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SCIENCE DESK

Why Humans and Their Fur Parted Ways

By NICHOLAS WADE (NYT)

One of the most distinctive evolutionary changes as humans parted company from their fellow apes was their loss of body hair. But why and when human body hair disappeared, together with the matter of when people first started to wear clothes, are questions that have long lain beyond the reach of archaeology and paleontology.

Ingenious solutions to both issues have now been proposed, independently, by two research groups analyzing changes in DNA. The result, if the dates are accurate, is something of an embarrassment. It implies we were naked for more than a million years before we started wearing clothes.

Dr. Alan R. Rogers, an evolutionary geneticist at the University of Utah, has figured out when humans lost their hair by an indirect method depending on the gene that determines skin color. Dr. Mark Stoneking of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, believes he has established when humans first wore clothes. His method too is indirect: it involves dating the evolution of the human body louse, which infests only clothes.

Meanwhile a third group of researchers, resurrecting a suggestion of Darwin, has come up with a novel explanation of why humans lost their body hair in the first place.

Mammals need body hair to keep warm, and lose it only for special evolutionary reasons. Whales and walruses shed their hair to improve speed in their new medium, the sea. Elephants and rhinoceroses have specially thick skins and are too bulky to lose much heat on cold nights. But why did humans, the only hairless primates, lose their body hair?

One theory holds that the hominid line went through a semi-aquatic phase -- witness the slight webbing on our hands. A better suggestion is that loss of body hair helped our distant ancestors keep cool when they first ventured beyond the forest's shade and across the hot African savannah. But loss of hair is not an unmixed blessing in regulating body temperature because the naked skin absorbs more energy in the heat of the day and loses more in the cold of the night.

Dr. Mark Pagel of the University of Reading in England and Dr. Walter Bodmer of the John Radcliffe Hospital in Oxford have proposed a different solution to the mystery and their idea, if true, goes far toward explaining contemporary attitudes about hirsuteness. Humans lost their body hair, they say, to free themselves of external parasites that infest fur -- blood-sucking lice, fleas and ticks and the diseases they spread.

Once hairlessness had evolved through natural selection, Dr. Pagel and Dr. Bodmer suggest, it then became subject to sexual selection, the development of features in one sex that appeal to the other. Among the newly furless humans, bare skin would have served, like the peacock's tail, as a signal of fitness. The pains women take to keep their bodies free of hair -- joined now by some men -- may be no mere fashion statement but the latest echo of an ancient instinct. Dr. Pagel's and Dr. Bodmer's article appeared in a recent issue of The Proceedings of the Royal Society.

Dr. Pagel said he had noticed recently that advertisements for women's clothing often included a model showing a large expanse of bare back. "We have thought of showing off skin as a secondary sexual characteristic but maybe it's simpler than that -- just a billboard for healthy skin," he said.

The message -- "No fleas, lice or ticks on me!" -- is presumably concealed from the conscious mind of both sender and receiver.

There are several puzzles for the new theory to explain. One is why, if loss of body hair deprived parasites of a refuge, evolution allowed pubic hair to be retained. Dr. Pagel and Dr. Bodmer suggest that these humid regions, dense with sweat glands, serve as launching pads for pheromones, airborne hormones known to convey sexual signals in other mammals though not yet identified in humans.

Another conundrum is why women have less body hair than men. Though both sexes may prefer less hair in the other, the pressure of sexual selection in this case may be greater on women, whether because men have had greater powers of choice or an more intense interest in physical attributes. "Common use of depilatory agents testifies to the continuing attractions of hairlessness, especially in human females," the two researchers write.

Dr. David L. Reed, a louse expert at the University of Utah, said the idea that humans might have lost their body hair as a defense against parasites was a "fascinating concept." Body lice spread three diseases -- typhus, relapsing fever and trench fever -- and have killed millions of people in time of war, he said.

But others could take more convincing. "There are all kinds of notions as to the advantage of hair loss, but they are all just-so stories," said Dr. Ian Tattersall, a paleoanthropologist at the American Museum of Natural History in New York.

Causes aside, when did humans first lose their body hair? Dr. Rogers, of the University of Utah, saw a way to get a fix on the date after reading an article about a gene that helps determine skin color. The gene, called MC1R, specifies a protein that serves as a switch between the two kinds of pigment made by human cells. Eumelanin, which protects against the ultraviolet rays of the sun, is brown-black; pheomelanin, which is not protective, is a red-yellow color.

Three years ago Dr. Rosalind Harding of Oxford University and others made a worldwide study of the MC1R gene by extracting it from blood samples and analyzing the sequence of DNA units in the gene. They found that the protein made by the gene is invariant in African populations, but outside of Africa the gene, and its protein, tended to vary a lot.

Dr. Harding concluded that the gene was kept under tight constraint in Africa, presumably because any change in its protein increased vulnerability to the sun's ultraviolet light, and was fatal to its owner. But outside Africa, in northern Asia and Europe, the gene was free to accept mutations, the constant natural changes in DNA, and produced skin colors that were not dark.

Reading Dr. Harding's article recently as part of a different project, Dr. Rogers wondered why all Africans had acquired the same version of the gene. Chimpanzees, Dr. Harding had noted, have many different forms of the gene, as presumably did the common ancestor of chimps and people.

As soon as the ancestral human population in Africa started losing its fur, Dr. Rogers surmised, people would have needed dark skin as a protection against sunlight. Anyone who had a version of the MC1R gene that produced darker skin would have had a survival advantage, and in a few generations this version of the gene would have made a clean sweep through the population.

There may have been several clean sweeps, each one producing a more effective version of the MC1R gene. Dr. Rogers saw a way to put a date on at least the most recent sweep. Some of the DNA units in a gene can be changed without changing the amino acid units in the protein the gene specifies. The MC1R genes Dr.

Harding had analyzed in African populations had several of these silent mutations. Since the silent mutations accumulate in a random but steady fashion, they serve as a molecular clock, one that started ticking at the time of the last sweep of the MC1R gene through the ancestral human population.

From the number of silent mutations in African versions of the MC1R gene, Dr. Rogers and two colleagues, Dr. David Iltis and Dr. Stephen Wooding, calculate that the last sweep probably occurred 1.2 million years ago, when the human population consisted of a mere 14,000 breeding individuals. In other words, humans have been hairless at least since this time, and maybe for much longer. Their article is to appear in a future issue of Current Anthropology.

The estimated minimum date for human hairlessness seems to fall in reasonably well with the schedule of other major adaptations that turned an ordinary ape into the weirdest of all primates. Hominids first started occupying areas with few shade trees some 1.7 million years ago. This is also the time when long limbs and an external nose appeared. Both are assumed to be adaptations to help dissipate heat, said Dr. Richard Klein, an archaeologist at Stanford University. Loss of hair and dark skin could well have emerged at the same time, so Dr. Rogers' argument was "completely plausible," he said.

From 1.6 million years ago the world was in the grip of the Pleistocene ice age, which ended only 10,000 years ago. Even in Africa, nights could have been cold for fur-less primates. But Dr. Ropers noted that people lived without clothes until recently in chilly places like Tasmania and Tierra del Fuego.

Chimpanzees have pale skin and are born with pale faces that tan as they grow older. So the prototype hominid too probably had fair skin under dark hair, said Dr. Nina Jablonski, an expert on the evolution of skin color at the California Academy of Sciences. "It was only later that we lost our hair and at the same time evolved an evenly dark pigmentation," she said.

Remarkable as it may seem that genetic analysis can reach back and date an event deep in human history, there is a second approach to determining when people lost their body hair, or at least started to wear clothes. It has to do with lice. Humans have the distinction of being host to three different kinds: the head louse, the body louse and the pubic louse. The body louse, unlike all other kinds that infect mammals, clings to clothing, not hair. It presumably evolved from the head louse after humans lost their body hair and started wearing clothes.

Dr. Stoneking, together with Dr. Ralf Kittler and Dr. Manfred Kayser, report in today's issue of Current Biology that they compared the DNA of human head and body lice from around the world, as well as chimpanzee lice as a point of evolutionary comparison. From study of the DNA differences, they find that the human body louse indeed evolved from the louse, as expected, but that this event took place surprisingly recently, sometime between 42,000 and 72,000 years ago. Humans must have been wearing clothes at least since this time.

Modern humans left Africa about 50,000 years ago. Dr. Stoneking and his colleagues say the invention of clothing may have been a factor in the successful spread of humans around the world, especially in the cooler climates of the north.

Dr. Stoneking said in an interview that clothing could also have been part of the suite of sophisticated behaviors, such as advanced tools, trade and art, that appear in the archaeological record some 50,000 years ago, just before humans migrated from Africa.

The head louse would probably have colonized clothing quite soon after the niche became available -- within thousands and tens of thousands of years, Dr. Stoneking said. So body lice were probably not in

existence when humans and Neanderthals diverged some 250,000 or more years ago. This implies that the common ancestor of humans and Neanderthals did not wear clothes and therefore probably Neanderthals didn't either.

But Dr. Klein, the Stanford archeologist, said he thought Neanderthals and other archaic humans must have produced clothing of some kind in order to live in temperate latitudes like Europe and the Far East. Perhaps the body lice don't show that, he suggested, because early clothes were too loose fitting or made of the wrong material.

Dr. Stoneking said he got the idea for his louse project after one of his children came home with a note about a louse infestation in school. The note assured parents that lice could only live a few hours when away from the human body, implying to Dr. Stoneking that their evolution must closely mirror the spread of humans around the world.

The compilers of Genesis write that as soon as Adam and Eve realized they were naked, they sewed themselves aprons made of leaves from the fig tree, and that the Creator himself made them more durable skin coats before evicting them. But if Dr. Rogers and Dr. Stoneking are correct, humans were naked for a million years before they noticed their state of undress and called for the tailor.

CAPTIONS: Photos: There are few hairless mammals other than humans, but they include the naked mole rat, above, the hippopotamus and the elephant. It is believed that mammals lose their hair only for particular evolutionary reasons. (Photo by Neil Bromhall/Photo Researchers); (Photo by Paul Smith for The New York Times); (Photo by Agence France-Presse/Getty Images)(pg. F4)

Chart/Photos: "A Million Years of Nakedness"
A new theory suggests that early humans shed their body hair not to bare shoulders or ankles, but to avoid parasites. They couldn't shake these bugs altogether, though; one parasite may have evolved to bother human hosts again.

PRIMATES DIVERGE -- The hominid line splits from a common chimp ancestor.

STANDING UPRIGHT -- Hominids become bipedal, walking on two legs (above left).

OUT OF THE WOODS -- Early hominids left forested areas for the savanna about 1.7 million years ago. They developed the more familiar features of modern humans, including external noses and longer limbs suited for walking.

DATING FUR LOSS -- The last mutation in the gene that causes dark skin color was about 1.2 million years ago. The gene came to predominate in Africa, where it was necessary to protect the small early hominid population from harsh sunlight (above right).

FASHION CAME LATE -- Humans may have been naked for most of the time since body hair loss, dated to the arrival of body lice that cling only to clothes, about 70,000 years ago.

Before -- An Australopithecus, sporting full-bodied fur about four million years ago.

After -- An archaic human walked fur-free about 1.2 million years ago, carrying fire on the savanna.

(The New York Times; illustrations by Michael Rothman)
(Sources by Dr. Mark Pagel and Dr. Walter Bodmer, The Royal Society)