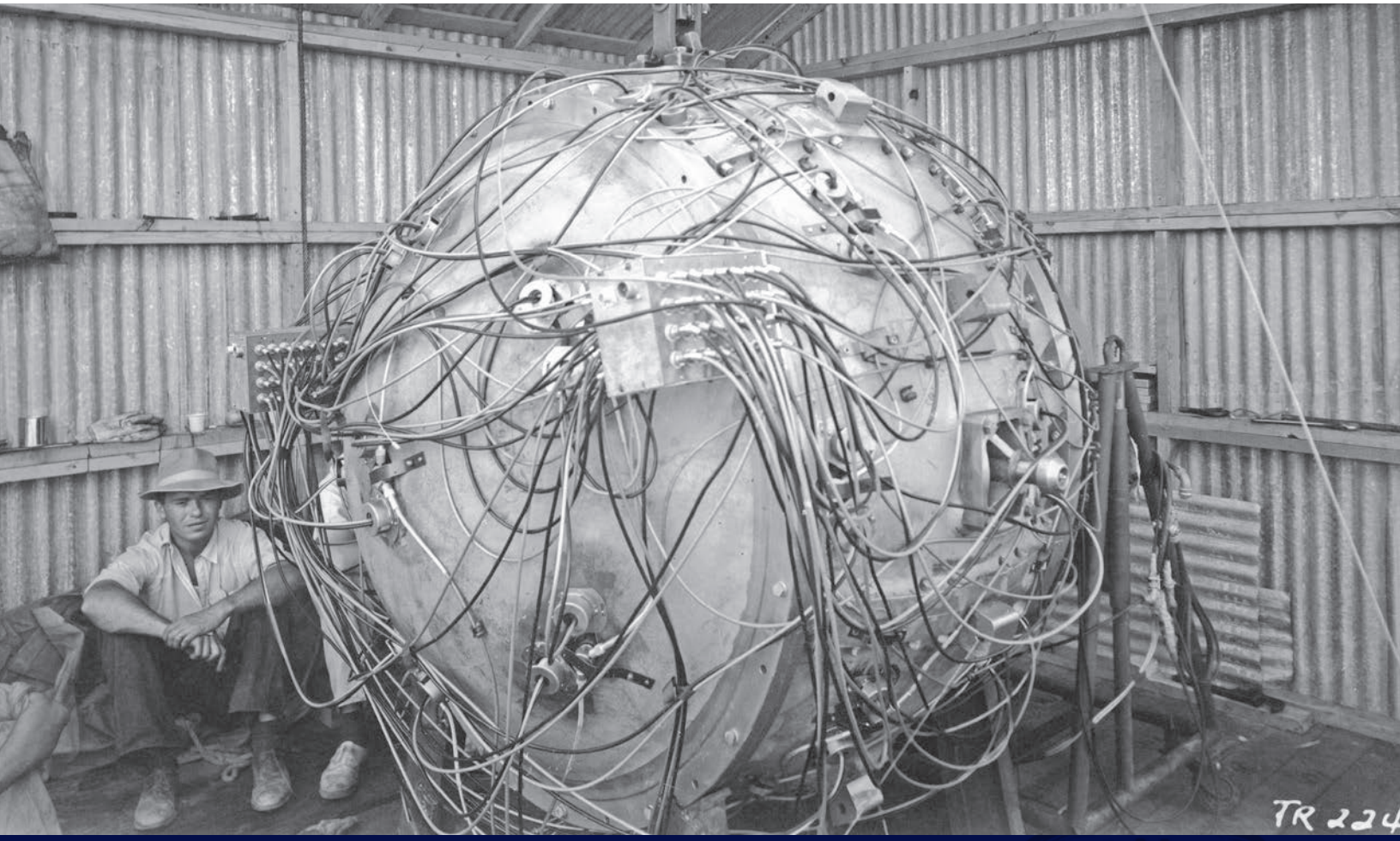
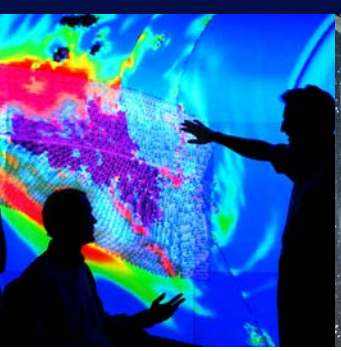
National Nuclear Security Administration

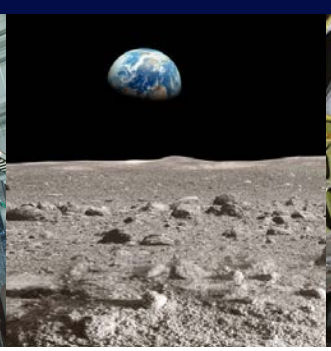



# 75 YEARS

## Trinity Test

The Dawn of America's Scientific Innovation



*Beyond the advances in nuclear physics and chemistry that made the first functional atomic device possible, Trinity was arguably the greatest scientific experiment ever conducted.*

**Lisa E. Gordon-Hagerty**
U.S. Under Secretary of Energy for Nuclear Security
Administrator of the National Nuclear Security Administration

# CONTENTS

1


## Manhattan Project: The Origin of the Trinity Test

In the 1920s-1930s, a young Hungarian-German physicist Leo Szilard led the field of nuclear research, submitting patents for a linear accelerator (1928) and cyclotron (1929), before collaborating with Albert Einstein to develop the Einstein refrigerator.

But when Hitler came into power in 1933, Szilard fled to England, encouraging his friends and family to do the same. In England, he first described the nuclear chain reaction (1933) and patented an early design for a nuclear fission reactor (1934).

In 1938, Szilard joined Einstein in the United States, but the rumor that a group of Berlin chemists had split the uranium atom made them so concerned that in 1939, they sent an urgent letter to President Franklin D. Roosevelt, warning him that that Axis scientists were working to turn new nuclear discoveries into a superweapon.

Roosevelt responded by launching The Manhattan Project, a nationwide network of laboratories and manufacturing facilities designed to collaboratively assist in the manufacture of a new atomic weapon.


## Los Alamos, New Mexico

When the Manhattan Project was first proposed, the future scientific director J. Robert Oppenheimer argued that all of the scientists needed a secure central facility, where they could freely exchange ideas. Military director Brigadier General Leslie Groves insisted on a location that would minimize security risks.

The Laboratory was established in 1943 and designated as site Y of the Manhattan Project for a single purpose: to design and build an atomic bomb.

It took just 27 months. On July 16, 1945, the world's first atomic device was detonated 200 miles south of Los Alamos at Trinity Site on the Alamogordo Bombing Range. Under the project leadership of General Leslie R. Groves and staff direction of J. Robert Oppenheimer, scientists at the Laboratory had successfully weaponized the atom.

2

# JULY 16, 1945

The world's first nuclear explosion occurred on July 16, 1945, when a plutonium device was tested at a site located 210 miles south of Los Alamos on the barren plains of the Alamogordo Bombing Range, known as the Jornada del Muerto. Inspired by the poetry of John Donne, J. Robert Oppenheimer code-named the test "Trinity".

Hoisted atop a 100-foot tower, the plutonium device, nicknamed Gadget, detonated at precisely 5:30 a.m. over the New Mexico desert, releasing 18.6 kilotons of force, instantly vaporizing the tower and turning the surrounding asphalt and sand into green glass. Seconds after the explosion came an enormous blast, sending searing heat across the desert and knocking observers to the ground.

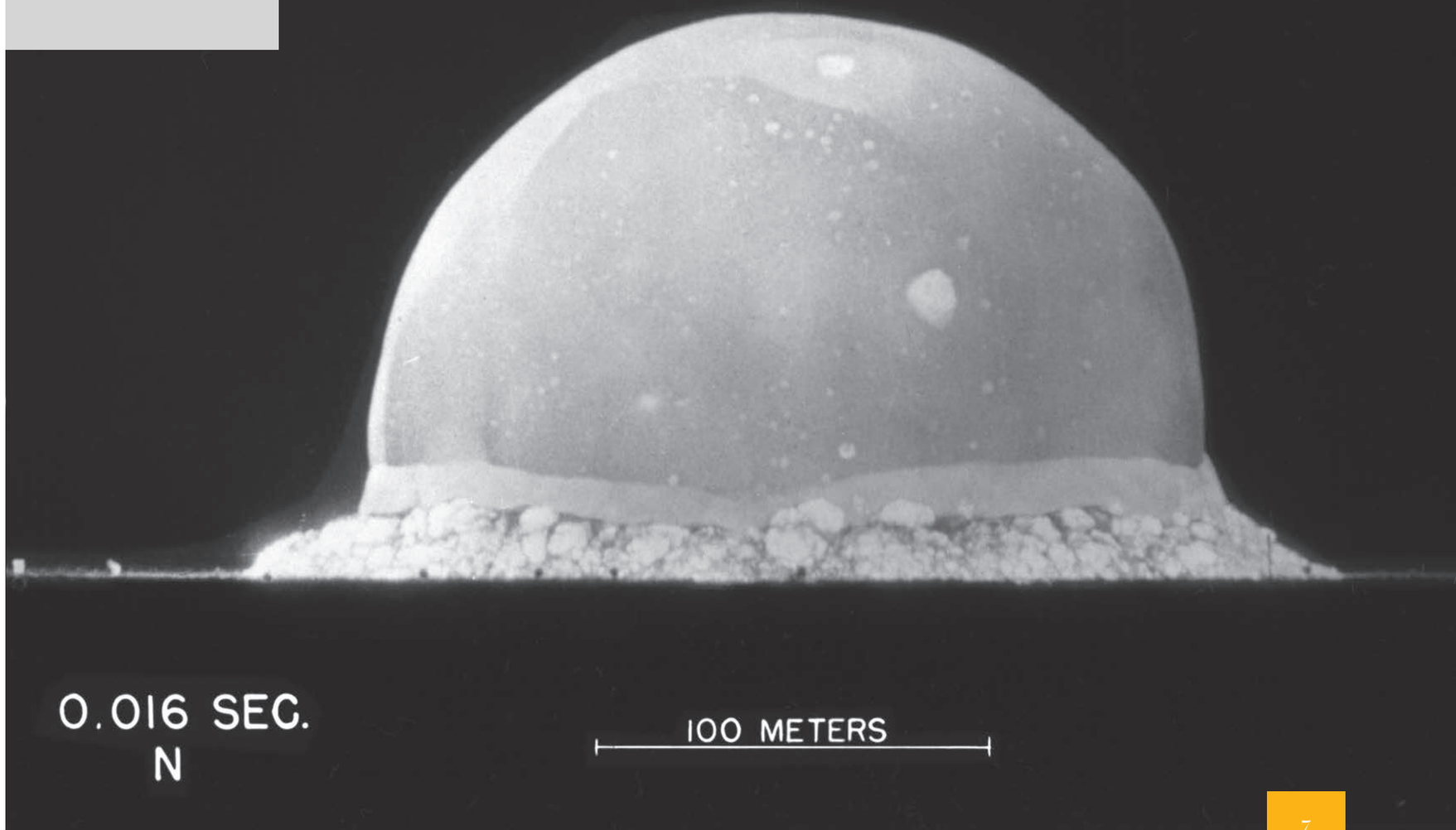
The success of the Trinity test led to the end of World War II less than two months later on September 2, 1945. Since then, nuclear deterrence has been the cornerstone of the U.S. defense strategy. The outstanding science of the Trinity Test launched our Nation into an era of leading scientific and technological innovations for over seven decades.

*White Sands Missile Range*



> *It was seen to last forever. You would wish it would stop; altogether it lasted about two seconds. Finally it was over, diminishing, and we looked toward the place where the bomb had been; there was an enormous ball of fire which grew and grew and it rolled as it grew; it went up into the air, in yellow flashes and into scarlet and green. It looked menacing… A new thing had just been born; a new control; a new understanding of man, which man had acquired over nature.*

**Isidor I. Rabi**
Manhattan Project Veteran,
Scientist, Nobel Prize Winner,
Trinity Test Eyewitness



1945 — Trinity Test

1945 — End of World War II

1946 — Electronic Numerical Integrator and Computer

1946 — Monte Carlo Method

1946 — Marshall Island Tests

1948 — Z Division becomes Sandia Laboratory

1949 — Clementine Nuclear Reactor

# 1940s

Manhattan Project: America's Groundwork for Innovation in

MEDICINE SECURITY COMPUTING SPACE INDUSTRY

## Monte Carlo Method

Physicists John von Neumann, Stanislaw Ulam, and Nicholas Metropolis developed the powerful statistical technique known as the Monte Carlo method, which sought solutions to mathematical problems using a statistical sampling method of random numbers. Today, the Monte Carlo computer code is applied in the fields of nuclear security, medicine, and space.

## Marshall Islands Tests

The nuclear testing program at Bikini Atoll was a series of 23 nuclear weapons tests detonated by the United States between 1946 and 1958 at seven test sites on the reef itself, on the sea, in the air, and underwater. The test weapons produced a combined fission yield of 42.2 mt of explosive power.

The United States was engaged in a Cold War nuclear arms race with the Soviet Union to build more advanced bombs from 1947 until 1991. The first series of tests over Bikini Atoll in July 1946 was code named "Operation Crossroads". The first test was dropped from an aircraft and detonated 520 ft (160 m) above the target fleet. The second was suspended under a barge, and produced a large Wilson cloud that contaminated all of the target ships. In retrospect, Atomic Energy Commission chair Glenn T. Seaborg described the second test "the world's first nuclear disaster."

## Clementine Nuclear Reactor

In 1945, Los Alamos scientists proposed the construction of the world's first fast reactor named Clementine. Completed in March 1949, Clementine in its first year maintained a full schedule that included several important weapons experiments. Despite its early demise in 1952, researchers acquired valuable weapons data and gained experience in the production and care of fast neutron reactors from the Clementine reactor.

Richard Phillips Feynman was an American theoretical physicist and Manhattan Project veteran, known for his work in the path integral formulation of quantum mechanics, the theory of quantum electrodynamics, the physics of the superfluidity of supercooled liquid helium, as well as his work in particle physics for which he proposed the parton model. For contributions to the development of quantum electrodynamics, Feynman received the Nobel Prize in Physics in 1965 jointly with Julian Schwinger and Shin'ichirō Tomonaga.

# 1950s

Manhattan Project: America's Groundwork for Innovation in

MEDICINE SECURITY COMPUTING SPACE INDUSTRY

## Explorer 1

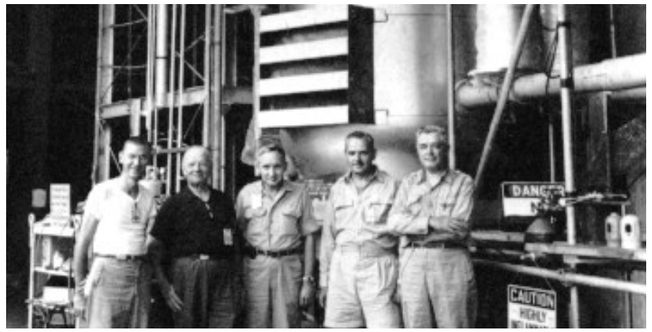
On January 31, 1958, the United States successfully launched its first satellite, Explorer I. This satellite carried a small payload of scientific instruments that eventually documented the magnetic radiation belts around the Earth, named after principal NASA investigator James Van Allen. Explorer I transmitted data for about four months until its batteries died on May 21, 1958. It remained in orbit for 12 years, circling 58,376 times around Earth, before burning up upon reentry into the atmosphere on March 31, 1970.

## Radiotherapy

The invention of the nuclear reactor in the Manhattan Project during World War II made possible the production of artificial radioisotopes for radiotherapy. Teletherapy machines using megavolt gamma rays emitted by cobalt-60 revolutionized the field of cancer treatment between the 1950s and the early 1980s. Cobalt machines were relatively cheap, robust, and simple to use, although due to its 5.27 year half-life, the cobalt source had to be replaced about every 5 years.

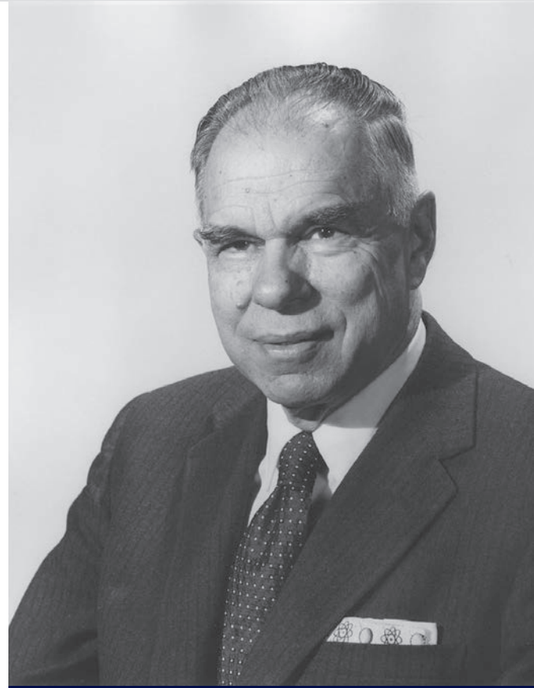
## Ivy Mike

The first fusion bomb was tested by the United States in Operation Ivy on November 1, 1952, in the Marshall Islands. Code named Mike, this test was considerably more powerful than all the high explosives used in two World Wars collectively with a yield of 10.4 megatons.




## Rocket-powered centrifuge

The first of Sandia's large environmental test facilities, the Old Centrifuge, was built in 1952 to test the Mk7 Honest John warhead by replicating the environment a component, device, or system is likely to encounter during its working life. The centrifuge simulated high g-force acceleration to replicate the stress encountered by a warhead accelerating towards its target.



Glenn Theodore Seaborg was an American chemist whose involvement in the synthesis, discovery and investigation of ten transuranium elements – including plutonium – earned him a share of the 1951 Nobel Prize in Chemistry. His work in this area also led to his development of the actinide concept and the arrangement of the actinide series in the periodic table of the elements.

# 1960s

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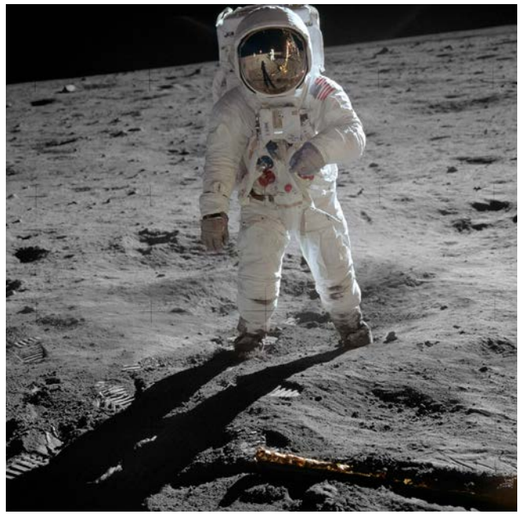
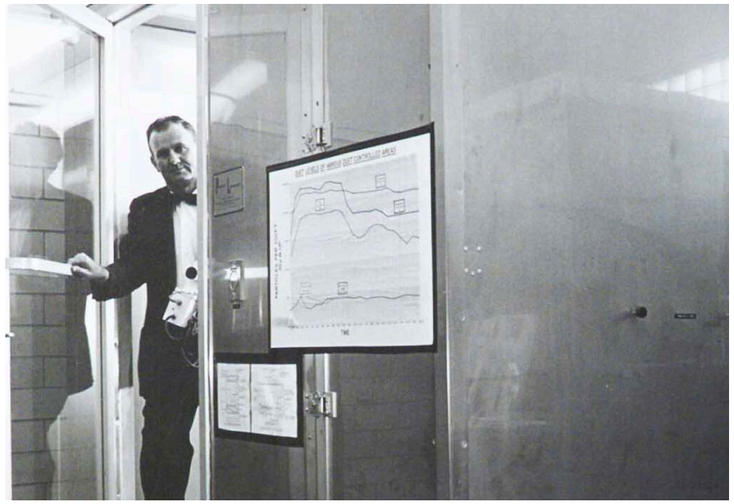
## Instrumentation of the Moom

The Apollo Lunar Surface Experiment Packages containing scientific instruments were left on the moon by U.S. astronauts, to send ongoing data back to Earth. The first package was solar-powered but relied on two 15-watt radioisotope heater units (RHUs) to keep its instruments warm enough to function.

Subsequent packages were each powered by 70-watt SNAP-27 radioisotope thermoelectric generators, and the ALSEPs contributed significantly to our understanding of the moon, including data on solar wind and radiation, and the observation that the moon is geologically active. The five ALSEP stations continued to operate until 1977.



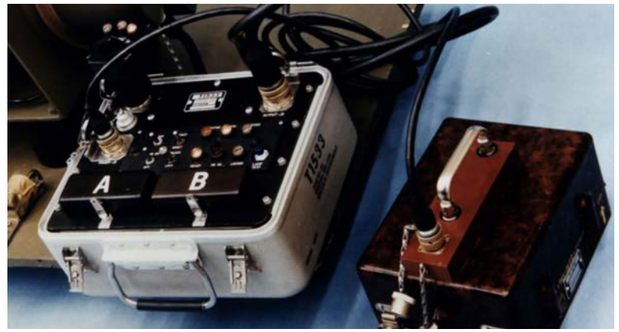


## Clean Room Technology

When Sandian Willis Whitfield came up with the idea for the laminar airflow clean room, it was intended to provide a dust-free environment for manufacturing close-tolerance weapons parts. Little did he or anyone else know that his idea would become a basic enabling technology for the $1.2 trillion electronics industry, improve hospital operating room safety, and advance space exploration.

## Nuclear Weapons Security

In 1960, Sandia developed the permissive action link, a coded electromechanical security lock that prevents unauthorized use of a U.S. nuclear weapon. The technology helped reassure the public that a scenario involving a stolen nuclear weapon was impossible.




## Purified Vaccines

National Lab researchers adapted nuclear separation technology to develop a zonal centrifuge used to purify vaccines, which reduced or eliminated unwanted side effects. Commercial centrifuges based on this invention continue to produce vaccines for millions of people.

Maria Goeppert Mayer was a theoretical physicist and received the Nobel Prize in Physics in 1963 for proposing the nuclear shell model of the atomic nucleus — work she conducted while at Argonne National Lab as a senior physicist. Goeppert Mayer's model explained "why certain numbers of nucleons in the nucleus of an atom cause an atom to be extremely stable".

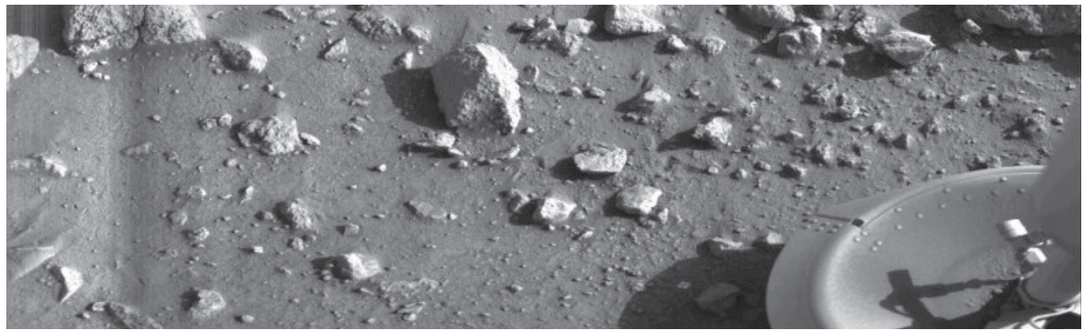
# 1970s

Manhattan Project: America's Groundwork for Innovation in

MEDICINE SECURITY COMPUTING SPACE INDUSTRY

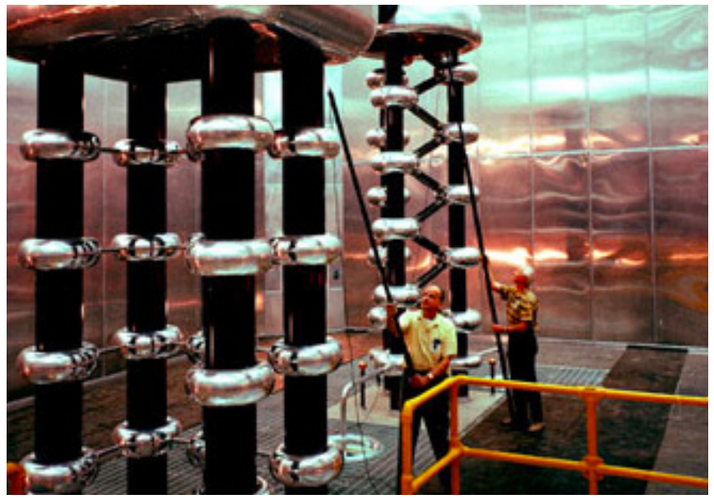
## Missions to Mars

Viking 1 and 2, launched separately in 1975, were NASA's first efforts to harvest data directly from the surface of the red planet. Each mission had two parts: an orbiter and a lander. Both Viking missions sent back photographs of the surface of the red planet and helped scientists learn more about elements present there (carbon, nitrogen, hydrogen, oxygen and phosphorus -- all essential to life on our own home planet). The two 42.6-watt radioisotope thermoelectric generators on Viking 1 and 2 were designed to last at least 90 days but lasted for six and four years, respectively.



## Los Alamos Meson Physics Facility

Since 1972, the 800-million-electron-volt (MeV) accelerator and its attendant facilities at Technical Area 53 (TA-53, often referred to as "the Mesa") at Los Alamos National Laboratory have been a resource to a broad international community of scientific researchers. The Los Alamos Meson Physics Facility (LAMPF), as it was originally called, hosts about 1,000 users per year to perform medium-energy physics experiments.

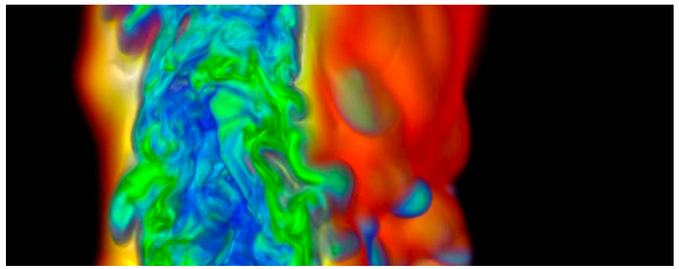


## Safe Secure Transport

The Safe Secure Transport (SST), designed at Sandia National Laboratories in the early 1970s, was the first trailer designed specifically to provide cargo safety and to prevent any potential unauthorized entry and access to national security assets.


## Chemistry

In the late 1970s, scientists at Sandia's Combustion Research Facility needed a more efficient way of solving combustion problems involving complex chemical kinetics phenomena. They developed a software suite named CHEMKIN, now licensed by industry and used worldwide in the microelectronics, combustion, and chemical processing industries.



Seymour Sack, a prominent Lawrence Livermore National Laboratory physicist, designed small bomb prototypes for warheads. During the late 1970s, he turned his efforts to the conception and realization of the modern, extremely safe, air-carried nuclear weapon. He designed the warhead for both the high-yield aerial bomb and the ground-launched cruise missile. Simultaneously, he directed both development projects. In this project, Sack developed the first use of insensitive high explosive and the first fire-resistant pit, thereby greatly enhancing the safety of nuclear explosives in crash and fire accidents.

7

1980 Plutonium-238

1983 Montebello Decision

1984 GPS Satellites

1987 INF Treaty

1988 GenBank

1989 High Explosives Applications Facility

1989 MELCOR

# 1980s

Manhattan Project: America's Groundwork for Innovation in

MEDICINE SECURITY COMPUTING SPACE INDUSTRY

## GPS Satellites

In 1984 the first global positioning system (GPS) satellite was launched with a Los Alamos X-ray detector on board. In subsequent years, more advanced sensors have been hosted on newer Defense Support Programs, GPS, and other U.S. government satellites. These systems monitor the entire globe, 24/7, for nuclear detonations–offering timely information to U.S. policymakers and the Department of Defense.

## GenBank

The Theoretical Biology and Biophysics Group at Los Alamos National Laboratory collaborated with other scientific groups to establish the Los Alamos Sequence Database in 1979, which culminated in 1982 with the creation of the public GenBank. In partnership with the firm Bolt, Beranek, and Newman, LANL stored more than 2,000 sequences in GenBank by the end of 1983.

## Plutonium-238 for Pacemakers

In the 1980s, Los Alamos produced 63 grams of high-purity plutonium-238 metal for the pacemaker program. Medtronics made about 250 of the plutonium-powered pacemakers, and about twenty-two were still stimulating human hearts more than twenty-five years after they were manufactured, a feat that no battery-powered pacemaker could match.

## Nuclear Power Safety

In 1989, Sandia first released MELCOR, a computer software for analyzing severe accidents in nuclear power plants. The software incorporates the results of nuclear power plant safety research gathered since the 1979 Three Mile Island accident, and is the de facto standard for evaluating plant safety among utilities and nuclear regulators in the U.S. and abroad.

Dr. Betty Wright was best known for her development and invention of the TATB spot test for identifying explosives in the field. She successfully patented her invention which has been widely adopted by military and civil institutions the world over. She worked for Los Alamos National Laboratory (LANL) as a research chemist in various fields including explosives and nuclear weapons, hazardous waste treatment, and environmental remediation. It was during her time at LANL that she developed her TATB test.

# 1990s

Manhattan Project: America's Groundwork for Innovation in
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## Planetary Exploration

When the Pathfinder spacecraft hit the surface of Mars on July 4, 1997, it bounced and rolled rather than experiencing a crash landing, largely as a result of airbags designed by Sandia and NASA's Jet Propulsion Laboratory. The airbags were based on parachute technology developed for nuclear weapons.

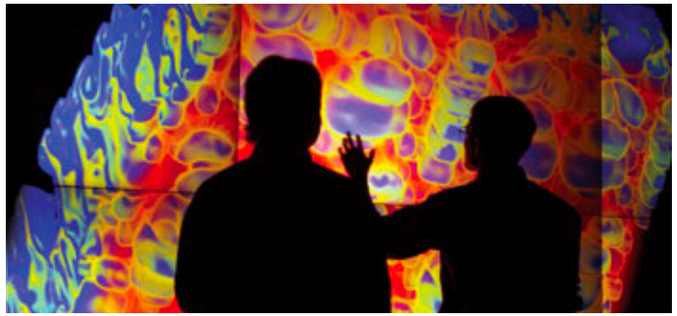
## Decoded DNA

In 1990, the National Labs joined with the National Institutes of Health and other laboratories to kick off the Human Genome Project, an international collaboration to identify and map all of the genes of the human genome.

A major responsibility of the Los Alamos during the HGP was to sequence the 90.4 million base pairs of chromosome 16 and to construct a detailed, high-resolution map showing the location of each of its approximately 1,300 genes. The task was especially challenging because the chromosome has a larger-than average proportion of duplications—long sections of repeating DNA.

## Stockpile Stewardship Program

In 1992, a national and international moratorium on nuclear testing signified the end of the nuclear arms race, dramatically affecting the Nation's two nuclear weapons laboratories—Livermore and Los Alamos—and engineering laboratory Sandia. However their central missions remain focused on national security science and technology. Although the U.S. stockpile of weapons is smaller than it used to be, nuclear deterrence remains an integral part of national security policy. In 1995, the Stockpile Stewardship Program (SSP) was born.



## Supercomputer Speed Record

Achievement of the one-trillion-operations-per-second computing milestone ushered in a new era in which high-fidelity 3-D simulation enabled scientists to pursue the goal of preserving a safe, secure and reliable nuclear deterrent without underground testing.

Victor "Vic" Reis retired from the Department of Energy in March of 2017. He is best known as the architect and original sponsor of the U.S. nuclear Science Based Stockpile Stewardship Program and its associated Accelerated Strategic Computing Initiative. On November 3, 2017, current and former DOE lab directors, colleagues and contemporaries of Reis gathered at Lawrence Livermore National Laboratory to honor him with the John S. Foster Jr. Medal, recognizing Reis for his significant contributions to national security, his innovative leadership in science and technology, and his dedication to national service, particularly for guiding the Nation's nuclear program through an uncertain time of budget cuts and the end of underground testing.

# 2000s

Manhattan Project: America's Groundwork for Innovation in

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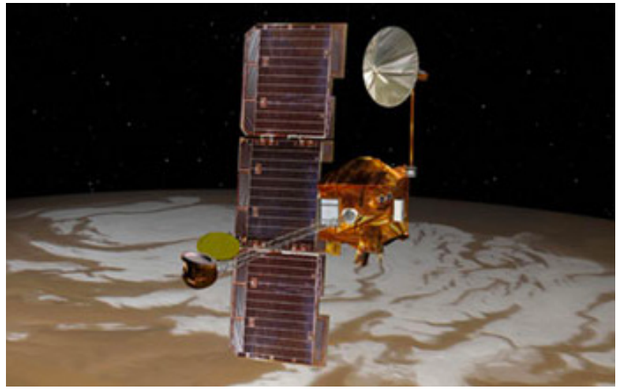
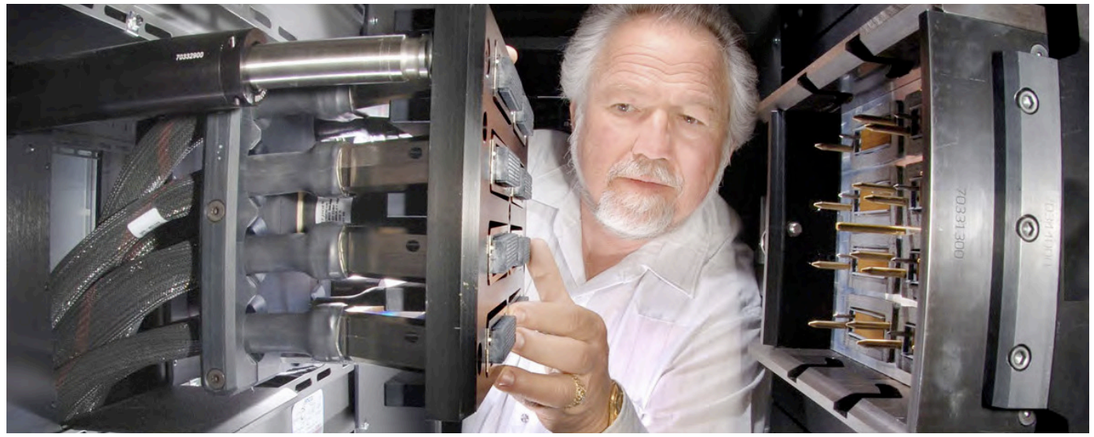
## Water/Ice on Mars

For more than a year in 2002, Los Alamos' neutron spectrometer carefully mapped the hydrogen content of the Red Planet's surface by measuring changes in neutrons given off by the soil, which indicate the presence of hydrogen, likely in the form of water/ice. The maps detail the distribution of water-equivalent hydrogen as revealed by Los Alamos National Laboratory-developed instruments aboard NASA's Mars Odyssey spacecraft.



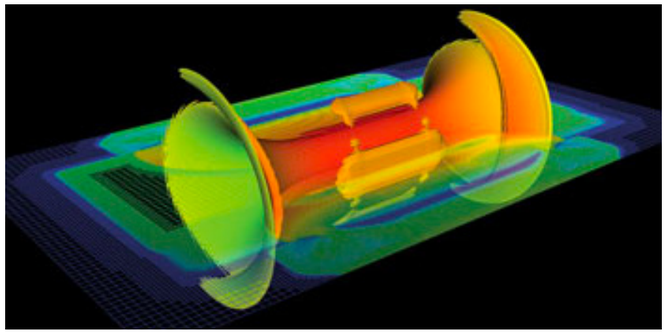
## Satellite Interception

In February 2008, Sandia's Red Storm high-performance computer was used to help the U.S. military plan and carry out the successful interception of a defective spy satellite that threatened to fall to Earth. A Sandia team ran hundreds of impact calculations using advanced modeling and simulation tools to determine the best way to ensure that the car-sized satellite — traveling 153 miles above the Earth at 17,000 miles an hour— was destroyed with a single missile shot.



## First 3-D Simulation of Nuclear Weapon

In 2002, scientists at Lawrence Livermore and Los Alamos National Laboratories completed two of the largest computer simulations ever attempted, the first full-system three-dimensional simulations of a nuclear weapon explosion. These simulations signified completion of an important milestone in the maturing of the National Nuclear Security ‚Administration's Stockpile Stewardship Program, which is responsible for maintaining the safety, security, and reliability of the Nation's nuclear deterrent. Both calculations ran on the ASCI White machine — then the world's fastest and most capable supercomputer — at LLNL.



## Anthrax Decontamination

In 2001, federal authorities used a decontamination foam developed at Sandia to help rid Capitol Hill buildings of anthrax. The foam — a cocktail that includes ordinary household substances such as those found in hair conditioner and toothpaste — neutralizes chemical and biological agents in minutes and is non-toxic and environmentally friendly.

Joanne Wendelberger has been a member of the Statistical Sciences Group at Los Alamos National Laboratory since 1992 and a Fellow of the American Statistical Association since 2005. Throughout her career, Dr. Wendelberger's research has been motivated by the need to develop solutions to complex interdisciplinary problems, with a growing focus on the interface between statistics and computer science. Her current research interests include statistical experimental design and test planning, statistical bounding and uncertainty, materials degradation modeling, sampling and analysis in large-scale computation and visualization, probabilistic computing, and education modeling.

2010 Oleo Sponge

2010 CubeSat Launch

2010 Enterprise Secure Network

2012 100 Tesla Non-destructive Magnetic Field

2014 SGEMP Experiments

2017 Global Diagnostic Labs

2018 NIF Double Fusion Yield

# 2010s

Manhattan Project: America's Groundwork for Innovation in

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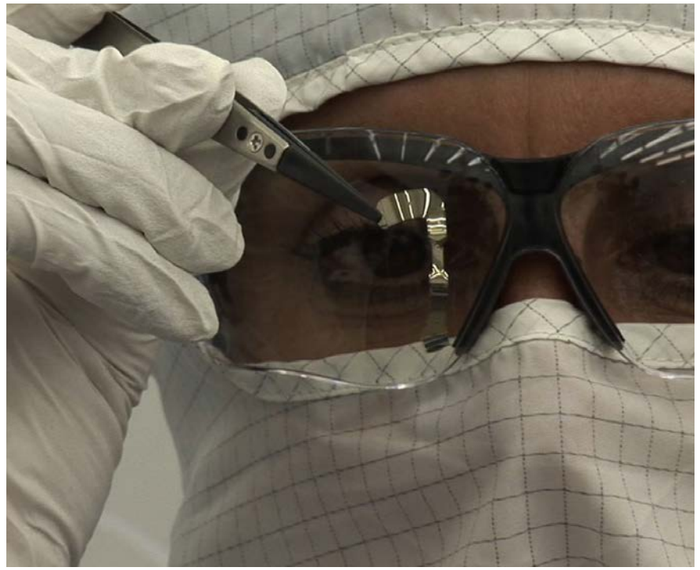
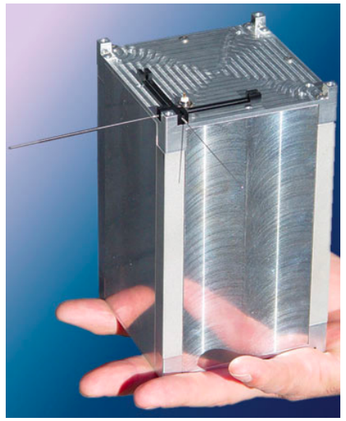


## Artificial Retina

In the DOE artificial retina project, LLNL served as the lead organization. The work with four other national laboratories, four universities, and a private company won an R&D100 Award in 2009 for the second-generation implantable system, Argus II. The device takes images from an external video camera and sends electric impulses to an array implanted in the eye. These impulses stimulate the retina and enable the brain to perceive patterns of light. As clinical trials continued, LLNL was the lead organization in developing a third-generation technology.

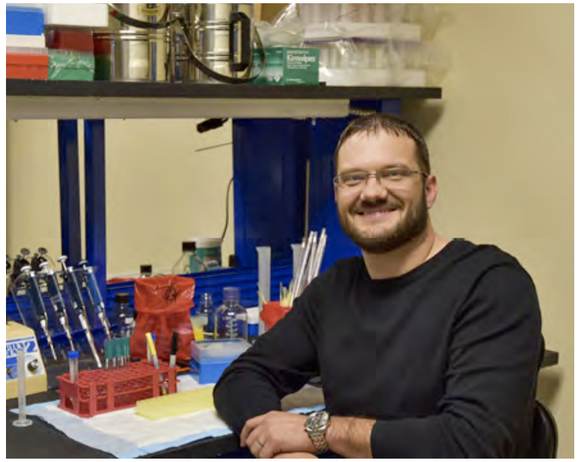


## CubeSat Launch

Los Alamos developed and successfully put four tiny "CubeSats"–satellites small enough to hold in one hand–into orbit in December of 2010. The satellites were designed and built (in less than six months) entirely at LANL at very low cost, to demonstrate rapid-response satellite capability.

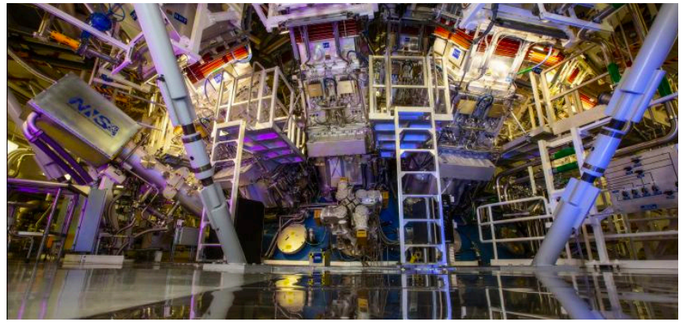
## Global Diagnostic Labs

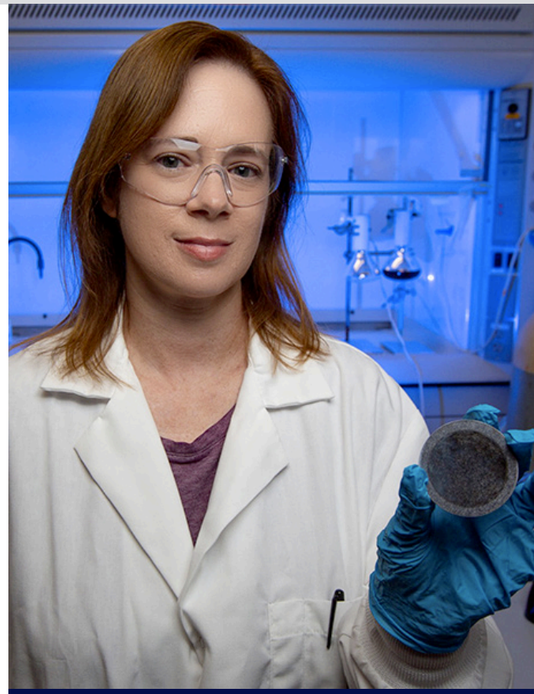
Sandia has helped in the design of diagnostic labs around the world that are safe, secure, sustainable, specific, and flexible. The Prototype Lab tool, developed in 2017, quickly generates construction drawings so international partners can prepare blueprints for builders in about half the usual time. The tool has been used for such designs as the central veterinary lab in Iraq and a foot-and-mouth disease diagnostic lab in Kenya.



## NIF Achieves Record Double Fusion Yield

The National Ignition Facility (NIF) is the world's largest and highest-energy laser system. NIF is an essential experimental tool supporting the National Nuclear Security Administration's Stockpile Stewardship Program. In 2018 the NIF laser system set a new record, firing 2.15 megajoules (MJ) of energy to its target chamber – a 15 percent improvement over NIF's design specification of 1.8 MJ, and more than 10 percent higher than the previous 1.9 MJ energy record set in March 2012.





Dawn Shaughnessy is the group leader for experimental nuclear and radiochemistry and the principal investigator for the heavy element group at Lawrence Livermore National Laboratory. Under her leadership, a team of scientists has discovered six new elements on the periodic table - the heaviest elements found to date. She recently led a group that named the newest heavy element to be accepted into the periodic table - Livermorium - in honor of the Lab and its host city of Livermore.

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# 2020

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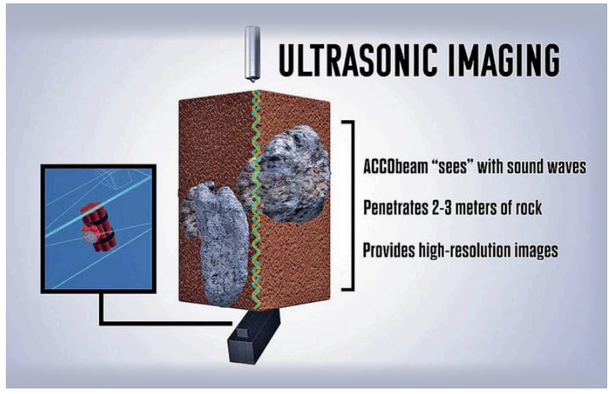
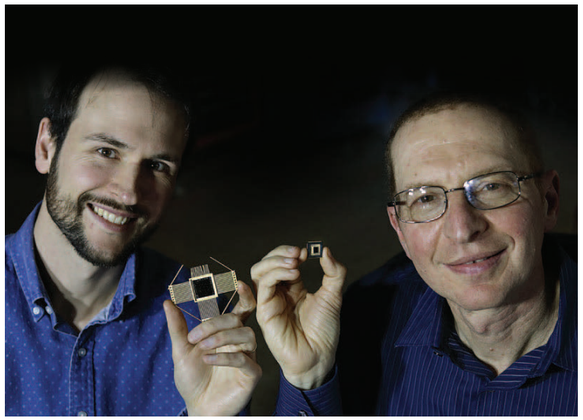
## Ultrasonic Imaging

At Los Alamos National Laboratory, a team of scientists invented a technology that uses sound to see through solid objects. By developing the innovative sound beam known as ACCOBeam, researchers can now identify issues several miles into the ground when exploring for natural resources and can improve long-range communications, imaging, and video transmission beneath the world's deepest oceans.



## Neuromorphic Computing

As the demands on computers rapidly change to more data-centric tasks — such as image processing, voice recognition or autonomous driving — the need for more efficient computing grows just as rapidly.

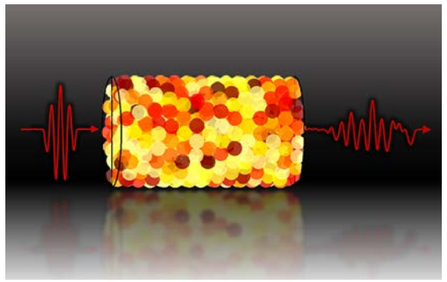
Sandia researcher Elliot Fuller introduced a novel approach to parallel programming of an ionic floating-gate memory array, which allows processing of large amounts of information simultaneously in a single operation. The research is inspired by the human brain, where neurons and synapses are connected in a dense matrix and where information is processed and stored at the same location.

## Wave Propagation

Physicist Eric Herbold used X-ray measurements and analyses to show that velocity scaling and dispersion in wave transmission is based on grainy particle arrangements and chains of force between them, while reduction of wave intensity is caused mainly from grainy particle arrangements alone.

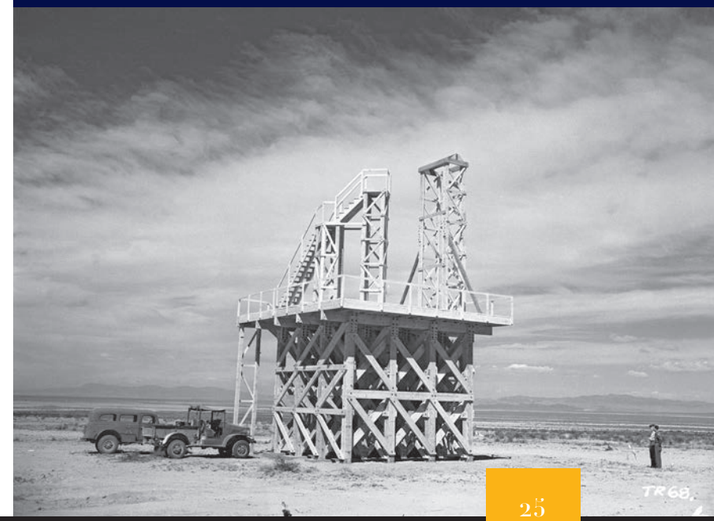
Stress wave propagation through granular material is important for detecting the magnitude of earthquakes, locating oil and gas reservoirs, designing acoustic insulation and designing materials for compacting powders.

Earlier research, dating back to the late 1950s, described "what" may be happening to the material underlying wave propagation, but the new research provides evidence for "why."



# … and Forward

America's National Laboratories have been changing and improving the lives of millions of people for over seven decades. Born at a time when the world faced a dire threat, the laboratories have come together to advance science, safeguard the nation and protect our freedoms for generations to come. The original network of Department of Energy Laboratories has grown into 17 facilities, working together to foster prosperity and invention for decades to come.



Sir:

Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendations:

In the course of the last four months it has been made probable-through the work of Joliot in France as well as Fermi and Szilard in America-that it may become possible to set up a nuclear chain reaction in a large mass of uranium, by which vast amount of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.

This new phenomenon would also lead to the construction of bombs, and it is conceivable-though much less certain-that extremely powerful bombs of a new type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

The United States has only very poor ores of uranium in moderate quantities. There is some good ore in Canada and the former Czechoslovakia, while the most important source of uranium is the Belgian Congo.

In view of this situation you may think it desirable to have some permanent contact maintained between the Administration and the group of physicists working on chain reactions in America. One possible way of achieving this might be for you to entrust with this task a person who has your confidence and who could perhaps serve in an inofficial capacity. His task might comprise the following:

a) to approach Government Departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium ore for the United States:

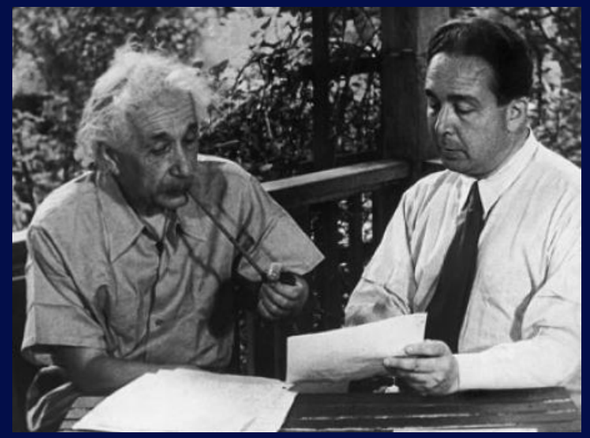
b) to speed up the experimental work, which is at present being carried on within the limits of the budgets of University laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the co-operation of industrial laboratories which have the necessary equipment.

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsacker, is attached to the Kaiser-Wilhelm-Institut in Berlin where some of the American work on uranium is now being repeated.

Yours very truly,

A. Einstein

Albert Einstein



In August 1939, six months after physicists Otto Hahn and Fritz Strassman had demonstrated the process of nuclear fission, Albert Einstein, at the urging of physicist Leo Szilard, sent a letter to President Franklin D. Roosevelt about the danger of Nazi Germany creating an atomic bomb.

# Trinity Test
# 75 YEARS


National Nuclear Security Administration