Review Essay

How to read for current developments in human genetics relevant to justice

Dalton Conley and Jason Fletcher, *The Genome Factor: What the Social Genomics Revolution Reveals about Ourselves, Our History and the Future* (Princeton, NJ: Princeton University Press, 2017), 296 pages. ISBN: 978069116474. $29.95.

Maurizio Meloni, *Political Biology: Science and Social Values in Human Heredity from Eugenics to Epigenetics* (London: Palgrave Macmillan, 2016), 284 pages. ISBN: 9781137377715. $109.99.

Scott Solomon, *Future Humans: Inside the Science of Our Continuing Evolution* (New Haven: CT: Yale University Press, 2016), 240 pages. ISBN: 9780300208719. $20.00.

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What do current, rapid developments in biological research and technology imply for the way political communities are organized with respect to justice? How can the citizen uncover the distinctly political, moral, and public policy-related issues raised by rapidly emerging biotechnologies? In particular, how can political scientists and other social scientists with no background or expertise in bioethics gain access to these topics? I show several ways how, by drawing on three recently published books: Dalton Conley and Jason Fletcher's *The Genome Factor: What the Social Genomics Revolution Reveals about Ourselves, Our History and the Future*[1]; Maurizio Meloni's *Political Biology: Science and Social Values in Human Heredity from Eugenics to Epigenetics*[2]; and Scott Solomon's *Future Humans: Inside the Science of Our Continuing Evolution*.[3]

None of these books is primarily political in orientation or content. None draws on political theory; none deploys a philosophical vocabulary. Yet all three have distinctly political implications inasmuch as the genetic manipulation of humans raises urgent moral issues — issues that can only be adjudicated in political community (rather than, for example, by natural scientists or, say, theologians). These implications emerge in what each book says about the complex interplay between human genes and the nonhuman environment. That interplay involves a variety of exchanges between human biology and the social, cultural, and economic environments in which we live. Historically unprecedented forms of interplay may emerge, forms extending from "self-chosen, self-directed eugenics"[4] to an "enlarged evolutionary role for the environment."[5] All three books support the widely embraced idea that genes and social environments do not exist separately from one another. The books differ as to how some aspects of human biology relate to the organization of just political communities (where justice refers in part to freedom of individual self-determination, a goal easily undermined by genetic manipulation).

I demonstrate how political theorists in particular might read these books for possible implications of recent developments in human genetics for social values, political behavior, and public policy. I do so in five areas: (1) the entwinement of human genes and their various environments, (2) the question of whether environmental factors are inheritable, (3) consequences of environmental changes, (4) the relationship between genetic markers and social inequalities, and (5) the use and abuse of genetic information and its interpretations for our identity as humans.

Gene/environment entwinement

All three books reject a narrow emphasis on genes, such as the notion that humans, in their makeup and behavior, can be reduced to their genes. Each book details ways in which humans interact with their genes through what I identify as many different cultural constructions. For example, communities create values to regulate social behavior and inculcate these values into individuals through lifelong socialization. Furthermore, communities create different notions of social justice and morality, and they do so self-reflexively when they

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articulate political visions for the legal and moral regulation of genetic research and its possible applications in human bodies. Thus, these books of biology are immediately, if only implicitly, books of politics. They are political because they interlace nature and nurture. That interlacing poses political questions (as distinct from scientific ones): which political visions, and what moral and legal principles, might guide human communities in regulating the rapidly developing capacity of biotechnology to intervene in our evolved nature as human beings? For example, are some unconventional forms of human enhancement (such as genetic engineering) — in contrast to conventional forms (such as education) — immoral or unjust? In which cases might we humans harm ourselves, morally and otherwise, as individuals and as communities, by modifying ourselves biotechnologically? The answers to these questions presuppose the answer to another: from a normative standpoint, what kinds of individuals, and what kinds of communities, do we want to be, or should we want to be, and by what arguments? By raising such questions, if only implicitly, these books offer a fresh perspective on the age-old quest for human self-determination, of communities and, through them, of individuals, as cutting-edge biotechnology opens up historically unprecedented possibilities of influencing our own biology.

The debate regarding the interlacing of nature and nurture matters in determining, for example, responsibility for observed inequalities among persons when those inequalities have a biological component (such as environmental influences on fetal development that issues in persons who suffer related debilitations or disabilities). Conley and Fletcher frame their nature/nurture understanding of human behavioral outcomes as "not genes or environment" but rather "genes times environment."[6] To this equation Meloni adds heritable epigenetic factors: G × E × HE.[7] (An epigenetic trait is stable, heritable, and derives from chromosomal changes yet with no alterations in the DNA sequence.) While Solomon does not address Meloni's view, and Conley and Fletcher reject it (as I will show), they do agree with Meloni's general assertions that the "genome's borders with the environment are porous,"[8] that the molecular gene does not have distinct boundaries, and that heredity involves more than genes.

From a politically interested perspective, I see two consequences of an assertion embraced by all three books: the assertion of porous borders, indistinct boundaries, and nongenetic factors of human heredity. First, to regard humans as products of both nature and nurture says nothing about the relative contributions of each source. How one regards the relative division of labor between biology (here in the form of G, or genes) and culture (here in the form of E, or environment) is a matter of taking into account a person's normative preferences and political identity. By this measure, Meloni's position is the most politically consequential of the three books. The equation G × E is a powerful claim about what humans are and how they came to be that way. But G × E × HE (where HE refers to heritable epigenetic factors) renders man-made cultural and historical experiences part of the equation, a claim even more powerful than G x E. To know something about how environment, lifestyle, biography, and even parents' and grandparents' experiences may interact with an individual's genome to produce changes experienced throughout his or her life (and perhaps even in later generations) is to know something about how prenatal and early postnatal environmental factors may influence the adult risk of developing various chronic diseases and behavioral disorders[9] or why children born during the Dutch famine of 1944–1945 had increased rates of coronary heart disease and obesity in light of maternal exposure to famine during early pregnancy (compared with persons not so exposed).[10] Here one sees how research that uncovers social, historical, and economic factors that change DNA expression is not only biological inquiry; it is political analysis as well, if only implicitly.

Second, the gene/environment entwinement can be captured only if it is captured along multiple dimensions. Consider two. One dimension involves the sheer complexity of the instructions for human life. According to Solomon, "most mutations to functional genes are thought to be harmful" (even as beneficial mutations drive natural evolution); as "many as 75 percent of mutations that swap one DNA base for another within genes cause some sort of reduction in survival or reproductive output."[11] Further, human genetic engineering raises significant risks of unintended consequences. As Conley and Fletcher point out, instead of a "single important genetic variant (or allele), there are often hundreds or thousands that contribute to variation in a given outcome," that is, not one "gene for X" but rather "many variants with small effects."[12] They claim that "93 percent of genes in the human genome are in some way connected," such that "if you tweak a gene in one corner of the network, it may have unanticipated consequences in the actions of other genes."[13] Complexity in nature, according to Meloni,[14] parallels

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complexity in culture. This parallel, in turn, can have biological consequences: the "unforeseen complexities surrounding the hereditary material" are "deeply affected by environmental signals, from cell to society."[15] In these various ways, complexity so understood can be dangerous to the very human life it makes possible.

In short, all three books convey a strong claim that humans perpetually confront significant risks, in nature (with naturally occurring gene mutations, for example) as in society (say, in possible unforeseen consequences of future human genetic manipulation). The politically most significant risks involve transformation. By transforming aspects of natural chance and contingency into cultural choice, humans may diminish and sometimes reverse the human dependence on nature. But even as they reduce some social risks of human life (such as improved health through improved hygiene), they generate others. Thus the human impact on the planet's ecosystems and geology, on the lithosphere and the atmosphere and the ecosphere, is now so significant that the earth will bear its signs for millennia, maybe for millions of years. A will to control, technological exuberance, and an unwillingness to "take men as they are,"[16] render life even more risky that it already is for man and nonhuman nature alike. Consider, for example, the unintended consequences around 1600 of European colonialism in the Americas (with a small pox pandemic and massive deforestation, but also the global trade that followed) or the European Industrial Revolution in the late eighteenth century ("when data retrieved from glacial ice cores show the beginning of a growth in the atmospheric concentrations of several 'greenhouse gases,' in particular CO_2 and CH_4,"[17] and when "analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane,"[18] or when in 1784 James Watt invented the steam engine). We achieve a sense of the magnitude of the risks that humans perpetually face when we observe the continuum between, say, the cumulative, unintended negative impact of European colonialism or the Industrial Revolution, and the possible, unintended, negative consequences of contemporary proposals to morally improve "human nature" by drug treatment and genetic engineering.[19]

To read Solomon, Meloni, and Conley and Fletcher together is to discover challenges for scholars of politics, for public policy actors, and for the general public. Do we "take men as they are" by accepting inequality-generating economic incentives in the marketplace and beyond?[20] Or do we change men, perhaps through moral bioenhancement, to further liberal democratic societies currently unable to deal adequately with anthropogenic environmental risks such as those I list here?[21]

On the other hand, even though complexity may be viewed as dangerous to the very human life it makes possible, complexity in the shape of genetic diversity is necessary to life. Solomon notes that "genetic diversity is critical to evolution because it is the raw material for natural selection. The more diversity a population has, the more potential there is for it to respond to natural selection; without any diversity to work with," selection as an evolutionary force "becomes impotent."[22] Species diversity increases the odds of species survival. Species that are less diverse are at greater risk of extinction "because they are both less able to adapt to environmental changes through natural selection and also more vulnerable to the spread of a specialized parasite."[23] Our species in particular is "relatively low in genetic diversity compared with our closest relatives, but that is changing quickly."[24] In the very long term, diversity is crucial to saving our species from extinction: our distant future will involve "diversification from the single earth-bound species known as *Homo sapiens* to a family of descendant species occupying worlds we are still in the process of discovering."[25]

The gene/environment entwinement at the heart of all three books takes yet another form in human genetic engineering. Manipulation of the human genome will always involve a measure of chance. It will have consequences for human society and the natural environment that cannot be anticipated. One might argue that the risks of genetic engineering are unacceptable given the sheer causal complexity of the human organism as well as various causal interdependencies (as evolutionary theory makes clear). One could equally argue that risk taking is necessary for the survival of the species. Or even that, to the "extent that genetic interventions can be used to enhance strengths and compensate for weaknesses in creative ways that expand opportunity without 'normalizing' their recipients," genetic interventions "could be a social force in improving tolerance for human diversity."[26]

Along social dimensions, however, the genetics of diversity is not particularly useful in analyzing inequalities in socioeconomic status, educational achievement, or relative rates of incarceration, among other indicators relevant to justice. As Conley and Fletcher note, "we can see that the genetic distance between groups within Africa is as great as the genetic distance between

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some very 'racially divergent' groups in the rest of the world."[27] This tells us nothing about understanding disparities along racial lines of social status, achievement, incarceration rates, and so forth. But a social genomics that studies the effects on an individual's genome of social phenomena such as stress or attachment, conflict, or isolation "reveals hidden dynamics of race that belie our intuitions."[28] Race examined at the intersection of biology and social environment tells us more about human communities than race examined genetically. Our knowledge of genetics can be misused to justify social inequalities just as it can be used to show that genetics does not generate inequalities of this sort. To be sure, biology cannot do the work of politics. But the work of politics cannot ignore genetic knowledge: our respective notions of environmental nature and of human nature depend on how we — in our various social, legal, political, and cultural communities — conceive of ourselves. To repeat: the work of politics cannot ignore genetic knowledge. As I show in the following section, some political communities "naturalize" a phenomenon such as structural racism, a phenomenon in fact environmental not genetic. Ignoring genetic knowledge in this context then allows communities to construe persistent socioeconomic and other disparities among ethnic groups as a product of genetics rather than, say, a maldistribution of human capital investment that tracks such disparities.

Inheritability of environmental factors

The single greatest disagreement among the three books concerns the question of whether or to what extent environmental factors are inheritable. "Environmental factors" refer to a range of phenomena quite beyond DNA and, by definition, not fixed at conception, such as "parents' or grandparents' lifetime experiences."[29] While Meloni, Conley and Fletcher, and Solomon all reject any sharp, hermetic division between biological and social domains, Meloni alone wants to jettison the widespread molecular, DNA-centric model of life in which information travels in one direction only, from evolved forms to their environments. He claims that "biological information goes in both directions and is not only contained in DNA sequences."[30]

Meloni, who subtitles his book *Science and Social Values in Human Heredity from Eugenics to Epigenetics*, would displace what he calls "hard heredity" or the "idea that there can be no environmental influence on hereditary material." He replaces it with a notion of "soft heredity" or epigenetics.[31] The term "soft heredity" emphasizes, in the words of Ernst Meyer, that the "genetic basis of characters" can be modified "either by direct induction by the environment, or by use and disuse, or by an intrinsic failure of constancy," and the modified genotype is then "transmitted to the next generation."[32]

Such transmission is politically relevant, especially if the effects are unwanted. After all, the issues of liability for damages and responsibility for altering the offending environment are political issues. And transmission in this context exceeds the transmission of DNA. If both genetic and social phenomena transmit information in human development, then heritability is possible even *without* DNA alteration: "epigenetic variations act as a parallel inheritance system through which the organism can respond more rapidly and flexibly to environmental cues by transmitting to cell lineages different 'interpretations' of DNA information."[33] In that case, the "epigenome is historical memory," the "molecular archive of past environmental conditions."[34] That means that our "ancestors' experiences 'manufacture' our biological features; their lifetime and ours is united"; in short, heredity "does not end at birth."[35] On the contrary, factors ranging from the environmental to the social and the experiential are "translated into signals at the molecular level" as various social "categories (race, class, social position), environmental factors (maternal care, nutrition, toxins), and bodily processes (metabolism)" are reconfigured "in molecular terms."[36]

One wonders: if aspects of a socially constructed environment can be genetically inherited, how would one ever determine the relative contributions of nature and nurture? After all, from Meloni's point of view, "postgenomics and epigenetics undermine the nature/nurture dichotomy on both sides."[37] To subvert the biology/culture divide is to view the biology of heredity as an inherently political phenomenon. Here epigenetically heritable factors become causally relevant to political phenomena. On the one hand, many environmental factors now appear to be possible partial generators of various forms of social injustice — factors such as air pollution, water quality, poor public health, unequal access to health care, inadequate food and drug safety, deficient pest control, poor childhood nutrition, unsafe housing, occupational hazards, even lack of literacy. On the other hand, a public policy of social remediation and social engineering of some of these factors now becomes a route to a more just

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society (where *justice* refers to social and legal equality and where political community takes responsibility for failures in the just distribution of such social goods as health and welfare, basic education, and freedom from industrial pollution). In this way, I would argue (by extrapolating from the three books), citizens might attempt to render at least some aspects of natural chance and contingency, at least some of the time, aspects of political choice. At least when the source of natural chance is clear and its control lies within the reach of the affected persons' community, natural chance might be rendered political choice. This was not the case near the end of World War II, when the German army blockaded food and fuel shipments from the countryside to the densely populated western provinces of Holland that resulted in the malnourishment of unborn children during the Hongerwinter ("hunger winter"). It is not the case today in North Korea, whose authoritarian government's investment in the pursuit of nuclear weapons has left millions of children (one in four) stunted and malnourished through a lack of food, medicine, and health care.[38] But it might sometimes be the case when socially constructed norms of justice become a reference point for analyzing and evaluating many aspects of biological heredity,[39,40] displacing biological nature as the inevitable, indispensable reference point for political and cultural interpretation that it has been for millennia in cultures around the world. For example, human psychological adaptations over millennia have decreased the disposition to violence in human social behavior in part by culturally constructed environments that facilitate nonviolent forms of intergroup competition.[41,42,43]

Expectably, significant disagreement accompanies this current revival of Jean-Baptiste Lamarck's notion that acquired traits can be inherited. Solomon does not speak to this revival beyond the claim that "[c]ulture, like genes, is heritable and has joined natural selection as a dominant force creating change in our species."[44] His claim is so general that the reader cannot tell whether he adopts a position of neo-Lamarckism. By contrast, Conley and Fletcher acknowledge that "in addition to our DNA code, there is a second, epigenetic, code that allows cells to turn genes off and on in different tissue types, at different times, and in response to different conditions of stimuli. It has long been thought that the epigenome was wiped clean with each new generation ... to allow a single cell to grow into an entire human."[45] Yet they find "little evidence at the present time that humans can inherit environmentally induced epigenetic marks"[46,47]

Thus, to reject any sharp, hermetic division between biological and social domains means one thing to Meloni and something else to Conley and Fletcher. To facilitate the pursuit of social justice, Conley and Fletcher disaggregate environmental from genetic influences: "once you eliminate the claim that there are biological or genetic differences between populations by controlling them away, we can show more clearly the importance of environmental (non-genetic) processes such as structural racism. Controlling for genetic differences de-naturalizes the outcomes."[48] Their most powerful example concerns race. They intervene in a highly contentious debate. Recent articles in the journal *Personality and Individual Differences*, which occupies an uncontroversial place in the landscape of institutionalized scholarly inquiry, readily illustrate the volatility of this debate. One treats the work of Hans Eysenck, who posits 80% heritability in observed IQ score variability between white and black Americans. The article argues both that observed differences could be determined "entirely by environmental factors" and that molecular genetics research shows no significant genetic determination of the IQ gap.[49] Another article evaluates Richard Lynn's observation that "while sub-Saharan Africans averaged lower on IQ tests than Europeans, internationally, East Asians averaged *higher,*" as well as his theory that "cold winters" contributed to East Asians and Europeans evolving brains larger, and IQs higher, "than more southerly populations."[50]

Against this background, Conley and Fletcher (but not Meloni or Solomon) discuss an "implied gene-environment interplay effect such that potential intellectual ability is inherited but requires environmental conditions of human capital investment to be realized in the form of IQ." "If it is true that blacks demonstrate a lower heritability of IQ than their white counterparts," then "we might want to know heritabilities for various groups as a diagnostic of how and where environmental conditions may be hindering a more efficient distribution of human capital."[51] That is, "IQ has both environmental and genetic bases, so any trend in its effects could be attributable to the environmentally influenced portion or the genetically determined one."[52] While "it could be that cognitive differences are genetically based," the "mechanism linking genes to IQ acts through social pathways (i.e., response to skin tone) rather than biological ones (i.e., brain structure). The darker-skinned sibling may get

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harassed by the police more often or get treated as less intelligent by his teachers (or parents for that matter) and this can, in turn, have real consequences for cognitive development."[53] Thus "even if genes predict racial differences in IQ, they could do so because genes are good predictors of racial identification and treatment in society."[54]

This debate poses urgent political questions about the goals of social and legal equality. Does responsibility for significant, persistent disparities in socioeconomic status, level of educational achievement, and rates of incarceration lie with political community rather than with the affected individual? If unequal "environmental conditions of human capital investment" are causally related to these disparities, should relevant political communities be obligated, morally if not legally, to redistribute human capital investment in ways calculated to reduce such disparities? Should political communities be responsible for providing enhanced opportunities to those groups whose achievement relative to other groups may have been undermined by a maldistribution of human capital investment? Should cultural and political efforts to combat institutional racism focus more on "social pathways (i.e., response to skin tone)" than "biological ones (i.e., brain structure)," and if so, in what ways?

For social and political values, one takeaway is that heritability is both biological and cultural and that in each case the mechanisms of inheritance are quite distinct. Given the burgeoning literature in epigenetics, we can expect continued interest in neo-Lamarckism. At present, however, this interest, along with claims that biological heritability is possible without DNA alteration, remains a minoritarian view. Not in dispute is the very notion of epigenetics understood as cells turning genes off or on in response to social stimuli. Dispute arises with regard to the depth and breadth of this phenomenon (a dispute reflected by differences among the three books, with Meloni's epigenetic approach particularly sensitive to issues of depth and breadth, and Solomon's book largely silent on the issue). The greater the extent to which nonbiological environmental factors affect the turning on and off of genes, the greater the moral and political salience of relevant environments.

Beyond these authors, I conclude that a new politics of social reorganization — informed by genetically informed political theory — would view social injustices as something not based on genes but on social factors. In that case, justice requires changes to social organization, not to human biology. And the differential treatment of groups could not be justified on any conceivable genetic basis. This new politics might follow from advances in our knowledge of epigenetics. At best, epigenetics offers significant potential in the social scientific diagnosis of social, economic, and political conditions that harm humans (or, more likely, populations weakly situated along various dimensions). But here, as in the first rubric, social and political norms must be careful to distinguish environmental from genetic influences. At worst, the pursuit of epigenetic understanding ends up confusing the social with the biological. That confusion would undermine the potential of social scientific diagnosis of biologically harmful social conditions. And it erodes the idea that an individual's failure in school, in the workplace, or in following the law might be due to the individual himself or herself; it eats away at the idea of individual responsibility.

Consequences of environmental changes

Most environments change constantly, and consequently the complex interplay between human genes and nonhuman environments changes as well. Our three works differ markedly in what each regards as a significant form of relevant change. Conley and Fletcher focus on cultural changes in the social environment: a "shifting environmental landscape can cause genetics to become either more or less salient depending on the particulars of that change."[55] For example, a "genotype that enhances risk-taking behaviors in humans could have been advantageous when we had to hunt and kill our dinners, but in today's society it might be more predictive of incarceration."[56] This perspective challenges political communities to rethink aspects of their approaches to social problems, such as crime and imprisonment. It does not excuse groups and individuals from culpability but encourages communities to broaden their range of approaches. Political efforts to prevent crime, violence, and the decay of communal life will profit from examining possible genetic backgrounds related to criminal or otherwise socially destabilizing behavior. Advances in understanding human genetics and its links to behavior should motivate communities to consider biologically relevant factors beyond biographical and sociological influences. If, for example, some risk-taking behaviors have genetic bases, then the promotion of socially positive outlets for and expressions of risk taking (from athletics to entrepreneurship) could well discourage some criminal activity. This path changes the focus in crime deterrence

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from risk-taking personalities as such to means of shaping them.

Conley and Fletcher give content to their subtitle, *What the Social Genomics Revolution Reveals about Ourselves, Our History and the Future*, with findings such as "genetic advantage or disadvantage" displays the "same magnitude of effect whether a child" comes from a "high- or a low-socioeconomic family."[57] Prima vista, the politically interested reader might think that genetics is decisive, not socioeconomic status. That reader will be interested in the authors' speculation that in "social democratic countries, like Sweden or Norway, a certain allele that predisposed individuals to be more cooperative and less competitive" might well lead to "significantly greater educational success, but in more competitive, laissez-faire capitalist settings, like the United States or Australia, that very same allele" might have a "negative effect on educational performance as a result of different cultural norms or expectations."[58]

Conley and Fletcher show that advances in human genetic research offer useful perspectives even in decidedly nonbiological contexts. Their work entails questions (beyond the scope of their own book) that challenge political theorists and other scholars: What kind of education best prepares its youth for life in a highly competitive society? What kind best prepares less competitive individuals for life there? What kind facilitates the development of cooperative personalities in environments that emphasize competition over cooperation? Advances in human genetic research raises an issue that dwarfs even these large questions: Can political communities render themselves more just, productive, even happier, by teaching themselves how to deploy relevant discoveries in human genetics? Or might such efforts sometimes go horribly wrong in ways we cannot anticipate?

Solomon develops a different perspective on possible consequences of environmental change. True to his subtitle, *Inside the Science of Our Continuing Evolution*, he addresses social inequalities that may affect species evolution. Some of these inequalities affect the political environment in terms of social integration. Social integration ideally pursues social change to advance a community's best interests. In the context of rapid developments in biological science and biotechnology, that pursuit involves a double-edged form of social control. On the one hand, greater social control over human biology might liberate us from some problems. It might do so by releasing an individual from the "abnormal," such as autism, blindness or deafness at birth, or Alzheimer's or Parkinson's disease later in life, so that he or she will lead a better, more "normal" life. On the other hand, in some cases greater social control over human biology might exacerbate the consequences of current social problems. Consider positional inequalities, where a social good confers an advantage precisely because it is maldistributed. Maldistribution in access to biotechnologies only reinforces additional social inequalities for adults — or more likely their children — who, because of their relatively worse-off starting position, would benefit from genetic manipulation more than would privileged persons yet who have little or no access to it. Indeed, social control over human biology may damage a connection with the natural world valuable in itself but also vital to human well-being. For example, an individual's chances of surviving and passing on his or her genes depend less today than ever before on the natural environment. Increasingly, those chances depend on access to health care and current and emerging biotechnologies. Access is a socioeconomic issue and thus a political issue.

Solomon also discusses environmental changes inside our bodies, in our microbiome, and outside, in cultural forces affecting patterns of human reproduction. Human biology and its natural environments constitute a collective ecosystem: co-dependent, coevolving, their fates often interlinked. According to Solomon, some microorganisms "might be not only helpful but an integral part of how our bodies function owing to millions of years of evolving together with us."[59] Further, "our microbes have been evolving in response to us, and so we may very well be evolving in response to them."[60] The human microbiome contains "one hundred times more microbial genes than does our own genome, meaning our partners can perform far more functions that we can on our own."[61] After all, "part of our evolutionary history involved outsourcing — some of the jobs that could be done in-house, by our own genes, are instead performed by the genes present in our microbial partners."[62] So, the author argues, some biotechnologies may have negative consequences for the ecosystems and biological processes that have made possible our survival in the first place.

Solomon highlights how technology and medicine unintentionally erode the "connection between a person's genes and his or her survival and reproductive success."[63] In cesarean sections — already very common in much of the world and becoming ever more common — the baby is surgically removed from the mother's abdomen. The procedure is usually safe and

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undoubtedly saves many lives. But individuals "acquire much of their microbiomes from their mothers. Many of these are transferred from mother to baby during birth, as the baby passes through the vagina and also comes into contact with microbes from the mother's skin and anus."[64] And while cesarean sections limit the infant's possibilities for acquiring its mother's microbes, so beneficial to the individual's health throughout life, "many women are given antibiotics during childbirth, even for vaginal deliveries, making it very unlikely that the baby is exposed to any living microbes."[65]

Technological advances in human biology reveal themselves, once again, to be double-edged: "Although antibiotics and medical procedures such as cesarean sections save lives, they are nonetheless having unintended harmful effects on microorganisms that have been our long-term evolutionary partners."[66] Political and social scientists, and not only medical professionals, can play a valuable role in evaluating and responding to the ambivalent qualities of some biotechnology, such as its deployment in some medical procedures. If any particular technology reduces some aspects of the relationship between human and nonhuman nature (in the way antibiotics may harm the patient's microbiome), are humans better or worse off, and by what measure? This is a political question; it involves the weighing of competing social values, such as public health and individual choice.

The other two books agree with Solomon's assertion that culture is no less heritable than genes.[67] Indeed, culture "has joined natural selection as a dominant force creating change in our species." Natural selection and human culture have always been related dynamically. Solomon sees selection as increasingly relevant to fertility, including "how we choose our sexual partners and the factors that affect how many children we have."[68] He observes changes in the ways we choose, whereby "preferences that evolved to assess the genetic quality of potential mates" are ill suited to modern matchmaking. Further, the "importance of our genes" decreases as our control over our reproduction increases through "widespread use of birth control and assisted reproductive technology such as in vitro fertilization,"[69] not to mention online dating.[70]

Like Conley and Fletcher, Solomon argues that an "individual's chances of survival, as well as the number of children he or she will leave behind, is now determined in large part by cultural influences, including socioeconomic status and access to modern health care, medicine, and birth control."[71] The political takeaway: social scientific and public policy–oriented analysis of complex modern societies needs to capture the dynamic quality of nature/nurture interconnections. Analysis needs to be as sensitive as possible to differences among environments. After all, one cannot speak of general or uniform or consistent consequences of environmental changes (all the more so when some of those consequences are unintended). Various environments differ in how they interconnect with the human genome and with what consequences. For example, a person's socioeconomic status may be affected by his or her genetic advantages or disadvantages. It is certainly affected by other nonbiological factors. Further, a person's microbiome may be influenced by particular cultural patterns in reproduction and vice versa. Political analysis, as well as the quest for social justice, needs to expand the term "culture" in ways that capture the ever-changing interconnection of human artifact and human biology.

Inequalities

We have already seen how a political analysis of recent developments in human genetics exposes an abiding tension between improving human welfare and weighing it down with new risks. All of these authors raise the issue of how current research into human genetics might undergird, perpetuate, or even aggravate existing social disparities along any number of dimensions. All of them implicitly invite the reader to draw political conclusions from biological research. Conley and Fletcher are interested in "how integrating molecular genetic information into social scientific inquiry informs debates about inequality and socioeconomic attainment"[72] of individuals but also of entire communities. Political scientists and other scholars should read this interest as a call to arms to a project driven by the following hypothesis: innate, inherited differences among individuals may be a "primary engine of social inequality."[73] If the hypothesis is ever confirmed, we should expect the integration of genetic markers to show "residual social inequalities in stark relief."[74] The project's most important tool is the genotype. If properly wielded, it could "help us understand why, for example, childhood poverty wreaks havoc on some individuals whereas others are resilient to such traumas."[75] The project is generating a great deal of information. By "accounting for the portion of IQ, education, or income that is the result of genes," for example, "we can see more clearly the

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inequities in environmental inputs and their effects on individuals' chances in the game of life."[76] And yet this flood of data about individual bodies poses ethical and political issues: "public policy will have to deal with this new information as lay citizens get a hold of their own (and others') genetic data."[77] It will need to "tackle the more traditional social policy domains of education, income support, economic development, and labor markets and interrogate the implication of genotype for those realms."[78]

As information about human biology, molecular genetic data contributes to dispelling various social prejudices and their associated forms of exclusion. Meloni examines issues of genetic discrimination and stratification in terms of poor people acquiring poor biology, perpetuating a cycle of inequality: "political uses of epigenetics may ask if the poor suffer an ongoing accumulation of bad biology" and whether doing so is "responsible for them slipping farther behind."[79]

Conley and Fletcher examine burgeoning inequalities in the criminal justice system: "Add in the sort of class or race stratification that is thought to exist in the criminal justice system" and DNA only "amplifies existing inequalities."[80] They observe a similar phenomenon in the military: the "GI Bill could have generated inequality within the veteran population even as it provided opportunities to veterans who might not have otherwise had them."[81] They identify this phenomenon in recruitment efforts focused on specific genotypes: "armed with knowledge of the gene-environment interaction between stress and genotype, should 'we' (i.e., the government) intervene in order to 'personalize' policy, which in this case might suggest focusing recruitment efforts on specific genotypes?"[82]

The three books make clear that the analytic power of social and political scholarship could be magnified in certain cases if it were informed, or better informed, by contemporary genetic research. But when political scientists and other scholars read current developments in human genetics for implications in social values, political behavior, and public policy, they also need to address the practical implications of such developments. Unfortunately, none of the three books offers a perspective on how genetic research might be involved in avoiding such possibilities. None opens up ways in which genetic research might be deployed toward contributing to the amelioration of social disparities. The authors may not have aimed at doing so. Yet if they had developed their arguments to the point of practical perspectives, perhaps even to the point of operationalizable suggestions, they might redeem the promise that the politically interested reader uncovers in their work: to connect the study of human biology to the analysis of social problems, to lay bare the practical thrust of scholarship devoted to capturing complicated realities not easily accessible to legislators and other public policymakers, let alone ordinary citizens in the public sphere. From standpoints of social and legal justice, these realities lead to very different opinions and to controversial debates. Social progress requires their considered, public debate and discussion.

Identity problems: Protecting genetic information but also individual identity

Another politically sensitive issue explored in the three books concerns identity. Political scientists and other scholars can read current developments in human genetics for possible consequences for human identity, understood in at least two senses: (1) the control and handling of an individual's genetic identity and (2) implications for a political community's understanding of our shared human identity. I would argue, beyond these books, that both senses are consequential for a person's legal and social status within community and that both pose dangers to that status.

One sense of human identity relevant to biotechnological developments concerns the use and abuse of genetic information, a matter of ever-greater moment. From a standpoint of justice, any form of genetic information is vulnerable to abuse. From a legal and ethical perspective, we can ask, with Conley and Fletcher, "Who has the rights to this genetic information? Newborns cannot give consent to have their genome sequenced, but they must live with the consequences of this decision for the rest of their lives. Should information about adult-onset conditions such as depression or high blood pressure be disclosed to parents, effectively taking away a child's right not to know (in the future)?"[83] Although all of these authors raise this question one way or the other, none pursues it. Certainly political scientists can ill afford to neglect it. For genetic information, when controlled and handled by others, is political where it affects the individual's life and welfare. The issue of what rules govern the influence others may wield over an individual's genetic information is political. To possess influence over an individual's genetic information is to impact such important aspects of his or her life as predispositions to particular diseases. Should the individual have a right not to know? What if

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he or she might prefer not to know? Should employers and insurances companies have access? Any particular answer to any such question will presuppose some conception of an individual's moral worth with respect to controlling his or her genetic information.

Further, "genetic screening will lead to many false-positive results," for example, when a "child may never be stricken with a disease but the family must live under a cloud of fear based on its possible emergence."[84] Genetic information is enduringly political in this context in an additional sense: it may be inaccurate or mistaken yet nonetheless affect how the individual is seen and treated in society (consider an insurance company's or an employer's interest in a client's or employee's genome map). It may be inaccurate or mistaken yet nonetheless affect how the individual is seen and treated in society. "Political" then means contestation regarding whether and to what extent individuals should not only have control over their genetic information but also be empowered to challenge and change information held by private and public institutions, especially when the individual regards the information as mistaken.

Conley and Fletcher identify legal and ethical concerns with the allocation of resources on the basis of genetic information. That information allows medical professionals to predict the individual's receptivity to different treatments: "While it may be disturbing to think that we would give or withhold treatment or resources . . . based on someone's genetic code, we might consider that we already ration health care, access to good schools, and many other resources based on the ability to pay."[85] In other words, private genetic information might well become part of governmental calculations about the best distribution of such social goods such as health and education. As biotechnology becomes able to harvest ever more information, the corresponding legal and ethical concerns only increase. Debates over questions of advisability and justice are debates of public policy and politics. And because "educational attainment, employment, and many markers of the ability to pay have some genetic roots, our current system of price-rationing access to many goods does have a hidden component of rationing based on genetics."[86]

All of the books raise such issues but none addresses them in any depth. Political scientists, among other scholars, would do well to pursue just such issues. For example, I see one alternative to allocating resources on the basis of ability to pay: allocate them on the basis of ability to benefit. In doing so, the political scientist could draw on information provided by biologists such as Conley and Fletcher. They argue that the "effects of a vast array of environmental factors, including medical treatments as well as social policies, have different effects on different people. Some of the sources of these different effects will no doubt be associated with easily measurable demographic or environmental factors like age, gender, or income level, but others may depend on genetic variation."[87,88] Allocating resources on the basis of the recipient's ability to benefit, as determined by his or her genetic information, would transform the common calculus for distributing scarce social goods in ways that political scientists could explore with respect to justice and efficiency.

Another sense of human identity relevant to biotechnological developments concerns how humans, as communities and civilizations, collectively regard themselves as humans. That regard may influence questions of moral recognition and legal rights of groups and individuals within political community. In this connection, Meloni's discussion of the political implications of biologically informed controversies concerning "human nature" should interest political scientists. He notes "how a scientific belief in nativism, inborn factors, and innateness" serve "as proxy for hard-hereditarianism especially of the right-wing kind."[89] On this view, "human beings are born with pre-existing cognitive structures and age-specific capabilities for learning that lead them naturally into society."[90,91] In recent decades, this view has become a "political tool of the promotion of a defense of a particular conception of Western democracy."[92]

Clearly, biological science and its technical applications are hardly independent of politics (understood as the contestation of values). Both science and technology generate significant ethical issues some of which call for political vision and legal regulation. The largest issue of all concerns human identity in the sense of what is often called "human nature." Social science generally regards human nature as socially constructed. Nothing in a social constructionist approach is in tension with a wholly naturalistic (or natural scientific) understanding of human beings. But while "scientific theories do not decide political values," any biological or technological framework is "open to unpredictable sociopolitical outcomes."[93] Unlike a biological understanding of human beings, a social constructionist approach can be useful to resolving ethical and legal issues, indeed necessary. Social construction is a political project when it is guided by value commitments under circumstances

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of significant disagreement among alternative commitments. For example, Meloni rejects a view that is more popular on the political left than on the right: if human nature is a blank slate, "with no innate structure of mind and no intrinsic needs of a cultural or social character,"[94] then it is defenseless against "the 'shaping of behavior' by the state authority, the corporate manager, the technocrat, or the central committee."[95]

Consistent with much contemporary social science, Meloni rejects this "moralized version of human nature"[96] according to which our species, understood naturalistically, possesses some kind of given, objective standard by which to recognize, criticize, and resist authoritarian and totalitarian regimes. His work suggests that the natural scientific understanding of our species will always be filtered through various metaphysical, theological, or political lenses, often urging one or the other form of social organization. Aristotelian metaphysics, for example, depicts human nature as something independent of individuals that causes them to become what they become. On this view, causes in nature are goal oriented, indeed teleological. Further, the "naturalness" specific to human beings is fixed and the standards for human behavior are given by nature. Human manipulation of the body therefore perverts the natural order. By contrast, the Book of Genesis asserts that a providential god created humans in its image, to rule over the rest of creation. Here the highest standards for human behavior are divine and human manipulation of the body violates divine intent. In terms of contemporary political approaches, Francis Fukuyama's is typical of the political right, and Noam Chomsky's of the left. The right is inclined to view aspects of human nature as fixed; the left, as malleable.

Meloni speaks of "political biology as a political epistemology of the life sciences"; it displays the "messy interconnection of epistemic and political events."[97] Any given understanding of biology cannot be separated off from the presuppositions of its particular epistemology. To seek out the implications of current developments in human genetics for social values, political behavior, and public policy is to uncover these presuppositions. Meloni provides an example: "Especially in an age of increasing inequality, political uses of epigenetics may ask if the poor suffer an ongoing accumulation of bad biology and whether this — as opposed, for example, to economic structures — is responsible for them slipping farther behind."[98]

Solomon focuses on a particular form of information, one that may alter the very course of human evolution: the engineering of human genetic information. In the shape of gene therapy, "particular genes are intentionally modified to achieve a desired outcome," for example treating "congenital diseases such as hemophilia or cystic fibrosis" with an "effect only on that particular individual." In another form, editing "genes within human germline cells" (genes that form eggs and sperm) opens up the "possibility that changes made in the lab could be passed on from generation to generation just like a natural mutation." Human germline engineering "could give us the ability to guide our own evolution, though this is not necessarily a good development." Solomon notes that "[a]lthough this technique has the potential to lead to heritable cures for genetic diseases, it also raises ethical questions about how such technology should be used." It raises questions also about which technologies should be permitted in laboratory research and which should be allowed for use on "human embryos intended to result in a pregnancy."[99]

For a social scientific approach to reflect current developments in human genetics, the political takeaway is clear. First, human genetics implies nothing about "human nature" in the sense employed by philosophers, theologians, and poets over millennia, namely as a standard by which to judge, and otherwise guide, how humans should behave if they are to behave justly and morally. Evolutionary contingencies are an implausible basis for ethical foundations in any case. Human biology in particular provides no basis for arguing that humans are so biologically similar that, on that basis alone, they should enjoy equal legal and other rights. Hull notes that "any character universally distributed among the organisms belong to a particular species is also possessed by organisms belonging to other species; and ... any character that happens to be limited to the organisms belonging to a particular species is unlikely to be possessed by all of them."[100]

Second, developments in human genetics challenge political communities to reconceive traditional attitudes toward the natural environment if they are to answer urgent questions of law and public policy: Is "human nature" damaged by reengineering it according to human design? Is a fertilized human egg cell something capable of "possessing" dignity and rights (and if so, in what sense of "possession")? If not, then at what point on the developmental continuum might it be thought to acquire such dignity — and how is dignity acquired? Does life at stages before birth (such as the eight-celled embryo) partake in some form of morality? Does it partake for example in "dignity"? Does it have some other

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status that would render it a candidate for guaranteed legal rights? Is an embryo's genetic engineering just if the embryo is understood to possess dignity, if not rights?

Even as social scientists acknowledge that "man is a biological entity before he is a Roman Catholic or a capitalist or anything else,"[101] they understand "human nature" in two complementary ways to uncover the political dimensions of our species-being. First, *humans transform both nature and culture*. They transform the body with which they are born (here we have analysis at the level of natural science and medicine). And they transform the ways communities and cultures overlay the natural body with socially constructed interpretations, for example, in the sense of gender, which is socially constructed, as distinguished from sex (here we have analysis at the level of social science and philosophy). Second, *humans abstract culture from nature*. For example, moral or legal personhood is a socially constructed quality that human communities grant to their members (if not to all members). Personhood abstracts from the embodied person: someone who enjoys dignity or rights may enjoy them regardless of the characteristics of their particular body (such as sex, age, skin pigmentation, height, body shape, or disability status).

Any community and culture that constructs human nature in these two ways can answer the question of whether human genetic engineering is anthropogenic without needing to appeal to some nonscientific understanding of nature in the manner of, say, Aristotle or the Book of Genesis. The community can do so if it views genetic knowledge as a fact that a wholly naturalistic view of human nature can work with in ways guided by contingent, socially constructed values. In that case, genetic knowledge does not provide humankind a model to which it must conform, for example in genetic engineering. Instead the community cannot but appeal to moral considerations of one sort or the other. Moral framing itself is socially constructed, a product of human imagination and will, in no way a feature of the natural environment. Biological "normality" is also a social evaluation rather than an objective natural scientific description. According to Daniel Smail, "Natural selection does not homogenize the individuals of a species." Hence the "search for a normal . . . nature and body type is futile. And so it goes for the equally futile quest to identify 'human nature.'"[102] If there is no unitary human species in a political sense (again, "political" understood as the contestation of values about how best to organize community), then the future of humankind will mirror its past at least in this respect: it will not possess a single, unitary, consensually held understanding of human nature.

Scholars interested in ethical and political implications in current human genetics should regard the term *human nature* as referring to characteristics cultural rather than biological. The question of whether some types of genetic engineering could change the very "nature" of human beings is then seen to be a matter of socially constructed preferences.[103,104] This would even be the case if, in the future, it becomes possible to endow given individual traits, or an organ, or an addition to the brain, that no human previously possessed. While the organism will have changed, the question of its *human nature* remains a matter of cultural estimation. It remains a matter of particular, historically contingent, always changing cultural preferences and value commitments.

On this politically aware approach, our respective notions of environmental nature and of human nature are dependent on how we (in our various social, legal, political, and cultural communities) conceive of ourselves. Our convictions about what is desirable with respect to our relationship with the environment, and with respect to our human genetic makeup, derive from those communities and not from some source beyond them (as in Aristotelian metaphysics or Jewish theology). As such, those convictions are unavoidably limited in all the ways that any cultural conviction is: embedded in in its own time, subject to the understandings and prejudices and other limitations of that time. Still, as a cultural conviction, it is always criticizable and revisable. To be criticizable and revisable is to lie within the sphere of politics, a sphere of permanent contestation about the best ways to understand ourselves, and social institutions most resonant, in their design and function, with those understandings.

For ethicists and social scientists, I see two upshots. First, what we humans are "by nature" depends in part on decisions we make as creators and carriers of culture. As human biology increasingly becomes an undertaking of human culture, "human nature" increasingly becomes a contingent expression of human will and imagination.[105]

Second, insofar as ethicists and social scientists seek to say something true about what humans are, not only biologically but in terms of moral potential as well, with a view to determining good ways of life or appropriate forms of social organization, they cannot be indifferent to the course of human genetic research. Inasmuch as cultural responses to natural scientific information

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are inevitable, our biological selves are themselves an environment for our social, cultural, and moral selves. But our moral selves should not be allowed to moralize our natural selves (in the manner of metaphysics or theology). The legal and political guides we need can only be socially constructed: guides to judge how best to regulate genetic information and how best to regulate possible future human genetic engineering.

From debates about the normative implications of scientific knowledge of human biology (what Meloni calls *Political Biology*), to concerns with protecting one's genetic information (what Conley and Fletcher think of as *The Genome Factor*), to speculations about manipulations of the human genome toward directing aspects of our future evolution (what Solomon sees as *Future Humans*), these books raise more issues than they settle. The political scientist and the sociologist, the ethicist and the public policy advocate, will discover here many issues relevant to what genetics imply for social and political values and for the organization of just political communities. Books like these enhance the nonbiologist's appreciation for the ways in which humans themselves constitute an environment, one among many.[106] *We are our own environment* in a sense resonant with social construction: "Our DNA is a powerful influence on our anatomies and physiologies. In particular, it makes possible the complex brain that characterizes human beings. But having made that brain possible, the genes have made possible human nature, a social nature whose limitations and possible shapes we do not know except insofar as we know what human consciousness has already made possible. In Simone de Beauvoir's . . . apothegm, a human being is . . . the being whose essence is in not having an essence."

Further, books like these enrich our understanding of our species as a particular kind of nature, one with the intelligence to consciously modify ourselves biologically. They make clear that the twenty-first century is the first in which the genetic understanding of human beings may well transform our world more profoundly than will any other kind of science and technology.

Scholars are not the only readership that benefits from asking political questions of the science and technology of human genetics; citizens in general benefit. Conley and Fletcher point to one reason why: while we (in any country) have yet to become a "society ruled by the genetically advantaged," one day we might become one if "those with power and resources start to control their own genetic information and use it to selectively breed themselves."[107] In that spirit of concern, I close with a few thoughts on a matter of import to all persons, not just scholars: justice as it relates to human genetics, bioethics, and biotechnology.

Philosophers often distinguish two senses of justice. In a narrow sense, they speak of moral duties the individual is owed, duties he or she can claim (sometimes as legal rights). In a broader sense, philosophers speak of the individual's moral duties toward others, especially but not only in the public sphere.[108] Some of the social values and political visions entailed by one current development in genetics, namely human genetic engineering, implicate justice in both senses. They do so in three ways.

First, different families of evolved organisms live within evolved borders or barriers among species. Does the prospect of human genetic engineering (of an eight-cell embryo, say) challenge these boundaries? This question requires a political community to decide whether prepersonal life (an embryo, for example) can bear rights, either as such or because it lies on a continuum that leads to unmistakable rights-bearing humans. It requires a determination of what members of the community owe, morally, not only to fellow humans but also to prepersonal life (and to nonhuman life as well).

Second, given the fragility of our bodies and our psyches, what moral duties are implicated in the profound vulnerability of human life to suffering? If a political community finds moral ennoblement in humans confronting their limitations in ways that render humans more humble and modest than they might otherwise be, then the political community might be morally obligated *not* to genetically manipulate anyone for the purpose of overcoming his or her relevant limitations. Or if the community rejects as hubris any effort of genetic engineering to, say, extend "normal" life spans beyond what is possible through cultural conditions (such as the progressive health insurance and public health programs of the modern welfare state), then the community would be morally obligated *not* to genetically engineer anyone. But if the community regarded the vulnerability of human life to suffering as a condition to be overcome insofar as possible, members might seem morally obligated at least to support those forms of genetic engineering that would reduce suffering, if not the fragility of our bodies and our psyches.

Third, questions of justice attach also to humans' need for other humans, a need that plays out along any number of dimensions. Some of those dimensions speak to the fact that most persons are socially embedded

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within a complex net of interconnections with other humans. Take the practice of athletics, for example. It is usually a group activity organized around various understandings of how to evaluate performance. If a political community feared that biomedical enhancements of athletes confound "naturally" occurring differences in athleticism and so destroy the very object of competition, then athletes would be morally obligated not to seek enhancements. Political community would be morally obliged not to offer them.

Taking the measure of social values and political visions entailed by human genetic engineering ideally is a task for the citizens of self-determining political communities. Accomplishing the task requires us to anticipate broad and enduring differences in conviction. Not only will different communities answer the relevant questions in different ways; any one community will experience internal disagreement as well. So the task of taking the measure of values and visions returns us, yet again, to politics understood as the contestation of values. Ordinary citizens and social scientists and political theorists alike need to be able to read current developments in human genetics and biotechnology for their social, political, and public policy implications. I have sought to show, by example, how they might do so.

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