THE FACTS OF SCIENCE & THE VALUES OF SOCIAL JUSTICE

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The theme of social justice has regained cultural urgency recently. Does science have any role to play? Certainly, when one thinks of addressing the disparities of power, profit, and privilege, one typically thinks of charities, social workers, political activists, or courtroom lawsuits. Not science. The world of facts is profoundly different from the realm of values. Reasoning from empirical evidence is unlike reasoning from ethical principles. So, no (most might contend), objective science seems to transcend social issues, with all their subjectivity.

Here, however, I wish to challenge this view (this month's Sacred Bovine) and show how, in some cases, science is most decidedly relevant to social justice (see also Yacoubian & Hansson, 2020; Shmaefsky, 2020). Further, this connection can be an effective tool to engage students who might otherwise regard abstract science as aloof from human concerns.

First, it may be helpful to review just how facts and values are related. No amount of observation or measurement, alone, will reveal or justify an ethical principle. Facts cannot be converted into values or vice versa – however much some people try to conflate them or blur the distinction. Facts describe what is, values set norms of what should be. Their modes of justification differ. Still, scientific facts can valuably *inform our reasoning about* values. For example, science can help document cases of injustice. Once the basic values have been established (independently!), science can help establish context, illuminate causes, elucidate consequences, or gauge the likely effectiveness of prospective solutions. Science can vitally *inform* – as illustrated in the following cases.

○ Criminal Justice

Consider the popular biology topic of DNA-based identification. Teachers often allude to the forensic use of DNA to find or confirm the culprit of a crime. But consider the converse. DNA evidence can also help determine who is *innocent*. Or who has been wrongly convicted. For over two decades, the Innocence Project (2020), a legal initiative, has used DNA testing to help exonerate persons imprisoned for crimes they did not commit. Since 1989, over 375 victims of injustice have been freed.

But the ethical context of science does not end there. The Innocence Project also analyzes the cases as an ensemble, looking for patterns. What can these cases collectively tell us about the root causes of injustice? While the DNA evidence helped *clear* the victims, what *caused* the wrongful conviction varies. Factors include (sadly) misused forensic science and lack of access to postconviction DNA testing. Our system needs more rigorous standards and more disciplined forensic practices to avoid scientific errors – and unjust verdicts.

Eyewitness identification is often regarded as the most reliable form of evidence. "What could be more trustworthy than direct observation?," one might suppose. Yet 69% of the cases resolved by the Innocence Project involved mistaken reports by witnesses; 84% of those cases involved misidentification by a surviving victim. The National Registry of Exonerations (2018), in their own analysis, found that this is the most important factor in cases of sexual assault. For many decades, psychologist Elizabeth Loftus has sounded the alarm about the vagaries of human memory and the pitfalls of eyewitness testimony (Loftus et al., 2019). The documented cases of injustice bring further weight to her claims and to the importance of heeding reliable science in securing criminal justice.

Finally, the data on wrongful convictions reveal other, deeper patterns. Of the 375 DNA exonerees to date, 60% were African American. Of the cases of flawed eyewitness testimony, 42% have involved a cross-racial misidentification. Likewise, the National Registry of Exonerations (2018) documents that when groups of individuals are exonerated "as a result of a large-scale pattern of police perjury and corruption" (involving over 2500 exonerees across two decades) they are "overwhelmingly Black." In other words, criminal injustice exhibits a strong racial bias. Jaythan Kendrick, freed on November 19, 2020, after serving 25 years for a murder he did not commit, fits the pattern well. He was misidentified by *two* witnesses, each originally coaxed into their testimony. Thus, people who want to pretend that there is no racial bias in the system – and thus that no remedial action is needed – are mistaken. Science does not determine the value of justice. But it does inform us how to achieve it. And lawyers are now pursuing systemic reforms based on the findings above.

○ Environmental Justice

Using a similar style of reasoning, science can also inform us about the distribution of environmental risks and harms across diverse segments of the populace. Ethically, of course, the burdens should be borne fairly and evenly. But scientific analysis indicates that they are not, and how they are not.

In 1984, in one of history's worst environmental disasters, a chemical plant in Bhopal, India, leaked over 30 tons of methyl isocyanate gas into the surrounding residential community. Some 15,000 persons died. Over a half-million were injured. But the harm was not distributed evenly. The neighborhood was a shantytown. (What person of means would have chosen to live next to such an industry?) The suffering thus fell disproportionately on the poor.

Bhopal may seem like an exceptional incident – a rare "accident." But evidence is plentiful for equally dramatic "slow-motion

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Bhopals." Exposure to pollution or toxic emissions may occur gradually, but with no less overall impact. For many years in the mid-20th century, hazardous waste disposal sites in the United States were more likely to be placed near communities of color (Commission for Racial Justice, 1987). The pattern continued. For example, in 2008, four million cubic yards of waste coal ash laced with mercury, lead, and arsenic was moved from a flooded plant in Tennessee to Uniontown, Alabama. A cleanup of the toxic sludge was needed – "of course." But why was it deposited in a small community with a median income of $14,000 and a population that was 90% Black? (Earthjustice, 2014; Milman, 2018). In 2014–2016 (in a case that students may still recall), city leaders in Flint, Michigan, allowed aging lead pipes to contaminate the public water supply, affecting the mostly African American community where 45% were living below the poverty line. Again, poverty and race featured prominently.

Similarly, the risks of climate change are not borne equally. Those who contribute least to the problem are generally those most likely to suffer the consequences. Some nations have prospered through industrial production, as they exported the long-term costs of their fossil fuel emissions to the rest of the world. Meat diets, with the associated production of methane by cattle, are primarily a prerogative of the affluent. When climate hardship comes, however, it will be the poor who are least able to afford or accommodate the changes. With increased flooding from superstorms and coastal surges from hurricanes (and probably rises in sea level in the future), those living in flood plains or along seacoasts will be more severely affected. Those areas, not surprisingly perhaps, are inhabited disproportionately by the poor. Scientists can see clearly that the effects of climate change will not be distributed fairly (Lahn, 2018; California Office of Environmental Health Hazard Assessment, 2020).

Science has helped document and clarify these injustices. Often enough, decisions about where to locate industries that pose environmental risks are based on minimizing economic cost or reducing overall harm. The criteria generally do not include local environmental history. Thus, although a decision may seem neutral and "reasonable," if it is layered on (and functions within) an existing injustice, it merely ***compounds*** the original injustice (Shue, 1992). Ultimately, poverty itself begets further injustice – ironically, under a deceptive rationale of apparent fairness. "Reduction of risk" ***overall*** does not mean that ***individuals*** are equally protected. Scientific analysis can importantly expose how inequities result, and thus how this very form of reasoning is flawed.

Other studies have shown that poverty is not the only factor in environmental disparities. For example, a 2016 study found that most toxic emissions nationwide come from just a handful of polluters and that, ***even when one controls for poverty as a factor***, the sources are disproportionately situated near communities of color (Collins et al., 2016). Another study in 2018 examined exposure to fine particulate pollution, or soot, whether from automobile exhaust, smog, coal furnaces, oil smoke, ash, or construction dust. All lead to respiratory problems. Nationwide, African American communities – regardless of their urban, suburban, or rural setting – are more highly exposed to particulates (Newkirk, 2018). That is, there is evidence of racism. Not necessarily attributable to particular individuals, but deeply embedded in the socioeconomic system. Again, the science helps document the injustice and make it irrefutably and inescapably visible.

Remedies may then ensue. In 2016, the U.S. Commission on Civil Rights heeded the evidence about Uniontown in concluding that when the Environmental Protection Agency (EPA) approved the transfer of all that coal ash waste there, it had violated the civil rights of residents. In 2019, a local court also acknowledged evidence of harm and directed the landfill operator to institute new safeguards (Walters, 2019). Based on this and other cases, national standards for the disposal of coal ash have now been adopted. However, the deeper systemic injustice will require broader changes in legislation and enforcement to fix. And while the circumstances are complex, science is disentangling the most significant causes and informing efforts at restoring justice (Diaz, 2017).

The EPA formally instituted a program for environmental justice back in 1994. The values are clearly stated: "Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies" (https://www.epa.gov/environmentaljustice). However, the science is essential in characterizing the inequity and in determining how best to solve it. The EPA now awards small grants for local projects. Recently, they have spent over $7 million annually. Over a period of 25 years, at least 1400 communities have benefited.

○ COVID-19 & Health Injustice

Finally, one may consider the recent effects of the SARS-CoV-2 coronavirus. From a strictly biological perspective, one might contend that viruses are blind to race, ethnicity, and social class. The privileged and the impoverished would seem equally susceptible. Yet statistics gathered as the 2020 pandemic unfolded clearly indicated otherwise.

Data inform us that some groups have experienced COVID-19's adversity disproportionately. For example, Blacks are more than five times more likely to test positive for COVID-19. In four states, the comparative rate for Native Americans is over fivefold. Prisons and meat-processing facilities – both high-density – have been among the top hot spots. Of those infected, the poor are nearly four times more likely to need intensive care. In addition, Blacks and Hispanics are more likely to have underlying conditions (such as diabetes, heart disease, or asthma) that worsen the health effects of an infection (a concrete downstream effect, no doubt, of the environmental injustice noted above). In some states, Blacks are dying at a rate more than 2.5 times their share of the population – and not just because of genetics (Ogedegbe et al., 2020). Finally, Blacks are more likely to be exposed to infection risk: through service-industry jobs (with no work-at-home option), through crowded workplaces or housing, through greater reliance on public transport, and so on (Turrentine, 2020; Van Beusekom, 2020; Wood, 2020).

The statistics are just abstract numbers. But numbers, appropriately interpreted, tell a story. In this case, they are not really observations about the virus or the disease. Rather, they are indirect measures of the ***context***: the social injustice in health and health care in the United States. As noted by the Centers for Disease Control and Prevention, the evidence of disparities, when coupled with underlying social values about fairness, can ideally inform our future practices on COVID testing and prevention. It may also inform our understanding of long-term health care policy in general.

○ Social Justice in the Biology Classroom

For students who may regard science as cold and remote from human affairs, the link between science and social justice can

potentially be a revelation. It can be a gateway into learning science. The examples above offer ready connections to the standard topics of molecular genetics, human physiology, and human ecology. They offer compelling cases of the relevance of biology to social values.

Curricular *goals* for science inevitably appeal to the importance of science in public and personal decision making. Yet it is remarkable, I think, that most curricular *content* ironically avoids such concrete engagement. Concepts are typically presented without cultural context. Even activities in "scientific practices" or "scientific inquiry" tend to drift to black-box exercises or investigations on simple or trivial topics. Perhaps those common lessons answer to what is perceived as a more pressing aim? – namely, what is manageable in a classroom. But do these alternatives help reach the targeted understanding about science in society? Usually not.

Biology teachers are generally not trained in ethical discourse or the dynamics of political negotiations. But this does not mean that they are without resources for teaching about social justice. Good old-fashioned science – collecting evidence and reasoning toward reliable conclusions – is relevant to achieving social justice in our culture (Allchin, 2020). And perhaps the time is ripe to engage this more fully in the classroom?

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