Chapter Six Mother and Child

Mammary Glands

Mammals are distinguished from other classes of animals by the female characteristic of suckling their young via mammary glands. There is a considerable variation in the number, size, shape and location, of the mammae: to suit the size of the average brood, and the specific needs of the young.

The suckling position of the females also vary, but generally involve standing, sitting, or lying on their sides. Some aquatic species, such as the Hippopotamus, require that their young dive underwater to suckle. Others, like the Whales and Kangaroos, can suckle on the move.

Thus the organic adaptations of the female, may be complemented by the behavioural adaptations of the young. In general, the female's organic and behavioural adaptations increase with the brain mass/body mass ratio.

The mammary glands of the Human specie are different from those of the Chimpanzee or Gorilla. These apes have relatively flat breasts and long nipples. This meets the needs of their young, who tend to have marginally protruding jaws and palates -- which need a proportionately long nipple. By contrast, the human breasts tend to be more bulbous, with a much shorter nipple.

In this context, there is no reason to believe that the needs of the hominoid (Ape) young varied very greatly, during the period of pre-hominidal evolution. However, when there are substantial, physiological variations of either mammae nipple size; or testes size; or penis size; it is reasonable to assume that these were caused by evolutionary adaptations - to changes in mating, reproduction, or infant-rearing systems.

In Chapter Five, the author proposed that the adaptation to the requirements of a subtropical climate involved a reduction in body size, which led to a change in the specie’s head to body ratio. This led to the extension of the period of helplessness of the hominid baby.

In this regard, it will be immediately apparent that a helpless hominid baby would need some maternal assistance to reach its mother's breasts. The mother would have to pick up its baby, and guide the baby's mouth to her nipple. The baby would be able to 'forage' for the nipple itself, and start suckling -- as both of these are reflex actions. However, the mother would still have to support the baby's head during feeding.

Even a helpless baby could still hang on to its mother, by holding on to her skin, or fur, providing the baby's hands and feet were guided to the right place -- and provided its hands and feet were kept open before contact was made. Infantile gripping is another reflex action, and hominid babies would be able to hang on to their mothers -- if they were placed in the appropriate position, in the appropriate way.

Unfortunately, it is not normal for babies to open up their hands, if they are very young -- because this requires cognitive ability. A young baby's hands tend to remain clenched, and they cannot grip anything unless it is physically placed into the palms of their hands.

Forward facing nostrils

Thus during suckling, a hominid baby would depend upon its mother for support, and the mother would tend to hold the baby's head close to her breast. This would tend to position the proto-hominidal, forward-facing nostrils of a hominid baby very close to the chest wall of the mother. As a result, an anxious, or careless, or frightened mother, could accidentally suffocate her baby as she pressed its head against her breast.

The hominoidal Ape baby does not stiffer from this problem because it can climb up, and hang on to its mother to suckle. Such a baby can feed itself without the need for maternal support. If its forward-facing nostrils are accidentally blocked, it will immediately move its head back by reflex action.

A helpless, hominid baby could not do this, as its head would be pressed in to its mother's breast by the mother's hand. It could not cry out, as the nipple would be in its mouth. Instead, it would silently suffocate.

It is proposed that the frequency of early hominid infant mortality, due to accidental suffocation, would be sufficient to lead to evolutionary adaptations by both babies and mothers.

In this context, it is proposed that the baby's nose would gradually change, so that the forward-facing nostrils of the hominoid Apes would be replaced by the downward facing nostrils of the present day humans.

It is further proposed that mammae of early hominids would be supplemented by fat -- to project the female nipple well clear of the chest wall. This would prevent the nose of the baby from being squashed up against the chest of its mother.

This organic adaption illustrates a possible example of series evolution, where one adaption can create a demand for another, consequential adaption.

Bulbous, protuberant breasts

For example, the evolution of bulbous, protuberant breasts could lead to further suffocation, albeit on a lesser scale. This is because the soft skin and fat of the breast, could envelop the nose of the baby and lead to its suffocation.

It is proposed that a further evolutionary adaption would involve the dilation of the blood vessels surrounding the mammary gland, and this would make the breast relatively stiff. The dilation of the blood vessels would be stimulated by the suckling action of the baby, and the stiff breast would prevent the baby's face and nose from being enveloped by the breast's soft, fatty tissue.

Another potential threat to the helpless baby would be the long, hominoidal nipple. This could easily choke the baby, as its head was pressed in to its mother's breast. It is proposed that this danger would lead to the evolution of the short, hominidal nipple.
These are minor changes of physiology, but quite typical maternal adaptations which meet the needs of the young. If the babies die, the specie dies. In this regard, the suckling of young babies is a very critical element in mammalian survival.

As a result, it is reasonable to deduce that any perceived changes to a baby's mouth, palate, lips, gums etc. , and its nose -- if this is close to the mouth, will be due to a change in infantile, or maternal demands.

It should be noted that it is very much easier for an adult to adjust to the demands of an infant, than the other way round. As a result, most evolutionary changes involving mammary glands and nipples, are due to adaptations by the adults to the needs of their infants.

A survey of the variations in the degree of adult breast and nose shape, between the various ethnic groups of present day humans, shows some correlation between the amount of nasal and breast protuberance. However, a comparative survey on the relative size of babies' noses, indicates very little overall variation. This implies that the adult nose and breast shape is probably determined by mating requirements (See Chapter 7 post.), or climate.

Flat Feet

The fossil record shows two, possibly interrelated factors concerning hominid locomotion and geographic distribution. Thus the early Australopithecines were only semi-bipedal. They could walk, but their long arm/short leg, skeletal structure was not very energy efficient, and this would limit their long distance, territorial mobility.

In this context, it should be noted that present day nomadic peoples of the subtropics are usually tall and thin, with relatively long legs and slim arms. This ideal for long distance, nomadic herders. By contrast, the early Australopithecines appear to have been adapted for short-range travel on the ground, coupled with a reasonable, tree climbing ability. This all fits the concept of a specie which is adapted to an island environment.

But there are a number of related developments which need to be considered. For example, there is the question of how the infants would be carried by their mothers. In this regard, it should be noted that Ape and Monkey infants hang on to their mothers by their hands and feet.

However, the bipedal Australopithecine specie would give birth to infants which had flat feet like its parents. These infants would not be able to hang on to their mothers fur, in the manner of an Ape or Monkey infant. Instead, the bipedal Australopithecine mother would have to carry her infant in her arms - until the infant was capable of walking by itself.

Body Temperature

The very act of carrying the infant could lead to problems for both the mother and her child. The mother would probably need to carry the infant on her hips, as human mothers do today. However, the close proximity of the infant could lead to an increase in its body temperature.

This is not a problem for Ape or Monkey specie as air can circulate between the body of the mother and the infant. By contrast, an infant carried in its mothers arms is in direct contact with the mother’s body - so no air can circulate between it and its mother.

In the context of its island environment, the act of walking would tend to take place when wading from island to island. As a result, the mother and baby would be kept relatively cool - and the increased temperature arising from the direct contact between infant and mother would be irrelevant. However, when the island environment disappeared, the infant temperature problem would emerge.

Homeostasis

To put the question of temperature regulation in its proper context, it might be useful to consider the issues involved. In this regard, it should be noted that one of the important adaptations of all mammal specie is their ability to maintain a constant body temperature, regardless of any external, environmental temperature variation.

This is important because normal cell metabolism can only occur over a relatively narrow range of conditions. This range was probably determined in the early biosphere by the conditions that prevailed when life first evolved.

For example, if life evolved in the sea, then the composition of sea water, at this time, would determine the rate of organic transformation of energy. The high specific heat of such water would mean that life evolved at a relatively stable temperature, while the sheer volume of the oceans would mean that little ionic change would occur due to dilution, or evaporation.

The transfer of organisms from an aquatic to a terrestrial environment, would require the evolution of organic mechanisms to resolve the problems of temperature variations, evaporation and excretion.

In this regard, mammals and birds (both of which are classified as homoeotherms), have evolved physiological systems which enable them to maintain a constant body temperature - irrespective of environmental changes. Other organisms (classified as poikilotherms), are directly influenced chemically by environmental temperature changes.

As a result, only the homoeothermic mammals and birds can live in the polar regions, as the poikilotherms would have their cell chemistry inhibited by the extreme cold.

The ability to maintain a constant internal equilibrium is called homeostasis, and covers not only temperature, but water balance, salt levels, nitrogenous waste control, and the carbon dioxide/oxygen ratio etc.

Mammalian body heat is generally produced either by the body's metabolic processes, or by the dynamic motion of the individual's body. The majority of this heat is transferred to the environment by radiation from the mammals' skin. In addition, the evaporation of perspiration from the skin leads to latent cooling, while some heat can be transferred to the air during respiration.

Thus the rate of heat transfer, in mammals, can be regulated by variations in the perspiration and respiration rate, and by the dilation or contraction of blood vessels near the surface of the skin.

The internal heat can be further regulated by changes in the metabolic process, which can be controlled by hormonal stimulation. Finally, mammalian heat losses can be regulated on a temporary, or relatively permanent basis, by the use of various types of insulators.

In this regard, many marine, polar specie have evolved layers of blubber, the thickness of which reflects the constant differential between their body temperature and that of the polar seas.

Degree of Hairiness

By contrast, where mammal specie face a considerable variation in environmental temperature, the insulator usually takes the form of hair, or fur. In hot weather, the hair can be smoothed down to reflect the sun's rays, and prevent the trapping of any air which could act as an insulator. However, in cold weather, such hair can be fluffed out -- to trap as much air as possible, to maximise its insular properties. In addition, the rate of hair loss can be varied, so that it is minimised in cold conditions, and maximised in hot conditions. This latter process is known as moulting.

In general, the degree of hairiness of a mammal depends upon three interrelated factors. The first is the metabolic rate of the specie individuals. The second is the specie individuals' surface-to-volume ratio; and the third is the environmental temperature range found in the specie's habitat.

In this context, small mammals, like shrews and voles, have a very high metabolic rate -- as they eat an amount equivalent to their own body mass every day. Thus they produce a lot of heat. However, their smallness means they have a very large surface-to-volume ratio - so they dissipate this heat very quickly, and they need hair as insulation for the times when they are not creating internal body heat.

Some mammals, like African elephants, have hair when they are young, but very little when they become adults. In this regard, the main danger to the infant elephant is that of dying of cold in the winter. As a result, it has a hairy coat to keep it warm.

The adult elephant, by contrast, is in danger of dying of overheating in the very hot conditions of a subtropical summer. This is because the adult elephant has a very small surface-to-volume ratio (i.e., the opposite of the shrew). Its large volume creates a great deal of heat, but its limited surface area cannot dissipate the heat very quickly. Thus the adult elephant has evolved various ways to maximise its heat loss, including the moulting of its juvenile hair - and becoming virtually naked. It has hair, but the hair is rather short and sparse.

In the context of hominid evolution, when the Australopithecine mother started to walk bipedally, carrying her baby in her arms, about 30% of the baby's skin would be in direct contact with its mother's chest and arms. This would alter the surface-to-volume ratio of the baby, as only 70% of its skin would still be exposed to the air.

The baby's volume would remain the same, but the skin would only radiate seven tenths of the baby’s body heat. As a result, the baby's temperature would start to rise. If the increase in temperature continued unchecked, the baby would eventually die of heatstroke.

Fortunately, the early Australopithecine mothers were not well adapted for bipedalism. As a result, they could only walk for short distances before stopping for a rest. In these rest periods, they could either put the baby on the ground, or sit it up on their knees. These rest periods would enable the baby to cool down - and survive.

In these early stages of Australopithecine development of bipedalism, the mothers would be making behavioural adjustments the requirements of their baby, while the baby would be making similar organic adjustments to the problems of overheating. For example, the baby's hormone controlled metabolic process would prevent the conversion of glycogen to glucose - to reduce the degree of internal heating.

In addition, the bipedal Australopithecine specie could reduce its temperature by a reduction in its body hair. This could be achieved by a simple slowing down of the growth rate of body hair, which is the process found in the human specie today. The individuals could keep warm by cuddling together.

It would appear that the development of the present day lack of body hair occurred in two stages. The first stage was when the bipedal Australopithecine moved from its island existence to an equatorial forest existence. The second stage occurred when the bipedal hominids were forced out of the semi-equatorial forests by the ancestor of the Chimpanzee.

When this happened, the hominids moved into the subtropical semi-desert environment, and adapted to the requirements of that climate. This resulted in the change in the head-to-body ratio, which led to the increase in the period of helplessness of the hominid baby. As a result, the hominid baby had to be carried in its mother’s arms from food source to food source.

Localised subcutaneous fat

This created extra temperature problems for the babies, which were met by a further reduction in body hair. In addition, it is proposed that further maternal adaptations to deal with the problem of the overheating baby, would be the development of localised subcutaneous fat. In this context, there are variations in the degrees of fatness of all individuals in all mammal specie. However, they are usually fairly marginal, as obesity can lead to severe physiological problems.

Thus in any specie population of early hominids, there would have been some females who would have been fatter than average. Their body fat would increase their own problems of dealing with excess body heat, which would normally put them at a disadvantage. As a result, hominid fatness would normally remain a minority characteristic.

However, in the context of hominid evolution, the fat females' body fat would act as an insulator between her and her infant. This would prevent her own internal body heat from being transmitted to her baby. As a result, the babies of relatively fat mothers would survive better than those of thin or average mothers. In time, the fat mother would become a temporary 'norm' of the specie.

The overall disadvantages of female fatness would eventually encourage the evolutionary selection of females whose fat was concentrated in those parts of the body which came into direct contact with the baby. In this context, it may be noted that the subcutaneous fat of present day human females is concentrated in the regions of the chest, shoulders, arms, hips, buttocks and upper thighs. This is precisely where the baby is carried by its mother.

It should be noted that if any specie characteristic is advantageous to one sex, but disadvantageous to the other sex, the characteristic will become sex-linked to the former. In this regard, the dominant males of the hominid specie would be responsible for the defence of their territories.

This would involve such a degree of physical exertion that the female level of subcutaneous fat would be disadvantageous. As a result, thsubcutaneous fat characteristic would be sex-linked to the female.

As previously noted, the metabolic processes would reduce the production of internal heat within the helpless baby's body. Initially this would simply involve the suspension of the conversion of glucose into energy. However, if the temperature was required to be yet further reduced, the metabolic hormones would induce the conversion of the glucose into glycogen - and thence into fat.

This process could affect the hominid baby, by creating a layer of 'puppy fat' during the critical periods following the birth of the baby. This fat would tend to prevent the hominid mother's own body heat from being conducted into the baby, but it would also prevent the baby from dissipating its own body heat. However, such fat tends to be concentrated in the abdomen, which is not a maximum heat radiation area.

Instead, most of the body heat is dissipated from the head and limbs, and these would not tend to be in permanent contact with the mother. This would stimulate the genetic selection of adaptations which would maximise heat loss in these areas.

In this regard, it is proposed that the process of moulting, which is common in mammals who tend to die of overheating, would be evolved by the helpless baby. Thus, the hair on the baby's head which grows in the final period of the foetal growth stage would be moulted within a few days of the birth of the baby.

This would allow maximum heat dissipation from the head, during the critical periods of maximum heat production, in the first weeks following the birth of the baby. Thereafter, the hair would grow again as the baby got bigger, and its surface-to-volume ratio improved. In this context, it should be noted that this is still a common characteristic of today' s human babies.

It is proposed that while some of these adaptations would evolve at the same time, others would develop on a series basis. In this context, each adaption which reduced the baby's tendency to overheat would allow the baby to survive a greater distance of carriage. However, this would lead to a consequent increase in bipedal adaption, which would eventually lead to yet more overheating problems for the baby. When the baby had adapted again, the evolution of bipedalism would proceed again - until the next overheating problem.

The physiological adaptations of any particular class of animals tend to be similar - if the environmental and organic circumstances are similar. In this regard, it will be recalled that the adult elephant, which occupies a similar habitat to that of the early hominids, suffers from severe overheating problems in the summer - and it has become virtually hairless.

Although there is a substantial difference in the size of an adult elephant and a hominid baby, when a new born hominid baby is carried in its mother's arms, the baby's reduced surface-to-volume ratio is nevertheless similar to that of an adult elephant.

It is proposed that the frequent death of hominid babies, through overheating, would lead to the evolutionary selection of a general reduction in the growth rate of the hominid specie’s body hair. This would reduce the insular quality of the hair, and help to maximise the dissipation of body heat.

If the infants got cold, they could huddle up to their mother when necessary. However, after achieving sexual maturity, the young adult males and females would no longer be tolerated by the mother or the dominant males. When independent, the females would have sufficient subcutaneous fat to remain warm in cold periods, but the males would evolve an increase in hair growth, to prevent their death through cold.

Sweat Glands

As previously noted, homeostasis not only maintains a constant body temperature, but also controls the water balance and salt levels. In this latter context, it should be noted that the hominoid Ape species all have sweat glands to regulate perspiration, and these are generally sited near the muscles involved in brachiation.

It is proposed that natural selection would favour any hominid babies who had a higher than average number of sweat glands, and particularly those which had glands in the areas of maximum heat dissipation.

Present day humans have nine times the average number of hominoid Ape sweat glands. These glands are concentrated on the head shoulders, arms, legs and chest which are the areas of maximum atmospheric exposure for a naked human baby, when carried in its mother's arms.

Salt levels

It is further proposed that the gradual spread of sweat glands, over the body of the hominid babies, would eventually lead to their death through heat exhaustion. The latter is a condition caused by a substantial reduction in the salt levels of the blood, which can happen to individuals who perspire too much in subtropical climates.

This would be remedied by the long term organic adaption the endocrinological system, to allow higher natural levels of salt in the bloodstream and body fluids. This would lead to further changes of diet to improve the salt intake by the specie.

One source of salt, favoured by subtropical insects, are the eye fluids of herbivores. It is hypothesised that the hominids would start to scavenge for such sources, as the eyes of a carcass can be easily removed with a pointed stick.

Tears

In addition to the problems of overheating, the helpless baby would have another source of aggravation caused by its lack of cognitive control. In common with present day babies, it would be unable to hold its head up. Although its mother would support its head during suckling, there would be a tendency for the mother when resting, either to lay the baby back on her knee, or to lay it down on the ground. This would result in the baby's eyes facing the sky.

It should be noted that the atmosphere contains dust, pollen, wind-blown sand and other potential irritants, which settle on the ground under the influence of gravity. These atmospheric irritants would fall continually on to the open eyes of the hominid baby.

The helpless, hominid baby would have a reflex capability which would enable it to blink, but it would be very exposed to eye irritation whenever its mother stopped to rest. This contrasts with the hominoid Ape baby which normally clings tight to its mother -- facing her chest and sitting vertically.

It is therefore proposed, that there would be an evolutionary advantage accruing to any individual hominid baby which had more watery eyes than average, as it could eliminate the eye irritants more easily. It is further proposed that in the long term, this continual selection of high fluid capacity eye sockets, would lead to the evolution of tears.

In this context, it should be noted the babies of all hominoid Apes cry. It only the production of tears which is unique to the human specie. It may also be noted that there is a marked similarity between the human physiological systems of sneezing, coughing and crying. For example, they all involve reflex actions, facial and throat muscles; and the use of fluids to rid the body of irritants.

Long leg/short arm

When all of these physiological adaptations had evolved, it is proposed that the process of bipedalism would continue, until the long leg/short arm structure had fully developed.

This would maximise the specie's power-to-weight ratio, and allow the development of long distance nomadism of the hunter-gatherer kind. This could explain the increase in geographic radiation which was achieved by the Homo Habilis specie and its successors.

The hominid fossils of the adults of these specie, suggest evolutionary adaptations in their mating and reproductive systems. These systems are considered in the next chapter.