EDITORIAL

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Science, Education and the World's Future; By Prof. Bruce Alberts

Dr. Bruce Alberts, Editor-in-Chief of Science magazine, and Professor Emeritus at the University of California, San Francisco (UCSF), presented a popular and thought-provoking talk to the participants of the Global Young Academy General Assembly in Pretoria, South Africa, on May 21 2012. Professor Alberts has kindly agreed to the publication of some of the ideas he addressed in the Future of Medical Education Journal. We take this opportunity to sincerely thank him for his long and deep support of young scientists.

We will publish responses to the following question in the next issue: In your opinion, how could young scientists unleash curiosity and creativity to support excellence in science education? We will publish your maximum 400 word comments in the next issue, provided that we receive them by 1st September 2012.

Science, Education and the World's Future; By Prof. Bruce Alberts

Professor Alberts began by briefly describing his own scientific career, which came to a halt a few years after he moved from the University of California, San Francisco (UCSF) to Washington, DC for 12 years (1993-2005) as the full-time president of the US National Academy of Sciences (NAS). He reminded the audience that science is not only crucial for human progress; it is also beautiful. As the Nobel Prize-winning physicist Richard Feynman once stated "The world looks so different after learning science. For example, trees are made of air, primarily. When they are burned, they go back to air, and in the flaming heat is released the flaming heat of the sun which was bound in to convert the air into tree. And in the ash is the small remnant of the part which did not come from air that came from the solid earth, instead. These things are beautiful things, and the content of science is wonderfully full of them. They are very inspiring, and they can be used to inspire others."

From science to science policy

If 12 years in Washington taught him anything, it's that science is even more important than most scientists think. For example, over this period Professor Alberts came to appreciate the enormous value of unbiased science advice in shaping government policy. One of the early reports he oversaw was on the perils of exposure to residential electric and magnetic fields. (It's not perilous, the NAS concluded; http://www.nap.edu/catalog .php?record_id =5155) Another study, on the presence of arsenic in drinking water, helped to overturn a former policythat had allowed for greater amounts of the element in drinking water in response to industry pressures. (http://www.nap.edu/catalog .php?record_id=6444). Scientific judgments like these are crucial for policymakers. Science has allowed humans to gain a deep understandingof the natural world. In many cases, we science can therefore predict the effects of current actions on the future.

It is important that the policy advice requested by the US government from the National Academies be firmly based on scientific evidence and be independent of the agency that requests the advice. At the same time that each report is delivered to government, the full text is released to the press, and to the public on the National Academies website. The recommendations and conclusions are not negotiated with the government.

During his tenure as president of the Academy, Professor Alberts travelled extensively to many regions of the world suffering from extreme poverty. He saw that science and technology can make a major difference for social development through many interventions. But most of these are much too fine-grained for outsiders to expect to be able to solve other people's problems. Thus, those in more scientifically advanced positions must help less advanced nations develop a greater capacity in science and technology, as appropriate to their needs.

The central lesson is that it is critically important that science, and scientists, achieve a much higher degree of influence throughout both their nations and the world. In particular, every nation needs much more of the creativity, rationality, openness, and tolerance that are inherent to science.

How to achieve these goals

To achieve these ambitious goals, we need to develop some strategies;

Strategy 1. Education

To generate a scientific temper1for our nations, we need to redefine what is meant by "science education" at all levels, from kindergarten through college. A five year old child can do scientific experiments such as the following; (a) Put on clean white socks and walks around schoolyard. (b) In class, collect all black specks stuck to socks and try to classify them: which are seeds and which are dirt? (c) Start by examining each speck with a 3 dollar, plastic "microscope", and then proposing their own hypotheses about which ones are seeds. (4) End by planting both those specks believed to be dirt and those believed to be seeds, thereby testing their own idea that the regularly shaped ones are seeds. The vision: imagine an education that includes solving hundreds of such challenges over the course of the years of schooling that lead to high school graduation – challenges that increase in difficulty as the children age. Children who are prepared for life in this way would be great problem solvers in the workplace. Even more important, they will also be more rationalhuman beings – people who are able to make wise judgments for their family, their community, their nation, and the world.

To remove a major barrier to progress at the precollege level, science education at the college level must change. An important problem is that the traditional lecture format allows a single professor to "batch process" many hundreds of students through an introductory science class. Can we create much better alternatives without a great increase in cost? The development of large interactive, "no lecture" college science classrooms is a promising innovation being widely used at the University of Minnesota and elsewhere.

Strategy 2. People

To spread science; we must spread scientists (Figure). To generate a scientific temper for our nations, we will need scientifically trained people in all professions. These individuals are invaluable for connecting our scientific community to the very different cultures of governmental agencies, pre-college education, law, the media, business, etc. In Washington, Professor Alberts witnessed the enormous success of the 35 year –old American Association for the Advancement of Science (AAAS) fellowship program that brings nearly 200 young scientists and engineers to work each year in government. Strong interactions between individuals with a science background form a valuable bridge between the scientific community and each government agency.

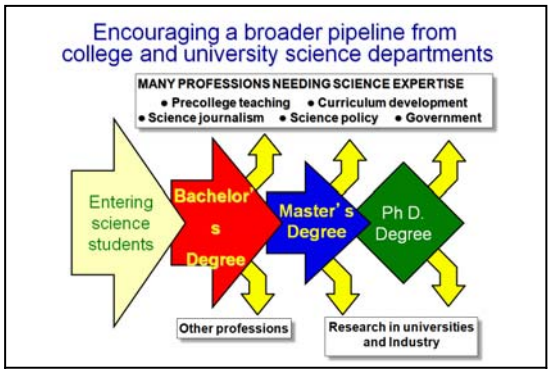

Figure. To spread science, we must spread scientists.

The impact of Science magazine

Memorising meaningless scientific jargon – as kids in his home state of California still do – puts children off science, he argued. Instead, what is required is an inquiry-based science education.

It's a call to arms Alberts has taken up as editor-in-chief of the widely read Science magazine, which is published weekly. The magazine has done this through, among other initiatives, special editions dedicated to science education, its Science Prize for Online Resources in Education, and a new project known as Science in the Classroom, in which one article from the magazine will be adapted for entry-level college science students every month.

He has also spread this gospel of inquiry-based education in his role as science envoy to Indonesia, since his appointment to this post in 2009. Rather than prescribe fixes to other countries' problems, he and other envoys instead propose that capacity be built in these countries so they can tackle their problems themselves.

More than that, science can bridge divides between countries, Alberts said.

"Science can be a powerful tool for connecting nations, and a powerful tool for diplomacy."

As we pursue this aim, we must not forget that as we spread the practical benefits of science, we also spread the scientific spirit, and the scientific values of openness and honesty that are so critical for the future. To reinforce this point, he quoted from a book called Science and Human Values by Jacob Bronowski (1956):

"The society of scientists is simple because it has a directing purpose: to explore the truth. Nevertheless, it has to solve the problem of every society, which is to find a compromise between the individual and the group. It must encourage the single scientist to be independent, and the body of scientists to be tolerant. From these basic conditions, which form the prime values, there follows step by step a range of values: dissent, freedom of thought and speech, justice, honor, human dignity and self respect. ….Science has humanized our values. Men have asked for freedom, justice and respect precisely as the scientific spirit has spread among them."

And he ended by quoting the famous French scientist, Louis Pasteur: "Science knows no country, knowledge belongs to humanity, it's the torch that illuminates the world."

1 . "Scientific temper" was first used by the first prime minister of independent India "Jawaharlal Nehru, 1889 – 1964".