MEDICAL AND PUBLIC HEALTH IMPLICATIONS OF BIOLOGIC ESSENTIALISM AND REDUCTIONISM

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ABSTRACT. *The focus on 'species' as a form of modern-day Platonic or biologic essentialism in Arthur Saniotis' and Maciej Henneberg's paper "Conceptual Challenges to Evolutionary Biology: A Necessary Step" finds agreement with another term used by medical and public health experts – 'race'. Both concepts lack clearly defined borders to convincingly show that distinct typologies exist. Reification of race as an objective term has led to unfortunate consequences in human history, and calls for a degree of caution in how science views its biologic categorizations and the technologies employing them which assess disease associations in groups. These technologies have attended to gross phenotype in the past, but the use of ancestry informative markers in current health research, and of various forms of molecular-level testing (genetic, epigenetic) in the field is now becoming widespread. While agreeing with Saniotis and Henneberg that the epigenome must be considered in apprising secondary concepts associated with biological essentialist terms, such as 'biodiversity' and 'health,' this commentary contends that for the human species, a more comprehensive set of environmental factors is required, ultimately extending to the societal level. A distinction needs to be made between microevolutionary processes, which are intergenerational, and macroevolution, concerned with population outcomes. In the human domain, the genome, epigenome, and broader environment act in concert. Most importantly, when considering macroevolution, appreciation of the arbitrariness of essentialist categories calls for a greater recognition of the rights of individuals so labeled, whether they be human or humankind's partners on this planet.*
KEYWORDS: *Essentialism, reductionism, species, race, health, genome, epigenome, microevolution, macroevolution, rights*

1. Introduction: Cosmic Evolution and Greek Mythology

Arthur Saniotis and Maciej Henneberg in their penetrating work "Conceptual Challenges to Evolutionary Biology: A Necessary Step" hit the nail on the head when they claim that evolutionary biology is working its way through the twin detractors of essentialism and reductionism. These two terms pop-up in applied biology (medicine, public health) and psychology these days just as much as in basic biology. A growing awareness exists that biology has moved excessively in the molecular direction, and that

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a need exists to move towards synthesis as a scientific activity. The authors cite the origins of essentialism, that an entity can be typed by a set of identifying characteristics - various pre-Socratic philosophers who developed elemental natural types as the motivating forces and supporting substances behind the universe. If we look to Greek mythology, there is an indication that the drive towards idealism and simplification in scientific explanations was culturally inevitable, but so is a way out. The cosmos of Greek mythology started with Gaia or a Mother Principle that spawned a primordial substance for the universe (Young 1976, p. 233). Gaia gave way to Uranus, then Cronus arose. The god Cronus, in eating his children and emasculating his father, represents not just a moral low point but also a principle of physical constraint on what existed previously. However, Zeus, son of Cronus, and heroic figures like Jason and Perseus, depict escape from constraint, or freedom. It is to be expected that scientific climates will undergo a process of deterministic descent and freedom-conferring ascent as well.

2. Use of Biological Essentialism for the Human Species

The use of essentialist types in biology, as the authors discuss, offers a way of categorizing and managing the natural world. That effort can be both helpful and rigidifying. Evolutionary types serve as a starting point for biologic explanation – something to hold onto, to grasp. The tendency to view people and organisms in essentialist ways is hardwired, perhaps for survival purposes, into the young human intellect. Even preschool children begin to distinguish between people according to gross features like skin color (Hirschfield 1997, p. 85). Such differentiating practices are reinforced by societal stereotypes. Science itself subscribes to essentialist typologies. Much of medical and public health research recruits participants, then analyzes and contrasts outcomes for members of different racial-ethnic groups. Clearly the Mayr definition of species, which focuses on interbreeding ability of two individuals, is superseded in human investigation by the desire to develop further geographic sub-categorizations, ultimately to form inferences about putatively “taxonomic” group differences and the need for targeting and withholding of resources (Long and Kittles 2009, p. 794). The differences under examination may accordingly not be between species; they may be between ancestrally separated members of the one human species (unfortunately termed “subspecies” by some biologists), but the outcome in terms of dichotomizing individuals and the use of differentiating categories is the same. So Foucault is right when he says that the human desire for truth is interspersed with human want of power (Foucault 1970). At its extreme, the typologizing and simplifying tendency can lead to nonchalance in violating other species and even, during the Holocaust, for example, the human species (Pernick 1997, p. 1770).

The authors note the advantages of classifying right down to individual biologic variation, but that short of this ideal, "it is practical to define collective units comprising many individuals for purposes of particular studies or utilitarian applications" (Saniotis and Henneberg 2013, p. 9). Such compromises are made all the time. Take the case of BiDil, a compound drug for heart failure that only on second sight was marketed specifically for African Americans. Following U.S. Food and Drug Administration rejection of the drug due to underpowering of the original study, the investigators launched a post-hoc analysis of the data, initially not broken down by race, that retrospectively showed benefits in this one group (Kahn 2003, p. 478). It would be nice to be able to discern a molecular marker or genetic locus that could identify individuals of all races who might benefit, rather than mashing all African Americans together and excluding members of other racial-ethnic groups as beneficiaries, but such capability is not at hand. This limitation, however, has not deterred the monolithic marketing of the drug.

Authorities have argued for using more specific markers of drug response than the gross racial-ethnic labels assigned by health practitioners and researchers. A hierarchy of proxies has evolved: use of clinician-assigned racial ascriptions -> use of patient self-assigned racial-ethnic identifiers -> use of country or region of origin -> use of ancestry informative markers (AIMs). The latter technique, which has arisen over the last decade, allows disease and trait inferences based on representative genetics from a specific global location. These identification techniques resemble in complexity the phenotypic typing strategies discussed by Saniotis and Henneberg, which they considered to be only approximate (p. 12-13). Three problems with the last, refined molecular approach to identifying race-ethnicity for the purpose of finding disease associations, perhaps the least generalizing of the forms of human racial-ethnic essentialism, are: (1) the global locations from which the original representative samples were taken vary with the set of investigators; (2) individuals benefiting from such research may not fit the profile of those whose tissue was used in the original research (e.g., individuals with varied and mixed ancestry); and (3) to consider this extreme molecular approach as definitive is akin to *hubris*, which the Greeks felt could lead to downfall. Martin Pernick has argued that science does refine its discoveries, but that every generation feels the technology at hand is the be all and end all. Nazi doctors were fully trusting in the usefulness of the categories they used to separate people and the fates attached to them. Ultimately we must see that our faith in a technology and the dichotomous readings it generates depends on judgments we have made about what human characteristics count as significant. The use of differentiating technology is a value-laden enterprise (Pernick 1997, p. 1770).

3. Counter Genetic Reductionism

The third caution above is particularly pertinent to the "Conceptual Challenges" article because the authors' work suggests that genetic analysis cannot completely predict phenotype in the next generation; epigenetic transmission must also in many developmental and environmental instances be taken into account (p. 12-13). Here they are referring to a collection of mechanisms – among them DNA methylation, wrapping of DNA threading proteins called *histones*, and metabolic-genetic-proteomic feedback loops – that can be transmitted from parent to offspring nongenetically, and can be propagated in the population without natural selection of genotypes (Newman 2013, p. 32; Jablonka and Raz 2009, pp . 134-6). The human "epigenome," rather, is influenced by lead and alcohol exposure, and by maternal nutrition, drug exposure and stress, especially as these exposures affect events in the mother's womb (Cranor 2013, pp. 113-17; Kuzawa and Sweet 2009). Genetic testing does not suffice to measure epigenetic changes. For maternal lead exposures, for example, a technique called pyrosequencing is used to quantitate methylation sites together with environmental assessment, such as blood lead measurements (Pilsner et al. 2009, p. 1467). In going beyond genetic reductionism, the authors are switching from a philosophy of Platonic idealism to one of Aristotelian emergence (Carroll 1994, p. 51). What emerges are higher levels of operation – the *epigenome* and associated cellular and metabolic feedback loops, the individual as a whole (and their behavior), the immediate environment (including the physical milieu and the shared family environment), the remote environment (larger social collectivities governing group behavior) – and interactions between the different levels (Payne et al. 2007; IOM 2006). It may be that the systems point of view can help to define a species, but I rather think it is most useful when considering the ensemble of factors that lead to individual phenotype. The individual should be assessed for their entire biopsychosocial profile, not by just superficial appearance (race, gender, ethnicity), for a more accurate prediction to be made about their health condition, proclivities, and susceptibilities.

The United States Institute of Medicine has indicated that multilevel "ecological" models can take into account health changes over the life course (IOM 2002). The environment modifies an individual's phenotype and health status for as long as they live. The *microevolutionary* trajectory of the individual from their original ontologic, or more properly ontogenetic, status when they were born is thus potentially influenced by inherited epigenetic factors involving interactions with the environment. Both genetic and epigenetic mechanisms involve transmission from one generation to the next, and as a consequence can have microevolutionary consequences for the succeeding generation and its members' health.

Population change, not individual development, constitutes *macro-evolution*. The mechanisms of natural selection and propagation within the population have been thoroughly charted for genetic mutations, but the authors need to say a bit more about how epigenetic changes get spread in the population if genetic selection is not taking place. Their mention of various examples of biodiversity (accelerated evolution, stress-induced hormonal changes in populations, population behavioral adoption) is a quick way of alluding to population-level mechanisms within an article that has a philosophical character. It is understandable how population-level pressures such as cultural requirements could lead to large-scale feedback between environment, individual behavior, and trait selection through time. Perhaps epigenetic mechanisms helped wedge differences between prehistoric human subspecies, such as Homo sapiens sapiens and Homo sapiens neanderthalensis, in the distant past. But a consideration of adoptive mechanisms raises the question of how ubiquitous epigenetic mechanisms are in the human epidemiologic context, say in disease resistance. Selection of epigenetic variants has been used to explain the genesis of antibiotic resistant clonal lines in bacteria (Jablonka and Raz 2009, p. 162). The converse, however, evolution of bacterial resistance in the human species, is better explained by natural selection with its arduous process of individual die-off and repopulation. In fact, one sees a combined genetic-epigenetic process – immune cell clonal selection – taking place within the context of a genetic process – natural selection.

Our views of human macroevolution have overtones for how we view the human race collectively. Cladistic analysis has shown that 85% of human genetic variation occurs within groups while only 15% occurs between groups (Long and Kittles 2009, pp. 777, 793). Perhaps a similar reckoning could be performed on the human epigenome, but the upshot of this genetic realization is that the lay concept of race as representing near-uniform categories of individuals is flawed. If Africans have a higher incidence of diabetes or hypertension than non-Africans, the chances of them having the same disease-specific mutations are low, due to this within-group genetic diversity. Conversely, in a Venn diagram representing nucleotide diversity, the circles representing European and Asian diversity would both fall within the larger circle of ancestral African genetic diversity (Ibid., p. 794). Tracing genetic variation at key genetic loci, human groups merge and derive from a common ancestral group. No doubt both genetic and epigenetic mechanisms are responsible for phenotypic variation, but consideration of genetic variation, at the very least, demonstrates a unity behind the variability.

Perhaps as important, then, as charting how a group is formed or achieves diversity is the matter of how a species' or group's rights are viewed, and how it is treated. Saniotis and Henneberg have also provided cogent arguments why a single individual cannot simply be categorized by phenotype or genotype, and how use of collective labels may lack validity and utility. This conclusion has social implications.

4. Epistemes in the Biocosmologic Model

Back to microevolution, Konstantin Khroutski has discussed assessment of the individual's full *CosmoBiotypology*. Such an analysis requires attention to three different levels: "subjective feelings and perceptions; adequate position in the social-ecological environment; and biological constitution or biotype (including genotype)" (Khroutski 2006, p. 142). This approach is far-removed from the simple procedures of either spot-checking a patient for race, ethnicity, or gender; or administering to them a genetic test for a rare, highly penetrant mutation. Jablonka has suggested that for traits and conditions that have a developmental origin, examination of epigenetic factors contributing to developmental trajectories, possibly captured by gene expression arrays checking specific genes under constrained environmental conditions, might elucidate the processes involved (Jablonka 2013, p. 80). On the applications as opposed to the research end, standard and methylated (the "MeDIP-chip") gene expression profiles could be added to larger inventories or batteries that would yield a personalized appraisal of health-related capacities.

The odd realization is that the more technologically sophisticated society becomes, the greater the capacity to inculcate the larger point of view – the holistic. Saniotis and Henneberg (p. 11) quote Bartlett on the tenor of the times: "By the dawn of the eighteenth century the pervasive power of reductionism had transformed the episteme, thwarting the possibility of a counter scientific worldview." This historic phase, in medical terms, is what Khroutski's biocosmology describes as the "Second – Western ('organic-pathological') modern traditional form of medicine," its "Second episteme" (Khroutski 2006, p. 142). But the Second episteme gives way to a Third ("Cosmist") episteme centering on the emergence of a personalistic medicine maximizing the intrinsic biological and psychological functioning of every individual in concert with their ecological-social environment (Ibid.). The Saniotis and Henneberg paper, with its realization of multi-level feedback, breaks ground for the emerging Third episteme.

5. Conclusion: Conceptual Change Within the Flow of Time

A paper on "Conceptual Challenges to Evolutionary Biology" naturally centers on the definition of *species*, but as I hope to have shown, its conclusions can equally apply to *race*. "Species" and "race" are two types of Platonic idealistic concepts, both susceptible to essentialism and biological reductionism. I do laud the authors for the insights they have gleaned and shared from their professional work with the Centre for Evolutionary Medicine. A distinction needs to be made between whether the new systems-oriented picture focuses on microevolution or macroevolution. If the former, new means of following rapid change (biology) and of assessing and aiding individual capacity to thrive (medicine and public health) are at hand. If the latter, recognition of the transitional continuity between groups, and of the respect owed to each, is a consequence. Given an interlinked ecosystem, due attention needs to be given whether we are talking plant and animal species or human beings. How we treat the members of a group is at least as important an endeavor as finding a means to taxonomize groups (Kuzawa and Sweet 2009, p. 8).

In either case, though, time is being introduced into the biological definition (rigid, essentialist "Platonic forms" or Einsteinian time-slices (point evolution) are replaced by continuities and processes), and space is expanding to fit multiple levels of operation, from genetic to the broader environment. This strategy is the antimatter twin of genetic reductionism. Science has climbed out of its descent from the smallest conceptual and metaphysical units into something greater and more breathtaking. Among the pearls of wisdom that he divined, Heraclitus claimed that a person cannot step into the self-same stretch of river twice. History is that way – it keeps moving forward, inviting the most meaningful and inspiring developments into its dynamic fold.

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