The Evolution of Humankind at the Crossroads of Interdisciplinarity

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The Challenging Progress of Genetics

In recent decades, popular culture has been flooded by a remarkable number of claims that biologists have been putting forward and double checking against an ever-increasing amount of evidence (for example, about occasional discrepancies between the sexual identity of a baby's brain and bodily makeup). Ever since the sheep Dolly was successfully cloned in 1996, many wondered about the possibility of having themselves cloned too, even though Dolly was apparently the only specimen out of a few hundred to be born alive – and it does not seem that such a troubling predicament has significantly changed so far. Getting one's own genome sequenced is now very affordable, at least if the purpose is to learn about genetic makeup in terms of, say, Italian, British, or Japanese genes – and even Neandertal or Denisovan ones for that matter. According to recent advertising,[1] at the fraction of the cost of a dance class, a genetic test can reveal an innate talent for dancing inherited from any of the interested party's ancestors – which would certainly be a good investment of time and money. These alleged new possibilities and problems continuously raised by genetics research bring to mind fictional narratives like Mary Shelley's *Frankenstein*, as well as real-life horror stories like the Shoah or the other genocides humankind has witnessed, suffered, and perpetrated throughout its remarkably successful but also quite troublesome history.

With its intellectually demanding and emotionally charged set of themes, the progress of genetics may very well by accompanied by a dangerous underappreciation, especially in popular culture, of important conceptual differences, for example, between sequencing a set of genes or a whole individual genome and replicating an actual

[1] https://www.ancestry.com/c/traits-learning-hub/dancing

biological organ or an entire individual organism. Consider also the difference between sequencing a fraction or all of someone's genome as opposed to being able to give meaning – in terms of actual biological and cultural development – to the resulting sequence of nucleotides, regardless of the organism to which it belongs, not to mention its evolutionary history and its environment.
These issues were recently addressed by two of the winners of the 2023 Balzan Prize, Jean-Jacques Hublin, who unexpectedly discovered the oldest *Homo sapiens* specimens at a Moroccan archeological site in 2017, and Eske Willerslev, whom the Balzan Foundation's General Prize Committee acknowledged for «leading the way in using ancient DNA (from teeth) to identify human pathogens and for retrieving DNA directly from environmental samples, opening a new scientific field». Hublin and Willerslev presented their work during the first part of the 2023 Balzan Prizewinners Interdisciplinary Forum held in Bern, Switzerland, on 16 November 2023.[2]

The Balzan Foundation's General Prize Committee's choice of this field of research for the 2023 awards highlights the aforementioned issues inherent in the larger field of genetics, as is clear in the Committee's *laudatio* of Hublin. They acknowledge «his commitment to the autonomy of science, and his ability to identify and take a distance from ideological interference», and underline the importance of his contribution to developing «a discipline that has had to build itself up against religious prejudice, reawakened by the growing influence of creationism today». Such influence is the main obstacle to a satisfactory understanding of the important themes of genetics and of biology at large, including those basic features of the social world that are intertwined with our biology, and our understanding of it.

The History of *Homo sapiens* Under a Microscope

In 2023 the General Prize Committee of the Balzan Foundation took an extraordinary step forward in its well-established tradition of promoting interdisciplinary research and scholarship by awarding two of the four Balzan Prizes (one in the humanities and one in the sciences) to a shared field of studies, broadly defined as the Evolution of Humankind. Under

[2] A video of the entire Forum is available on the official website of the Balzan Foundation.

this general heading, the 2023 Balzan Prize for Paleoanthropology was awarded to Jean-Jacques Hublin, and the 2023 Balzan Prize for Ancient DNA and Human Evolution was awarded to Eske Willerslev. Both Hublin and Willerslev were recognized by the Committee for having contributed to a significant transformation of the scientific community's general understanding of when, where, and how our species came into existence on the African continent, and of how it subsequently went on to colonize Eurasia, Australia, and the Americas. More specifically, Hublin's analyses of fossil materials previously unearthed at Moroccan and Bulgarian sites enabled him to move the origins of *Homo sapiens* considerably back in time, including the arrival of our species in Europe, whereas Willerslev sees the genetic ancestry of present-day populations as the result of continuous movements and admixtures of human groups, which allowed him to form a thorough understanding of several populations' histories – in Australia, the Americas, Northern Europe, and large areas of Eurasia. Hublin's and Willerslev's contributions broadly dovetail with each other, and offer a new and promising overall narrative, bringing together results achieved by disciplines that are so differently conceived and practiced as anthropology and genetics. The two prizewinners each work independently from each other in an interdisciplinary fashion, and mainly on different – but not necessarily unrelated – research questions. As the General Prize Committee pointed out, Hublin's ability to synthesize data from cutting-edge technologies and from archeological sites located in Africa (Morocco, Ethiopia, Algeria) and Europe (France, Bulgaria), enabled him to establish a new provisional timeline and geographical framework for the appearance of the first populations of *Homo sapiens* to be identified as such – that is, to be distinguished from other human populations (like Homo *ergaster*, *neanderthalensis*, or *denisova*) with which, however, some interbreeding did occur. On the other hand, Willerslev's discovery that modern and ancient DNA from plants and animals can be retrieved directly from environmental samples allowed him to record biodiversity across time and space, leading to more specific hypotheses on the fauna and flora in and around the grottoes where hominins dwelt at certain times in their migrations, as well as on the spread of human pathogens. Willerslev was thereby able to establish new historical reconstructions of several migrations of *Homo sapiens*, their interactions with other populations, and their reactions to environmental factors which in turn affected their

own genetic and morphological makeup, all of which identify specific populations of *Homo sapiens*.

Darwin's Finches as a Model for the Evolution of Humankind

Peter and Rosemary Grant were awarded the 2005 Balzan Prize for Population Biology, for their outstanding long-term studies demonstrating evolution in progress in Galápagos finches. Three years later, they delivered the 2008 Balzan Lecture at the Accademia dei Lincei, in Rome, in which they foreshadowed the aforementioned development of current research on human origins. The Grants recorded the arrival in 1981 of a very unusual finch on Daphne, one of over a hundred islands in the Galapagos archipelago. These islands were made famous in 1859 by Charles Darwin, especially for their different populations of finches which he offered as a model for the process of speciation. The Grants lived on Daphne for extended periods of time over four decades in order to further understand the evolution of those finches. As the Balzan General Prize Committee stated in their *laudatio*, «the Grants have used variation in mitochondrial DNA and microsatellite regions of nuclear DNA to show that the 14 species of finch have indeed evolved from a common ancestor that arrived in the Galápagos 2-3 million years ago». What the Grants found in their fieldwork, however, is that, after reaching the status of endogamous populations (or «species» according to the Darwinian definition of the term), although they had become diagnosably different from each other, those finch populations had not reached a point where they could not interbreed for reasons of genetic incompatibility.

The immigrant finch that arrived on Daphne in 1981 appeared to be a male hybrid, morphologically similar to *Geospiza fortis* but much larger, more like a *G. scandens*. By genetic analyses it was identified as a *fortis-scandens-fortis* (the result of a *fortis-scandens* hybridization, and a back-crossing with *fortis*). A normal finch would have learned his father's song, a prerequisite and a constraint for finding a suitable female and mating with her, but the Grants thought that this finch's song was unusual, describing it as recognizable and distinctive. After an unsuccessful attempt at mating with a *fortis*, he mated with another hybrid of the same constitution (*fortis-scandens-fortis*). His sons, and his grandsons successfully reproduced, preserving their ancestor's culturally transmitted song over several generations. In 2003-2005 a

severe drought reduced this lineage to only one brother and sister, and in 2008, when the Grants delivered their Balzan Lecture, the finches' inbred couple was still alive and had produced 15 offspring, which were interbreeding with each other only, thereby forming an endogamous population. In other words, they had created a new species, at least in behavioral terms. They concluded that hybridization could be a very rapid route to change, allowing a population to move along a new evolutionary trajectory in new or changing environments. Their acknowledgement of the importance of this process looks ahead to the later work of Hublin and Willerslev:

> Hybridization and introgression of genes through back-crossing may be more widely important than is generally believed. In the literature there are numerous instances of introgressive hybridization in many groups of organisms […] It has even been recorded in our own human lineage, with molecular genetic evidence of introgressive hybridization between Neanderthals and our own ancestors. Thus, it is clearly a force to be reckoned with.[3]

Interdisciplinarity as a Crossroads

Luigi Luca Cavalli Sforza received the 1999 Balzan Prize for the Science of Human Origins for his comprehensive work on human evolution that integrated genetic and cultural features. In his acceptance speech, he stated: «multidisciplinarity is a major enrichment especially in those sciences in which, as in history, repetition of the experiment is impossible, and may provide a sort of analogue of it».[4] At that time, the task at hand was to understand our differences for what they are as opposed to either ignoring them, or misunderstanding them for what they are not – and it still is. As Ernst Mayr, 1983 Balzan Prize for Zoology (including his criticism of the concept of species) put it at the

[3] Peter and Rosemary Grant, *The Evolution of Darwin's Finches, Mockingbirds and Flies.* Firenze: Casa Editrice Leo S. Olschki, 2010, 44-45.

[4] Luigi Luca Cavalli-Sforza: A Panoramic Synthesis of My Research - 16.11.1999 (balzan.org)

time, one should be mindful of those predicaments in which biological evolution fails to accommodate the wishes of the taxonomist.[5]
The long history of so-called Social Darwinism, the controversies over sociobiology, as well as the interference of Creationism show how important it is to keep both cultural studies and scientific research fully at work on the understanding of this ongoing process, the Evolution of Humankind, and to maintain ongoing communication with each other. Spanning at this point more than half a century, The Balzan Foundation's contribution to such a crucial endeavor has been remarkable, and may become a rich source of reference points for both the scientific community and the public at large.

[5] Ernst Mayr, *The Growths of Biological Thought. Diversity, Evolution, and Inheritance*. Cambridge MA: The Belknap Press of Harvard University Press, 1982, p. 295.