



"The Blue Marble"

Joseph N. Tatarewicz

As one of the Apollo astronauts quipped dismissively while at work on the surface of the moon, "If you've seen one Earth, you [have] seen them all." The famous photograph of the whole Earth, taken in 1972 by the crew of the final Apollo mission and dubbed "The Blue Marble," is one of the most iconic images of our time. It has been used to express Earth's isolation and fragility and was adopted by the growing environmental movement and the annual Earth Day celebration started two years earlier. Apollo 17 was the last piloted lunar mission, and no humans since have been able to capture such an image directly.

It is a great irony that this photograph should become the icon for environmental stewardship and an awareness of the limits of technology and science, since it was made possible largely by technological systems originally designed for military purposes. Still, "The Blue Marble" is an aesthetic of considerable power and simplicity--and one acquired through very complex and even accidental means.

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Image: View of Earth as seen by the Apollo 17 crew traveling toward the moon. [NASA photograph](#). The uncropped version of this image can be seen on the [Lunar and Planetary Institute](#) and the [NASA astronaut photography](#) websites.



Notes from the Director

As Earth Day approaches on April 22, I find myself reflecting on *Inventing for the Environment* (MIT Press, 2003), a volume that the Lemelson Center produced a few years ago. I do so in the conviction that its theme looms even larger today than it did when the book first came out. Countering the view that technology only disrupts natural processes, our book's contributors focused on inventors and innovators who have devoted their imaginations to shaping a better environmental future. Their efforts ranged from innovations in city planning, urban sanitation, and the emerging practice of industrial ecology to technologies on a more individual scale, like straw-bale buildings and high-tech "hypercars."

Today, the buzz is all about "sustainability," with an emphasis on alternative energies, renewable resources, and carbon-neutral technologies. Sustainability, however, has taken on a whole new dimension with the rise of the eco-city concept, a development that I mentioned in a [prior column on new technology towns](#). I say "concept" because, although the idea has been around for at least a couple of decades, no eco-city has yet been fully realized.

As defined by the visionary urban ecologist Richard Register, eco-cities are designed to be in balance with nature. Actually they come in many sizes and flavors, including retrofitted derelict industrial areas and small eco-villages, as in the plans for "Bicycle City"--a particular favorite of mine. The most fascinating variety, however, is the attempt to build completely new cities on the principle of total environmental sustainability. Using the most advanced technologies (including some not even invented yet), these new cities are meant to be completely self-sufficient. Each will generate its own power, grow its own food, and recycle its water, while minimizing to near zero the output of waste, especially CO₂.

Two of the most extravagant projects currently on the books are [Masdar](#) in Abu Dhabi of the United Arab Emirates and [Dongtan](#) in China. Abu Dhabi is touting Masdar as the "greenest city on earth," eventually a zero-carbon footprint town of 50,000 inhabitants and 1,500 businesses. Most spectacularly, the city is built on a plinth or platform, with all the infrastructure and transportation concealed beneath. Competing with Masdar for the title of the world's first fully realized eco-city is Dongtan, about twenty-five miles from Shanghai. The city will produce its own energy through wind, sun, biofuel, and recycled waste, including human sewage.

Both projects pose formidable environmental challenges. The green city of Masdar sits in the middle of a desert and Dongtan on a major wetland. Their very concept raises a host of questions and issues, but the central ones are these: Although real money has been put behind these projects, how real are they? In the end, is ultimate sustainability really sustainable? Some say they are exciting new directions, but others claim that, in the case of Masdar, the eco-city diverts attention away from Abu Dhabi's petroleum industry, and, with Dongtan, China creates a fig leaf for its polluted metropolises. Even if they prove to be extravagant diversions, attempts to build the sustainable city, even attempts with flaws, may provide the real-life experience needed to make our planning richer, more oriented to the fuller urban life so necessary for true sustainability.

Best regards until next month,
Arthur Molella
 Jerome and Dorothy Lemelson Director



Have You Seen?

Putting the energy of the sun to work generating electricity is a "hot topic" these days. But it's not new for Subhendu Guha, senior vice president and chairman of [United Solar Ovonic](#) in Auburn Hills, Michigan. A world-renowned authority on photovoltaic technology, Guha has been working with solar panels for more than two decades. When he met with middle-school students as part of the Lemelson Center's Innovative Lives program, he had this advice for the future inventors in the group: "Don't be afraid to try new ideas and don't be disheartened if it doesn't work the first time.... To put an idea into practice can take time." Maybe the time for widespread use of solar power has come?

Learn more about Subhendu Guha and try some solar energy experiments in the [Innovative Lives section](#) of our website.

Image: Subhendu Guha by Jeff Tinsley, Smithsonian Institution



Trivia Challenge

In each edition of *Prototype*, we offer a question about an invention or inventor that you and your friends and family can try to answer. Sometimes the answer can be found on the Lemelson Center's website, where you can also learn a little more about the subject. Email your answer to us at prototype@si.edu along with your name and mailing address. Each month we'll select winners randomly to receive a small prize from the Center.

Thank you to everyone who entered the March challenge and congratulations to Eileen T. of Braddock Heights, Maryland, and Don N. of Scottsdale, Arizona, who (among others) knew that Patsy Sherman and her fellow chemist Sam Smith realized that a mixture that they hoped would be a rubber substitute was actually the forerunner of the fabric protector Scotchgard. Eileen and Don will each receive a year's subscription to *Smithsonian* magazine--and you can read more about the invention of Scotchgard on our [Invention at Play](#) website.

This month's question: What inspired Roman Szpur's invention of high-efficiency wind turbines?

Maybe you should try the activity for families and schools below to inspire your answer!

Illustration by Jennifer Swartzendruber



From the Archives

Atoms smashing! People protesting! Cutting-edge science meets grassroots activism! What are we talking about? The Archives Center's Superconducting Super Collider (SSC) Collection! This rich resource combines a case study of a science project--building a particle accelerator--with an insider's view of the community activism generated by concerned citizens in response to it.

Over twenty-two years ago, ground was broken in Waxahachie, Texas, for one of the world's most expensive instruments for basic science. The Superconducting Super Collider was a particle accelerator that physicists planned to use to accelerate two streams of protons (particles with a positive electrical charge that form part of the nucleus of an atom) to a velocity of 20 trillion electron-volts (TeV) in opposite directions within the tunnel's parallel beam tubes. The SSC design called for a 10-foot-wide tunnel to be laid out in an oval pattern similar to a racetrack, approximately 53 miles in circumference and 14 miles in diameter. Full-scale construction began in 1991 and, in 1993, boring for the main tunnel and several vertical access shafts started. Had the project been completed it would have been one of the largest public works undertaken in the United States.

While there are other well-documented particle accelerators--Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois; Stanford Linear Accelerator Center (SLAC) at Stanford University; and CERN in Geneva, Switzerland, to name a few--the failed SSC provides insight into one of the most significant United States government-funded projects of the 20th century as well as the substantial community mobilization in response to it. The collection represents the "NIMBY" ("Not In My Back Yard") syndrome that many large public-works projects encounter when local citizens face disruption in their community. The huge scale of the SSC meant that it would have a significant environmental and cultural impact on the area selected. A unique strength of the SSC collection lies in its documentation of both supporters' and opponents' activities.

States were invited to submit site proposals for the project, and from the twenty-five that applied, eight finalists were selected: Arizona, Colorado, Illinois, Michigan, New York, North Carolina, Tennessee, and Texas. These eight states are represented in the collection and much of the documentation highlights opposition to the project. Citizens were deeply concerned about radiation, explosions, fire hazards, and the contamination of wells from the SSC. Opponents organized and actively campaigned against the accelerator. Through public hearings, leaflets distributed by mail and by hand, and letter-writing campaigns to local politicians, the activists raised public awareness about the threat of uprooting hundreds of people from their homes, the heavy tax and utility burdens, and the environmental issues that the SSC represented. In New York, the group Citizens Against The Collider Here (CATCH) was able to force the state to withdraw from the competition. Slogans like "Save Our Quality of Life" and bumper stickers such as "No Collider in Tennessee" were common in all of the finalist states.

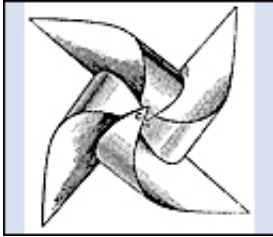
The SSC collection, however, also documents how supporters addressed the concerns of opponents. Prominent city officials and politicians traveled to the proposed sites to discuss the economic and scientific benefits of the SSC, and city governments distributed bumper stickers supporting the project. Scientists and engineers rebuffed claims that the SSC would produce large amounts of deadly radioactivity and contaminate the entire area.

In the end, though, the anticipated tremendous costs that dogged the project eventually helped to undermine it. In June 1992 and again in June 1993, the U.S. House of Representatives voted to cancel funds for the SSC; both times, the Senate restored funding. However, in October 1993 the House rejected the Senate's second restoration, and President Clinton echoed Congress's decision to cancel further work on the SSC. The project received a small budget to support

termination activities through 1996. Once the remaining projects were shut down and the scientists and staff dispersed, only several empty buildings in the rural Texas countryside remained of the once-ambitious facility ... along with fourteen miles of tunnel underneath it.

Alison Oswald, Archivist, Lemelson Center

Image: Detail of a bumper sticker from the SSC Collection. You can [learn more about the SSC on the Lemelson Center website](#).



Inventive Ideas for Schools and Families

Wind turbines are machines that convert wind into energy. They look a lot like windmills or pinwheels. The blades of the turbine are connected to a generator. When the wind moves the blades, the generator makes electricity. This electricity can be used to power our homes, schools, and even whole towns! [Download this Spark!Lab activity](#) to create your own wind turbine. What would you use it to power?

Image: Originally published in Horace H. Cummings, Nature Study by Grades (New York: America Book Company, 1909). Copyright 2008, [Florida Center for Instructional Technology](#).



Our Podcast--Prototype Online: Inventive Voices

On March 20, 2009, fifteen teams of student innovators from around the nation presented their award-winning inventions at the National Museum of American History for the annual March Madness for the Mind competition. In this podcast, Peter Lu from MIT and Angel Hall from Washington State University tell us what it is like working in Lesotho and Malawi to design inventions that bring clean energy and water to remote communities in developing nations. [Tune in!](#)

Image: This bicycle-powered water pump from WaterCycle at Washington State University provides an easy-to-use, durable, and affordable means of irrigation to farmers in developing countries. Courtesy National Collegiate Inventors and Innovators Alliance.

Prototype, April 2009

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