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# "Guilty of the Good We Did Not Do"

Many of us marveled in awe in March 2018 at the sight of the Ghana teacher who, using colored chalk, drew on his blackboard a snapshot of how an open window of the Microsoft Word software would look like on the screen of a computer [1]; see Figure 1. His school did not have any computers and his young students needed to prepare to pass the Ghanaian national exam, which requires familiarity with computing and information technology. I was not only moved by the action of this amazingly dedicated and patient teacher drawing his creation on the board, but also by the sight of his attentive students sitting on their desks and copying the information from the blackboard onto their notebooks. Just pause for a while and consider how revealing these images are about human nature and its restless drive for knowledge.

While we take for granted our desk computers, software packages, laptops, and smartphones, without even giving a thought as to how precious these tools are, there are eager students, with great potential, in disadvantaged regions yearning to imagine what the screen of a computer would look like! It appears to them as if computers are characters from a fictional novel. That is a shameful gap; one that continues to exist today at the dawn of the 21st century.

This past March 2019, we also witnessed a Kenyan science teacher being awarded a US$1 million prize for being the "world's best teacher." This teacher spends 80% of his salary to help the poorest students of his school buy their books and uniforms [2]. To the amazement of many, these types of stories do not only occur in villages in Africa or Asia, but also occur in wealthier countries, including in the United States of America, where Good Samaritans frequently assist their needy students. There is untapped potential in our world, with great challenges to uncover. I will focus in this editorial on Africa, knowing very well that the same challenges and potential exist elsewhere on the globe.

According to [3], Africa generates less than 1% of the world's research while accounting for about 16% of the world population. The continent has 79 scientists per million inhabitants, compared to 4,500 for the United States [3]. These are alarming statistics if we consider that Africa needs to develop its science base to meet immense challenges that are likely to affect the continent even more seriously than other locations, especially in relation to climate change, agriculture, health, and population growth. The lower research output in Africa is not for lack of institutions of higher education. There exist literally hundreds of universities, with those from South Africa and Egypt often appearing among the highest ranked in the continent. Nevertheless, according to a study by the Center for World University Rankings, there are only 10 universities from Africa appearing in the list of the top 1,000 universities worldwide [4]. In the opinion of many experts, the main challenge facing African universities is the lack of sufficient resources or adequate infrastructure to promote a vibrant research environment, besides low salary scales. A relatively recent study [5] suggests that over 80% of academics and students in sub-Saharan Africa have held unpaid research positions.

One should also not underestimate the consequential and damaging repercussions

**FIGURE 1.** Photos of Ghanaian teacher, Owura Kwadwo Hottish, drawing Microsoft Word on a blackboard have gone viral. (Source: Owura Kwadwo Hottish; used with permission.)

from a history of colonialism and slavery that continue to reverberate to this day. Many African countries have only gained independence as recently as the mid 1950s. This dynamic was acknowledged by former U.S. President Barack Obama in his speech to the people of Africa in Addis Ababa, Ethiopia, in July 2015, when he declared [6]: "So, too, here in Africa. This is the cradle of humanity, and ancient African kingdoms were home to great libraries and universities. But the evil of slavery took root not only abroad, but here on the continent. Colonialism skewed Africa's economy and robbed people of their capacity to shape their own destiny. Eventually, liberation movements grew. And 50 years ago, in a great burst of self-determination, Africans rejoiced as foreign flags came down and your national flags went up."

We are talking about a proud continent, rich in history and also in potential. According to the International Monetary Fund (IMF), some of the economies with the fastest rates of growth in the world are actually located in Africa, including Ethiopia, Rwanda, Ghana, Kenya, Uganda, and others [7].

The difficulties that African universities face do not mean that impactful research is not happening in Africa. There are many laudable and world-recognized efforts in various domains, especially in relation to fields of particular significance to Africa including research on HIV/AIDS, climate change, agriculture, and anthropology. For example, Glenda Gray, a South African physician known for her work on HIV research and President of the South African Medical Research Council, was named in the 2017 TIME list of 100 most influential people in the world [8]. The husband and wife professors Salim and Quarraisha Abdool-Karim are award-winning epidemiologists from South Africa, widely recognized for their work on infectious diseases. The husband is a member of the U.S. National Academy of Medicine, while the wife is a recipient of the 2016 L'Oreal-UNESCO Award for Women in Science. In 2017, she was also named by the BBC as one of the seven trailblazing women in science; this list starts with Marie Curie [9]!

And if we go back a few decades earlier, we can mention the transformative contribution by the South African surgeon Christiaan Barnard (1922–2001) who performed the first successful heart transplant in 1967. Interestingly, this is how Barnard referred to his feat, "On Saturday I was a surgeon in South Africa, very little known, and on Monday I was world renowned." How many lives on a global scale have the works of these various individuals saved?

There is no question that talent exists in abundance in Africa, especially younger talent with the continent's population accounting for the youngest median age in the world at 19.7 years according to *Wikipedia*. But talent this young needs to be nurtured. Given an opportunity, they can grow, shine, and compete at the highest levels. Examples are many from within the continent and also from outside.

Former U.S. President Obama's father was a Kenyan who traveled to the United States to receive an undergraduate degree in economics from the University of Hawaii and an M.A. degree in economics from Harvard University in the 1960s. It took only one generation for the son to rise to the highest office in the United States and leave a mark on the world stage. Another prominent public figure of African descent is the former U.N. Chief Kofi Anan (1938–2018) from Ghana, who studied in the United States and Switzerland in the early 1960s. He went on to share along with the United Nations the 2001 Nobel Peace Prize for their work "for a better organized and more peaceful world." On the science side, the South-African American physicist Allan Cormack (1924–1998) shared the 1979 Nobel Prize in Medicine for his work on X-ray CAT scans and was later awarded the U.S. National Medal of Science in 1990. He taught at Tufts University. Another example is the 1999 Chemistry Nobel Laureate Ahmed Zewail (1946–2016) who emigrated from Egypt to the United States and taught at Caltech. He is known as the "father of femtochemistry." This list of individuals is not meant to be exhaustive in any way. They are only meant to serve as examples, while

acknowledging that many other prominent scientists and leaders exist across other countries in the African continent. Not to mention the long list of impactful scientists and leaders of African-American heritage in the United States alone.

I am a believer in the power of diversity in science. In one of my earlier editorials on the "blindness of science," I spoke about the value of diversity and how it enriches the academic discourse [10]. I am also a believer in the power of education and how it can serve as a bridge to empower people, improve their conditions, and bring communities closer together. Everyone wins from an environment where education prevails, and where science works hand in hand to solve challenges that affect people regardless of their race, ethnicity, origin, gender, or religion. We are all subject to the consequences of climate change, independent of where we live. The same life-threatening diseases can mortally wound us all; none of us is immune by their geography or history.

For these reasons, educational and research institutions in the Western world should do more to reach out to the African continent. We cannot progress through the 21st-century thinking of conquering Mars and the stars while students in remote villages are only imagining what computers look like! How many powerful and promising minds don't attain their full potential due to lack of opportunity? Today, when we face a computationally challenging problem, we throw more computing cores at it and launch our powerful supercomputers into full gear. But brute force computing alone cannot solve all problems. Many problems in science require an injection of a higher dose of creativity, and not of computations. The human mind is the nuclear center of creativity in this universe, something that machines, no matter how powerful or how "intelligent" they are claimed to be, will never match. We can assign more creativity to our problems by enlarging the pool of thinkers around them.

There are many ways by which western institutions of higher education can reach out to African educational institutions, including allocation of research funding for joint projects, fellowship

funding for student training, mutual and regular visits by researchers and students, offerings of educational courses and training, organization of scientific meetings, and joint publications. Many universities and foundations from the United States and Europe are already moving in this direction. The Bill and Melinda Gates Foundation invests in solutions that advance health conditions in Africa. Stanford offers Africa MBA fellowships. MIT offers the MIT-Africa program for engagement with African countries. Carnegie Mellon University offers the CMU Africa program, while EPFL in Europe offers a range of MOOC courses for African countries. The power of the online medium can be used to great advantage to facilitate interactions.

The Institute for Electrical and Electronics Engineers (IEEE) has also identified Africa as a focus area and has formed an ad-hoc committee to develop an IEEE strategy for Africa. Our former IEEE Signal Processing Society (SPS) President Rabab Ward has been a vocal proponent and regular supporter for such efforts. She even started her academic career teaching in Africa! More recently, the SPS has approved an initiative to support continuing education and outreach efforts to Africa. We have funded an effort to support visits by distinguished speakers to African countries. We have also established a new position of Vice-President Education for the Society. One of the responsibilities of the position is to develop our continuing education program, as well as enrich our online library of educational material, seminars, tutorials, and short courses, and make this wealth of information available for use in outreach efforts. We have further instituted a standing policy of US$1 annual membership fee for all students, in an effort to make our Society affordable to students everywhere including from disadvantaged regions. We have reduced the tutorial fees at our conferences for all students to a minimal level. These steps are making a difference. At our most recent ICASSP conference held in Brighton, United Kingdom, from May 12th to 17th of this year. I was informed that the number of students enrolled in the conference has increased sixfold compared to the previous ICASSP edition held in Calgary, Canada 2018 (750 students registered in 2019 versus 128 in 2018), thus enabling ICASSP to pass the mark of 3,000 attendees for the first time in its history. Also, the number of student memberships in our Society has doubled in one single year since instituting the US$1 policy.

As a professional organization we need to live by the maxim that "every man is guilty of all the good he did not do." There are many opportunities for an organization with our resources and capacity to make a meaningful difference in the world and we should. As the saying goes, "if you see someone without a smile, give them one of yours."

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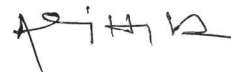
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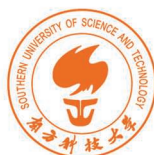
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