tion released a study indicating that at least 115 million people worldwide had died over the preceding 15 years due to the sabotage of nuclear power. Suffering with lower energy and low economic growth rates, poorer or no health care, and lack of infrastructure, millions in the developing nations were denied the very means for survival.

Today more than 2 billion people live without electricity. Their life expectancy is comparable to what it was in the United States five decades ago. There are only 440 nuclear power plants in the world operating today, with nearly 90% of them in the industrialized nations.

Today, nuclear energy provides Argentina with 8.6% of the electricity it generates. In Brazil, the figure is 3.6%. Their plans from the 1960s were never allowed to materialize.

In his Atoms for Peace presentation in 1955, Detroit Edison head Walker Cisler said: "Atomic energy has stirred the imagination of men more than almost any other subject in history. It has engendered a worldwide hope that the lot of all people can be greatly improved. . . . The incomparable research laboratory, the human mind, is busy in many people and in many lands. . . . I believe sincerely that in this kind of mutual endeavor is the highest hope of advancing nuclear energy into its ultimate and most significant role its peaceful use for the betterment of mankind everywhere. The challenge is great; the reward greater."

For Further Reading

21st Century Science & Technology magazine has published many articles on nuclear technology, radiation, nuclear history, environmentalist history, population, and eco-hoaxes. A subject index can be accessed for 1988-99 at www.21stcenturysciencetech.com, and back issues can be purchased online.

Some suggested *21st Century* articles include:

"Getting the Atom Away from the Army," by Theodore Rockwell, Summer 2004; "Who Owns the Environmentalist Movement?" by Rogelio A. Maduro and Ralf Schauerhammer," Fall 1992; "The Great Atomic Bomb Hoax," by Carol White, Fall 1994; and "The New Nuclear Power," by Marjorie Mazel Hecht, Spring 2001.

Also useful is *The Health Hazards of NOT Going Nuclear* by Petr Beckmann (Boulder, Colo.: The Golem Press, 1976). This is a classic review of nuclear and radiation questions, which, unlike most academic books on the subject, treats anti-nuclear lies with irreverent humor.

The Many Applications Of Nuclear Energy

by Marsha Freeman

When access to U.S. nuclear technology was declassified under Atoms for Peace, most nations had neither the industrial infrastructure, nor the scientific and engineering manpower, to begin building nuclear power plants. But beside the more efficient production of electricity from nuclear reactions, fission offered the near-term possibility of qualitative improvements in agriculture, medicine, biology, and industry. Unlike energy created from the burning of fossil fuels, nuclear reactions produced not only higher-quality heat, but radioactivity.

During the 1950s and 1960s, dozens of small U.S. reactors were exported around the world, to be used for research, for the training of scientific and engineering manpower, and for the production of radioactive isotopes.

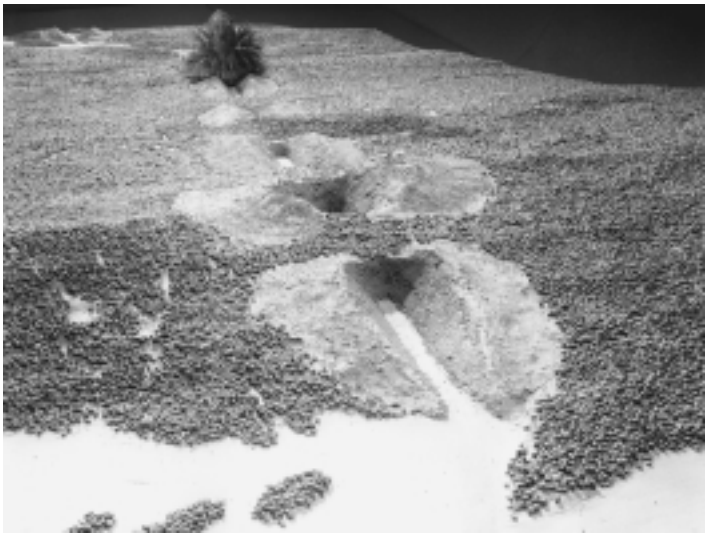
Radiation has been used in a number of ways to cure diseases, such as a variety of cancers, but diagnostic technologies were the earliest medical use, when portable X-rays were used during World War I. Dental X-rays, chest X-rays, mammograms, and many other tests have now become routine uses of radiation. Radiation is also used to sterilize medical equipment.

Radioisotopes are used to test new drugs, where their unique imaging characteristics can track possible side effects, and the effectiveness of a drug's ability to attack a disease. In agriculture, radioactive tracers can be used to determine how efficiently nutrient supplements, such as fertilizers, are absorbed by plants, and irradiation is used to create new crop varieties.

By far the greatest and most immediate impact that radioactivity could have on agriculture, was seen decades ago as its application to the food supply. In 1955, at the first Atoms for Peace conference, the United Nations Food and Agriculture Organization (FAO) promoted the use of radioactivity to preserve food. "Every day nearly 100,000 additional hungry mouths appear at the breakfast table," they reported. Twenty-five years hence, they said, this could be up to 4 billion human beings.

They reported that a very conservative estimate would be that losses from fungal and bacterial infection, and the ravages of pests, destroy 10% of world food supplies, but that the figure would be up to 50% in tropical climates. Such problems could be solved through the application of radiation. The "vast field of potentialities of the peaceful uses of atomic energy has hardly been touched," they concluded.

Similarly, while commercial-scale power plants provide



Peaceful Nuclear Explosions were under investigation in the 1960s for use in large-scale engineering projects. This is a model of the use of PNEs (one is exploding in the background) to create a sea-level Panama Canal. In the foreground is the Atlantic Ocean.

electricity, advanced reactors, which were under development even 40 years ago, could have many applications.

The August 1978 cover story of *Fusion* magazine promoted the deployment of "Nuplex Power for City Building." In 1967, a group of scientists and engineers at Tennessee's Oak Ridge National Laboratory, under the direction of the Atomic Energy Commission, had undertaken studies of agro-industrial nuclear-centered complexes, or nuplexes, to be built in developing nations. The stated intent was to allow nations to "leapfrog" in their development, and progress from subsistence agriculture to a nuclear-powered economy.

"The time has come," stated a 1968 Oak Ridge report, "when the energy derived from nuclear energy can be looked upon very seriously as a key for releasing indigenous agriculture from the bondage" imposed by primitive methods. Input from nuclear power, it stated, "could free these people from Malthusian limitations hitherto imposed upon their indigenous food supply. . . ."

The nuplexes envisioned, which would vary depending upon their location, would be new cities, with electrical energy supplied from one or a cluster of nuclear reactors. Surrounding the city would be industrial complexes; chemical, metals, and material fabrication factories, and others which could use the power, and importantly, high-quality process heat, for industrial production.

In arid regions, nuclear-powered desalination would provide water for the cities and to "make the deserts bloom." Electricity from the power plant would run the pumps needed for irrigation.

In addition to bringing electricity to rural homes and farms, as Franklin Roosevelt's Tennessee Valley and Rural Electrification programs did in the 1930s, agriculture could now benefit from the production of fertilizer, pesticides, mechanized equipment, and other manufacturing inputs, with the goal, as stated by Oak Ridge, of bringing productivity in the Third World up to that of the Imperial Valley in California.

The nuplex studies assumed that the next-generation nuclear technologies would be made available to developing nations. These included breeder reactors, to ensure an available supply of nuclear fuel, and high-temperature nuclear reactors, to provide "waste" heat at appropriate levels for industrial applications.

An article in a subsequent 1978 issue of *Fusion* reported that high-temperature gas-cooled reactors were "on the verge of commercialization," which indeed they were. Today, however, the only nation that has such reactors in operation, is China, with designs to develop larger-scale commercial advanced reactors.

In the 1950s, Dr. Edward Teller first used the term "geographic engineering," to describe how nuclear fission would allow man to reshape his environment. In 1957, Project Plowshare was initiated, to investigate whether peaceful nuclear explosions, or PNEs, could be used for the most difficult large-scale remolding of Earth's geography.

In his 1962 book, *Project Plowshare,* Ralph Sanders—who co-authored the hydrological development proposals in President Eisenhower's address on the Middle East to the United Nations in 1958—explained that "geographic engineering could help less developed lands where they need it most, in the development of infrastructure." Peaceful Nuclear Explosions would take on the vast jobs, such as digging new harbors, canals, and dams, that require moving vast tonnages of soil, more economically and quickly than chemical explosives.

Projects that were proposed for study included a second, sea-level Panama Canal, a canal to bring water from the Mediterranean Sea to Egypt's Qattara Depression, new harbors along the Pacific Coast of South America, the Jonglei Diversionary Canal in Sudan, and a series of dams and canals along the Mekong River in Asia.

In 1962 there were still unanswered questions about the use of nuclear explosions for geographic engineering. The scientists and engineers hoped that the possibility of continuing at least underground nuclear testing would allow them to develop the technology that would reduce emitted radiation. But the real hope was to replace fission with fusion, and virtually eliminate the radiation problem.

Testifying before the Joint Congressional Committee on Atomic Energy, Teller said in 1960: "I can say, not with certainty, but with quite a bit of hope, that we can make nuclear explosives for peaceful purposes so clean that the worry about radioactivity in its peaceful applications may disappear completely." The research was never done, and the program was discontinued.