Reply to Kristýna Brzobohatá

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A book reviewer should summarize the author's argument and then critique it point by point, ideally by referring to specific passages. You have done neither. Please let me do the job you left undone.

Europeans have a surprising variety of hair and eye colors. Their hair colors are produced by alleles at over 200 loci and their eye colors by alleles at over 124. Those alleles arose over a relatively short time, certainly less than the forty thousand years of *Homo sapiens* in Europe. Only some kind of selection, and very strong selection at that, could have caused so many alleles to proliferate over so little time.

Some have argued that the selection was driven by a lack of vitamin D. As humans moved out of Africa and into Europe, where sunlight is weaker, natural selection lightened their skin in order to allow sufficient penetration of UVB for synthesis of vitamin D. As a side-effect, the reduction in skin pigmentation also caused changes to hair color and eye color.

That scenario has three problems:

- The genetic linkages are weak between skin color, hair color, and eye color. Pale skin often coexists with dark hair and dark eyes. Thus, selection for lighter skin should weakly affect hair and eye color. Keep in mind that the genes are different in each case: European skin became white through new alleles at *SLC45A2*, *SLC24A5*, and *TYRP1*, hair color diversified mainly through new alleles at *MC1R*, and eye color diversified mainly through new alleles in the *HERC2-OCA2* region.
- If the selection had been only for lighter skin, and had diversified hair and eye color only as a side-effect, hair color would have simply become less black and eye color less brown. We still need to explain the proliferation of so many new alleles and colors.
- The new hair and eye colors are not simply more diverse. They are also brighter and "purer" – they occupy thinner slices of the visible spectrum than the original black and brown. Pure colors are unusual in nature and occur typically in situations where an animal or a plant is seeking to draw attention, whether to get pollinated, to warn predators, or to attract a mate.

The "side-effect" scenario also fails to explain why women are much more likely to have red or blond hair, and three to five times less likely to have black hair. This natural sex difference has been confirmed by controlled studies. Among Czechs, 19 % of women and 11 % of men have the highest gradation of hair redness. Hair and eye colors are also more evenly distributed among women: the less frequent colors are more common, and the more frequent ones less common.

European hair and eye colors thus seem to be due to selection that acted primarily on women. Was it sexual selection? A colorful appearance is not an adaptation to the natural environment, which favors a less conspicuous look to avoid detection by predators. It is usually an adaptation to the social environment, i.e., a way to get noticed. Visual attention is focused on or around the face, and this is where two color polymorphisms have arisen separately in Europeans for the hair and the eyes.

Color polymorphisms are often created by sexual selection, specifically by the desire for novelty. A color gets attention not only by being bright and pure but also by being rare. To the extent that a rare color becomes more frequent in a population, through selection, it also becomes less attractive, and the pressure of selection shifts to less frequent colors, including those that have recently appeared through mutation. Over successive generations, more and more color variants will accumulate in the population.

The argument for sexual selection seems strongest for the hair and eye colors of Europeans. What about their skin color? Could their albino-like skin be likewise due to intense sexual selection at some point in the past?

Again, we come back to the counter-argument that selection for white skin was driven by a lack of vitamin D. That argument fails, however, to explain why the skin has not whitened to the same extreme degree in populations at similar latitudes in Asia and North America. Even in Europe, humans were brown-skinned long after their arrival some 40,000 years ago. Three research teams have estimated that white skin became prevalent no earlier than 19,000 years ago. In some regions, Europeans were brown-skinned until almost the dawn of history, as shown by DNA dated to 8,000 years ago from Luxembourg, 7,000 years ago from Spain, and 5,000–4,000 years ago from England.

Some authors have modified the vitamin D hypothesis by arguing that ancestral Europeans lost a major dietary source of vitamin D when they became farmers and abandoned fishing and sealing. However, two studies of ancient DNA have shown that Europeans were already white-skinned in Scandinavia 9,500 to 6,000 years ago and in the Baltic region 7,460 to 5,360 years ago. That was long before the arrival of farming, when fishing and sealing were contributing much to the diet.

What, then, caused Europeans to become white-skinned? Probably the same sexual selection that created their hair and eye colors. Unlike the latter, however, their skin color did not become polymorphic. It simply became very pale. The reason may be that sexual selection was guided by a pre-existing dimorphism: in all populations, men are browner and ruddier than women. Lighter-skinned women are thus seen as more feminine in traditional cultures and preferred as mates. Therefore, if sexual selection is strong enough, it could drain the gene pool of alleles for dark skin.

Ultimately, women have a lighter skin for the same reason they have a smaller nose

and chin, smoother, more pliable skin, and a higher pitch of voice. These are visual, tactile, and auditory cues that originally identified the human infant to an adult observer, who would respond by feeling less aggressive and more willing to provide care and nurturance. The infant's lighter skin is especially noticeable in societies where the adult is much darker. A new Kenyan mother may tell her neighbors to come and see her *mzungu*, i.e., "European." When Zambian girls were asked to describe how Africans look, some wrote: "At birth African children are born like Europeans, but after a few months the color changes to the color of an African."

Whether we are talking about the whitening of the skin or the diversification of hair and eye colors, the changes to the European phenotype occurred during a limited span of time, specifically during the last ice age some ten to twenty thousand years ago. They also occurred within a limited geographic context, essentially the plains stretching from the Baltic to central Siberia.

Those plains were at that time a vast expanse of steppe-tundra. Despite their high bioproductivity, they provided humans with only one food source: meat from wandering herds of reindeer and other game. Dependence on that food source had two consequences:

- *A high male death rate*. Men had to hunt over long distances of cold, unstable terrain that offered no alternative sources of food. There was thus a high risk of death from starvation and other hazards of hunting.
- *A low polygyny rate*. Only the ablest hunters could provide for more than one woman and her children, since the latter could not provide for themselves. Women had no food autonomy.

The result: a glut of women on the mate market; intense rivalry among them for male attention; and strong selection for eye-catching female features. Such features became more frequent with succeeding generations, eventually forming the current European phenotype.

Robert G. Bednarik: Gudenus Cave The Earliest Humans of Austria. Archaeopress Archaeology, 2023. 174 Pp.
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This text only saw the light of day this year, even though it might have been expected to be published somewhere after 1963 to 1966 – albeit in a considerably more meager form – when its author conducted minor rescue research here. The first excavations, which unfortunately affected almost the entire area of the cave, were carried out here in 1883–1884 by Father Leopold Hacker from the nearby monastery in Göttweig, of course without any documentation. The first chapter is devoted to the history of the research, in which we also read that a decisive step towards the recognition of cultural stratigraphy was made by Obermaier and Breuil in their article from 1908, when they identified an ancient component with hand axes in the findings, assigned to the Acheulian (Obermaier 1912), and then younger finds (antler spear points, perforated reindeer antler, eyed needles, pierced animal teeth, a reindeer engraving on a supposed needle case and stone tools). In 1922, Josef Bayer excavated the remains of sediments in a rock niche, where he confirmed the existence of the Middle Palaeolithic, while some of the finds dated to the Magdalenian were questioned by R. Pittioni (1954) in his classic compendium of Austrian prehistory. In Chapter 1, we find all the important illustrations from older publications.

The second chapter is devoted to the geography and the natural environment. A pseudokarst flat cave with three entrances is formed in an amphibolite cliff above the Kleine Krems stream below Hartenstein Castle in the region called Waldviertel in Lower Austria. Sediments, the sequence of which was not recorded by the main excavation, were periodically stirred up by water. The site's geology, hydrology, temperature, and drafts were subjected to a thorough analysis, which is certainly commendable, but somewhat redundant for such a sparsely populated and carelessly explored area. The 3rd chapter is devoted to the author's rescue research, during which he discovered inconspicuous artifacts (initial cores and flakes) in several hard-to-date positions and apparently in secondary positions. Artifacts made from quartzite, coarse local rocks, and crystal belong to older periods of occupation of the settlement.

I could only comment on the relevance of the stratigraphic observations only after a detailed study. The mentioned research from the 1960s, although elaborated on in Chapter 4 both sedimentologically and palynologically, did not address the question of the cultural affiliation of the older finds – although these considerations make up almost the entirety of Chapter 5, accompanied with colour photographs of the artifacts. Based on these findings and the reevaluation of old finds, in the last chapter, the author arrives at a picture of settlement occupation in at least five periods:

1. Lower Palaeolithic (Middle Acheulian) with altered hand axes, falling into the Rissian at the latest, 2. older phase of Middle Palaeolithic with non-altered bifaces, dated to Eemian, 3. Middle phase of Middle Palaeolithic with pronounced side scrapers, 4. traces of Early Upper Palaeolithic in the Middle Wurmian (Szeletian, Olschewian, "Alpine Palaeolithic"), 5. Late Magdalenian.

In my opinion, the creation of this model suffers from a number of shortcomings. The objects are not properly depicted (e.g. in the form of new drawings with cross-sections), sometimes we can only imagine the ventral sides, which is especially important in the case of hand axes. Among them, only the objects in Fig. 88–89 and 97, long known, can be included, while the hypothetically assigned artifact in Fig. 90 and on the cover only remotely resembles a biface and its other side is unknown – isn't it a fragment of a flake after all? Dimensions and raw materials are listed only selectively and there is no overall table of findings.

In the end, the author does not hesitate to integrate the created model into the Central European and even the world framework, which is helped by the Australian perspective (R. Bednarik has been living in Melbourne for decades). However, the finds are too poor for such far-reaching considerations and their