

PHYLOGENETIC DEVELOPMENT OF SWEAT AND MAMMARY GLANDS

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Sweat glands, and mammary glands, which are modified sweat glands, are unique structures peculiar to mammals. The evolution model of origins predicts that there will be an upward, irreversible development of both sweat glands and mammary glands as one goes up the ladder of mammalian development. Observations reveal, however, that there is an up-and-down variation of complexity of sweat glands among the orders of mammalia. Gaps are evident, as sweat glands are absent in two orders, Proboscidea and Rodentia. With regard to mammary glands, there is not a smooth downward loss of teat number among orders of mammals as sheep, horse and elephant all have a single pair of teats just as man. These data correlate nicely with the prediction of the creation model: that the Creator did not follow the mode of evolutionary development but rather made different provisions of sweat glands and mammary glands in different animals of the class, mammalia, in order to serve His specific purposes.

The ability to sweat is unique to the animal class of mammalia. A further distinctive trait of mammals is the nourishing of their offspring from milk secreted from mammary glands. It is obvious that the name mammal, meaning milk secreting animal, is derived from the word mamma (milk). The relationship between sweat glands and mammary glands may be considered under histology, i.e., the study of tissue structure. There are numerous anatomical and physiological similarities between sweat glands and mammary glands. Some authorities^{1,2} claim that mammary glands are modified sweat glands. But if so, it seems odd that mammary glands are well developed in all mammals, sweat glands in only some.

If evolution is the true explanation of the origin and diversity of life, the development of sweat glands and mammary glands would be a smooth, upward, irreversible process. There would be some degree of uniform increase in complexity directly related to each mammalian order culminating in the most advanced stage in man. Any great gaps of development or regression away from this upward development would be counter to the predictions of the evolutionary model of origins.

However, if the doctrine of special creation is the true explanation of the origin and diversity of life, the provision of sweat and mammary glands in various species of the order of mammalia would be variable, and reversible. They would be absent in some species, and most highly developed in man.

Let us take a look at the data that describe the occurrence of sweat glands and mammary glands in the various species of animals going up the supposed ladder of development.

Sweat Glands

One function of skin involves osmoregulation, i.e., the control of the passage of pure solvents from the lesser to the greater concentration when two solutions are separated by a membrane which selectively prevents the passage of solute molecules but is permeable to the solvent. Through osmoregulation i.e. perspiration, the loss of heat through evaporation is controlled. In mammals the control of heat release in this way is usually regulated by structures called sweat glands. As the body temperature increases the rate of secretion of sweat in-

creases. The sweat contains water and various electrolytes. The heat loss occurs via kinetic energy or latent heat of evaporation released when the sweat evaporates into the air. If a mammal does not sweat, it must have some other mechanism by which it can relieve excess body heat. The relative loss of water via respiration (i.e., cool air breathed in, warm out) or sweating varies from species to species.³

Authorities are not in complete agreement as to the presence of sweat glands or similar structures in some animals. According to Young⁴, amphioxus has no skin glands, fish have a water-proof layer of skin, amphibia have fish-like skin, reptiles have dry skin with no skin glands and birds have no sweat glands and therefore very little heat loss from the skin. Bentley⁵ claims that amphibia can absorb sodium and water. Hafez⁶ claims that birds, rodents and lagomorphs (rabbit family) do not have sweat glands. Swenson⁷ claims "many small-mouthed mammals (mouse) which have no sweat glands and do not pant, use evaporation of saliva which they spread over their skin surfaces." Vander *et al*⁸ claim that most other mammals differ from man in lacking sweat glands. This last statement is essentially untrue as we shall see. Indeed, conflicting opinions can be found on a number of these points; these are cited to show what is commonly said.

Sweating may act to maintain homeostasis of fluids and electrolytes; and to regulate body temperature. Sweat glands have been classified physiologically into two types: 1) apocrine (holocrine)—structures that lose part of their cellular protoplasm when they secrete and 2) merocrine (eccrine)—structures that secrete only their glandular solvent when they secrete. These sweat glands vary in size with changes in ambient temperature, becoming larger in winter and smaller in summer.

In cats there are coiled eccrine sweat glands on the skin and apocrine sweat glands in the hair follicles.⁹ Yet, Taylor¹⁰ claims that sweat glands in cats and dogs are confined to the plantar surface of their feet. Miller¹¹ partially agrees with Taylor's opinion concerning sweat glands in dogs, claiming that merocrine glands are found only on the foot pads while apocrine glands are found in the hair follicles. Bensley¹² claims that in rabbit sweat glands are absent from the general skin surface but are present in the hair follicles of the lips, internal surface of the ear and external genital organs. This disagrees with the opinion of Hafez¹³ cited above. Sheep

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have sweat glands only in their primary hair follicles.¹⁴ Therefore, they rely primarily on respiration for cooling, except for whatever cooling is obtained directly by conduction. Sheep, camels and donkeys can drink approximately one-fourth their body weight in water at one drinking without any apparent harmful effect.¹⁵ Hafez¹⁶ claims that morphologically the sweat glands of camels appear to be an intermediate state of development between cattle and man. The pig has very ineffective sweat glands, its cutaneous water loss being very low even in hot weather. Because of this the pig wallows in water or mud in order to lose heat. A smear of wet mud on the pig's skin promotes an evaporative rate comparable to man, who possesses the highest sweat rate of all mammals.¹⁷ In spite of their ineffectiveness, the pig's sweat glands are large, yellow-brownish and visible to the naked eye.¹⁸

Bos indicus cattle have larger sweat glands and greater numbers than *Bos taurus*. There are more sweat glands on the hump of Brahman cattle than on their flank. Also, Brahman cattle have their sweat glands activated at a higher ambient or skin temperature than those of *Bos taurus*. Brahman cattle depend largely on sweating and barely use respiratory exchange for cooling purposes.¹⁹ The goat can dissipate heat via its great superficial vascularization in its horn.²⁰ Hippopotamus secretes a red, apocrine sweat which is referred to as "bloody sweat."²¹

Elephants have enormous bodies and very small mouths. They have no sweat glands and perform no panting or intense salivation. They cool themselves by sucking cool water into their trunk and spraying themselves.²²

Sweat glands are highly complex in horse and man. The eccrine type glands are better developed, more numerous and more functional in man than other mammals.²³ It is estimated that commonly man loses 20% of his heat lost through evaporation and can lose up to 80% of his heat thus during vigorous exercise.²⁴ Indeed, limitations on such loss of heat may limit one's performance. Accumulated sweat that drops off the skin yields no heat loss. Humans with leprosy who cannot sweat relieve heat by panting and slobbering.²⁵

As to the phylogenetic development of sweat glands in man, Rothman states "the apocrine glands, paralleling the gradual decline of the hair system, have become rudimentary in most places, while the eccrine glands have developed to a most perfect system."²⁶

With regard to development of sweat glands within the class of mammalia, Montagna states that "both types of sweat glands have existed for a long time and may have appeared independently in the different orders of mammals."²⁷ This quotation alludes to evolutionary presuppositions.

Do sweat gland numbers differ among different races of man? According to Table 1,²⁸ the answer is yes. They vary from a low of 558 per square cm of skin in Caucasians to 950 per square cm of skin in Negrito youth. This is a 70% increase in sweat gland number for the Negrito youth over Caucasians. Incidentally, the development of sweat glands is almost the inverse of what a Darwinian of the last century would have called

the evolutionary development of the races.

On the basis of this review, all mammals do not possess sweat glands. Sweat glands are absent in elephants and most rodents. Also, there is not an upward development in complexity of sweat glands as we go up the alleged ladder of mammalian development. The cat has highly-developed eccrine sweat glands, sheep poorly-developed sweat glands only in their primary hair follicles, camels have medium-developed sweat glands, pig poorly-functioning sweat glands, cattle poorly functioning sweat glands, and horse and man the most highly developed system of sweat glands. The absence of sweat glands in two orders of mammals with their arbitrary development in other orders correlates nicely with the presuppositions of the creation model.

Table 1. Variation of the number of sweat glands in different races.

Race	Mean no. of sweat glands per square cm. of skin
American (white)	558.2
American (negro)	597.2
Filipine	653.4
Moro	684.4
Negrito (adult)	709.2
Hindu	738.2
Negrito (youth)	950.0

Mammary Glands

Mammary glands are accessory reproductive structures that resemble histologically apocrine sweat glands. Their secretion of milk serves to nourish their offspring after birth. During puberty they develop in both sexes but attain functional utility only in females. The hormonal mechanism for the manufacturing of milk differs among species. In some species both estrogen and progesterone produce both ducts and alveoli, in others estrogen produces ducts while progesterone produces alveoli. At the end of the reproductive period of the female mammal, the mammary glands incur involution and shrink.²⁹ (This is obviously a simplified outline of the matter; there are many complications which can not be included here.)

Of interest in the phylogenetic development of mammary glands is the number of teats in various species. Some mammals have up to 25 teats. The numbers of teats have a relationship to the number of offspring that can be born at a time. The teats in all placental mammals are arranged in two long rows.

If there were phylogenetic development of the number of teats according to evolutionary presuppositions, we would find a uniform loss of teats going up the alleged ladder of mammalian development culminating in a single pair of nipples in the highest developed mammal, man. However, if there is nonuniform loss of teat number going up the so-called ladder of development with regression toward single pairs in various mammals, this would correlate with the creationistic presupposition of variations in structures and functions among different levels of mammals due to the Supreme Being's specific purpose for certain species.

Let us look at the data on teat number among mammals.

The egg-laying monotremes have no nipples at all. For example, duck-billed platypus expresses its milk from 100 milk ducts on its chest.³⁰

The cat, a typical carnivore, has two series of five teats each making ten in number. The pig of the order *Artiodactyla*, suborder *Suina*, has usually 12 in number, the same as the dog, a carnivore. Ruminants of the order *Artiodactyla* but the suborder *Pecora*, have four teats called udders. Yet, small ruminants like sheep have two in number, just like man. The horse of the order *Perissodactyla* and suborder *Equoidea* has two single teats like man. Also, the elephant of order *Proboscidea* has a single pair of teats very much like man.³¹

The similarity of teat number in dog and pig and the single pair of teats in sheep, horse, elephant and man are not an indication of a uniform loss of teat number going up the ladder of so-called mammalian development. Instead they are observations indicating a specific highly-developed function for certain mammals in different orders which correlates rather neatly with the creation presupposition.

Summary

Sweat glands are absent in two orders of mammals, *Proboscidea* and *Rodentia*. There is an up-and-down variation of complexity of sweat glands among the other orders of mammals. With regard to mammary glands, there is not a smooth downward loss of teat number among orders of mammals. For instance, sheep, horse and elephant have a single pair of teats the same as man. These observations tend to agree with the predictions of the creation model of origin of matter and life, and to run counter to the predictions of the evolution model of origins.

References

- ¹Hole, Jr., J. W. 1978. Human anatomy and physiology. Dubuque, Iowa: W. C. Brown Company, p. 746.

- ²Pansky, B. and House, E. L. 1966. Review of gross anatomy. New York: The Macmillan Company, p. 228.
³Prosser, C. L. 1973. Comparative animal physiology. Philadelphia: W. B. Saunders, p. 406.
⁴Young, J. Z. 1958. The life of vertebrates. Oxford: Clarendon Press, p. 31.
⁵Bentley, P. J. 1971. Endocrines and osmoregulation. A comparative account of the regulation of water and salt in vertebrates. Berlin: Springer-Verlag, p. 19-21.
⁶Hafez, E. S. 1968. Adaptation of domestic animals. Philadelphia: Lea and Febiger, p. 65-67.
⁷Swenson, M. J. 1970. Duke's physiology of domestic animals. Ithaca: Cornell U. Press. p. 821.
⁸Vander, A. J., Sherman, J. H. and Luciano, D. S. 1970. Human physiology: the mechanisms of body function. NY: McGraw-Hill Book Co., p. 439.
⁹Crouch, J. E. 1969. Text atlas of cat anatomy. Philadelphia: Lea and Febiger, p. 58-59.
¹⁰Taylor, William T. 1951. Functional mammalian anatomy. NY: D. Van Nostrand Co., Inc., p. 32.
¹¹Miller, M. E. 1964. Anatomy of the dog. Philadelphia: W. B. Saunders Co., p. 883-885.
¹²Bensley, B. A. 1938. Practical anatomy of the rabbit. Philadelphia: P. Blakiston's Son and Co., p. 25.
¹³Hafez, *Op. cit.*, p. 65-67.
¹⁴Hafez, *Op. cit.*, p. 65-67.
¹⁵Swenson, *Op. cit.*, p. 752.
¹⁶Hafez, *Op. cit.*, p. 65-67.
¹⁷Hafez, *Op. cit.*, p. 285-286.
¹⁸Getty, R. 1975. The anatomy of the domestic animals Vol. I and II. Philadelphia: W. B. Saunders Co., p. 142.
¹⁹Hafez, *Op. cit.*, p. 268.
²⁰Prosser, *Op. cit.*, p. 406.
²¹Swenson, *Op. cit.*, p. 821.
²²Swenson, *Op. cit.*, p. 823.
²³Swenson, *Op. cit.*, p. 821.
²⁴Prosser, *Op. cit.*, p. 406.
²⁵Swenson, *Op. cit.*, p. 821.
²⁶Rothman, S. 1954. Physiology and biochemistry of skin. Chicago: University of Chicago Press, p. 821.
²⁷Montagna, W. 1963. "Phylogenetic significance of the skin of man." *A.M.A. Archives of Dermatology*. 88: 1-19.
²⁸Clark and Lehman. 1917. *Anatomical Record*. Vol. 12, p. 392.
²⁹Taylor, *Op. cit.*, p. 31-32.
³⁰Swenson, *Op. cit.*, p. 1356.
³¹Getty, *Op. cit.*, p. 149.

PANORAMA OF SCIENCE

Alone in the Universe

Iosef S. Shklovsky, a Moscow State University astronomer says: "We are alone in the universe."¹ Now that's a switch for a secular scientist and one who along with Carl Sagan in the 1960's authored a classic paper arguing that there should be millions of inhabited planets similar to Earth in the Milky Way galaxy. He indicates that there is nothing (no intelligent information) coming from the trillions of stars (with hypothetical planets) that cannot be explained on the basis of natural phenomenon.

Shklovsky says that the prevalent belief that we are not alone in the universe goes back to "cloudy ideas of the multiplicity of inhabited worlds that penetrated ancient religions." The very idea is that since the earth is inhabited, and, by current dominant evolutionary world-view, became that way by chance events and processes, there "must be other worlds out there somewhere

similar to earth." However, any mathematician will tell you that a statistic of ONE cannot be extrapolated into millions and billions. The fact that the earth is inhabited proves nothing regarding possible inhabited worlds elsewhere.

He concludes that: "The fact that we have come to grips with most of them (the few fundamental laws of physics) and yet still cannot detect a manifestation of extraterrestrial life means that such life is exceedingly rare." I would say that carbon-based life elsewhere in the Universe is not only exceedingly rare, but ZERO. This statement is supported by Scripture: e.g., Psalm 115:16: "The heaven, even the heavens, are the Lord's but the earth hath he given to the children of men."

References

- ¹Dickinson, Terence, 1978. Soviet scientist says we are alone in the universe. *Astronomy News* 16 (6):2-4. *Astronomy News* is published by the Edmund Scientific Co., 7789 Edscorp Bldg., Barrington, New Jersey 08007.