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Staff Name: **PRESIDENT OBAMA**

Document Date: **April 24, 2014**

Correspondent: **JOHN HOLDREN**

Subject/Description: **MEMORANDUM RE: SCIENCE AND TECHNOLOGY
VISUALIZATIONS FOR THE PAST DOZEN YEARS,
SCIENCE MAGAZINE AND THE NATIONAL SCIENCE
FOUNDATION HAVE JOINED FORCED TO CELEBRATE
THE OLD AXIOM: A PICTURE IS WORTH A THOUSAND
WORDS. ATTACHED ARE COPIES OF SOME OF THE TOP
RECENT SUBMISSIONS**

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THE WHITE HOUSE

Washington

April 24, 2014

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6/25/14

MEMORANDUM FOR THE PRESIDENT

FROM: JOHN P. HOLDREN

RE: Science and Technology Visualizations

For the past dozen years, *Science* magazine and the National Science Foundation have joined forces to celebrate the old axiom: **A picture is worth a thousand words.**

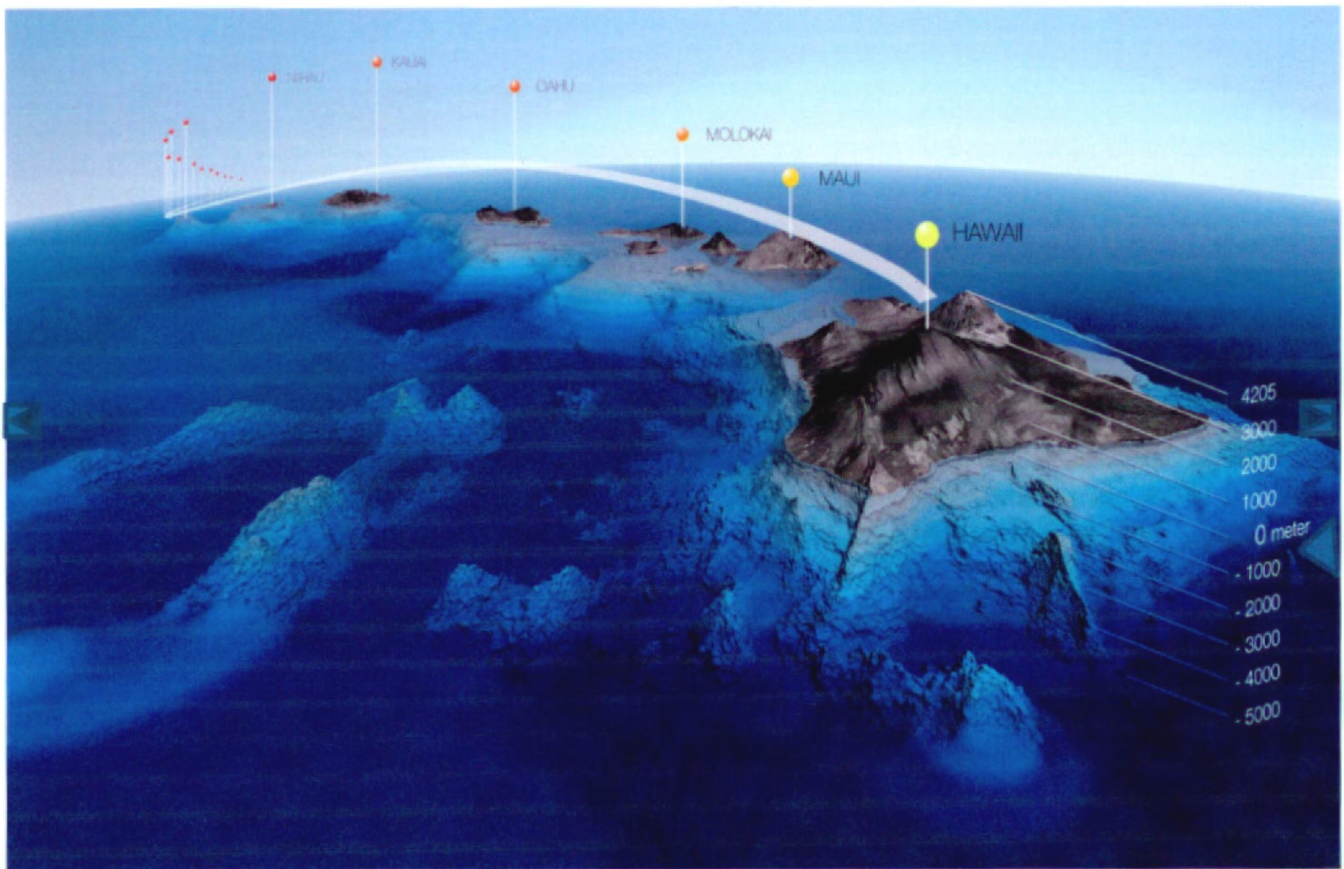
"The International Science and Engineering Visualization Challenge" is a competition that honors this time-honored tradition of using illustration to communicate to students and the public the complexities -- and the beauty -- of science, engineering, and technology, and to describe powerful scientific concepts in ways that words sometimes cannot.

Attached are copies of some of the top recent submissions that are both visually captivating and scientifically informative, and also able to excite popular interest in subjects that typically are inaccessible to non-experts.

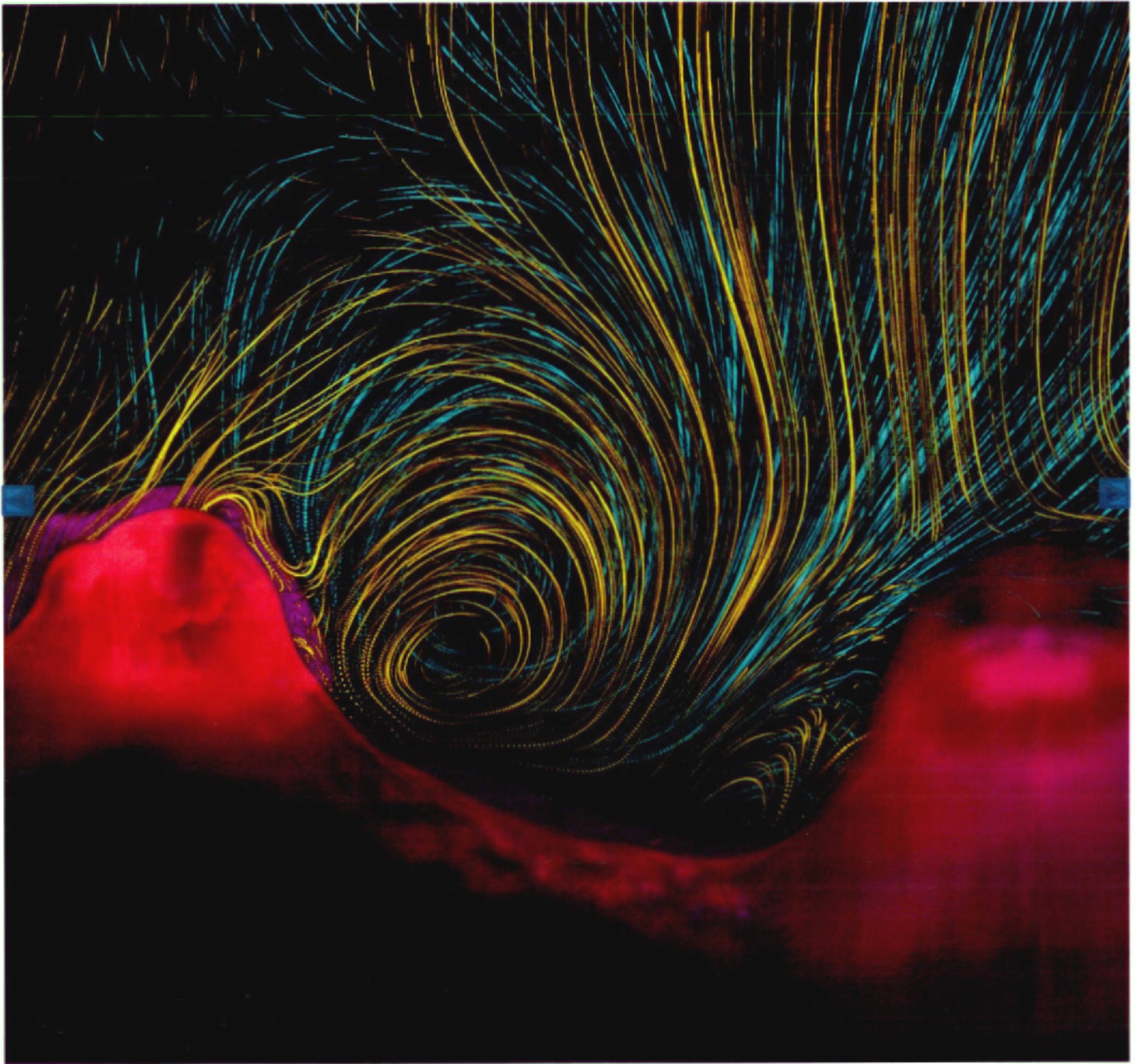
Studies of the sources of U.S. economic growth have consistently shown that 50 percent or more of the nearly 7-fold growth this country has enjoyed since the end of World War II has been attributable to science-and-technology-based innovation, resulting from investments in research and development (R&D). Not so easily quantified -- but indisputably enormous -- are the contributions that advances in technology arising from R&D have made to our nation's security, public health, environmental quality, and other dimensions of quality of life.

Seemingly obscure studies have led to many major practical outcomes including development of life-saving medicines and treatments; game-changing social and behavioral insights; and major technological advances related to national security, energy, the environment, communications, and public health. Discoveries born from basic scientific research have transformed our lives, and fueled our economic growth through the creation of new industries and large companies.

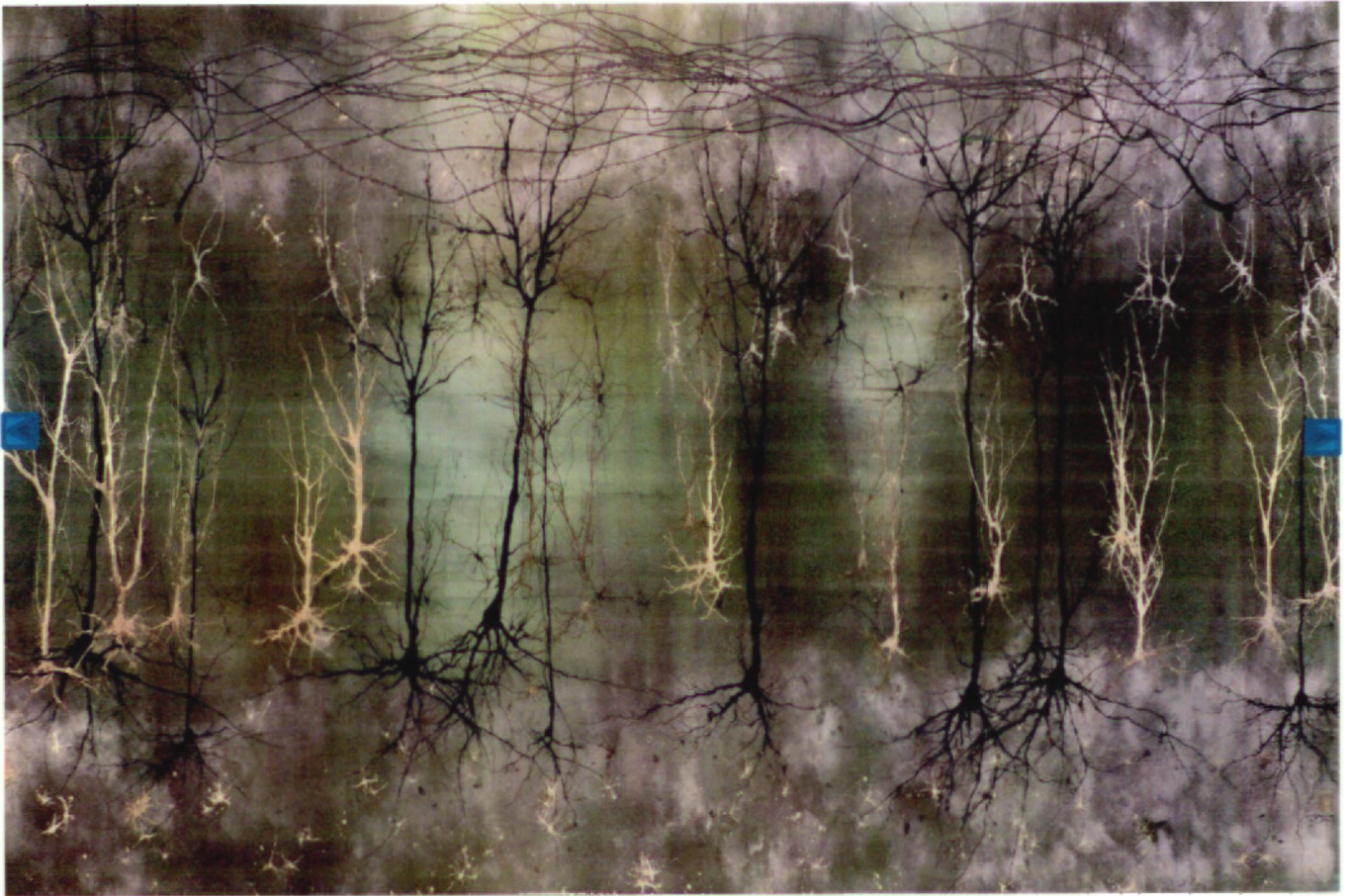
You have repeatedly stressed that America has been from the beginning a nation built on hope -- hope that Americans can build a prosperous, healthy, secure society, as well as a free and democratic one, for themselves, their children, and their children's children. Your Administration's investments in R&D and in STEM education are one of the higher manifestations of that hope and an indispensable investment in this nation's future.



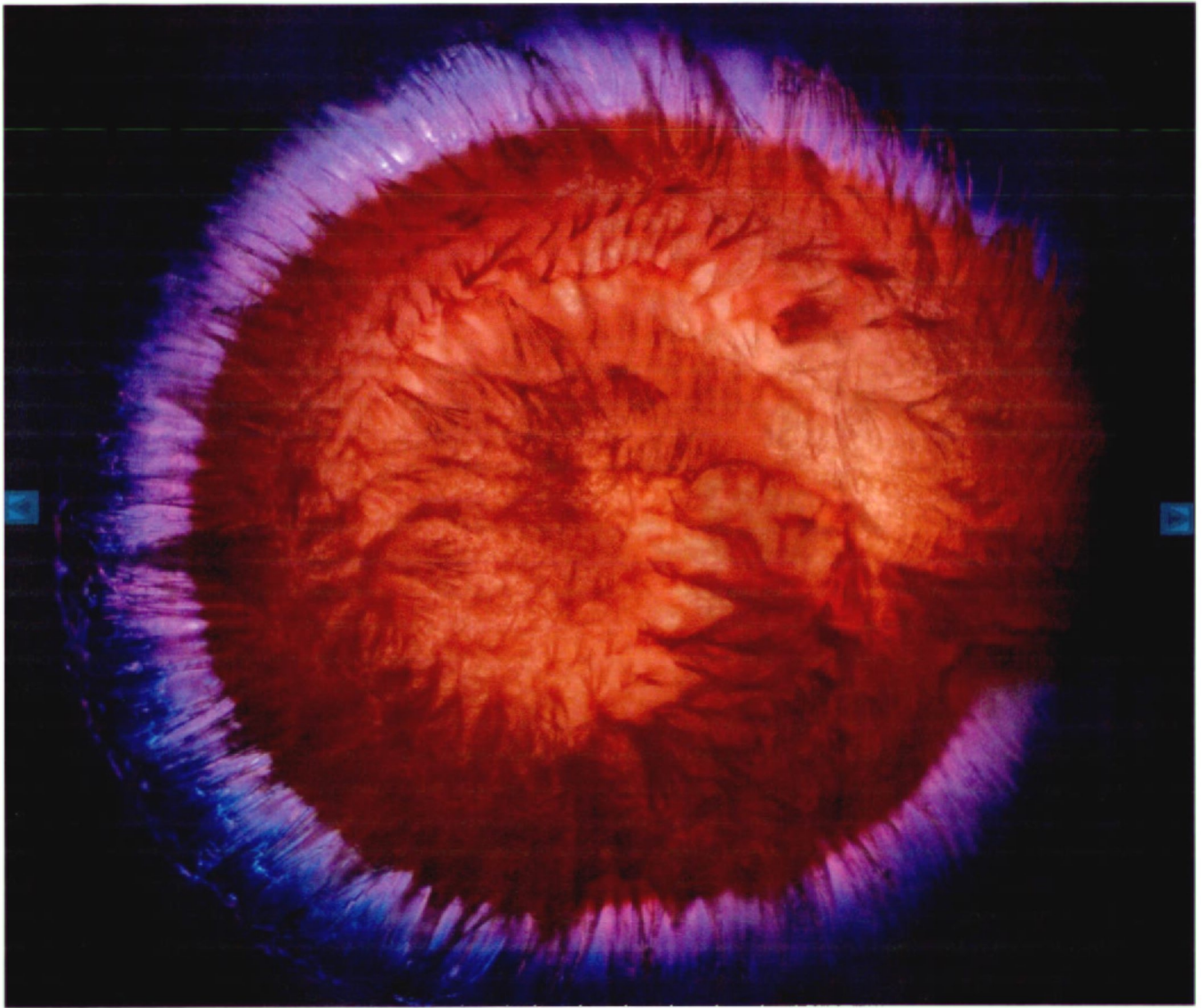
Mount Everest may be the highest mountain on Earth above sea level, but it's not the world's tallest mountain. That honor goes to the Hawaiian volcano Mauna Kea, part of 3,500 mile-long string of volcanoes stretching westward from the Hawaiian Islands. When measured from its base on the Pacific Ocean floor, it is nearly 3,300 feet higher than Everest. The summit of Mauna Kea houses the world's largest observatory for optical, infrared, and submillimeter astronomy with telescopes operated by astronomers from eleven countries—one of many examples of the Obama Administration's commitment to international collaboration to advance the frontiers of science.



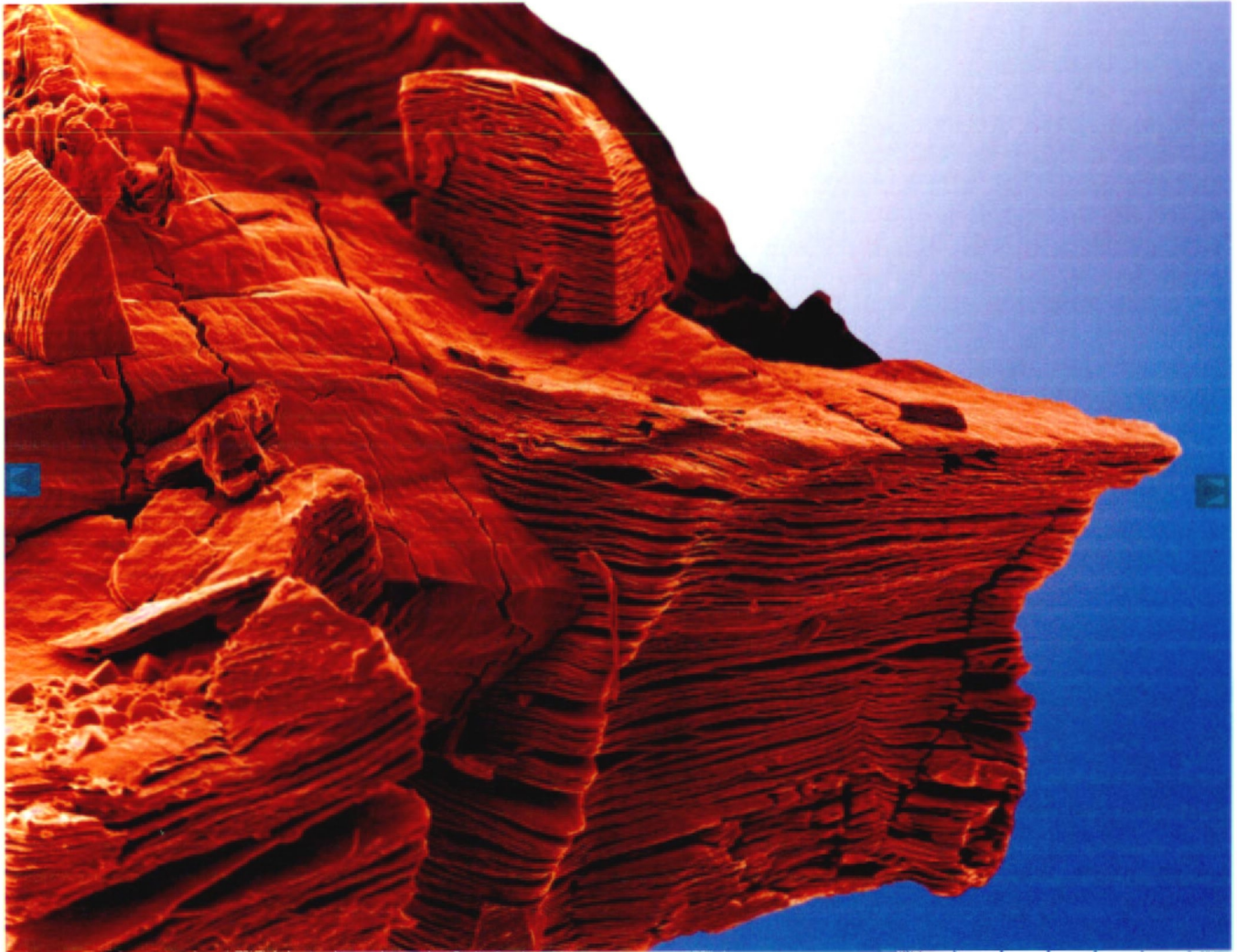
Photographs of a coral reveals the hidden flow generated by the small hairs, or cilia, that cover its surface, which generate a long-lasting surrounding whirlpool pattern that draws nutrients toward the coral. The accumulation of carbon dioxide in the atmosphere, primarily from the burning of fossil fuels by humans, is gradually making the oceans more acidic and is threatening to decimate corals around the globe before scientists can plumb their secrets—one of many reasons the Obama Administration has launched an aggressive Climate Action Plan to reduce carbon pollution..



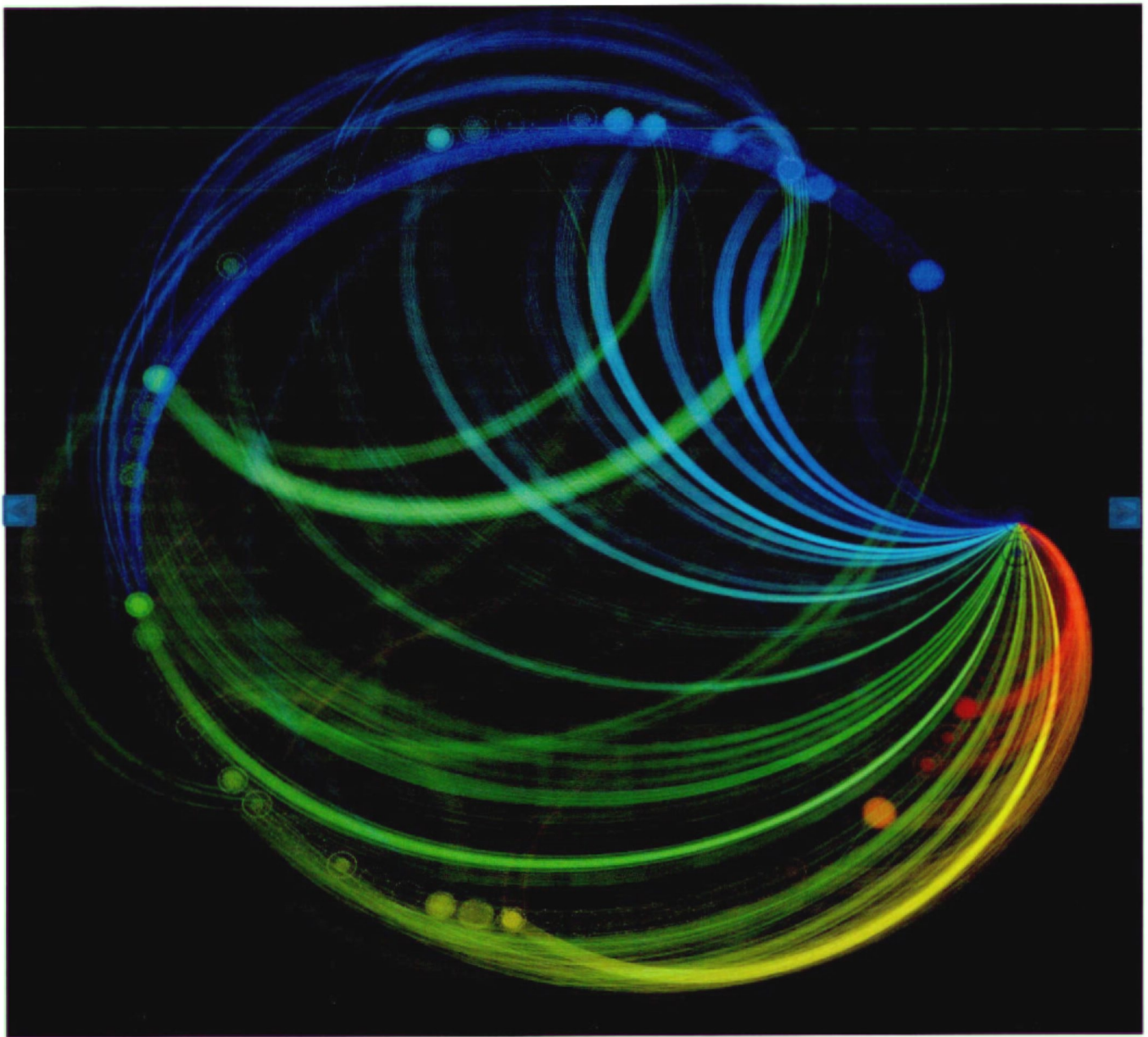
A slice of the brain's cerebral cortex reveals the delicate structure of individual neurons, whose branch-like structures make trillions of connections with one another to give rise to consciousness, sensation, and emotion. The Obama Administration's BRAIN Initiative is accelerating the development of new technologies to help researchers produce real-time pictures of complex neural circuits and visualize the rapid-fire interaction of cells that occur at the speed of thought. The initiative promises to improve the diagnosis and treatment of brain diseases and injuries and lead to better approaches to teaching and learning.



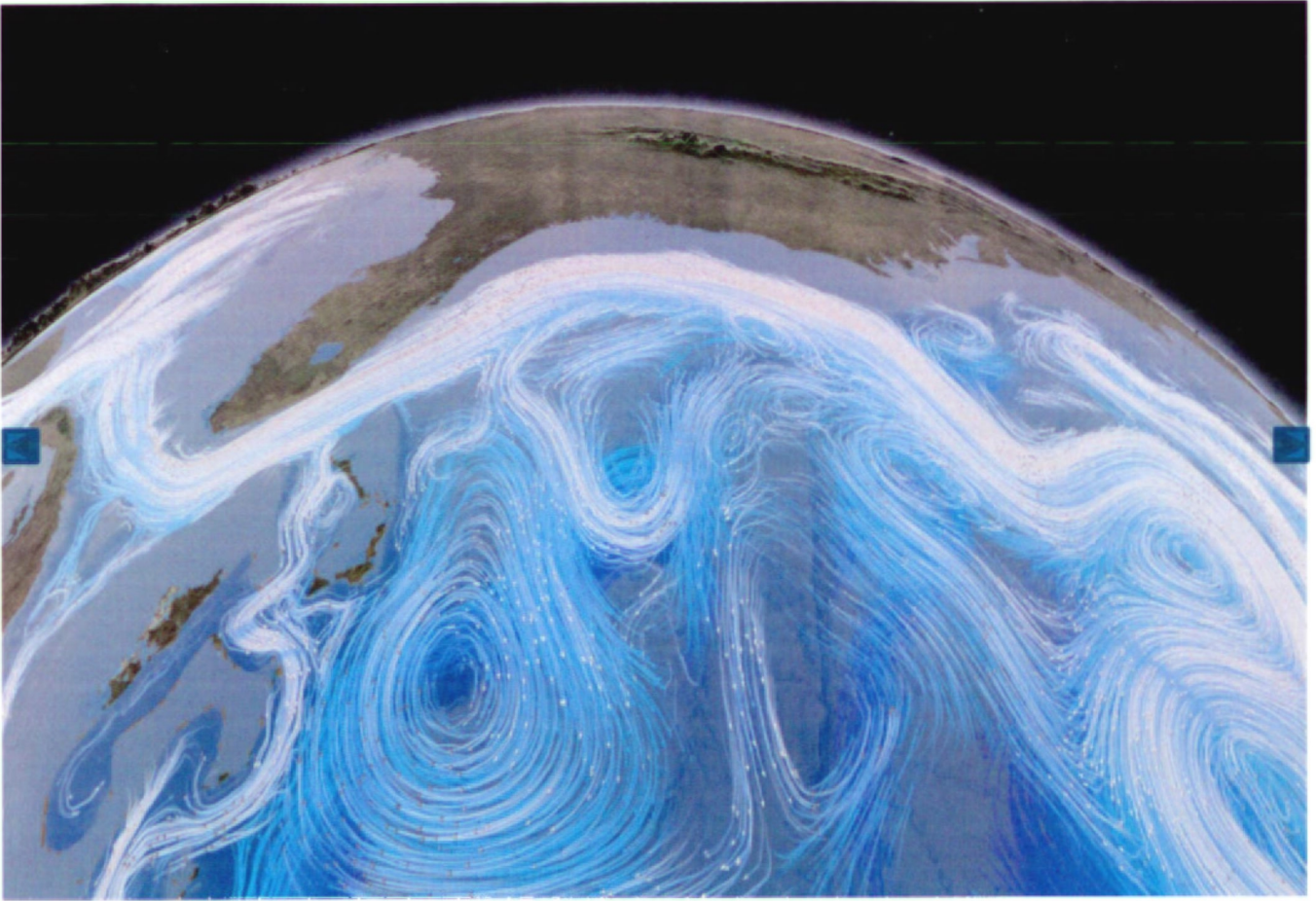
A tomato seed's elegant corona is actually a secret, natural defense. The trichomes, or little hairs, on the seed's surface secrete a chemical coating that gives tomatoes their signature taste and acts as a natural insect repellent. The Obama Administration's expansion of agricultural research aims in part to replicate such natural processes to allow for safer pest management strategies in an era of changing climate and other environmental stresses, and is creating opportunities for new businesses and jobs that integrate one of civilization's oldest practices—farming—with 21st century biotechnologies.



This isn't a geologic feature of a red-rock bluff in Utah; it's a titanium-based, nanostructured material made from ultrathin layers of matter only five atoms thick, as seen under an electron microscope. Nanomaterials exhibit novel mechanical, electrical, and optical properties with potential applications in next-generation energy storage devices, sensors, solar cells, and spacecraft. The Obama Administration's Materials Genome Initiative is supporting a range of efforts to discover, manufacture, and deploy advanced materials twice as fast as in past years, at a fraction of the cost.



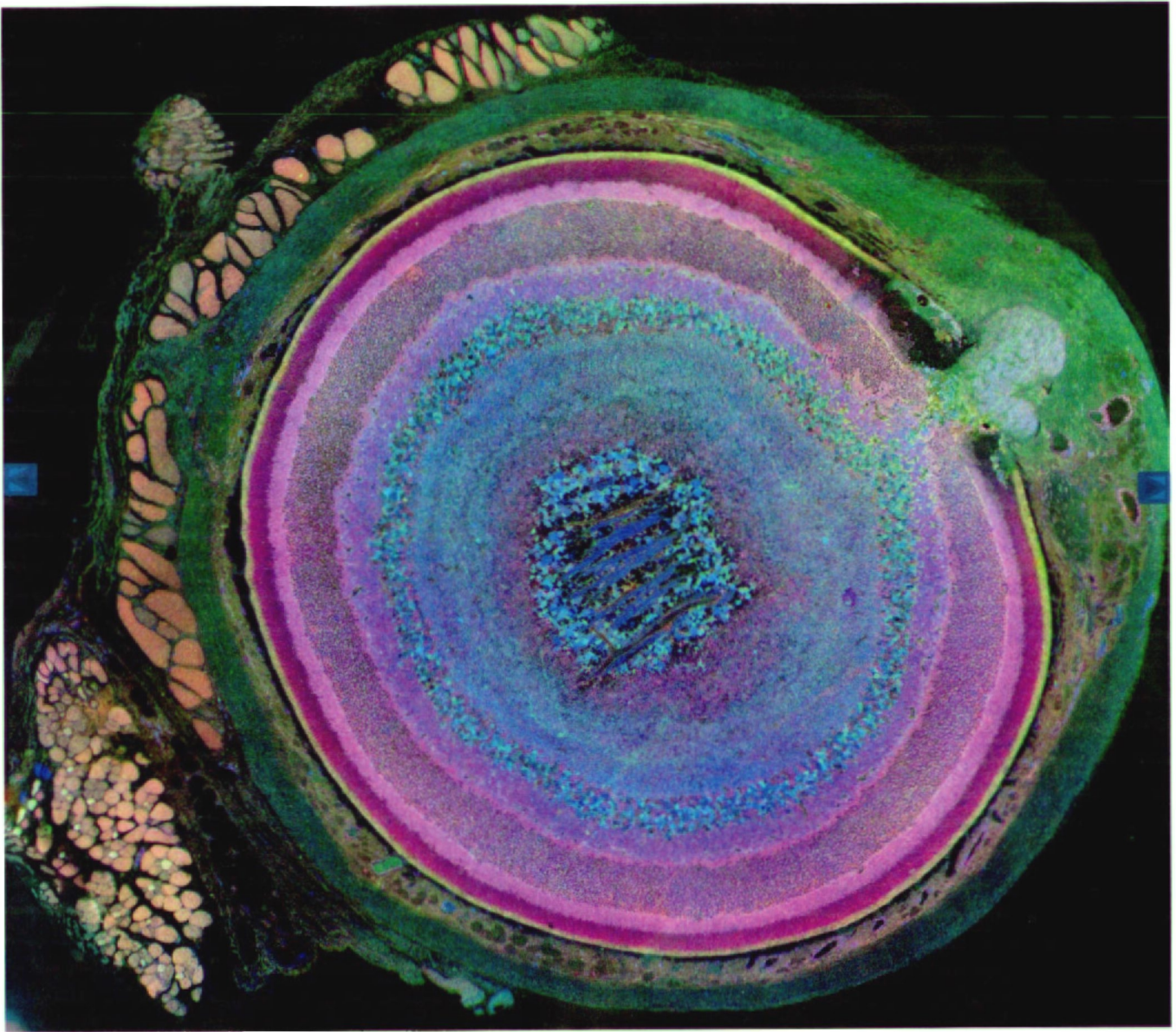
Inspired by the neural architecture of a monkey's brain, this neon swirl is the wiring diagram of a new kind of computer designed by IBM's cognitive computing group and designed to detect patterns, plan responses, and learn from its mistakes. Advances in computer science are a key driver of American innovation and commercial competitiveness. Through creative, multi-agency collaborations such as the National Information Technology Research and Development (NITRD) program, and through its support for collaborative work between Government and industry, the Obama Administration is committed to advancing breakthrough technologies to revolutionize computing, networking, and software applications.



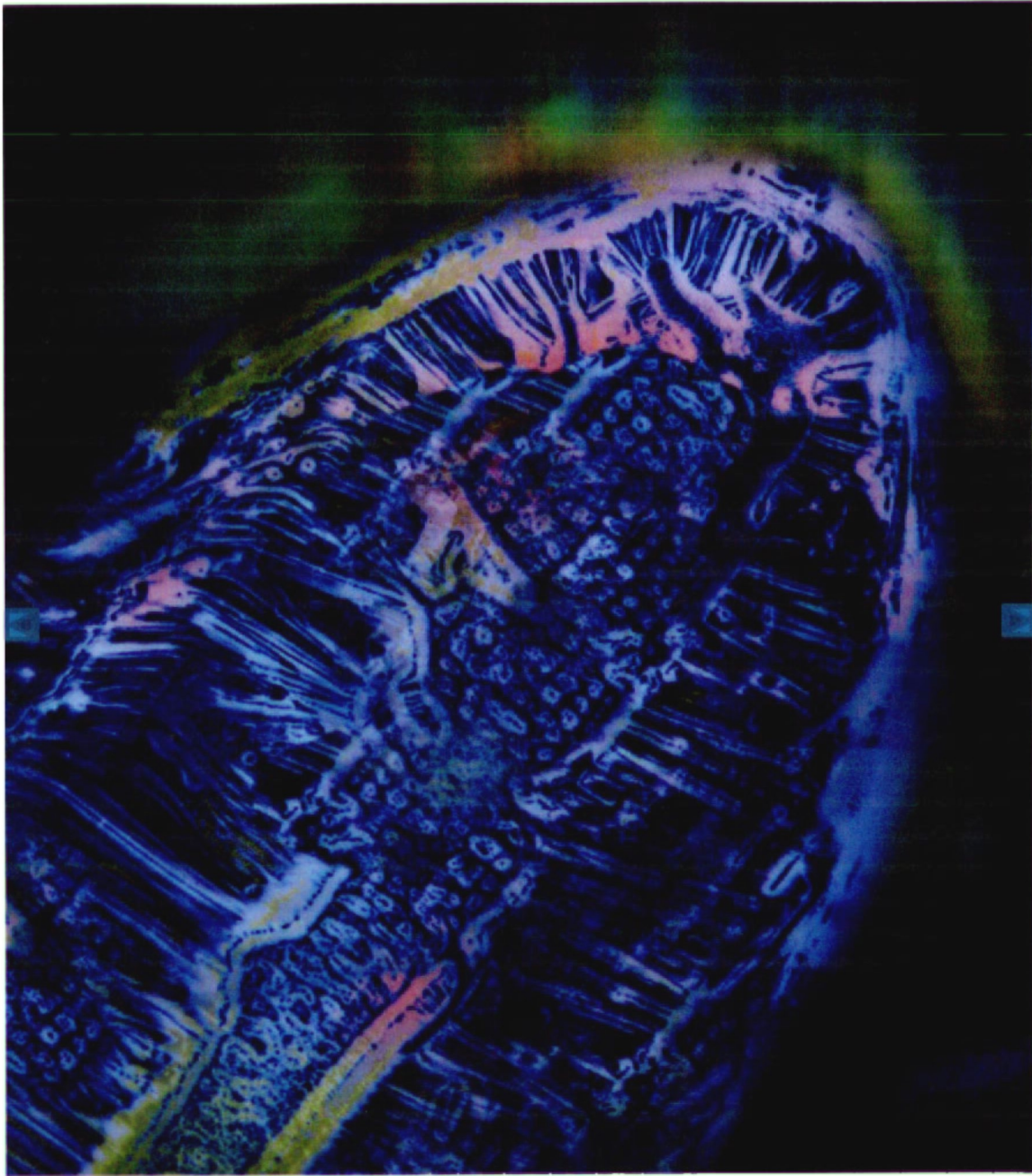
NASA's Scientific Visualization Studio used real satellite data and six computational models to create a vision that is both beautiful and scientifically precise. These swooping lines reveal how the Sun's warmth penetrates and permeates Earth's atmosphere, driving wind patterns in immense loops and whorls and how different parts of the climate system interact at very different scales. NASA's work is part of a larger Obama Administration commitment to Earth observation for purposes of understanding weather and climate, natural resource use, and ocean health, among other applications.



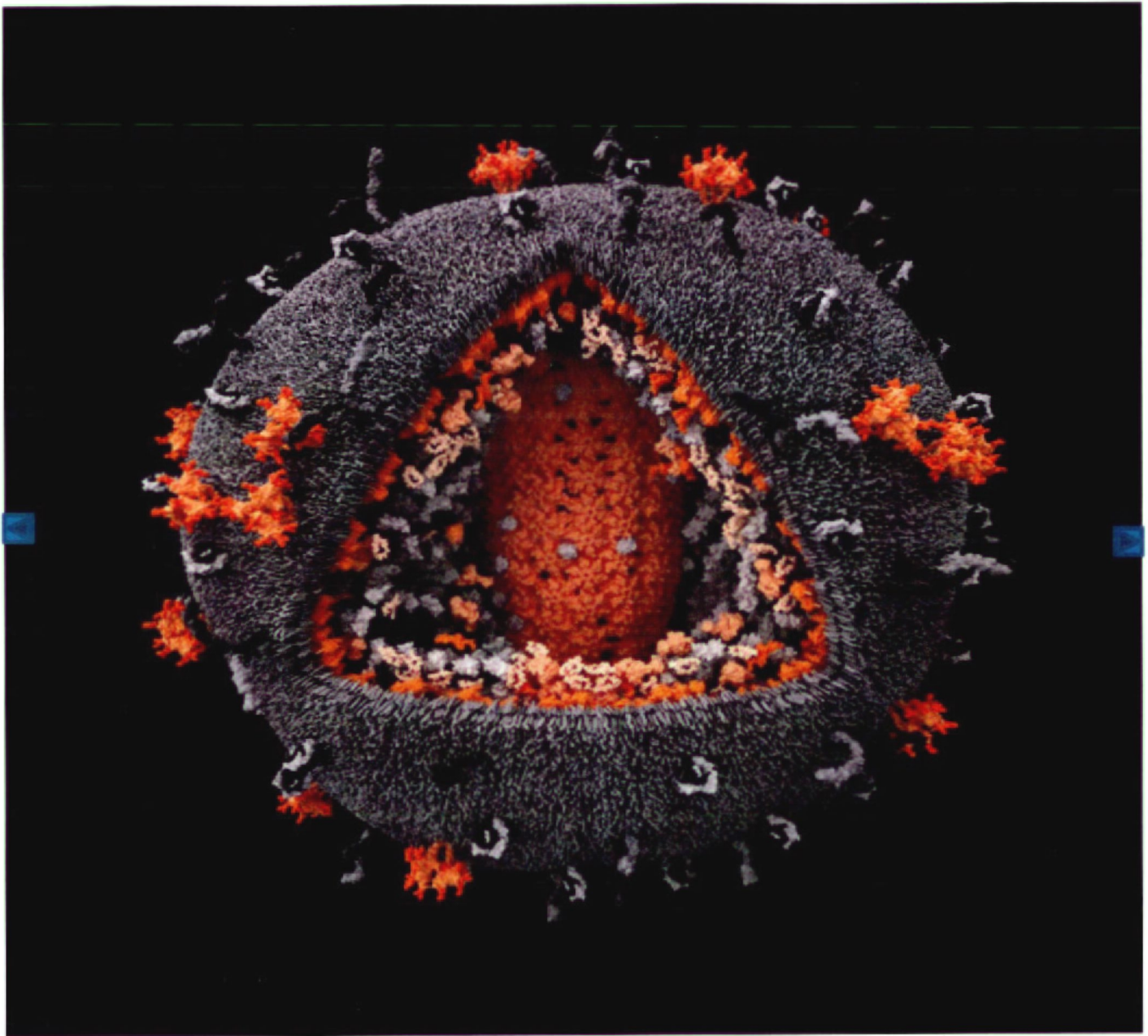
Although the sea urchin's body is made of a substance as soft as chalk, the **microscopic crystals seen here in its teeth are hard enough to grind holes in rock**, providing these invertebrates with unique capacities to survive and thrive in tough marine environments and tantalizing researchers in fields as diverse as materials science and genetics who would like to mimic the urchin's architecture and apply some of its biochemical tricks for biomedical applications. Chemicals and biological materials from marine organisms are today used in 10 anti-cancer drugs. Marine ecosystems are an increasingly important source of medical treatments, nutritional supplements, pesticides, and other commercial products.



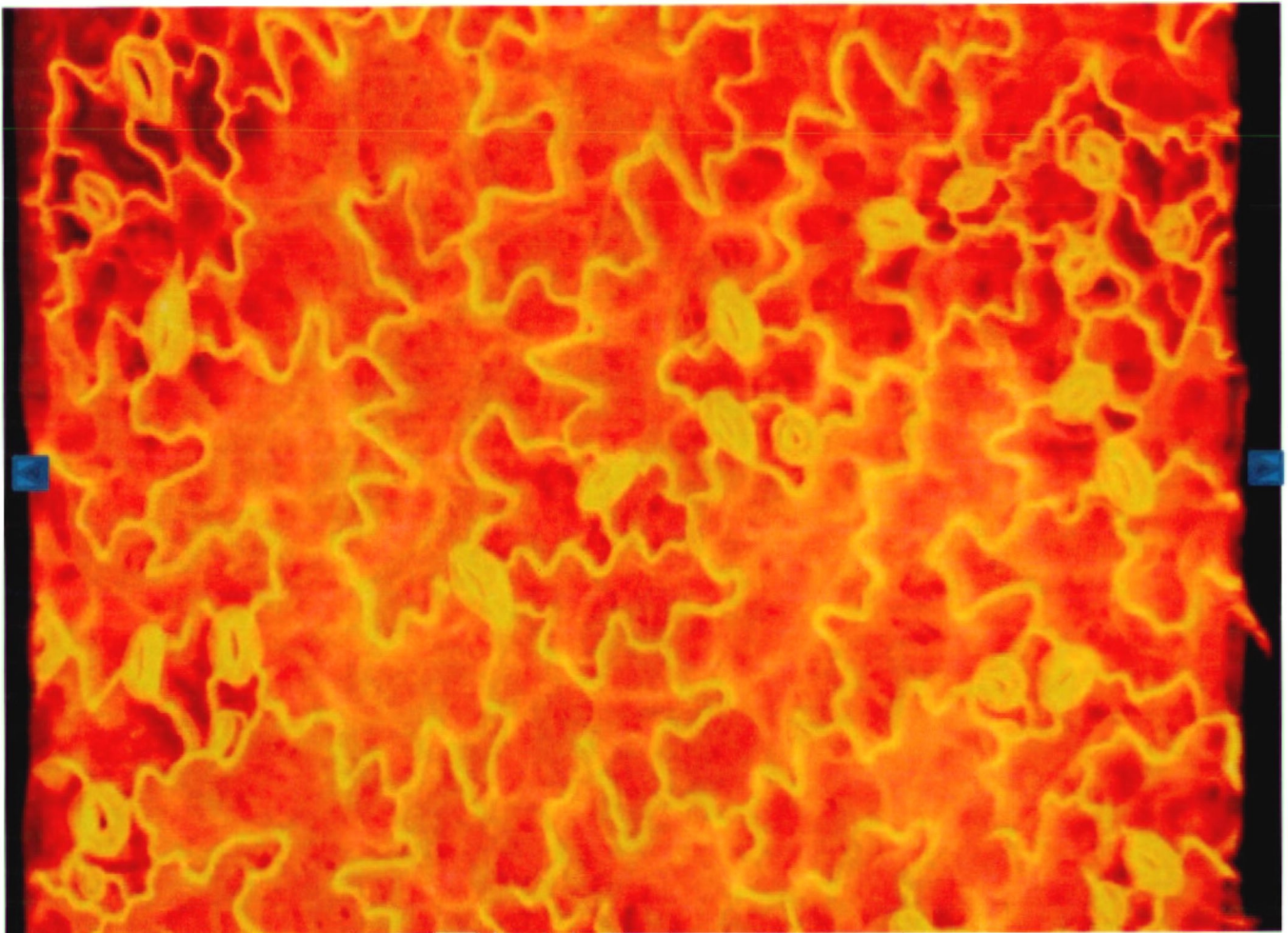
There are over 70 distinct types of cells that comprise a mammal's eye, shown in this beautiful set of concentric rings. Scientists' recent ability to examine specific tissues and system components at the nanoscale level—supported in part by the Obama Administration's multi-agency National Nanotechnology Initiative—has had significant implications for medical research, providing preventions, treatments, and cures for people affected by retinal degenerative diseases.



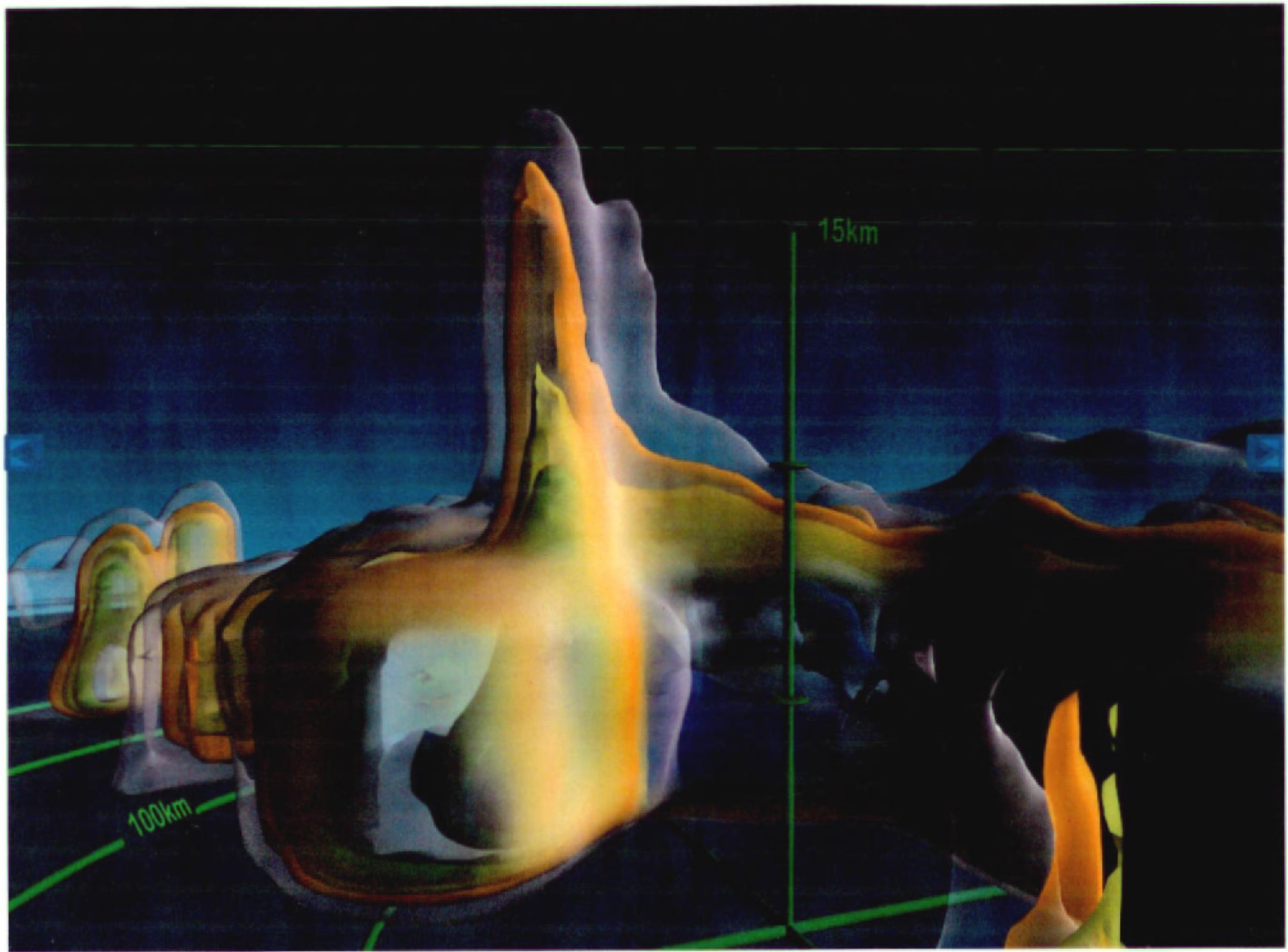
This 2-millimeter long fragment of self-assembling polymers is used to construct miniature “lab-on-a-chip” devices for biomedical and environmental diagnostic applications. Polymers, both natural (such as cotton) and synthetic (such as most plastics) are substances whose molecules are composed of a large number of repeating units. Obama Administration research efforts supported by the Defense Advanced Research Projects Agency and other agencies are exploring how such substances can be made compatible with biological systems to create a new generation of diagnostic and therapeutic devices.



At first glance, this 3-D computer model of the Human Immunodeficiency Virus could pass for a fluffy gray and orange Nerf ball. But its real-world counterpart is far more destructive and has claimed more than 36 million lives, wreaking more global havoc than some wars. The Obama Administration's National HIV/AIDS strategy relies on scientific breakthroughs to reduce the number of people affected with HIV/AIDS and to increase access to care and optimize health outcomes for people living with the disease.



Leaf tissues pictured in bright orange, yellow, and red colors help scientists study the genetic factors that influence the architecture of the “pavement cells,” which form a strong interlocking layer across a leaf’s surface and help determine its overall shape. Researchers have recently developed an artificial leaf to better understand how a natural leaf’s cellular network operates to generate energy from sunlight. The work was funded in part by the Obama Administration’s Department of Energy, in recognition that studies of Nature’s solar cells can advance the development of sophisticated solar energy technologies.



The center of a hurricane's eye may be calm, but its walls are anything but. As NASA's Tropical Rainfall Measuring Mission satellite orbited above the Caribbean, it captured radar images of a hurricane's vast clouds, dubbed "hot towers", that rose nearly 11 miles into the sky. These gigantic chimney clouds are like cylinders of an engine, releasing enormous quantities of heat and helping spin the winds inside the storm. Supercomputers simulate satellite images from the unique vantage point of space to better predict how climate change may result in more severe weather events.



Protein plaques and tangles in the brain like those depicted in this computer-generated illustration are associated with Alzheimer's disease and may hold clues to the prevention or treatment of this devastating ailment, which is growing more prevalent as the population ages. In January 2011, President Obama signed the National Alzheimer's Project Act that calls for increased funding and an aggressive and coordinated Federal research effort to find new avenues for the design of therapeutics and pave the way for early detection by helping healthcare professionals identify those who are predisposed to the disease.



Nanotechnology – the science of the very small – is a young field, but it’s already changing the world. Advances enabled by the Obama Administration’s investments underpin a wide variety of applications and products on the market today, including electronic circuitry, displays, sensors, battery technology, disease therapeutics, and wear-resistant coatings. Scientists employ lasers to develop new methods to craft thin carbon nanotubes and precisely vary their diameters and properties, and can even bulge them out like pears along their length.