What Is Good for Children Is Good for Mankind: The Role of Imagination in Discovery

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Thank you for this opportunity to share my vision of the future of scientific inquiry with a very special audience. Not surprisingly, my views on the nature of science have been shaped by my own background—my years as a chemistry major at Wheaton College in Massachusetts and, after that, at Johns Hopkins as a specialist in medicine and neonatology, with a focus on respiratory adaptations to extrauterine life. The creation of a human baby in 9 months is indeed a wonderful thing, all the more so for the dramatic physiological transition that is required for the infant to move from a liquid environment to breathing air, once the umbilical cord is clamped. We have much descriptive information, but little insight into the molecular adaptations that orchestrate the onset of sustained breathing and clearance of lung liquid. That sense of mystery—the sense of how much, yet also how little, we know about human physiology—is one of the things that attracts me to the field of neonatology.

In that I am hardly unique, of course. No less a figure than Albert Einstein held that the most beautiful thing we can experience is the mysterious, and called it “the source of all true art and science.” That thought, in turn, leads naturally into what I take as my main theme here: the role of the imagination in scientific discovery. As scientists we are all steeped in the “scientific method” of problem solving, with its framing of hypotheses, testing, and reproducible observations. But the entire enterprise must start with imagination if it is new knowledge we are after.

As scientists we are all steeped in the “scientific method” of problem solving, with its framing of hypotheses, testing, and reproducible observations. But the entire enterprise must start with imagination if it is new knowledge we are after. For a human to fly before they could make it a reality, though the thought of more than 300 people in a modern passenger plane may have taxed even their scientific imaginations. Marconi was able to imagine, and then invent, wireless communication, but I doubt that even he could have conceived of the worldwide real-time communication implicit in that initial discovery. I realized how much had taken place in my own lifetime after I visited the World War II Museum in London, and saw the small office with a single telephone that Churchill used to talk to Roosevelt. Now the U.S. president is able to fly nearly halfway around the world for a Thanksgiving dinner with distantly posted soldiers. And, of course, the imagination of an earlier president, John F. Kennedy, in framing the challenge of a safe lunar landing by humans led ultimately to the first steps by astronauts on the moon, and later to remotely controlled robots on Mars.

The excitement of where the scientific imagination has led us in exploring outer space is matched, I think, by discoveries in the “inner space” of the very small—such as the incredible frontiers of nanotechnology, or the interior workings of the single cell. We have seen brilliant insights into the way biologic cells function, communicate, live, and die on cycles that are precisely timed over a period of years and, in some instances, over 100 years. The mapping of the human genome showed the power of imagination in defining a goal and enlisting scientists from around the world to collaborate in identifying the location of the genes on each of the 46 chromosomes. The function of most of these genes remains unknown, as does the function of non-coding regions sometimes referred to as “junk DNA.” Yet powerful new tools, such as the breeding of strains of mice in which one gene is “knocked out,” are enabling us to learn the functions of these genes. And the fact that each cell in the body has a complete copy of the genes, and that only identical twins share the same map, not only has transformed forensic medicine—providing the ability to identify each individual by DNA testing of specimens of hair or saliva, for example—but also has raised the promise of new medications and personalized approaches to medicine itself.

All of these discoveries and approaches to solving human problems began with “imagining something different.” And the issues society faces now will require comparable scientific imagination. By the year 2050—within the lifetime of many in this audience—the human population is expected to grow from its current level of 6.3 billion to 8.9 billion. Will that increase be “good” or “bad”? I submit that it could be either. Poor outcomes could include pervasive poverty and its sequela—hunger, deficiency diseases, armed conflicts, regional disparities in life span. Yet improved outcomes are also possible, depending on the extent to which we recognize and anticipate environmental change. “Good” will prevail if we acknowledge and anticipate the requirements implicit in such a population increase, and the expectation for a long and prosperous life. A long life-span depends on understanding how to maintain better health; that, in turn, requires a sustainable environment and access to health care.

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One example would be applying what is already known to benefit health: access to clean water, clean air, and appropriate nutrition, and ways to prevent epidemics and control the spread of infection, even in the absence of appropriate vaccines or antibiotics—such as what was so brilliantly executed in recent years in the experience with SARS.

Control of atmospheric pollution; proper disposal of nuclear waste; addressing inadequate food and water supplies: we all have our own list of needs for the future. High on my list right now is concern for the many thousands of children who are separated from parents by scourges such as ever-present war and the HIV pandemic. Every child needs to be wanted, to be assured of safety and love and education. We have known this truth for centuries, but ignored it all too often. I am appalled by the exploitation of children as soldiers; by brutalities such as amputations inflicted as punishment for child “offenders”; by the widespread use of land mines, which can grievously injure the curious child who asks, simply, “What is this?”

In the United States, the largest industrial country, we see major regional differences in infant mortality (defined as deaths in the first year of life), with the differences skewed about 2.5 times toward nonwhite persons relative to white persons. The excess of nonwhite-infant deaths persists year after year. The Institute of Medicine recently distributed the findings of a study that highlighted the right to equal treatment and that set out a plan to end racial and ethnic disparities in clinical diagnosis and treatment in this country. Making that plan a reality will require that we mobilize the will and resources to do so.

Fortunately, the escalation in production of new knowledge promises a wonderful future in its application in solving human problems. We have recognized the horrors of war since the days of Homer. But over the same span, we have gone from a strictly oral means of sharing experiences, to inventions that potentially give every human on earth access to an incredible range of human experience, both from recorded history and from the daily news. Knowledge acquired by observation and experience is ours for the asking, through radio, video, e-mail, and satellite communications. And the availability of new knowledge has immense implications for our ability to teach and preach.

J. Robert Oppenheimer famously recalled that, as he watched the first controlled nuclear explosion at Alamogordo, New Mexico, he thought of words from the Hindu scripture, the Baghavad Gita: “I am become death, the destroyer of worlds.” He understood that the bomb’s creation raised the possibility of a global conflagration that could obliterate civilization itself. Yet that same recognition also spurred the meetings by concerned scientists to alert all of us to the dangers we face, the founding of the United Nations to promote a meeting place for resolution of conflict, and the support of efforts to help the children of the world through UNICEF, the United Nations Children’s Fund.

I had the privilege of knowing and working with the late James Grant, the former head of UNICEF. His ability to make friends and suggest ways to lessen the burden of poverty in the nonindustrialized nations is legendary. He worked with dictators, presidents, and the press to highlight the desperate situation of many of the world’s children. One example was his advocacy of oral-rehydration therapy to treat the dehydration caused by diarrhea, and the need for wells to provide clean water in the future. He communicated with the public by urging national leaders to be photographed with infants as they received oral hydration or immunization. Eradication of smallpox was a dream come true, and organizations such as UNICEF and Rotary International have been most helpful in financing these programs. Other organizations have enlisted the press to promote health practices, such as the highly successful “Back to Sleep” campaign in Australia to prevent sudden infant death syndrome (SIDS) by providing public information on the appropriate sleeping position for infants.

And so I return, inevitably, to where I began this address—to the subject of children. That is not merely because of my own background as a neonatologist, but also because, in a larger sense, what is good for children is good for mankind. And the idea of children naturally plays into my other theme: the imagination’s role in the power of science to transform our thinking about the world around us. Think back to your own childhood. You were almost certainly curious and imaginative yourself, or you would not be here tonight. That kind of imagination has played a significant part not only in the pursuit of new knowledge, but also, throughout the centuries, in mythology, literature, and scripture, and in storytelling even before the creation of written languages.

Mythical figures persist today—from gargoyles to dragons and even to wizards. In 1998, J. K. Rowling of Edinburgh published her first novel about the schoolboy Harry Potter and his adventures in a school for wizards. The series of Harry Potter books has since captivated individuals from 8 to 80 years of age—even those who know it is “make believe.” If you want to speak to your seatmate in an airplane, just pull out your Harry Potter paperback book; the odds are great that the person next to you has read it, or at least a family member has.

I have the good fortune to know a distinguished Edinburgh neonatologist, Ian Laing, who was present at the birth of Ms. Rowling’s infant, and I thought perhaps we could lure them to be principal speakers at this meeting. However, though Ms. Rowling thanked us for the invitation, she replied that she thought she should give her attention to her 6-month-old daughter—a reason no pediatrician could protest!

Howard Bennett of George Washington University Medical Center, Washington, D.C., has even, in a 30 October 2003 letter to the New England Journal of Medicine, described the appearance of a new childhood ailment—“Hogwarts headaches,” caused, perhaps, by the sustained suspense and tension of young readers as they spend long periods enchanted and excited by these books. My 8-year-old grand-nephew, however, informs me that Harry Potter will surely be okay in the end, despite any danger, since “he is a true wizard.”

And what has all of this to do with science? For an answer to that, I will rely once again on Albert Einstein—as quoted in an announcement for a recent exhibit on magic at the Museum of Science in Boston: “Understanding the seeming differences between science and magic are more similarities than you might imagine. Both disciplines rely on a process sparked by mystery and nurtured by curiosity.” It is indeed a thrilling experience to create new knowledge.

References