pelee in Lake Erie, Canada:

The two separate hunting seasons in 1950, totalling four days, produced perhaps the greatest hunting in the world. The event will go down in hunting history, for on this tiny, 10,000-acre island over 25,000 birds were shot - more than two and a half birds per acre. Most people feared that such a liberal hunting season had killed the proverbial goose, but after the smoke had cleared, there still remained a bird per acre.

In the genus *Crossoptilon*, the Ear pheasants, crossbreeding in captivity has repeatedly taken place. This contributed to the disappearance of the Brown-eared Pheasant (*Crossoptilon mantchuricum*) of which only a few birds had been imported in the eighteen sixties, resulting in a small population that seemed to suffer from inbreeding. The spoiling of the offspring of the three males and two females imported in 1864 and 1866 in the Jardin d'Acclimatation in Paris need not be overdramatized, were it not that the Brown-eared Pheasant has become very rare in its original distribution area, northern China and the Charhar in Inner Mongolia. Rescuing this pheasant through specimens bred in captivity seems hardly possible (Wayre, 1969). The White-eared Pheasant (*Crossoptilon crossoptilon*) includes several subspecies and since the last imports (before 1940) these birds have become very rare and impure. The number of pure birds caught in the wild remains low and breeders have to be careful not to cross the captive White-eared Pheasant with related species or subspecies. The Blue-eared Pheasant (*Crossoptilon auritum*) (fig. 3) was imported late (1929) but became very well established in acceptable numbers. The rapid fluctuations of the numbers of birds in captivity, the very negative effect of wars on captive populations and the permanent threats in the wild make the future of many species like these Ear Pheasants very uncertain.

Many galliform species are extremely rare in their original habitat as a result of shooting and/or biotope destruction and this is where the advice and practical assistance of aviculturalists comes in. Re-establishment programmes, for instance those supported by the Pheasant Trust, exist for some *Syrmaticus* species which have been bred in captivity and released in their native country. Such programmes are very complicated. The low number of wild birds may have been caused by over-cropping or by the more serious destruction of biotope. Moreover, one has to reverse the domestication process, in which a species passed through a genetic bottleneck. The inbreeding effects of captivity should be limited, not visibly affecting the birds and leaving necessary potential as untouched as possible. For such programmes large numbers of birds are required and the rate of success is very low or, sadly enough, often negligible. *Not* domesticating, or, to put it otherwise, *not* changing a species in captivity, while it is meant to be released, is very difficult and in the long run impossible.

The release of captive birds in an area where the wild ancestors have strongly decreased in numbers is a very difficult operation and should be practised only as a last option. In fact, if no specimens remain in the wild, one may replace the former wild horses by mustangs.

5. WATERFOWL

The group of birds I am fairly well acquainted with is the family of the Anatidae, the geese, swans and ducks. I am not only familiar with the keeping and breeding of several of these species, but I am also interested in aspects of domesticity. Of the 258 species of Anatidae, I kept or currently keep 56 species, most of which have reproduced in confinement. An advantage of waterfowl keeping, compared with the keeping of Galliformes, is the relative immobility of Anatidae if they are pinioned or clipped. Without complete wings, waterfowl can be confined by low fences. Gallinaceous birds have such strong legs that, together with fluttering wing movement, even when pinioned, they can jump or scramble over high fences, making covered pens necessary.

The keeping of waterfowl originally started in prehistoric times with a few species that were abundant and easy to keep, like the Mallard (*Anas platyrhynchos*), the Muscovy Duck (*Cairina moschata*), (fig. 4) and the Greylag (*Anser anser*). The domestication aspects of these species are treated extensively in literature (Kear, 1990; Delacour, 1954; Benecke, 1994; Grow, 1972). Subsequently a larger number of species, in general represented by strong birds with a wide ecological range, were adopted by man. The term 'wide ecological range' refers to the ability of these species to live under diverse conditions and can even to survive under conditions offered by man which are called 'captivity'. Therefore, this group did not include species that lived in the Arctic or Antarctic, on sea water or in very clean torrential mountain streams or required other very specific conditions. The main criterion was not necessarily food quality but the susceptibility of these species to infective agents that are common in warm or temperate environments, especially in captivity. It is striking that in many cases temperature is hardly important. Many waterfowl species from tropical regions can be kept outdoors in latitudes with below-zero temperatures during winter. The group that could be kept easily before 1940 in situations where water was available includes all the swan species, with the exception of the Coscoroba Swan (*Coscoroba coscoroba*), which is an illustration of what is stated above. It can stand low temperatures, a fact that can easily be concluded from its distribution, Patagonia, Tierra del Fuego and the Falklands, but it requires clean water, because it is highly susceptible to contagious diseases (Delacour, 1954).

All geese are relatively easy to keep, not only the large *Anser* and *Branta* groups, but also their African, South American and Australian ecological counterparts, the genera *Chloephaga* (fig. 5), *Cyanochen, Neochen, Alopochen* and *Cereopsis,* the Sheldgeese and their relatives. An exception is the Kelp Goose (*Chloephaga hybrida)* which is highly specialized, feeding on sea coasts during low tide in disease-free surroundings. In fact, it does not feed on kelp but on sea lettuce and other marine vegetable matter (Todd, 1996). Belonging to the large group of geese eating herbaceous matter (grass), the Sheldgeese are highly territorial and very aggressive. This makes them unsuitable for (economic) domestication.

A large number of duck species were kept even before 1940. Of the genus *Anas,* the most common form, the Mallard, had since long been turned into a range of domestic breeds. Closely related species or subspecies from tropical areas, for instance the Laysan Duck (*Anas laysanensis*) from the small island of Laysan, and the Koloa (*Anas platyrhynchos wyvilliana*) from Hawaii, must have developed relatively recently from Mallards gone astray. Although living on tropical islands, Laysan Ducks and Koloa can stand low winter temperatures very well and this may be an indication of their recent development from Mallards, which is unlikely to predate the Holocene.

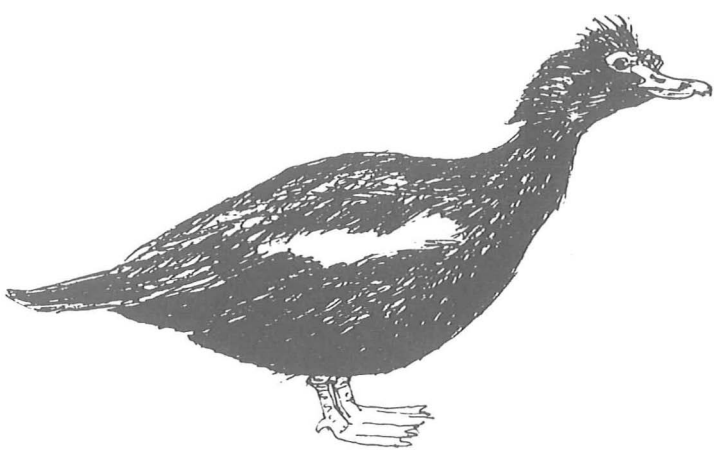

Fig. 4 Muscovy Duck (*Cairina moschata*).

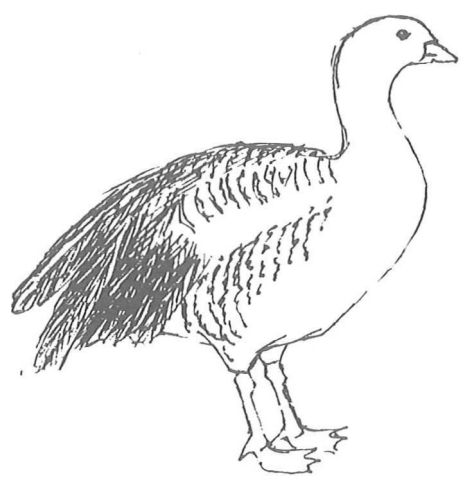

Fig. 5. Magellan Goose (*Chloephaga picta*).

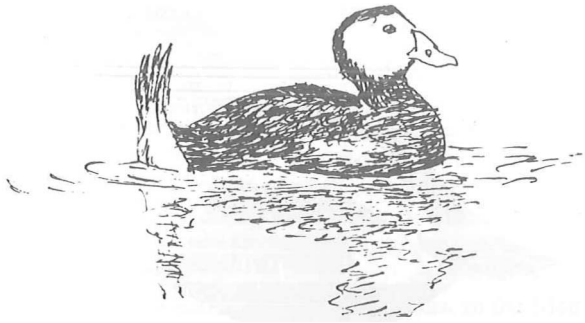

Fig. 6. White-headed Duck (*Oxyura leucocephala*).

Fig. 7. Chilean torrent Duck (*Merganetta armata armata*).

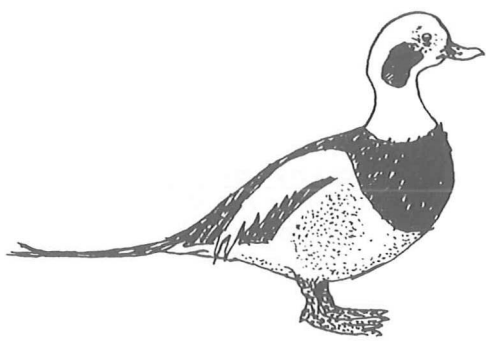

Fig. 8. Long-tailed Duck (*Clangula hiemalis*).

This is in sharp contrast with Meller's Duck (*Anas melleri*), a mallard-like species from the island of Madagascar, which must be considerably older than the Laysan Duck and the Koloa. The eggs of the large Meller's Duck are much smaller than those of the Mallard, indicating that this species is adapted to the warm conditions of Madagascar, given the relation between the size of the newly hatched ducklings and temperature. Larger ducklings retain heat better than smaller ones under the same temperature conditions.

During the late seventies and early eighties better facilities for the housing of demanding species became installed in more and more aviaries of private people. Zoos of course had more trained staff and often obtained the most modern equipment. There was an increasing trend in zoos to create such conditions not for individual species but for ecological units, for instance the 'tropical rainforest' or the 'African savannah'. The aim was to present more natural surroundings with regard to climate, vegetation and birds and small animals. Private breeders developed an amazing knowledge of exigent species and of necessary technical conditions, such as clean running water obtained through pumping, which prevented the birds from fouling the swimming and drinking water. Another important detail was that breeding pairs were not kept together with many others on ponds, as they were in zoos, but were kept separate. It is logical that productive strains were developed automatically in captivity, because birds that did not reproduce simply died out. Indeed, such a system does not differ at all from reproduction under natural conditions, where the most successful strains will gradually dominate the population. At the same time more and more specialized feeds were produced by several companies. The form and presentation of this food could also be crucial. For instance, for the Stifftails (*Oxyura*) (fig. 6) floating food had to be developed because these birds will hardly leave the water. At the same time the floating food should not disintegrate, so it will remain available to the ducks and not foul the water.

In this way technology and avicultural desire introduced a new range of duck species to be kept in captivity and to be propagated if possible. This most recent series includes the Mergansers and the Smew (*Mergini*), the Scoters (*Melanitta*), the Pygmy Geese (*Nettapus*), the Pink-eared Duck (*Malacorhynchus membranaceus*) and even the highly specialized and much demanding Torrent Ducks (*Merganetta*) (fig. 7), the Harlequin Duck (*Histrionicus histrionicus*) and the Long-tailed Duck (*Clangula hyemalis*) (fig. 8). To establish a captive breeding population of the Chilean Torrent Duck (*Merganetta armata armata*) and the Bronze-winged Duck (*Anas specularis*) plans have been developed by Mike Lubbock (Sylvan Heights Waterfowl) and the Chilean El Refugio Staff (Aviornis International, U.K. version, December 1996).

The Long-tailed Duck offers special problems because of its complicated moult (Glutz von Blotzheim, 1969; Delacour, 1959). It is one of the more numerous ducks of our world; unfortunately thousands are killed in fishing nets and through oil pollution. To illustrate the interest in the keeping of this new species, a pair raised in captivity in 1997 would fetch 15,000-20,000 Dutch guilders (10,000 US $).

The difficulty of the initial keeping and breeding of one of these demanding species is illustrated by the example of the Hooded Merganser (*Mergus cucullatus*) (Delacour, 1959). Before 1950 the Hooded Merganser never lived for more than a few months

when captured, although some birds winged by shooting survived longer on large ponds. C.A. Pilling from Seattle first established a pair of 'Hoodies' in captivity from cripples he obtained in 1950 and 1953, respectively. The male had to be force-fed for ninety-four days before he started to eat by himself. Pilling writes:

Since that time they have become very tame and will come up to me when I call them by name and eat from my hand. They will eat anything the other ducks eat now including bread, whole grains, turkey pellets and game bird feed. Before the breeding season I feed them a mixture of raw meat, fish and grains but most of the year I don't bother to make anything special for them.

In 1956, Mr. Pilling's Hooded mergansers produced twelve ducklings and in the following years more Hooded Mergansers were raised. Today this beautiful bird is found in many private collections where it does very well on clean, running water.

The lesson to be learnt from the history of aviculture of the Anatidae or the Galliformes is that the many species differ very much in their requirements. The advance of the technology is reflected in the possibilities of bird keeping. One must realize that this must have been the same in prehistoric times. The generalist species were first taken into captivity where some species were domesticated even at an early stage. The specialists could only be kept in captivity because of the increasing knowledge aviculturalists obtained of the birds and the technical advances in feed and accommodation. Of course it was necessary to provide the required conditions for the generalists in the early phases of bird-keeping. One could even postulate that at that time the bird' requirements were proportionally just as hard to realize as the technical sophistication under which superspecialists were tamed much later.

6. INBREEDING

The establishment of a small population in captivity may lead to a rapidly growing one if the genetic composition of the initial group is good. If one or more lethal factors are present, at first in a heterozygotic form, they will soon be bred pure and lead to the death of the affected specimens. If the factor is recessive it will not easily leave the population but one will still be able to breed some healthy specimens. It is however a misunderstanding that inbreeding is dangerous. Inbreeding was and is very common in animal husbandry and in the wild in island populations. Genetic drift means that a restricted gene set is present and of this set genes will very easily be lost, bad ones as well as good ones. Inbreeding causes difficulties only if negative traits are bred more and more purely, subsequently causing trouble. In island forms one can easily accept that such traits may not have been present or were soon lost.

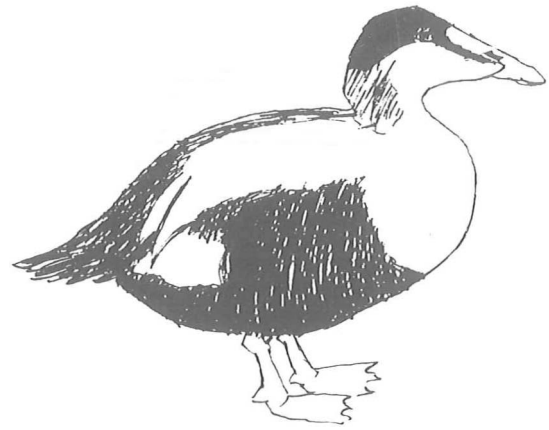

Fig. 9. European Eider (*Somateria mollissima*).

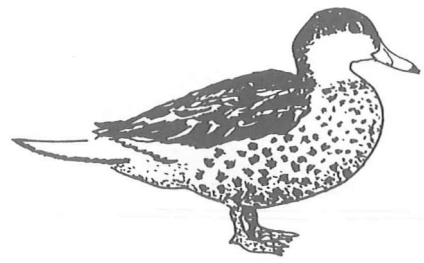

Fig. 10. Bahama Duck (*Anas bahamensis*).

If an island population is established, the genetic variation becomes very narrow, resulting in a small homozygotic population. An extreme situation occurred with the Laysan Duck, which twice went through a very narrow genetic bottleneck. At one stage only a single specimen was left with her clutch of eggs, resulting all the same in the re-establishment of a healthy population.

6.1. Genetic variation in ornamental birds

In some species of parrots, pheasants and waterfowl, changes (domestic traits) occurred soon after such species started being kept. The Canary (*Serinus canarius*) is a good example of form and colour variation in a captive species. In parrot-like birds, the Budgerigar (*Mellopsittacus undulatus*) is available in many colour varieties.

As stated above, several colour varieties appeared in the Pheasant (*Phasianus colchicus*). Such traits are valued by man and are selected upon. One may consider a white ring in the Caucasian Black-necked Pheasant (*Phasianus colchicus colchicus*) among these factors. A comparable feature is the white neck-

ring that appears in some Cackling Geese (*Branta canadensis minima*).

In waterfowl several species developed white or 'blond' strains. In Eider Ducks (*Somateria molissima*) (fig. 9) this happened in a few generations, suggesting that the light-coloured specimens are not mutants but must be the result of inbreeding of a heterozygotic recessive trait present in the wild population. The same is true for mallards and African Yellow-billed Ducks (*Anas undulata*), which give rise to white specimens in a few generations. In the Mandarin Duck (*Aix galericulata*), the Carolina Duck (*Aix sponsa*), the Red-crested Pochard (*Netta rufina*), the Pintail (*Anas acuta*) and the Bahama Pintail (*Anas bahamensis*) (fig. 10) the development of white strains took more time. For an explanation of the occurrence of mutants or recessives, see Bottema (1992).

7. CONSERVATION

Keeping animals will inevitably lead to changes that we call domestication. The genetic composition of an animal species will always change under conditions of captivity because these conditions differ from those in the wild. Genetic drift will play a pronounced role because the number of birds transferred to captivity is generally small. Once such birds have become domesticated, they are less suitable for re-establishing a wild population. They are not only different from their ancestors but they may even be no longer adapted to natural conditions. Indeed, very large numbers have to be released to allow the process of natural selection and adaptation.

Benecke (1994: p. 71) gives an example of dental anomalies in wolves from zoos. The aim of the zoo is to breed genuine wolves but the selection process starts to work under the new conditions and these new circumstances may support animals that are very well adapted to zoo life but which would have rapidly succumbed in nature. The appearance of aberrant traits is obvious for those people who sharply screen the physical appearance of mammals or birds. Of course other, less visible (physical or mental) properties may have changed also but these are more difficult to detect. It is important to realize that changes in genetic composition (domestication) will take place unnoticed and as a passive process until the individuals display traits which are positively selected upon. Domestication is often regarded as an active process on the part of the people who started keeping animals. It is clear that man may influence the process but cannot avoid or halt it. The keeping and breeding of animals by man is nowadays often mentioned in connection with re-establishment programmes. There are several species which are extinct in nature and now can exist under the protection of man only. Some of them have changed to forms that differ very much from the original wild form. The aurochs (*Bos taurus primigenius*) for instance became extinct shortly before 1620 (Rokosz, 1995). But its descendants, in the form of numerous cattle breeds, demonstrate the biological success of the ancestor. To our ethical way of thinking the disappearance of the original form is felt to be a loss.

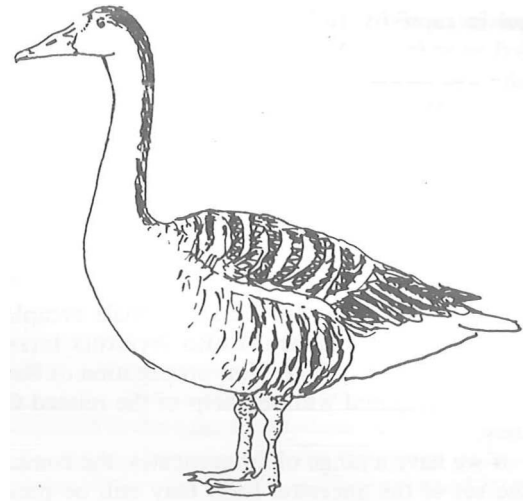

Fig. 11. Swan Goose (*Anser cygnoides*).

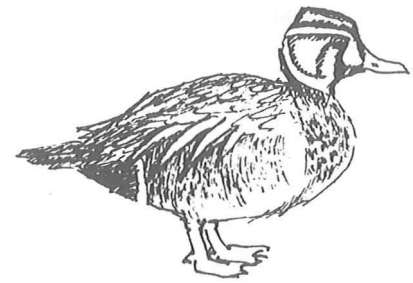

Fig. 12. Baikal Teal (*Anas formosa*).

Simpson's law states that: "Nobody can be his father's ancestor". This is true, not only for a domestic form and its ancestors, but also for wild forms among themselves or any other form. It is striking that the Chinese Goose, a typical domesticate, could be bred back to wild-type birds simply by using the ancestral form, a wild male Swan-Goose (*Anser cygnoides*) (fig. 11). The F_1 hybrid was dominated by the genes of the wild parent and made it easy to produce wild-type birds which are altogether not pure.

A peculiar manipulation by man is suggested for the Baikal Teal (*Anas formosa*) (fig. 12), a bird that was caught in large numbers before World War II but that stubbornly refused to breed in confinement. When finally the numbers in East Asia went down rapidly, people more seriously tried to raise Baikal

Teal in captivity and a production line was developed, probably first in Germany. Baikals of two large waterfowl breeders in America, imports from Europe, which were DNA tested, turned out to have Garganey (*Anas querquedula*) genes. The Garganey is a teal that breeds more easily in captivity and besides the Baikal drakes have no problem whatsoever about mating with a related species. It was observed already that Baikal males in captivity develop their nuptial plumage later than their relatives in the wild. This makes sense because the Garganey male completes his nuptial plumage late (RuRo Aviornis International, 128, 1996: p. 81). Thus propagation of Baikal Teal was acquired with the help of the related Garganey.

If we have a range of domesticates, the complete gene set of the ancestral form may still be present in 'pieces' dispersed over the domestic breeds. We might even collect these pieces and put them together. In this way Heck cattle may be a reasonable copy of the aurochs. A good example is produced by the mating of a black mouse with a white albino mouse. The offspring will show the original wild colour that neither of the parents could create on its own. The black one still owned the colour characteristics but was not able to distribute colour over the hairs, whereas the white one lacked all colour but still had the ability to distribute colour. Thus the F_1 showed up as normally wild-coloured.

An amazing report of man dealing with a wild bird thought to be extinct, is the story of the Giant Canada Goose (*Branta canadensis maxima*). The species *Branta canadensis* differs from the northern Grey Geese, belonging to the genus *Anser*, in its ability to form and maintain a series of separate forms that are fairly different and more so as geographical distance increases. The various taxa of Canada Geese inhabit different geographical regions with specific ecological properties. In these regions and the corresponding wintering grounds there is remarkably little genetic mixing. The underlying mechanism must be sought in a low out-breeding rate and fixed habitats for the subspecies in the summer half year as well as during the winter. In this way taxa have been formed. In captivity, Canada Geese of different subspecies easily interbreed, resulting in the spoiling of the characteristic subspecies.

One of the 12 subspecies identified by Moffit (Delacour, 1964), the Giant Canada Goose, became extinct around 1920 (Todd, 1976). Specimens from Minnesota and North Dakota were present in the American Museum. Written information on this subspecies was available from correspondence between James Moffit and elderly field men who reported their shooting results, size, weight and behaviour of the geese they bagged in the eighteen-eighties. Such information, as published by Mershon in 1925 in the journal *Field and Stream*, gives a good description of the feeding behaviour and colouring of the birds, and reports weights up to 17 pounds.

The Giant Canada Goose was a resident bird of the lakes in the central plains of North and South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, western Kentucky and Tennessee and northern Arkansas. They were much lighter in colour and much heavier in weight than for instance the nominate form, the Atlantic Canada Goose (*Branta canadensis canadensis*). As a resident bird, the giant was far more vulnerable than its migratory relatives, which were less confronted with human pressure. In the last century the nominate form had spread over large parts of the United States, Europe and New Zealand. The early colonists in the eastern U.S.A. first encountered the Atlantic subspecies and in fact caused its large numbers, using it as a decoy and spreading this subspecies, which consequently became very common.

Delacour (1954) states that Giant Canada Geese were kept by some people as decoys and that they were even bred for the table. The Giant Canada Goose evidently had all the right attributes for domestication. The geese were larger than Greylags (*Anser anser*). They were rather tolerant towards each other. They were available in large numbers in central North America at that time and locally they were even kept. Nevertheless it is clear that more factors play a role for species to be firmly domesticated. In the first place there were already domestic geese, brought over from Europe by the numerous colonists. One form developed into an American breed, the Pilgrim Goose. It may have its origin in small French farms in Picardy (Delacour, 1964), but Kear (1990) suggests that the Mayflower carried British geese of Dutch stock. When people wanted to breed geese for meat and down production they had reliable European geese from various origins at hand and there seems to have been little interest in a new farmyard bird. Although some locals kept Giant Canada Geese there was no demand to stimulate and expand keeping.

This discussion would have been a purely academic debate over an extinct goose, were it not that H.C. Hanson discovered a great flock of these geese in Minnesota (Hanson, 1965). Hanson describes his observations which undoubtedly indicate that the reports on the extinction of the large subspecies were based upon insufficient surveying. Some people are of the opinion that flocks still occurred on the vast plains of Central North America, others do not believe this at all (Simon Tarsnane, *Gazette*, April 1987). The giants are very easy to breed and nowadays large numbers occur especially as a result of large-scale production by the North Dakota Game and Fish Department (*Gazette*, March & April, 1985). In this programme selection is applied, demonstrating that the taxonomical definition of the

Giant was rather uncertain and the basic material included specimens of the subspecies *Branta c. moffitti* in the west and *Branta c. interior* east of the range of *Branta c. maxima*. The history of the Giant Canada Goose is a good example of the impact of man upon a species. Indiscriminate shooting and biotope destruction rapidly exterminated the bird. Personal interest however saved the bird from oblivion. The opportunity for a new attempt at domesticating the Giant is there, but will of course not be seized because there is no demand, no market for such a new creation.

8. 'LIVING APART TOGETHER'

One theory on the domestication of the Red Jungle Fowl (*Gallus gallus*) is that the wild birds became increasingly attached to settlements where their own territories bordered human habitation. Fact is that Red Jungle Fowl, caught in the vicinity of settlements nowadays, is often impure. For instance, melanistic strains occur. It is unclear whether these are the result of crossing with domestic chickens, or of inbreeding of recessive factors present in the wild group. The first option is supported by the observation of the mixing of Mallards and domestic ducks around lowland settlements throughout the northern Netherlands. Domestication as suggested for the Bankiva (Red Jungle Fowl) is difficult to prove and the theory mentioned above allows for other man-animal relations in prehistory than those we witness nowadays in modern Asia. The origin of the house hen draws the attention already for a long time (see also Reinhardt, 1912).

Man's commensalism with, for instance, Barn Swallows (*Hirundo rustica*) in Eurasia and North America, or the House Finch (*Carpodacus mexicanus*) in California and many other species, can be used as examples in which a merely unilateral relationship developed. Man was not aware that he initially influenced the nesting location of several bird species by building houses, but he was not unwilling to provide some help. Farmers will open their barn doors early in the morning for the nesting Barn Swallows, but they never consider taming or exploiting the birds. Keeping insect-eating swallows in a cage is virtually impossible. Furthermore there is no economic point in domesticating swallows. In the case of the House Finch, domestication could easily have been attempted, since this seed-eater has proved to be a generalist by conquering most of the United States including Hawaii, from its homeland California, whence it was spread by people. Although various Eurasian species of Rose Finches (*Carpodacus*) are kept as cage birds, it is striking that they were never propagated in any numbers. The reason for this may be that they could never compete vocally with the related Island Canary which gave rise to an enormous variety of breeds.

9. INTIMATE BEHAVIOUR: AN INNATE OR LEARNING PROCESS?

The initial natural tameness or shyness of wild living mammals and birds in prehistory can only be guessed at and I doubt whether standards can be given for tameness. We can of course observe the basic difference that is suggested for Eurasian species exposed to a hundred thousand years of hunting pressure and the American species meeting the hazards of mankind in the Late Pleistocene only. The results can be observed by studying the behaviour of North European *Anser* species and can be explained by the theories in Martin & Wright (1967). It is obvious that the European geese avoid all humans, whether they carry shotguns or not. I observed that Atlantic Canada Geese, returning from their wintering grounds to their breeding grounds in Connecticut, within three days left their nesting pond to collect scraps of food at the kitchen doors of houses around the lake (fig. 13). Such behaviour would suggest genetically established absence of fear of man, but in nature such a trait would be selected for negatively and the owners of such genes would soon disappear. In the example of Connecticut one should not forget the role of the local inhabitants who welcome the geese that return after the snow and ice had melted and feed them. As geese can become quite old, the ability to learn pays and the same geese that feed at back doors in Connecticut will be wary in the southern states where they winter and where shotguns await them.

The behaviour towards man seems to be a learning process, as can be seen in Pink-footed Geese (*Anser brachyrhynchus*). These birds come from their breeding grounds in Greenland, Iceland and Spitsbergen which are almost uninhabited by man to their wintering grounds in Great Britain and the Netherlands, mainly in south-western Friesland. They are afraid of man because they have little faith in their legal protection. The fact that the Pink-foot bones in the zoological collection of the Groningen Institute of Archaeology come from birds bought at a local poulterer's shop, prove that in this they are right. At the same time Pink-feet are not afraid of sheep and cattle, animals they never meet in their breeding quarters. Quite obviously the young birds simply look at the response of their parents towards the unknown farm animals. Because the parents show no fear, the young birds also ignore them.

Is this behaviour only a learning process? No! It is not that simple. I studied the man-related behaviour in my Bean Geese which initially were decoys selected for netting or shooting (Bottema, 1989). Also their offspring were immediately very tame, in-

Fig. 13. Migratory Canada Geese (*Branta canadensis canadensis*) with their offspring in a private garden in Connecticut, USA.

sisting on being hand-fed and approaching and following humans. Now this behaviour could of course also be a learning process maintained in a group selected and trained for bagging. Therefore I took the eggs of a very tame female decoy Bean Goose and put them under a chicken together with eggs of a Pink-foot, a species that was not developed for decoying, as it is by nature very aggressive and wild. When the downy goslings of the two species hatched, they showed very different behaviour. The young Pink-foots stayed with their foster-mother; the Bean-goose Goslings immediately left their small flock and very confidently approached people, demonstrating that a selection for this behaviour had taken place during the development of the decoys. In a way the findings relating to decoy geese resemble the results of studies on silver foxes by Dmitry K. Belyaev et al. (Trut, 1999). The Russian investigators bred hundreds of polar foxes and selected on criteria of tameness. In the forty years of the breeding programme they avoided inbreeding that was kept below 2-7%. Very soon they had bred foxes which behaved like dogs and which developed a bond with people by their own choice. The change from an aggressive, snarling fox to a docile animal is explained by hormonal alterations, which were thought to change the animal, instead of an explanation by the presence of mutant, recessive heterozygote traits.

10. A BOND BETWEEN MAN AND GOOSE

To illustrate the development of a bond between a goose species and man, with particular emphasis on the goose's side of the story, I shall present my own observations on wild and feral Barnacle Geese (*Branta leucopsis*). Even before 1940, farmers living along the north coast of the Dutch province of Groningen kept Barnacle Geese, which they undoubtedly obtained from catchers or shooters. Of course the Barnacle Goose has a much longer history in captivity, and their first nesting record dates from as early as 1848 in the London Zoo (Delacour, 1954). Up till now, the birds have not changed much in captivity. One white Barnacle is known from its wintering grounds in Scotland, where it was seen and filmed by Sir Peter Scott during several years. The only other aberrantly coloured birds I know were two dirty

Fig. 14. Pair of pinioned Barnacle Geese (*Branta leucopsis*) in Yde, the Netherlands. The goslings were not pinioned and such banded birds were reported later from various locations northward up to Gotland, Sweden.

buff-white specimens from the Moscow Zoo sold to the Netherlands in the sixties. The Groningen farmers acted like the Minnesota wheat farmers who kept Giant Canada Geese because they occurred in the area. Barnacle Geese use the Groningen Wadden Sea coast as their wintering grounds and they too could be caught locally. From one of these farmers I obtained a pair of Barnacle Geese that nested every year, producing 4-6 young (fig. 14). They were kept in a biotope that differed from their breeding grounds in arctic Spitsbergen and from the alluvial clay wintering grounds on the Groningen sea coast. The biotope of my Barnacle Geese in captivity is a meadow on Pleistocene sandy soil.

In the first years the offspring were pinioned and distributed to other aviculturalists, but later I kept the offspring full-winged to see what would happen. There are examples of Barnacles being kept full-winged in large flocks, for instance at Wormley Bury in England (Delacour, 1954) or Skansen near Stockholm. Also a friend of mine, Bertus van Manen, living about 5 km from my farm, for several years gave his young Barnacles the opportunity to use their full wings. His experience is the same as mine: their behaviour varies widely. Some young birds leave the same year, others stay with their parents for several years. One should realize that the parents of all these young geese had to stay because they were unable to fly away. Van Manen banded the young geese to be informed about their future. The records were quite surprising, because the geese were reported back not only from the wintering grounds in the Lauwerspolder in the northern Netherlands, where tens of thousands of Barnacle Geese may be seen; they were also recorded in Gotland in the Baltic and one was reported three times from Wilhelmshaven in Germany (communication A. Veenstra, Westervelde).

The pattern of leaving the home ground where they had been raised, was quite variable. As is widely known, geese have a strong family tie. Hence the young birds stayed close to their parents and the family would chase away or threaten other geese including Barnacle Geese. During the late winter months or the early spring, my goslings would disappear though sometimes only part of a nest would leave. In general, but not always, the young males would leave first and one could already see that their

father was less friendly towards them than towards his daughters. Occasionally there were birds that stayed and I think that their first moult on the farm may play a role in their decision to stay there afterwards. Birds always disappeared during stormy nights. The Barnacle Goose is an excellent flier and it is not plausible that they were blown away. In my opinion the birds used a strong wind to reach a destination that is unknown to me. I did not see any of these birds return for a long time.

This pattern of flying away changed abruptly after the following happened. In 1995 three pairs of Barnacles suddenly turned up together on 10th of May. They were obviously paired and the females were clearly ready to lay eggs. One of the pairs included a female that undoubtedly knew the situation, pens, feeding trays, and nest boxes. She was not at all shy and could almost be hand-fed. The male, however, did not dare to land in the enclosed meadow and eventually disappeared. Quite probably this male originated from somewhere else. The female took the nest box that had been left a week before by a pair of Cacklings after their eggs had hatched, and two days after her arrival the Barnacle laid her first egg. Because the other nest boxes were all occupied by other goose species with strong territorial behaviour, the four other Barnacles flew away after a few days. The single female raised two young birds and by the end of the summer she was flying around daily for about five to ten minutes with her own offspring as well as the five young full-winged Barnacles of my own pinioned pair. On 5th of December there was a rather severe night frost and in the morning, as I fed the birds, the full-winged geese took to the air and disappeared without circling over the farmyard. They did not return.

In the first week of May 1996 again three pairs arrived. I recognised the head pattern of three individuals with certainty. One was the single female. Her mate landed in the adjacent meadow to observe the pens with suspicion and left after two days. The second pair were one of those that came the year before, but left when they found all the nest boxes occupied. They did so again this year. The third pair took the box of a Bar-headed Goose (*Anser indicus*), and chased the occupant out so that she lost her clutch. I put a nest box for the single female in an empty pen next to that of the unfortunate Bar-heads. It is common knowledge that geese are nesting in the open in marshes, tundras or on sea coasts under natural conditions. Still, if they are given the opportunity they will prefer a nest box over an open nest site. This is of interest from the side of the archaeologist. Prehistoric hunter-gatherers eventually made such a decision. The single female laid five eggs and started to sit on them. She was however constantly harassed by the neighbouring Barnacles and when one single gosling hatched, it was killed. The absence of a male to defend the territory was very obvious. After having a spoiled season, the single female went to the pinioned pair, definitely her parents, who had five goslings that season and who accepted the loner. The other pair raised four goslings and did not mix with or were threatened by the pinioned pair. I took the opportunity of the moult to ring the full-winged adults and also banded the goslings before they could fly. The feral pair started wandering about as soon as the family could fly. The two groups of birds did not mix, the pinioned parents with their flying offspring and the single female stayed in the fenced meadow that the pinioned pair could not leave. The other flock was flying around, sometimes kilometres away, and only grazed in neighbouring meadows. On 8th of December the single female suddenly left with the juveniles of the pinioned pair, three days later than the year before. The other flock invariably flew around, but after the onset of heavy frost several weeks later, they also disappeared.

Certain facts are worth mentioning. The returning birds displayed the same behaviour as the birds I saw nesting at Spitsbergen. There they returned to the island to start looking for nesting sites immediately after their arrival and the pair formation and the development of eggs had already taken place during the migration northward. Although my birds disappeared from the site where they hatched some years ago and are reported from sites far away, they can find the way home just as well as their wild counterparts. The fact that these birds return to the place where they hatched proves that they are to some extent conditioned to such a place. If the location is defined by man, a bond between goose and man can be established but one may wonder whether the location or the human being is more important. The behaviour of adults is more predictable than the behaviour of sub-adults. This is also true for domestic geese. In keeping domestic geese it pays to breed young and eat them at Christmas rather than to eat the old ones and keep the young ones. The latter category is unpredictable. They still have to prove that they can reproduce, lay fertile eggs and sit properly, whereas the parents have already demonstrated their ability. Many geese start to be reliable parents at an age of 4-5 years and then will produce offspring for decades.

Now the observations above concern the behaviour of birds that were hatched in captivity and turned feral. What about the choice of Barnacle Geese when not influenced by man? There is a tendency among these geese to select nesting sites close to settlements, as I saw in Ny Ålesund on Spitsbergen in 1987. Birds choose nesting sites within the village, quite in contrast to the shy Pink-footed Geese. Such a choice was without doubt made because it gave protection

against marauding polar foxes and large gulls. It is the same behaviour that is seen in Eider Ducks that seek protection in Icelandic farmyards where the owner guarantees undisturbed sitting but may take the valuable down. Here I return to the question: How was the situation long ago in prehistory? The Barnacle Goose has been protected in north-western Europe for a long time, whereas the various species of the genus *Anser* are not. If we took up indiscriminate shooting of Barnacles, it is likely that they would not nest among the wooden houses of Ny Ålesund. Such an expectation is supported by the responses of birds that are prosecuted in a certain part of their distribution range and that are solidly protected elswhere. In the Netherlands the Widgeon (*Anas penelope*) is hunted among other things because it consumes grass. Farmers complain about the damage, and after all, this bird has been shot for centuries. Widgeons are wary birds and circle a long time before they settle in grassland. The appearance of people will flush them at a considerable distance. Their behaviour was quite different in the outskirts of Kyoto, Japan, where I saw hundreds of Widgeons on a pond in a large park, together with Falcated Ducks (*Anas falcata*). These birds would eat bits of bread and my first impression was that they were ornamental fowl. The biologist who took me to the pond, explained that these were genuine migratory birds coming from mainland Asia. It was strictly forbidden to shoot them and their behaviour was indeed very different from that of our Widgeons. Thus tame behaviour can be displayed by birds in certain situations whereas in other situations the same birds remain shy. It should be stressed however that in case of decoys useful behaviour of another origin can be demonstrated in birds which have been selected for hereditary tameness by man.

11. CONCLUSIONS

In this paper it is explained that domestication is a logic result of animal breeding. The examples can be found also nowadays in the results of avicultural activities. Successful keeping and breeding of waterfowl and gallinaceous birds is highly depending upon the technical development of food and environmental quality of the housing and lodging of the birds but this statement is also true for prehistoric times. Rare exotic species are very much in demand, and their value seems to depend mostly upon the price. Species that are bred in large numbers may end up as a culinary object. Behavioural aspects of aviculture are very instructive for the study of early domestication. Tameness is only to a small part a learning process, mostly hereditary traits are heavily selected upon.

12. ACKNOWLEDGEMENTS

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13. REFERENCES

ALLEN, D.L., 1953. *Pheasants afield. The pheasant in North America – history, habits and future.* Collier Books, New York.

BENECKE, N., 1994. *Der Mensch und seine Haustiere: Die Geschichte einer jahrtausendealten Beziehung.* Theiss, Stuttgart.

BOTTEMA, S., 1989. Some observations on modern domestication processes. In: J. Clutton-Brock (ed.), *The Walking Larder.* Unwin Hyman, London, pp. 31-45.

BOTTEMA, S., 1992. Book review of: The palaeoethnobotany of Franchthi Cave. Excavations at Franchthi Cave, Greece (by Julie M. Hansen). *Paléorient* 18, pp. 135-137.

BROUWER, G.A., 1954. *Historische gegevens over onze vroegere ornithologen en over de avifauna van Nederland.* Brill, Leiden.

CLUTTON-BROCK, J. (ed.), 1989. *The walking larder. Patterns of domestication, pastoralism and predation* (= One World Archaeology, 2). Unwin Hyman, London.

DELACOUR, J., 1954. *The waterfowl of the world*, vol. 1. Country Life Ltd., London.

DELACOUR, J., 1956. *The waterfowl of the orld*, vol. 2. Country Life Ltd., London.

DELACOUR, J., 1959. The waterfowl of the world, vol. 3. Country Life Ltd., London.

DELACOUR, J., 1964. The waterfowl of the world, vol. 4. Country Life Ltd., London.

GLUTZ VON BLOTZHEIM, U.N. 1969. *Die Vögel Mitteleuropas, Band 3. Anseriformes* (2. Teil). Akademische Verlagsgesellschaft, Frankfurt am Main.

GLUTZ VON BLOTZHEIM, U.N. 1973. *Die Vögel Mitteleuropas, Bd 5. Galliformes und Gruiformes.* Akademische Verlagsgesellschaft, Frankfurt am Main.

GROW, O., 1972. *Modern waterfowl management and breeding guide.* American Bantam Association.

HANSON, H.C., 1965. *The Giant Canada Goose.* Southern Illinois University.

KEAR, J., 1990. *Man and waterfowl.* T. & A.D. Poyser, London.

KOLBE, H., 1972. *Die Entenvögel der Welt.* Verlag J. Neumann, Neudamm.

MARTIN, P.S. & H.E. WRIGHT, 1967. *Pleistocene extinctions: the search for a cause.* Yale University Press, New Haven.

OPIE, I.& P., 1974. *The classic fairy tales.* Book Club Associates, London.

REINHARDT, L., 1912. *Kulturgeschichte der Nutztiere.* E. Reinhardt Verlag, München.

ROBERTS, N., 1989. The Holocene. An environmental study. Basil Blackwell Ltd., Oxford.

ROKOSZ, M., 1995. History of the aurochs (*Bos taurus primigenius*) in Poland. *Animal Genetic Resources Information* 16, pp. 5-15.

RuRo, 1996. Aviornis International 128.

SERPELL, J., 1989. Pet-keeping and animal domestication: a reappraisal. In: J. Clutton-Brock (ed.), *The Walking Larder*. Unwin Hyman, London, pp. 10-19.

TODD, F.S., 1996. *Natural history of the waterfowl*. San Diego Natural History Museum & Ibis, San Diego.

TRUT, L.N., 1999. Early canid domestication: The farm-fox experiment. *American Scientist* 87, pp. 160-169.

WAYRE, J., 1969. *A guide to the pheasants of the world*. Country Life, London.