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Keywords: hairlessness, hair reduction, hominid evolution, human evolution, thermoregulation.

The Vestiary Hypothesis of Human Hair Reduction

The vestiary hypothesis proposes that hair reduction in humans, a characteristic of the species, evolved coincident with a developing intellectual capacity that permitted the use of artificial insulation. Functional hairlessness permitted the elaboration of an extraordinarily effective mechanism for heat dissipation, whole-body evaporation, but with the sacrifice of the heat retention function of typical pelage. The latter necessity was met by clothing, which required capability for fabrication and cultural transmission, and may have developed early in hominid evolution.

1. Introduction

Why should man be functionally hairless, Darwin (1871) pondered, when other members of the order primates although inhabiting hot regions are well clothed with hair. Considering human hairlessness to be thermally disadvantageous, he sought explanations in the sexual function of the remaining hair patches. Disadvantages and advantages, causes and effects of hair reduction have been much discussed since then, most proposed explanations logically revealing some aspect of the phenomenon. However most fail to account for the distinctiveness of man's hairlessness among mammals his size. In this paper I discuss a synthetic view of human hair reduction, the vestiary hypothesis, which relies on the coincident evolution of hair reduction and intellectual capacity.

2. Hairlessness in Perspective

Humans are not actually hairless. In fact the numbers and density of hair follicles are not especially different from their nearest primate relatives. Furthermore male and female humans have about the same number of hairs. Most of these hairs are relatively miniscule, and certainly neither protect the skin nor provide appreciable thermal insulation.

Remnant hair patches clearly have secondary functions. Facial hair serves communicative and sexual signalling functions. Axillary hair patches are associated with apocrine and eccrine sweat glands, no doubt also having social and sexual functions, as do hair patches associated with ano-genital surfaces. Head hair, usually enhanced by various cosmetic means, now is used for social signalling, but may fundamentally have a more functional purpose, as discussed beyond. Hairs covering other body surfaces, although of slight development, are innervated by sensory receptors that record changes in position and contribute to tactile sensibility.

3. Heat Loss Considerations

The most critical function of hair reduction is the increase in surface area available for evaporative cooling. Far from being disadvantageous thermally, functional nakedness has permitted humans to develop the most efficient cooling system of any mammal (Mount,

Journal of Human Evolution (1985) **14**, 29–32

0047–2484/85/010029 + 04 $03.00/0

1979). This adaptation has been brought about by the elaboration of a remarkable array of eccrine sweat glands, occurring at a density of hundreds per square centimeter over most of the body. Watery secretion of these glands, elicited by thermal stimuli, cools the skin and blood as it evaporates.

The development of bare-skin thermoregulation has generally been ascribed to meeting the exigencies of survival in the thermally stressful tropical dry savanna environment (Harris, 1980). Mostly it has been considered to be a requisite for a diurnal hunting regime, especially strenuous hunting chases (Campbell, 1966; Morris, 1967). However the diurnal hunter hypothesis relies on an unproven theory of very early hominid activity, and does not explain why the non-hunting female should also have reduced hair, or why other savanna hunters have not lost their hair. It is not unreasonable to expect that humans, like many predators, could avoid the heat of the day by hunting crepuscularly. Human thermoregulatory adaptation must involve all diurnal activity, not just infrequent hunting chases.

Any extensive exercise in hot environments can cause thermal stress. Like other endotherms, humans must closely regulate body temperature despite diurnal activity, and hyperthermia because of sustained strenuous activity limits human physical performance (MacDougall *et al.*, 1974). Such excess heat loading in hot environments is a problem for all such mammal predators especially those that run (Taylor & Rowntree, 1973). Furred mammals remain cool by heat avoidance, and by evaporation from nasal and oral passages. Such adaptations particularly functional in avoiding elevation of brain temperature (Taylor & Lyman, 1972). Wheeler (1984) has contributed importantly to understanding the crucial importance of regulating brain temperature, especially noting that primates including humans lack a carotid rete and associated nasal chambers that would permit direct conductive cooling of the brain. Wheeler (1984) furthermore suggested that the large-brain human primate would experience severe thermoregulatory problems in a hot climate, because of an inability to cool differentially the large mass of the heat sensitive brain. Humans have instead developed a strategy of maintaining the entire core temperature by whole-body evaporative cooling rather than specifically cooling the head. Thus in humans, general hair reduction permits maintenance of core temperature, including brain temperature in hot environments.

Despite whole-body cooling, the direct effects of solar radiation may still be severe. Wheeler (1984) showed that human bipedal posture exposes a minimum body surface to direct overhead solar radiation. Bipedal posture can thereby explain two other human adaptations. The remaining full development of hair on the head functions, as is typical, in reflecting solar radiation away from the skin (Macfarlane, 1968). In addition, humans to some extent use the pachyderm solution of having a thick skin, in that the thickest dermis, outside of palmar and plantar surfaces, is on the nape and upper back (Harrison & Montagna, 1969).

Thus man can maintain his core temperature in a hot environment by behavioral avoidance of thermally stressful conditions, efficient cooling over a functionally hairless body, and physical protection of the areas left most exposed by his posture. Nonetheless, other primates also survive in such environments, with hair although with less effective cooling systems. Baboons for example occupy much the same habitat as did ancient hominids (Dunbar, 1983). The success of such quadrupedal primates suggest that bipedalism alone cannot account for survival of primates in hot environments, nor the possibility of whole body hair reduction in humans.

4. Heat Conservation Considerations

To understand fully human hair reduction, one must consider its disadvantages; nakedness is of no value in heat conservation. To accomplish this one needs insulation. Heinrich (1977) pointed out that improvement in insulation has two functions, to reduce heat gain when activity is high (such as hair on the head) and to retard heat loss when activity is low, the latter he found to be the most common function of natural insulation. Humans do compensate to some extent for their functional hairlessness. Heat loss is retarded by the presence of a characteristic layer of subcutaneous fat. This adaptation detaches heat loss retardation from heat dissipation because the evaporative cooling system, consisting of eccrine sweat glands, hairless surfaces, and superficial capillaries, can bypass the fatty layer. Nonetheless the fatty layer is not totally sufficient at low temperature during periods of inactivity.

The vestiary hypothesis allows that during such cool periods of inactivity, which generally occur at night, heat loss in humans was retarded by the use of removable insulation, i.e. body covering (Kushlan, 1980). Body covering, in the form of covers and portable clothes, undoubtedly was first derived from animal skins, and later fabrics, and was probably augmented by the use of controlled fire and artificial shelter, neither of which would be sufficient without personal coverings.

These artifactual adaptations presuppose a developing innovative intellectual capacity, but could have occurred at an early stage of hominid evolution. Unfortunately preservation of evidence of such vestments is highly improbable. Sheltering behavior, however, is apparent in contemporary apes, Hearth fires may have been in use 500,000 years B.P. and certainly were associated with *Homo erectus* (Leakey & Lewin, 1977).

5. A Synthetic Understanding

Advantages of the vestiary hypothesis of hair reduction lie in its simplicity, co-evolutionary implications, and congruity with modern human experience. With respect to the latter, one can ask what today is the principal function of clothing, and under what conditions is clothing shed? The geographical distribution of clothing design reflects ambient thermal environments (Chatterjee, 1978).

The implication for mosaic evolution of human characteristics is intriguing. As the human brain developed, man required a progressive elaboration of a mechanism by which core temperatures could be controlled, especially during diurnal activity in tropical habitats. Lacking a way of keeping his head cool independently, humans evolved an alternative solution of whole-body hair reduction, which itself was permitted by an improving intellectual capacity that lead to the development of removable insulation, in order to prevent heat loss.

This hypothesis provides a framework for understanding other proposals related to hair reduction. The suggestion (Campbell, 1966; Morris, 1967) that hairlessness evolved in a savanna environment for hunting appears to be partially correct, but the existence of a unique diurnal hunting style is not a requirement. Rather it seems likely that early hominids were basically omnivorous by general adaptation (Rose, 1978) and that scavanging may have been more important than hunting (Shipman, 1983). These activities did not require a chase, but may have required being out by day. Glass (1966) first proposed that the use of clothing provided insulation, but his suggestion that hair reduction provided no intrinsic advantage seems incorrect and unlikely (Hailman, 1966).

Hair was retained in patches where it served as attractant, display, appeasement, or threat functions (Guthrie, 1970, Morris, 1967). Certainly the exposure of skin permitted development of tactile sensitivity in sexual behavior, part of the function of remaining body hairs. It has been suggested that hair reduction took place by neotenous development (Keith, 1912). However, the loss of hair appears to occur rather late in development (Harrison & Montagna, 1969). Bipedalism permitted the limiting of thermally-insulating hair to the head and freed the rest of the body to be covered with hair. The early development of bipedalism, over three million years ago (White, 1980), thus permitted near total hair loss as intellectual capacity increased.

Clothing, once devised for heat conservation, could subsequently be used for other purposes, such as ornamentation. Clothing also protects the skin from exposure. Furthermore, loose clothing can recreate the insulative properties of hair by reflecting direct insulation while permitting air flow across the skin surface.

Thus the coincident evolution of hair reduction and removable insulation permitted the adaptability of humans to both hot and cold environments, diurnal activity and nocturnal inactivity. None of these could have occurred without the development of the wit to fabricate artifactual insulation, at early stages in hominid evolution. Species lacking such innovative powers and cultural transmission could not escape their doubly-functioning permanent insulation.

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