



Science Is Blind

I started drafting this editorial on July 4th while sitting in my hotel room in Versailles, France. Both the date and location have great significance in our modern history, which motivated my choice for the theme of the article.

The date of July 4th coincides with the commemoration of Independence Day in the United States. It refers to the day back in 1776 when the Declaration of Independence, drafted by Thomas Jefferson and his colleagues, was adopted. The location, next to the Palace of Versailles, which housed the Kings of France until the outbreak of the French Revolution in 1789, reminded me of a second historical document approved that year by the French Constituent Assembly and known as the *Declaration of the Rights of Man and of the Citizen*. This document was also drafted with input from Thomas Jefferson. Both documents ascertained the rights of men and served as drivers for civil liberties, although with some challenges along the way.

Today, we experience a continuous stream of news, stereotypes, and opinions about immigrants and foreigners, including veiled arguments hinting at the superiority of one race or ethnicity over another. As scientists, we value diversity in all its forms and know that science and education should help reduce inequities due to

racial, ethnic, gender, religious, or economic biases.

I am the son of immigrants. My parents immigrated in the 1950s to the far-away, beautiful, and generous land of Brazil where I was born. Later in life, I followed in their footsteps and immigrated to the United States, the most creative and inventive land on Earth, a land of opportunities, one that was described as the “shining city on the hill” welcoming hard-working people from all corners of Earth with its majestic Statue of Liberty. The statue itself was a gift from the people of France to the American people in 1886; a

second historical link between the two countries besides the declarations mentioned previously. One of the main reasons for the prominence of the United States on the World stage today is that it embraced diversity, pushed for equality, and opened its doors to the best and brightest who helped propel a wave of innovation and economic growth.

The Founding Fathers wrote in the U.S. Declaration of Independence that “We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty, and the pursuit of Happiness.” I have always marveled at the beauty, simplicity, and clarity of this statement. Yet, this sentence has had

its sufficient share of criticism since its early days. Some have wondered how a statement that “declares all men to be equal” could coexist with segregation and slavery. Abraham Lincoln responded to this criticism by arguing that the statement represented an ideal that the country should be striving to achieve. Others argued that the statement should have declared that “all men *and* women” are equal as a stepping stone toward gender equality. And yet others question whether “all men” refer to citizens only or should include other residents as well. The title of the French declaration mentions both

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“men” and “citizens” and went on to state similarly that “men are born and remain free and equal in rights.” It is amazing how even in these honest attempts at declaring equality, the language can sometimes fail us. Today we understand the statements in a broad figurative sense in that they are blind to gender, race, ethnicity, origin, or religion. There is no question that the United States, with its generous embrace of diversity and immigrants, has led the way in pushing the frontiers of the human pursuit of opportunity, creativity, and ingenuity.

In this article, we focus on science and discovery, and on how diversity in all forms empowers both of them. Science should be blind to borders or national origin, race or gender, ethnicity

or religion, or any other alien consideration. Curiosity, ideas, and ideals are innate to the human condition; they cannot be confined to particular groups or boundaries and have wings of their own. The statistics speak loudly in support of diversity and inclusiveness and show how they have been drivers of innovation in the United States and other developed countries. Roughly one-third of all Nobel Prizes in the physics, chemistry, medicine, and economics fields received by Americans have been awarded to foreign-born scientists [1]. And according to a 2018 report [2] by the U.S. National Science Foundation, foreign-born individuals account for about 30% of college-educated workers in the United States in science and engineering. Among workers with Ph.D. degrees, the percentage is higher at 42%. Similar figures apply to countries in Europe. According to a 2012 working paper from the National Bureau of Economic Research [3], approximately 57% of scientists in Switzerland are foreign born (with Germany being the main feeder), 38% of scientists in Sweden are foreign born, 33% in the United Kingdom, 28% in The Netherlands, 23% in Germany, 22% in Denmark, and 17% in France. That figure is 47% in Canada and 45% in Australia. These numbers were based on surveying over 17,000 scientists in 2011.

It is not difficult to name several famous immigrant scientists who have revolutionized science and technology in the United States such as Nikola Tesla (originally from Serbia) and the Nobel Laureates Niels Bohr (Denmark), Albert Einstein (Germany), Enrico Fermi (Italy), and Ahmed Zewail (Egypt). We can also list entrepreneurs such as Sergey Brin (originally from Russia, cofounder of Google), Jerry Yang (Taiwan, cofounder of Yahoo!), Amar Bose (India, founder of Bose), as well as the cofounders of YouTube Steve Chen (Taiwan) and Jawed Karim (born in Germany to a Bangladeshi father). Steve Jobs himself (cofounder of Apple) was the son of a Syrian immigrant. Jeff Bezos (founder of Amazon) was adopted by a Cuban immigrant. If we also examine the list of recipients of the U.S. National Medal of Science in

the domain of engineering sciences on Wikipedia we will find an extensive list of foreign-born awardees. I counted approximately 22 between 1962 and 2012 including, from our discipline, names like A. Viterbi (2007, Italian-American), R. Kalman (2008, Hungarian-American), and T. Kailath (2012, Indian-American). To my surprise, the list contains hardly any female recipients.

Yet the significant contributions of female engineers and scientists should not go unnoticed. I enjoyed watching the 2016 movie *Hidden Figures* with my daughters. It tells the wonderful story of a group of African-American female mathematicians working for NASA during the early development of the U.S. space program in the late 1950s. These mathematicians were referred to as *computers* within NASA. They were placed in segregated offices and had to use separate restroom facilities. Nevertheless, they persevered and earned the respect of their colleagues with superb grace, determination, and utter qualification. One of them, named Katherine Johnson, was entrusted with checking the trajectory for John Glenn's spacecraft. She received the U.S. Presidential Medal of Freedom in 2015 from President Barack Obama. These women surpassed racial and gender biases during their time and left a lasting mark on the history of the U.S. space program.

Science prides itself of objectivity. Scientists and academicians tend to view themselves as unbiased individuals upholding the highest standards of fairness. They presume that they are color- or race- or gender-blind. Unfortunately, this is not always the case even in modern times, and we need to remain vigilant. Many known examples exist. Consider the experience of Emmy Noether (1882–1935), who is considered to be one of the greatest mathematical minds of the 20th century, and yet she is unknown to most of us [4]. She was a pioneer in the field of abstract algebra. She was not able to secure a professorship in Germany due to her gender

and ethnicity, and had to teach her courses at the University of Gottingen under the name of another male colleague, none other than David Hilbert (of Hilbert space fame). Even Marie Curie (1867–1934), the two-time winner of the Nobel Prize in Physics (1903) and Chemistry (1911), and who is an inspiration today to women worldwide in the STEM fields, had her application to join the French Academy of Sciences rejected [5]! Marie Curie was also a foreign-born scientist: born in Poland and naturalized French. Moving closer to statistical signal processing, consider the story of David Blackwell (1919–2010), of Rao-Blackwell Theorem fame in mathematical statistics and a student of J.L. Doob. He made superlative contributions to Bayesian statistics, dynamic programming, and game theory. He had to leave his postdoctoral position at the Institute of Advanced Studies due to objections about his race at Princeton University

in the early 1940s [6]. He ended up being the first black faculty member to join the University of California at Berkeley in 1955, and the first black American inducted into the U.S. National Academy of Sciences in 1965.

Scientists are not immune to racism, even someone as notable as the 1921 Nobel Laureate Albert Einstein (1879–1955). Many of us were startled to read this past June about entries in his 1922–1923 travel diaries revealing appalling remarks about “Chinese” and “Levantine of every shade.” The comments were written when Einstein was in his 40s and still living in Europe. It is conflicting to believe that this is the same person who, after moving to the United States in 1933, spoke against racial segregation. Science itself is not immune to racism either, and has been used in the past, and even today, to advance prejudices and to justify the superiority of one race over another.

A moral imperative for scientific organizations

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of inclusiveness given our diverse membership which is spread over all continents. While 40% of our members in the IEEE Signal Processing Society originate from the United States, 27% of them are from Asia; another 27% are from Europe, Africa, and the Middle East; 3% are from Canada; and 3% are from Central and South America. The fact that the numbers are aggregated for Europe, Africa, and the Middle East is an anomaly of the IEEE accounting system, which should be fixed. The practice of aggregating statistics is misleading because it masks challenges that may exist in certain regions.

We also continue to be dominated by a largely male membership base accounting for 80% of our members. We are working tirelessly to enlarge our pool of female members, which is part of a broader effort toward attracting more women to the STEM fields where they continue to be a minority. Let us not forget that even in the United States, women were not admitted into the undergraduate programs of many Ivy League schools (including Harvard, Yale, and Princeton) until the late 1960s and early 1970s. Also, in the United States, only about 25% of STEM graduates are women; the figure drops to 17% for the electrical engineering discipline. A recent study [7] suggests that regions in the world where the gender gap is smaller (such as countries in Europe or the United States) tend to have a smaller percentage of women in the STEM fields than regions where the gender gap is larger (such as some countries in Africa or the Middle East). For example, 41% of STEM members are women in Algeria, while that figure drops to less than 20% in The Netherlands and

Belgium. This observation speaks in favor of diversity: one way toward increasing the representation of the STEM fields may be to have more openness toward regions with larger gender gap (where salaries and opportunities for women are more limited).

In another effort by our Society toward increased diversity, we are reaching out to students from all backgrounds, especially students from underprivileged regions. We have adopted a US\$1 per year membership policy for all students. We are now the US\$1 student Society within the IEEE; so tell your students and tell your friends. Our Society has also affirmed its commitment to be considerate of the diversity of its members in all its activities, including publications and conferences. We

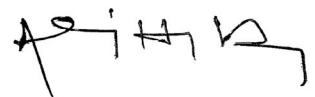
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experience diversity in many ways. We experience it in every conference we attend, with literally hundreds or thousands of attendees flying in from different regions. We experience diversity in every paper we read with authors from diverse countries, and in every lecture we give with curious faces from varied backgrounds looking at us with eagerness to learn and understand. We are an open Society. We understand that, given an opportunity, each member can make a contribution and have an impact. We have no borders in our professional Society. Your science pushes you forward. Our activities serve as a melting pot where cultures converge; scientists of different races and ethnicities; of different cultural backgrounds and religions, all standing equal under science. Our diversity, life, and work experiences enrich our scientific debates.

We live in a global world today where we are constantly reminded that the human condition has innate biases and suspicions in it. Yet, as scientists, we should keep an open mind and use science to promote understanding and inclusiveness. Once, when moving through an immigration line at a U.S. airport, an immigration officer requested to see my passport. Looking at me, she asked respectfully: “Mr. Sayed, how come you have a Middle-Eastern name but were born in Brazil?” Sensing that she was approachable, I looked at the name tag on her shirt and responded: “Ma’am, just like you, you have a beautiful Asian name and speak perfect English.”

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