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## Cover story

## Science the endless frontier



“Science The Endless Frontier” is a report to President Franklin D. Roosevelt, United States of America (U.S.A.), by Vannevar Bush, Director of the Office of Scientific Research and Development submitted in July 1945 [1]. The report begins with the quote by President Roosevelt, “New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.” (November 17, 1944). And the summary of the report begins with the title, “Scientific progress is essential” for the war against disease, for our national security, and for the public welfare, and thus, we must renew our scientific talent. It resulted in the creation of the National Science Foundation in 1950.

Basic research with no immediate application has been the engine of the steady progress of science and technology, and ultimately the growth of society. One example is the study on retrovirus [2]. No human diseases were known to be caused by retrovirus, and yet many researchers just wanted to study it to produce plenty of information about the virus. When the previously unknown disease, later known as acquired immunodeficiency syndrome (AIDS), broke in 1981, it was scary, as nobody knew what it was. In less than a few years, it was found to be caused by a retrovirus, and it was followed by the therapy using antiretroviral drugs and protease inhibitors. In 1996, the treatment was so effective, virtually nobody died from AIDS. Many diseases, however, are more difficult to handle. Despite extensive research on  $\beta$ -cell replacement approaches, its translation to managing diabetes without daily insulin administration has been difficult. Maybe the answer can come from totally unexpected findings from totally unrelated fields of research. It is worthwhile to diversify our research efforts and expand our horizon beyond the zone where we are comfortable with our current expertise.

Good investments in research is based on the study of certain topics just out of pure curiosity. That is what scientists do: research out of curiosity. If 10,000 researchers delve into 10,000 different research topics, some of them will turn out to be breakthroughs that allow us to find cures for difficult diseases. We just need to allow researchers to try crazy ideas and seemingly useless research. In fact, this approach has been the source of the dominance in science and technology by the U.S.A. For the last few decades, however, the U.S.A. has made a few missteps in its investment in science and technology. The government funding agencies dictated a specific type of research by pooling the resources. In retrospect, despite its good intentions, such a narrow vision has been a mistake. This type of approach may work for developing a nuclear bomb or landing a man on the Moon and returning him safely to the Earth. When it comes to human body, however, such an approach

is not a suitable one. There are too many unknown unknowns. A single narrow approach to solve the mystery of the human body is bound to be incomplete.

Hollywood has portrayed space as the final frontier. But there is more. Science is the endless frontier. We will never have a complete understanding of everything, and our scientific endeavor will never cease to bring new results that amaze us. For the last few decades, the majority of research has been based on the saying that “There’s plenty of room at the bottom”, and it has been dominating what we think and do. Let’s take a deep breath here, count to ten, and realize how much more room there is at the top. What is the point of focusing on such a small space with such a narrow view? Greek gods were telling themselves, “We, the gods, will live as long as the humans believe in us. The day the humans no longer believe in us, all the gods will disappear.” [3]. As long as scientists believe that something at the bottom can cure cancer, the bottom will exist. The endless frontier, however, requires exploration of everything to where our imagination leads. It is time for us to get out of functional fixedness and liberate ourselves from the confined research topics. There is no need that the vast majority of scientists think alike and do similar things with only marginal, if any, return. Let our young scientists whose creativity is unbound roam around the universe of uncertainty, and expand their boundaries to infinity and beyond. Individual scientists need to find their own voice through experimenting new ideas and learning from mistakes and failures. Science is hard, but we should maintain our goal of understanding cancer, diabetes, Alzheimer’s disease, and many others. Publication is not our endpoint. Let’s keep our goal of eliminating all diseases with the endless frontier spirit. As Megan Rapinoe said [4], “We just have no quit in us.” What can be more majestic than this?

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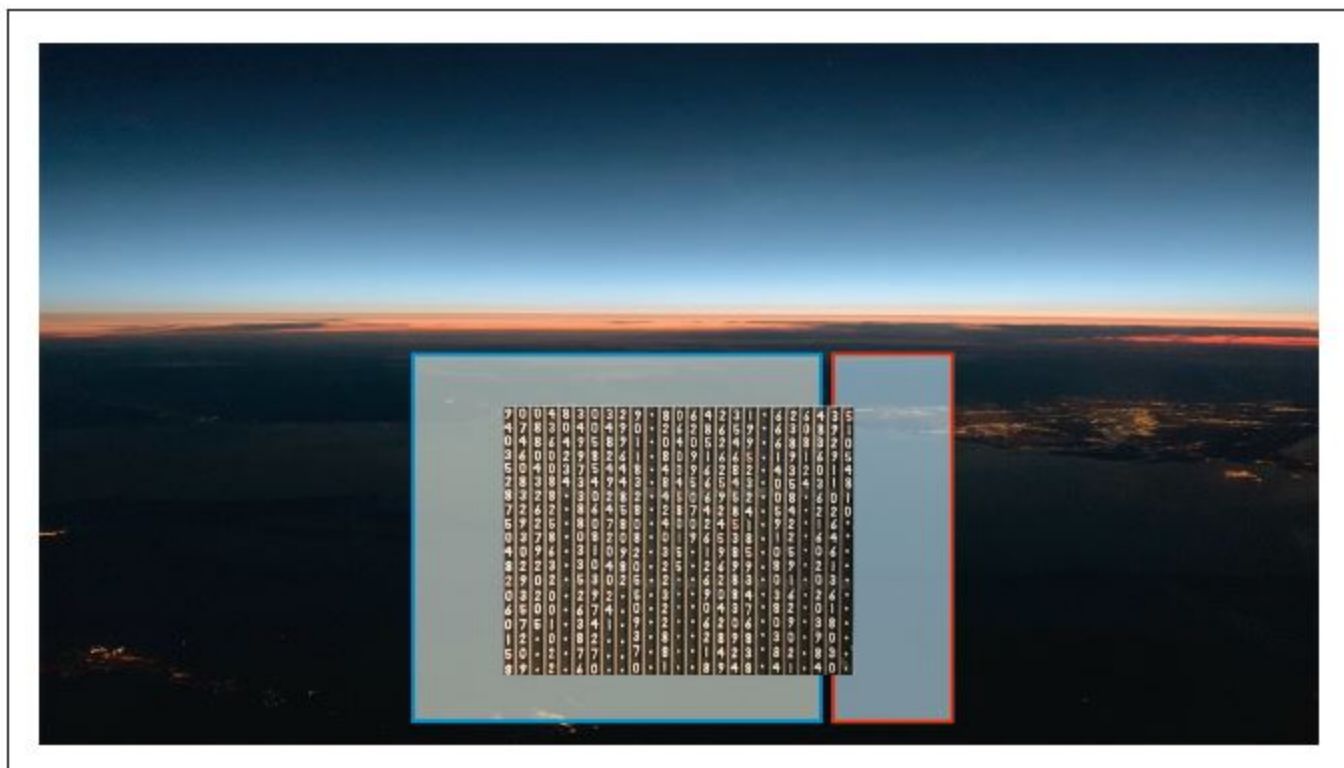
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