

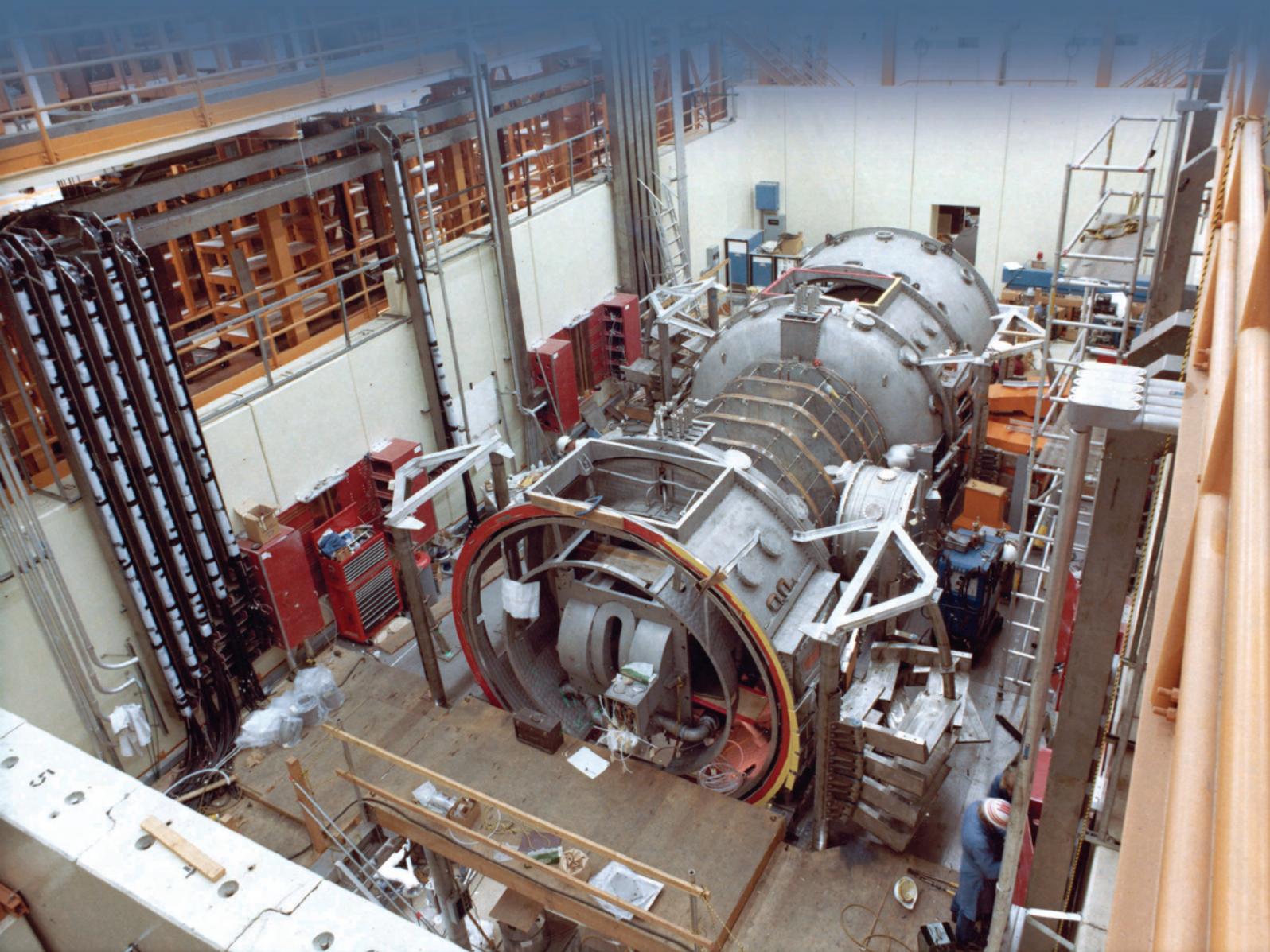
21st CENTURY SCIENCE & TECHNOLOGY

SUMMER 2009

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Fast Path to Fusion Power



- **Interview with Fusion Pioneer Richard Post**
- **Is the Fear of Radiation Constitutional?**
- **DDT to Combat Dengue**

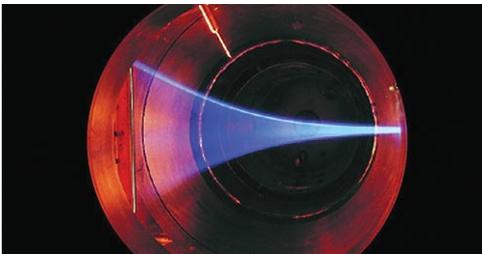
21st CENTURY SCIENCE & TECHNOLOGY

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LLNL

A plasma formed inside a vacuum chamber, showing a fan shape caused by the field of a magnet similar to that of the Mirror Fusion Test Facility.

ON THE COVER: The Tandem Mirror Experiment (TMX) in construction in the late 1970s. Photo courtesy of Lawrence Livermore National Laboratory; cover design by Alan Yue.

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EDITORIAL

Mars: The Next 50 Years

by Marsha Freeman

KEPLEROPOLIS, July 20, 2059— Today is a day of joyous celebration on Mars. As the citizens of Kepleropolis look back 90 years, to commemorate the historic first steps of human explorers on the Moon, their eyes are fixed on the imminent launch of their newest spacecraft, Kepler II. This will be the first craft to use the revolutionary new, and still-experimental, anti-matter propulsion system. If successful, the spacecraft will reach neighboring stars, comfortably within the lifespan of the scientists who are anxiously awaiting the discovery of new worlds. There is great excitement that Kepler II will open up the universe to mankind, just as 90 years ago, Apollo opened up the Solar System.

While Kepler II will not be carrying a human crew, its mission is to visit Earth-like planets orbiting distant stars, once thought to be impossible to reach in a human lifetime. Over its five-year mission, its predecessor, Kepler I, launched into Earth orbit in March 2009, had identified hundreds of target solar systems to explore. Johannes Kepler (1571-1630), who determined the laws of our Solar System, would undoubtedly be pleased that our scientific instruments will soon be looking for planets around other stars.

While everyone in Kepleropolis is anxiously awaiting today's Kepler II launch, pausing to follow the minute-to-minute progress of the launch preparations on large screens placed throughout the city, researchers working in the Advanced Propulsion Laboratory are especially anxious.

The revolutionary new anti-matter propulsion drive that will take Kepler II to the stars began its development more than 20 years ago on Earth. But it was brought to realization by a scientific

team working in the Lab in Kepleropolis. Now it was time see if the system could deliver.

Just as those who came before them nervously watched the first satellite launch, in 1957; the first manned mission, in 1961; the first human footsteps on the Moon, in 1969; and the first manned landing on Mars, in 2048, these young pioneers paced back and forth, waiting for lift-off.

Finally, the moment arrived, chosen to coincide exactly with Neil Armstrong's first step onto the Lunar sur-

EDITOR'S NOTE

We have excerpted here a very small portion of Associate Editor Marsha Freeman's article, which is posted on the *21st Century* website, and we encourage readers to read and distribute the entire piece. See www.21stcenturysciencetech.com/Articles_2009/Mars_50-years.pdf. We also recommend readers to view the LaRouche Youth Movement video, "From the Moon to Mars: The New Economics," available at <http://www.larouchepac.com/node/11573>.

A review of Marsha Freeman's new book, *Krafft Ehrlicke's Extraterrestrial Imperative*, appears on page 78.

face, now almost a century earlier. The booster engines ignited, and Kepler II was easily carried aloft. Once in Mars orbit, the anti-matter drive sprang to life. Kepler II was on its way to discover new Earths.

Very few people living on Mars today were alive when Neil Armstrong spoke those first words from the surface of the Moon. But no one here can forget on



JPL/NASA

Before men are sent to Mars, in 2024, an international robotic mission will be deployed to return samples of rock and soil to be intensively examined in laboratories on Earth. In this artist's drawing, an ascent vehicle is taking off from the Martian surface, to deliver its cargo. The rover, which collected the samples and delivered them to the vehicle, takes shelter behind a rock.

whose shoulders he stands. However, what is very difficult for citizens of Kepleropolis to understand, especially those who did not witness or participate in the Second American Revolution of 2010, is how it was that so many decades could have been wasted.

For years after the abrupt end of the Apollo Program in 1972, space enthusiasts would lament that it would take a crisis, like that faced by President John F. Kennedy in 1961, to goad an administration in Washington to make the commitment needed for a visionary, multi-decade program to move human civilization into space. That crisis came in the Fall of 2009.

Perception finally caught up with reality. The global financial house of cards, based not on any physical economy, but on criminal enterprise, speculation,

and outright stealing, in order to "make money," finally collapsed. Commerce, production, and life itself came to a standstill. Here was the opportunity to start over, sweep away decades of pessimism and failed policies, and return to the principles which today, on Mars, seem like common sense. The revolution began by "exorcising" the worship of money.

Starting Over

A series of global, credit-based international exchange-rate and trade agreements was quickly concluded, reflecting back to the policies of U.S. President Franklin Roosevelt, and initiated by economist Lyndon LaRouche, who had proposed a four-power agreement among the U.S., Russia, China, and India. Through this arrangement, each nation could contribute to the restart of the

overall global economy.

One immediate task was turning what could have been an ugly, violent mob-reaction to the collapse, and descent into a New Dark Age, into a renewal of the letter and spirit of the first American Revolution.

Great projects of infrastructure building got under way on Earth, in the footsteps of the first U.S. Treasury Secretary, Alexander Hamilton, who had designed and implemented the credit policies that built the economic infrastructure of a young United States. The first task in 2010, was the rebuilding of a planet devastated by disease, starvation, and war, and to reverse the decades of accumulated physical decay.

But as space visionaries insisted at that critical moment, only a multi-generational great project could challenge and mobilize the long-dormant creative resources of the human mind. The scientific discoveries of such a project would unleash the next revolutionary generations of technology, and drive economic growth on Earth.

The politicians reluctantly came to agree. And so, in that spirit, the project to build a science city on Mars came into focus. The cultural pessimism that had taken hold in the late 1960s, and kept its grip on much of the world's population for 50 years, began to disappear.

In fact, the natural optimism of humanity had not been extinguished during the dark decades of economic decline, only submerged. With the focus now on the future, socially anomic video games, "reality" television, fixations on sex, violence, and "competitive" sports, and a "culture" of death had no place. Mankind would, once again, find its true nature, in the process of discovering the secrets of the universe. The question posed to every citizen of the world was: What can you contribute to the future of mankind?

And so it was decided, in early 2010, by nearly all of the nations of the world, that through a coordinated effort, enlisting the necessary talents of all of man-

kind, within 50 years, human civilization would move to Mars.

Living on Mars

From the start, moving humanity to Mars had as its central purpose the ability to acquire a greater understanding of the universe, by creating a multi-planet home for humanity. For this reason, scientists explained, there could be no thought of trying to “save money,” by setting up an outpost, or an Antarctica-like base-camp on the Red Planet. A science city was designed, with a sufficiently large population, which is now approaching half a million, to support not only the scientific staff and facilities of Kepleropolis, but, eventually, to create an independent new world, as the jumping-off point for developing the further reaches of the Solar System.

Scientists and engineers were optimistic that they could solve the technical challenges to get man to the outer planets. But medical professionals were not convinced that men and women could safely *live* there. They were unsure of how the human body would adjust to the one-sixth gravity of the Moon, or, later, the one-third gravity of Mars...

For decades, scientists had worked within their different medical specialties to find preventive and palliative measures to combat each one of the body's adjustments to microgravity. But this approach left the traveler ingesting a pharmacy-worth of drugs, sometimes with counteracting effects, and spending many boring hours on treadmills.

Then, about 20 years ago, it dawned on the engineers who were developing new exercise equipment, that before returning to Earth, orbital and Lunar citizens could combat just about *all* of the debilitating effects *at once*, by simply spending time in a variable-gravity Lunar centrifuge!...

In late 2018, after new laboratory modules, more advanced equipment, nuclear power supplies, and six additional crew members had been added to the ISS, a proposal that had been made in the 1960s by space visionary Krafft Ehrlicke, came to fruition.

It had occurred to Ehrlicke that the adaptation to microgravity which was detrimental to the health of Earth-returning crew members, could be *therapeutic* to whole groups of people, for whom Earth's 1-gravity was a burden. This included

those suffering from circulatory ailments, where the removal of gravity could lessen the workload for the heart...

Life in microgravity meant that many of the physical infirmities of old age were no more. The Earth-orbital population grew by leaps and bounds, as seniors moved out of nursing homes on Earth (which, in any case, had become more like hospices, where people were sent to die), and took up residence where they could live comfortably and work productively, while looking down at their home planet, from 250 miles up.

But there was one very serious and potentially life-threatening biological hazard in space that was not so easily resolved: exposure to radiation.

In low-Earth orbit, the Van Allen belts deflect harmful radiation, protecting crews. And on planetary bodies, there is no lack of material to shield people, plants, and animals from the constant bombardment of cosmic rays and solar particles and radiation. The first extraterrestrial living quarters were simply covered with Lunar and Martian soil. More recently, new materials have been developed to blanket the cities, which can filter out damaging rays, while letting in natural light.

But what about the radiation that crew members would be exposed to during the trip to Mars, navigating through up to 50 million miles of radiation-soaked interplanetary space?...

The solution ... was [to] avoid exposing the travelers to dangerous doses of cosmic radiation, by getting to Mars as quickly as possible.

Getting to Mars

Today, families of vehicles navigate the ocean of interplanetary space around the clock, traveling between the Earth, the Moon, and Mars. Only a few miles from downtown Kepleropolis is the Interplanetary Space Launch Center. The space port is responsible for coordinating the vehicles arriving and departing the Red Planet, similar to the function of a busy airport on the Earth...

What made this routine personal contact between the planets possible? It was changing the relative relationship between space and time. Conventional rockets bring people to Earth-orbit in eight minutes, and to the Moon in two days. Extend that technology to Mars, and the trip could take seven or

more months. But today, to traverse the tens of millions of miles to Mars, takes the same time as it does to go to the Moon! (See: <http://www.onorbit.com/node/1276>.)

The development of a fusion-powered plasma rocket has reduced the travel time between Earth and Mars to less than a week. No longer would doctors have to worry about subjecting crews to weeks, or months, of damaging radiation, or the debilitating effects of weightlessness.

The creation of the fusion rocket can be largely credited to the talent and perseverance of Dr. Franklin Chang-Diaz...

Why Fusion?

When it comes to rocket propulsion, the hotter, the better. The efficiency of the rocket engine increases, as the temperature and velocity of the propellant pushed out the rear increases. And the energy produced by the fusing of light ions is orders of magnitude higher than that of any other energy source that has so far been developed...

Parallel to the development of the plasma rocket technology, there was a crash effort to develop a multi-megawatt space nuclear fission plant. This technology had shown great promise decades earlier, but had been abandoned in the early 1970s, in the United States, when there was no plan to go to Mars, and in the early 1990s in Russia, after the collapse of the Soviet Union...

In 2030, a revolutionary 200-megawatt nuclear-powered VASIMR rocket got its first test run in Earth orbit. The nuclear energy source used was an improved version of the Russian Topaz reactor from the 1990s. Just four years later, nuclear-propelled cargo ships were making regular runs between the orbits of the Earth and the Moon. Not long after that, ships were delivering cargo from the Moon's orbit, to that of Mars—in only 39 days. Interplanetary commerce had become a reality...

Throughout human history there have always been naysayers and pessimists. The establishment of the city on Mars is just the most recent proof, that the human spirit can overcome any crisis: that by marshalling his unique creative abilities, man discovers the laws of the universe, and then shapes the universe to the betterment of all mankind.

Letters



Free Energy? It's a Fraud!

To the Editor:

Re: "The Astounding High Cost of 'Free' Energy" (www.21stcenturysciencetech.com/Articles%202008/Energy_cost.pdf): You need to think outside the envelope... Start with Nicola Tesla.

www.metacafe.com/watch/915226/free_electricity_from_thin_air/

Thomas Lombardi

Laurence Hecht Replies

The video in your link is a fraud. The work done by electricity is not measured in volts but in watts, which are volts times amps.

If you think of electricity like water flowing through a wire, the voltage is like the pressure and the current (amperage) is the amount of liquid flowing. You can have a lot of water pressure passing through a pinhole, but it will take a long time to fill up your coffee cup.

That is the situation in the demonstration. If the energy of the free radio waves in the air were significantly higher, they would be dangerous to us.

If he had turned the multimeter dial over to amps, you would have seen that the reading was so low that there was scarcely a few milliwatts (thousandths of a watt) available. You can buy a million times that from Con Edison for about 12 cents an hour. The cost of charging your cell phone is less than a penny, thanks to our power grid.

Did the fellow in the video actually charge the cell phone with the so-called free energy? No. He only showed that there was enough power to activate the screen icon on the cell phone. This takes very little power.

Why do you suppose the author of the video failed to point this out?

Do you think you could actually charge a cell phone this way? Try it. Then write me back in two weeks, and tell me



PRNewsFoto/Acciona

There is no "free energy": Here, Acciona's Nevada Solar One concentrating solar power plant, the world's largest, produces less than 15 megawatts of power, averaged over the course of a day.

if the power from this free energy exceeded the discharge rate of the battery.

Next consider that we are not talking about running cell phones, but powering an industrial society.

The Global Warming 'Debate'

To the Editor:

I was looking at your website hoping to find more on the global warming debate.

I applaud sensible discussion about global warming. I have a technical, tertiary education, but will immediately admit up front that I am not a climate scientist. The more I learn the more I realize I don't know.

I try not to come to the debate from a position. Rather, trying to extract evidence from opinion. So I don't have 'a position.'

What does concern me is the attitude both sides of the debate have about the other. Clearly there are some well-respected scientists on both sides of the argument who push the evidence for and against.

But there are also a whole swag of other people, some scientists also, again on both sides, who argue from a position and a conviction, rather than accepting that the science either way is not certain. Each side claims the other is stupid, extreme, has a vested interest, etc., etc.

Surely we should all be concentrating on the science and trying to find out more. Not knocking those who we see as being 'on the other side.' Sadly, the whole debate has degenerated into a

silly game of point-scoring.

I think that the many websites who push for either side of the argument could help here by refraining from personal attacks; from claiming that views of others are 'stupid,' or based on lies. It really doesn't help.

Why don't you all concentrate on the science and help to educate us rather than simply adopt an adversarial position?

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Index for 1988-2005 available on website

Marjorie Mazel Hecht Replies

Unfortunately, the political agenda behind global warming has made civil debate or even discussion of the science nearly impossible, even among scientists. The fact is that the manufactured issue of "global warming" is intended to kill people, lots of people. For documentation on this genocidal intent, see "Where the Global Warming Hoax Was Born," www.21stcenturysciencetech.com/Articles%202007/GWHoaxBorn.pdf.

In climate (and in other areas), science no longer searches for "truth" and causality. Instead we have "consensus" and computer models.

We'll see what happens to the global warming agenda as the economic collapse deepens.

On Bloated Windbags

To the Editor:

When, in your article ["Deepest Solar Minimum in Nearly a Century: Goodbye Global Warming," by Gregory Murphy and Laurence Hecht, www.21stcenturysciencetech.com/Articles_2009/Solar_Minimum.pdf] you engage in emotionally saturated rhetoric such as:

"But the bright side may be that such bloated windbags as Al Gore and his leaner companion James Hansen who have led His Royal Consort Prince Philip's genocidal global warming promotion, will finally be silenced."

... in a magazine that espouses to clarify 21st Century science and technology, you undermine the credibility of anything that you may have to say in defense of your own opinions supported by the very nebulous "many specialists" (who apparently speak without name or credentials).

As I am about to send this email I am musing (ha ha) about the colourful language that you reserve for the opinion of this sender.

Wilf Wenzel

The Editor Replies

We usually take letter-writers seriously, so don't worry. If you read other articles on the website, you can find documentation of the Malthusian intentions behind "global warming" and the outright genocidal statements of



NASA

A mosaic image from the Hubble and Spitzer telescopes and the Chandra Observatory of the starburst galaxy, Messier 82 (M82). The galaxy has a bright blue disk, webs of shredded clouds, and fiery-looking plumes of glowing hydrogen blasting out of its central regions.

Prince Philip. You can also find articles by various specialists that include their credentials.

The point we are making is that the science indicates cooling and a new Ice Age, and that the alarmism is a hoax, which, if not stopped, will result in the death of millions of people. Those who promote this deliberate hoax deserve to be ridiculed.

(Personally, I find "bloated windbag" to be an apt term in describing Al Gore!)

Hubble Telescope Remembered

To the Editor:

My hope is that David Cherry was a young man when he wrote the outstanding article about the Hubble Telescope in the Spring 1994 issue of *21st Century* magazine, and that he is still involved. My copy of the magazine has some yellow cast to the pages but the story is real. It was real then and it is real today as the astronauts return from the space mission

to up-date the Hubble.

I hope your next article is soon and that you will let me know what issue will carry the article.

As a bit of a sidelight, back in 1994 I sat in a meeting with two men from Danbury Instruments and the one man told us he was responsible for the polishing error on the original "blank."

Then some time later I saw an article that told of a back-up cast blank for the mirror and the value of that second blank was \$7 million (back then). It would be interesting to learn what has happened to that second cast glass blank.

Now it's Hubble in HD . . . LOL

Mike Quaranta

The Editor Replies

Yes, David Cherry is still around and copies of the Spring 1994 issue with his article, "The Hubble Space Telescope: Bringing the Cosmic Past to Light," are available at \$5 each.

We have asked him for a follow-up.

The Secret of the Supercentenarians

by Rick Sanders

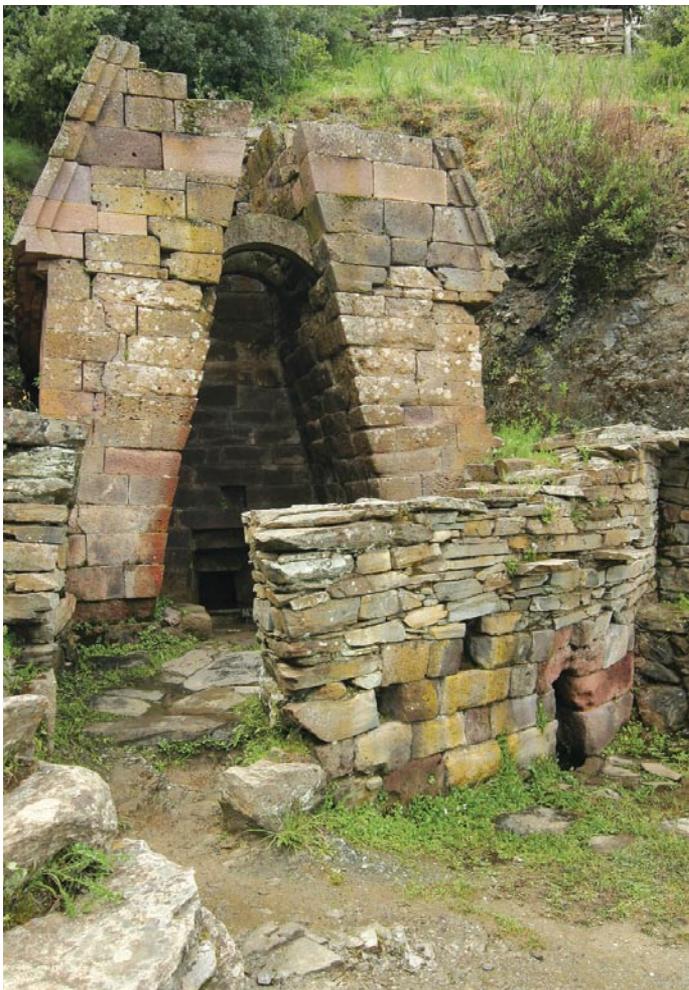
How is it possible that there are pockets in the world where men and women live to be as old as the hills, and nobody has found out the secret? In some of those parts they don't even notice when you get to be a mere hundred, but they do throw a good party when you reach 110 (supercentenarian). Some serious health professionals have been trying to figure this out, but few seem to have gotten past the speculations of "yoghurt," "genetics," "fresh air," and "hard work."

As you'll see, I've uncovered more than enough clues for serious researchers to get to the bottom of this. And the clues were lying right in front of my eyes, just like Edgar Allan Poe's purloined letter.

21st Century had stimulated my interest in radiation hormesis a while back.¹ Then some health problems of people around me really got me going on this research.

Here's how I proceeded. Since in my ignorance I thought that all the famous "Shangri las" were in the mountains, my first hypothesis was the longevity was the result of hormesis which came with the high altitude, because the protective blanket of the atmosphere is much thinner at higher altitude, and there's a lot more background radiation than in low-lying coastal areas.

1. For example, see "It's Time to Tell the Truth About the Health Benefits of Low-Dose Radiation," by Jim Muckerheide, *21st Century*, Summer 2000, <http://www.21stcenturysciencetech.com/articles/nuclear.html>



The ancient Su Tempiesu sacred well in Sardinia: A clue to the area's large centenarian population?

This assumption is more than plausible: In the United States, for example, where these kinds of things are measured and recorded, studies show that cancer rates for people living along the coast are much higher than for those lucky folks who live in the mountains.

So I looked at a few of the relevant mountainous places where there were an unusually high proportion of centenarians (Sardinia, the Caucasus, Ecuador, among others), and that all seemed to fit. But there was one snag: At least one place, in Japan, had a number of

centenarians much higher than the average, but it was located near sea-level.

An anomaly. So I started a little cross-gridding. Was there anything they had in common? It was obviously not genetics, nor diet. With such widely diverse groups, some ate mostly vegetables, while others, such as those in the Caucasus, ate a lot of animal fat.

Then I investigated what the tourist brochures said about these areas, reasoning that the locales would have to say something special about themselves in order to attract visitors. There, I thought I'd find the clue.

I went on an Internet search. One of the oldest men in the world lived in Japan, Yukichi Chuganji (March 23, 1889-Sept. 28, 2003), who passed away at 114 years and 189 days. Where did he live, and what is special about the place? Chuganji was a retired silk-worm breeder who lived in the city of Ogori, Fukuoka prefecture, near the center of the island of Kyushu, Japan.

Why should tourists come to Fukuoka? It is virtually at sea level, but *it has a natural hot spring*.

One anomaly in Japan, not to be skipped over, is that 42 percent of Japan's centenarians live in Okinawa. Although Okinawa has no hot springs, it does have "sacred springs," and the background radiation of these springs is considered high enough by those who know how to measure it (the U.S. military), that they spent a lot of money (needlessly) on radon mitigation.

Other data showed a radiation level

in Okinawa's water of 35.7 Bq/l. This means that it has high enough levels of radioactivity, so that if you were to drink the water all year, you would be roughly at the therapeutic levels of a two-week stay at the world-famous spas.

Next I checked out Hainan, China, which is 6,000 feet or so above sea level, where people lead healthy and long lives. Most interesting is the Nanshan Village at the foot of Nanshan Mountain in Sanya. The village has a population of more than 4,500 people, most of them working the land. Among the elderly, 10 are more than 100 years old, and 90 are more than 80.

There are more than 300 hot springs in the area, and the tourist brochures say that the Nantian Hot Spring is famous for its therapeutic action, because its water is said to contain trace elements.

More Hot Springs

And then I looked at the famous Caucasus Mountains: No pollution, hard work, and clean water? Is it the yoghurt? No! The oldest man there said he wouldn't touch the stuff. This was Mirzahan Movlamov, who turned 121 in 1998. It certainly is not ethnicity: the centenarians include Russians, Georgians, Armenians, and Turks; about 4,000 in the Caucasus, and 1,844 of them in Georgia.

Hot springs? I could not find out whether or not there were hot springs right where the centenarians were living. However, it's a pretty safe bet that the springs are there: The name of Georgia's capital, Tbilisi, means "hot springs," and by the 12th Century there were over 60 thermal baths in Tbilisi.

Another famous, and controversial, place is Vilcabamba, Ecuador. In 1969, Miguel Salvador, an Ecuadorian heart specialist, examined 338 men, women and children chosen at random in the town of Vilcabamba. He found that they were free not only of arteriosclerosis and heart disease, but also of cancer, diabetes, and degenerative diseases such as rheumatism, osteoporosis and Alzheimer's.

But what impressed Dr. Salvador most were the numbers of old people, and the fact that they were all extraordinarily fit. He found that one in six people in Vilcabamba was over 65, twice the U.S. average and five times that of the rest of Ecuador. A 1971 census confirmed Salvador's observations: Out of a total

population of 819, nine were centenarians. In comparison, the United States at the time boasted only three centenarians per 100,000.

Some people attribute this to the special properties of the valley's hot springs. Vilcabamba means "Sacred Valley" in Quichua.

And now for the incurable romantic: A male/female ratio of centenarians of 1:1 exists in in Sardinia, Italy. Some 135 people per million, live to see their 100th birthday on Sardinia, while the Western average is near to 75. Centenarians are scattered around all of the island's 377 municipalities, but in the mountainous interior around the Nuoro province, the prevalence of centenarians is striking: 240 in every 1 million people. While in other countries there is an average of five women to one man who reach 100, in Sardinia overall, the female-male ratio is only two to one. And in the province of Nuoro, the number of men reaching 100

is equal to the number of women who do so.

Among its Methuselaha, Sardinia recorded Antonio Todde, the world's oldest man, who died less than 3 weeks away from his 113th birthday. Another super-centenarian, Giovanni Frau, died on June 20, 2003, at the age of 112.

Sardinia was famous for its hot springs in Roman times, many of which have fallen into decay, but there is at least one, about 10 miles from the town of Nuoro, the capital of the province of the same name, which is described for tourists as follows:

BENETUTTI Aurora Hot Spring Resort. Indicated in the treatment of gynecological disorders, respiratory tract ailments, forms of rheumatism and arthritis, skin ailments. Type of water: sulfur-bromine-sodium chloride-radioactive. Types of treatment: aerosol, mud baths, insufflation, ozone vapor, baths.

QED.

The Benefits of Low-Dose Radiation

Lest our readers think we believe in magic potions, there are many well documented studies about the benefits of low-dose radiation. If certain levels of radiation increase longevity, this will be due not only to the general hormetic benefits, but also to its decreasing the incidence of some of the main killer diseases, like cancer.

The following items are excerpted from *Underexposed: What If Radiation Is Actually Good for You?* by Ed Hiserodt (Little Rock, Ark.: Laissez Faire Books, 2005).

- A study done at the hot springs in Misasa, Japan, with high radon levels, compared lung cancer there and in another area where there is a spring with minimal waterborne radon. The lung cancer incidence for Misasa was 50 percent of that of the low level radon areas, and mortality from all kinds of cancers was 63 percent of that of the low level radon area.

- In laboratory studies of leukemia, mice exposed to between 20 cGy and 130 cGy of ionizing radiation, had a 20 to 30 percent drop in mortality from leukemia compared to controls.

Studies of workers in the nuclear industry show the same type of results.

- In Ontario, Canada, cancer mortality for nuclear plant workers was 80 percent lower than that of other members of the labor force.

- Los Alamos National Laboratory workers who had been exposed to 100 millirem, had an overall rate of cancer mortality that was only 58 percent that of controls. The only cancer mortality that exceeded the controls was brain cancer, which exceeded controls by 17 percent. Other cancer categories varied from 56 to 75 percent of that of the controls. No thyroid or bone cancer mortality was found in exposed persons.

- Another study of plutonium workers at the Rocky Flats plant showed that overall cancer mortality was lower than that of the general population: Deaths from cancer among 7,113 plutonium workers, between 1952 and 1979, were 64 percent of the number expected in the general population.

—Rick Sanders

Not so very long ago, the British colony of Malaya was stuck at the productive level of Middle Ages, providing the British Empire with tin and rubber for its factories at rock bottom, “free trade” prices. It was part of the grand 1,000-year colonial vision of the British Empire, upon which the Sun never set—and the wages never rose. It meant a meager existence and no future except servitude for the armies of plantation workers and their families.

However, World War II and Franklin Roosevelt’s America greatly weakened and almost finished off the British Empire, and independence movements flourished in the colonies. In 52 years of independence from the British, Malaysia has successfully urbanized its population, industrialized its economy, and inspired other less developed nations to do the same. For 22 years, Dr. Mahathir led the nation as the father of development, famously telling poor countries to look east not west, and to buy British last. He championed the rights of the underdog nations.

Now Malaysia is making serious preparations to go nuclear with the positive announcement of a nuclear policy by its new Prime Minister, Najib Rasak, who set 2025 as the date for Malaysia to add nuclear power to the electrical grid. Najib was inspired by his visit to an exhibition of South Korean nuclear reactors and a nuclear program which allowed its population to leapfrog from a war-destroyed country in the 1950s, to become a high-wage industrial giant.

A Blow to the Greens

Najib’s virtual overnight conversion to nuclear energy was a victory for Malaysia’s nuclear and scientific community that had united to patiently educate the public on nuclear’s necessity and safety. But it was a bitter blow to Malaysia’s green environmental movement, which had

VIEWPOINT Malaysia Is Going Nuclear!



by Mohd Peter Davis

long dominated the newspapers and was rejoicing in President Obama’s love affair with primitive green technology.

Suddenly, the greenies found they had lost the intellectual battle. Their imported anti-nuclear fear campaign, based entirely on tired old anti-

development propaganda about Chernobyl, nuclear waste, and the anti-development beliefs of the World Wildlife Fund and Greenpeace, had been effectively exposed in a spirited counter offensive by senior scientists and engineers. The nuclear community finally declared war on this evil greenie nonsense; they wrote pro-nuclear articles for the newspapers and made themselves available for interviews.

This struck a chord with the population that had been hit by 40 percent increases in petrol prices, and it also prepared the ground for the pro-nuclear announcements by the Prime Minister and both the Science and Environment Ministers. Instead of reiterating the usual ideological hype that man is destroying the planet with sinful carbon dioxide and global warming, the Ministers noted the simple reality that Malaysia was already importing the coal for its power stations and would run out of oil and gas within 10 to 20 years. If the electricity supply were disrupted, it would be back



Courtesy of Nuclear Malaysia Agency

Malaysia’s Triga test reactor at the Bangi Headquarters of the Nuclear Malaysia Agency. The 1-megawatt Mark II Triga reactor began operation in 1982.



Courtesy of Nuclear Malaysia Agency

The radioisotope production facility at Malaysia's Triga nuclear research reactor. Malaysia has nuclear engineers and scientists, but will need to train the younger generations to prepare for a nuclear economy.



Courtesy of Nuclear Malaysia Agency

Headquarters of the Nuclear Malaysia Agency at Bangi, Malaysia. Malaysia's nuclear community is campaigning to let the population know that nuclear power is key to their prosperity.

to the well water and gas lamps of the colonial days and early decades of independence.

Scientists, engineers, and professionals—all members of the Malaysian Nuclear Society which was celebrating its 20th anniversary—gave the population a birthday present by ridiculing the green technology that was supposed to replace fossil fuels. Solar panels with rechargeable batteries are great for street lamps and holiday islands, but for factories and modern society? Aren't windmill farms a little bit stupid for Malaysia, known by centuries of sailors as the land of no wind?

Imported Opposition

Clearly, the natives were getting restless, indeed insolent; the local anti-nuclear greenies were out of their depth and needed help. It was time to send Malaysia a sharp rebuke from the well-funded, royal-sponsored green environmental movement. But all they could muster was an opinion piece in the Malaysian *New Straits Times*, which re-warmed an anti-nuclear mantra published a year earlier in the *Jakarta Post*, when Indonesia had the audacity to show enthusiasm for going nuclear.

Both articles came from the same

puffed-up American professional green environmentalist, one Benjamin Sovacool, a young expert in "energy policy" no less, who had moved from the United States closer to the action in South East Asia—the British Empire's safe house at the Lee Kuan Yew School of Public Policy at the National University of Singapore.

This green-behind-the-ears environmentalist was telling sovereign Asean nations, with democratically elected governments, why they should definitely not go nuclear. What the young energy policy expert did not mention, of course, was the huge energy deficit in the 10 Asean nations. With nearly 10 percent of the world's population, these nations need 18 times more electricity than currently produced to catch up with the modest per capita electricity production of their near neighbor, Australia.

On this scale, the poorest Asean nation, Cambodia, trapped in the stone age, needs 900 times more electricity production to enjoy a decent standard of living. Since Thailand, the Philippines, Vietnam, and (heaven forbid) Myanmar are also taking the nuclear road, they too should soon expect the same re-warmed rebuke in their lead-

ing English newspapers from the young American greenie, Dr. Benjamin Sovacool.

A consensus is growing among Malaysia's considerable number of highly trained nuclear scientists, engineers, and professionals, some now retired and many close to retirement, that the time has come to simply ignore the ignorant flat earth green environmentalists. Instead, the nuclear community needs to concentrate on educating the public, including politicians and top public servants. The truth of the matter is that nuclear energy is by far the safest energy technology ever invented by mankind, without which Malaysia's youth (some 50 percent of the population are under 23 years old), will have a future no better than colonial plantation workers.

The anti-nuclear greenies, including Professor Sovacool, should practice what they preach and go back to nature without electricity and learn how to tap rubber and harvest palm oil fruit bunches for a living. The rest of us want to build the future.

Mohd Peter Davis is an honorary visiting scientist at the Institute of Advanced Technology, Universiti Putra Malaysia.

American Chemical Society: Milking Soy Beans for Sunbeams

by Gregory Murphy

Attending the American Chemical Society's 238th National Meeting and Exposition in Washington, D.C., Aug. 16-20, I was overwhelmed by the level of environmental insanity, aimed at shutting down scientific progress and committing genocide in the name of saving the planet. One exception was a session on the National Ignition Facility inertial fusion project, which seemed to be the ACS's one concession to advanced technology.

There was a palpable sense of unease about the conference's focus on national security and green chemistry, as I learned in discussions with scientists attending the conference. Several scientists told me that in light of the economic breakdown, this conference should have had a focus on real scientific progress and not appeal to the green job mania. Often these comments were sparked by a discussion of the Mars project promoted by Lyndon LaRouche. The Mars prospective was an effective antidote, injecting real optimism into the anti-science atmosphere being projected by the American Chemical Society. Sadly, the NASA exhibit at the conference was dedicated to "global warming," without mention of advancing the space program.

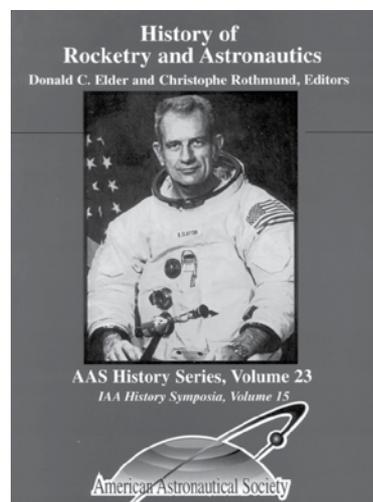
A group of scientists is fighting the leadership of the American Chemical Society on the insane position of the organization on man-made global warming. Chemist Peter Bonk is circulating an open letter to the president of the ACS, which so far has about 100 signers. (To sign, or get more information on the open letter, contact him at peter.jbonk@gmail.com).



Green energy in Gulliver's time: An illustration of the Academy of Lagado, where a scientist is "extracting Sun-Beams out of Cucumbers ... to warm the Air in raw inclement Summers."

The Jonathan Swift award for the most silly idea at the conference goes to the group of scientists working on extracting enzymes from soybeans to produce luminescence chemicals that can make items glow in the dark. This is a modern-day version of the extraction of sunbeams from cucumbers, as depicted by Swift in his *Gulliver's Travels*. At the ACS meeting, it was highlighted as a "green chemistry" success story.

Sadly, research money is being directed to anti-scientific research like this soybean milking, instead of real scientific research geared towards discovering the next universal physical principle that will advance human civilization.



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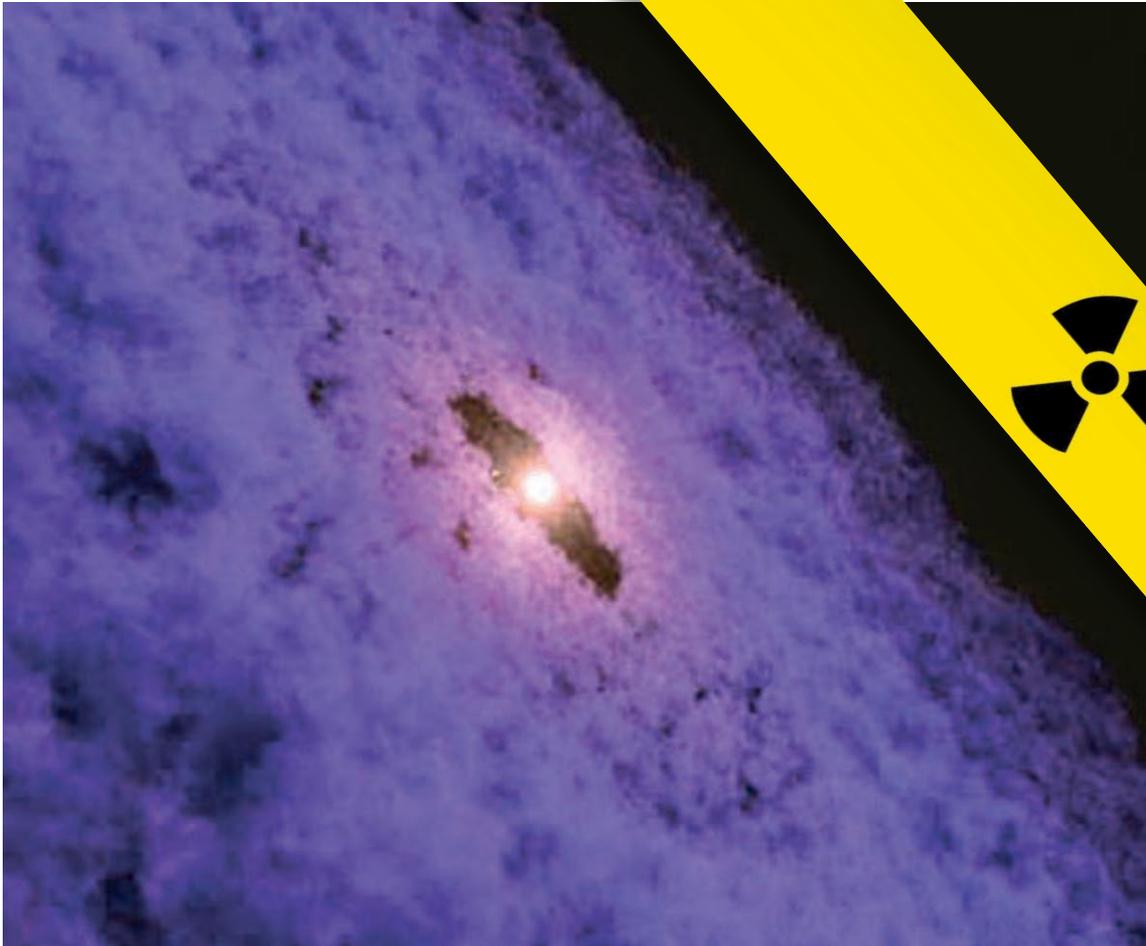
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An expanding halo formed by X-rays coming from the neutron star SGR J1550-5418, as captured by the Swift satellite's X-Ray Telescope (XRT). The halo forms as X-rays from the brightest flares scattered off of intervening dust clouds. For a video of the event, see http://science.nasa.gov/headlines/y2009/10feb_sgr.htm

NASA/Swift/Jules Halpern, Columbia University

SCIENCE FOR LEGISLATORS

Is the Fear of Radiation Constitutional?

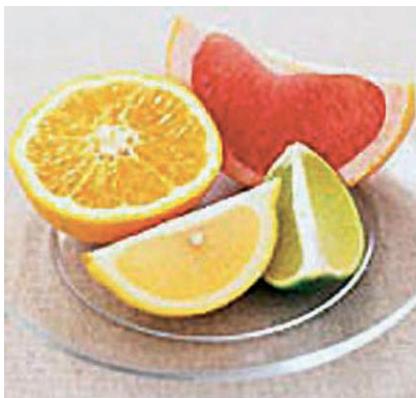
by Laurence Hecht

A primer to help the present majority of misinformed policymakers and citizens to learn the truth about radiation, and the wonderful power for good that it holds out for mankind.

A recent burst of high-energy X-rays and gamma rays from the Southern Hemisphere constellation Norma, should serve to remind us that the current widespread fear of anything to do with radiation is much out of harmony with those *Laws of Nature and of Nature's God*, famously invoked in our Declaration of Independence. As the rights defined in that document stand, along with our Constitution, as twin pillars of our nation's fundamental law, the question arises: Should not the incitement of such fears against a natural and necessary phenomenon, with

the clear intent of misleading a frightened populace down a path of national self-destruction, rise to the level of a Constitutional violation? However that point may ultimately be decided at law, our urgent aim here is to aid that present majority of misinformed policymakers and citizens in general, to learn the truth about nuclear radiation, and the wonderful power for good that it holds out for mankind.

What makes this task urgent is the present, rapidly accelerating economic collapse. Denial of the clear immediate and future benefits to be derived from knowledge of the atomic and subatomic realms (a denial due in significant part to the ignorance and prejudice of the audience we now address), constitutes a serious and immediate threat to the survival of our own people as well as those of other nations.¹ Unless those widespread fears and prejudices respecting nuclear radiation are soon reversed, the threat to human civilization as a whole will



The human body is full of radioactivity—all natural—from the foods we eat, like citrus fruit or bananas (sources of potassium-40 and carbon-14). Edward Teller used to joke that a man would get more radiation from sleeping with two women than living next door to a nuclear plant.

be catastrophic. The currently popular proposals to increase our reliance upon so-called renewable energy sources, such as wind and solar, demonstrate a level of incompetence respecting the elementary principles of physical economy, such as to doom to inevitable failure whatever other well-intentioned, even courageous, measures might be forthcoming from the present Administration. Motivated by such urgent considerations as these, we are convinced that the serious reader, even without prior familiarity with the subject matter, can gain a working grasp of the essentials of these matters, and overcome those ill-founded prejudices he or she may have previously accepted without examination.

Now, to the galaxy. As detected by NASA's Swift X-ray Telescope, a small object about 30,000 light years distant,

lying within our Milky Way galaxy in the direction of the constellation Norma, began a series of forceful eruptions on Jan. 22, at times producing over 100 X-ray flares in as little as 20 minutes. The most intense of these were estimated to contain more total energy than the Sun produces in 20 years! In addition, the new Fermi Gamma-ray Space Telescope has detected 95 bursts of radiation from the same object in the gamma ray band of the spectrum, the same general type of radiation that comes from radioactive objects on Earth. The object, located about 30,000 light years away, is of a type known as a neutron star.

Despite the large numbers, there is nothing that unusual about these events. Bursts of radiation of this power, and far greater, are normal occurrences in the universe. Much of it ends up in our bodies. Another flux of radiation known as

cosmic rays (we shall explain and distinguish the different common types of radiation shortly), is bombarding Earth's atmosphere continuously. This type of radiation consists mostly of very energetic protons (hydrogen nuclei), as well as the nuclei of heavier elements, all the way up the periodic table. The determination of the content of cosmic rays was an important focus of physics for the first half of the 20th Century.

Colliding with atoms in our atmosphere, the cosmic rays transform the elements in a way similar to a particle accelerator, creating many radioactive by-products. Included among these is carbon-14, a radioactive isotope of the element carbon which is found in every molecule of our bodies. Green plants respire this naturally produced carbon-14, and use it to grow. When we eat vegetables, or the meat of animals

1. Such potential benefits include, but are not limited to: 1) nuclear-powered generation of electricity and industrial process heat; 2) production of hydrogen-based fuels for replacement of petroleum; 3) production of fresh water by nuclear-powered desalination; 4) nuclear medicine; 5) development of new materials and industrial processes through nuclear research; 6) research and development up to and through the engineering stage of more advanced forms of nuclear energy, including fission-fusion hybrids, and thermonuclear fusion devices of both the inertial and magnetic containment design; 7) research into anomalous phenomena in the subatomic domain, including but not limited to (a) "cold" fusion (low energy nuclear reactions); (b) anomalous coherence phenomena, including self-organizing phenomena in plasma; (c) non-linear spectroscopy, generally; 8) research into insufficiently explored regions of the biotic domain, including, but not limited to (a) biophoton emission and other manifestations of the relationship of life to the electromagnetic spectrum; (b) isotopic anomalies related to living matter; 9) matter/anti-matter reactions.

Radioactive Elements in the Human Body

Radioactive Isotope	Half-Life (years)	Isotope Mass in the Body (grams)	Element Mass in the Body (grams)	Activity within the Body (Disintegrations/sec)
Potassium 40	1.26×10^9	0.0165	140	4,440
Carbon 14	5,715	1.9×10^{-9}	16,000	3,080
Rubidium 87	4.9×10^{10}	0.18	0.68	600
Lead 210	22.3	5.4×10^{-10}	0.12	15
Tritium (^3H)	12.43	2×10^{-14}	7,000	7
Uranium 238	4.46×10^9	1×10^{-4}	1×10^{-4}	3 - 5
Radium 228	5.76	4.6×10^{-14}	3.6×10^{-11}	5
Radium 226	1,620	3.6×10^{-11}	3.6×10^{-11}	3

Source: R. E. Rowland, "The Radioactivity of the Normal Adult Body," <http://www.rerowland.com/BodyActivity.htm>

A conservative estimate of the radioactivity in the human body, showing the isotopes responsible for about 8,000 disintegrations per second. Other sources estimate a total of about 15,000 disintegrations per second.

that have eaten them, and when we breathe fresh air, we take this carbon-14 into our bodies. The carbon-14 present within the average human body is responsible for *more than 3,000 radioactive disintegrations every second*.²

Another naturally occurring isotope, potassium-40, is the most abundant radioactive substance in our bodies, responsible for *4,440 disintegrations per second* inside the average adult. Potassium is an essential mineral for cell function, and with every gram of it that we consume, about 1/10 milligram is the radioactive isotope. We obtain potassium from eating fruits, vegetables, and meats. Potatoes, figs, chicken, hamburgers, citrus fruits, and bananas are all high in potassium-40.

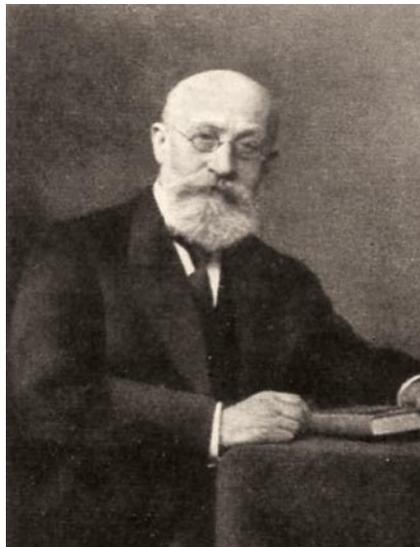
If every radioactive disintegration represents a cancer threat, as so many people have been led to believe, then perhaps we should consider a legislative ban on cosmic rays and orange juice. Or, might it be wiser to first know a bit more about the whole subject?

1. What Is Radioactivity?

Discovery of the Electron and Proton

We shall begin by attempting to understand what we mean by such terms as *radioactivity*, *isotope*, *proton*, *gamma ray*, etc. But first a warning. Most of these and other terms we shall employ here are, properly, not things, but concepts. We may, at times, form visual images of them, but we must remember that not only are they not generally perceptible to our senses, but even if they were, our conception of what they are would never be comprehended by a verbal definition. The same methodological warning applies here as to the inevitable failure of any effort to interpret *natural law* in the manner of the strict constructionist. An infinite number of readings of the Constitution will never yield the intent of the framers, if it is not known through other means. The same applies to the terms employed by science. A true understanding of them can only be gotten by studying and repeating the path of experimental discovery. No deep understanding of science is ever attained by any other means.

And so we proceed. We shall start then with the experimental discovery of the *electron* and *proton*. A central focus of scientific investigations in the 1880s and 1890s was the behavior of gases contained within glass tubes, from which most of the air had been sucked out, and an electric potential



Eugen Goldstein, working at the Berlin Observatory, discovered that when small holes are drilled in the cathode, other rays shoot out from the back, like fiery sparks. He called them Kanalstrahlen, which was translated into English as canal rays.

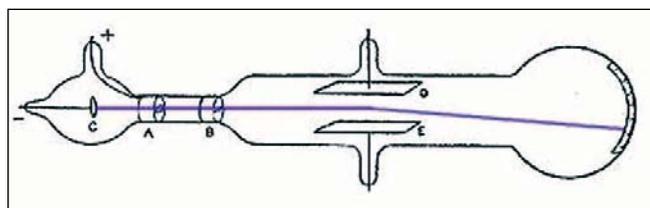
(voltage) excited between metal wires placed at opposite ends of the tube. Depending on the gas or gases left in the tube, a beautiful, fluorescent glow, ranging from coral pink, to pale green, to a deep indigo blue, is observed. The ray seems to originate from the negatively charged electrode (*cathode*) at one end of the tube, hence the name *cathode rays*. However, despite its resemblance to a light beam, it turned out that the colorful ray, unlike an ordinary light beam, could be deflected by a magnet, or by strongly electrified plates placed parallel to the walls of the tube.

A very strange phenomenon is observed when small holes are drilled in the cathode, and it is placed in the center rather than at one end of the tube. It then occurs that in addition to the *cathode rays*, which pass toward the positive electrode, other rays shoot out from the back side of the cathode, like fiery sparks. Because they seemed to originate from the little holes (channels) drilled in the cathode, these were called *Kanalstrahlen* by Eugen Goldstein, who discovered them in his laboratory at the Berlin Observatory in 1886. The term was translated, somewhat over-literally, into English as *canal rays*, though *channel rays* might have been more accurate.

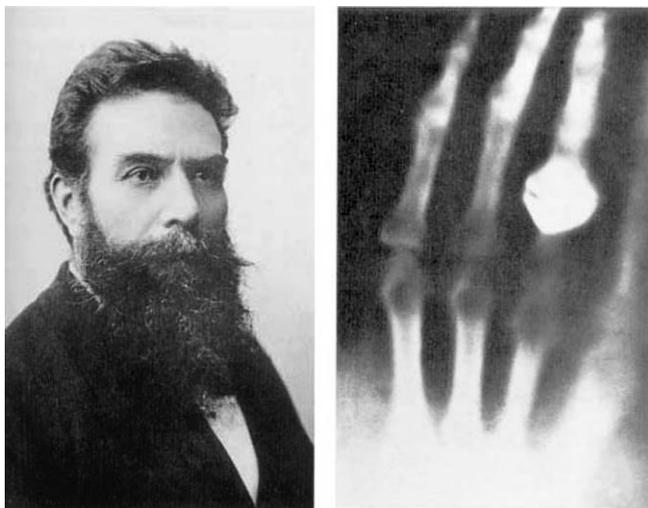
It turned out that, like the cathode rays, the *canal rays* could also be deflected, although in precisely the opposite direction, by a sufficiently strong magnetic or electric field. It was this common property that proved the key to the initial unmasking of both the cathode and canal rays. For in 1896, the assumption was made by J.J. Thomson at Cambridge University's Cavendish Laboratory, that the cathode rays, unlike light beams, actually consisted of tiny electrified particles of negative charge. Wilhelm Wien in Aachen found similar results, and, in 1898, Wien showed that the canal rays could be considered as positively charged electrical particles.



British scientist J.J. Thomson followed up on work in Germany, which had laid the foundations of studies of the negative and positive rays produced in evacuated glass tubes when an electric current is passed through the tube. In his second experiment (below), Thomson showed that a cathode ray was deflected by electrified plates, indicating that it had a negative charge.



2. R.E. Rowland, "The Radioactivity of the Normal Adult Body," <http://www.re-rowland.com/BodyActivity.htm>



Wilhelm Roentgen caused a scientific sensation by his discovery of what he called X-rays in 1895. He was experimenting with gas discharge tubes, and found that they would light up a screen painted with fluorescent material. He discovered that the X-rays could penetrate many materials, including human tissue. Here is his first X-ray picture: his wife's hand, showing her bones and her wedding ring.

By measuring the amount of deflection produced by an electric or magnetic field of given strength upon the two different types of rays, it was possible to compare the bending of the ray to that of a larger body of known charge and mass experiencing the same amount of electric or magnetic force. After all the measurements and calculations were done, it turned out that the *cathode ray* possessed a mass more than a thousand times smaller than that of the least massive *canal ray* (today we know it more exactly as 1,836 times smaller). The least massive canal ray, it turned out, was that produced when the gas in the tube was hydrogen, and by this and other evidence, *canal rays* came to be seen as electrified versions of ordinary chemical atoms (today called *positive ions*).³ The hydrogen ion thus became known as the elementary particle of positive electricity, or proton. The *cathode ray* particle, discovered first, became known as the elementary particle of negative electricity, or *electron*.⁴

3. Remarkably, the tiny mass of the hydrogen atom was already known, thanks to the hypothesis put forward by Count Amedeo Avogadro in 1811, that equal volumes of gases all possess the same number of molecules, and the work of the Austrian physical chemist Josef Loschmidt in calculating in 1865 what this number actually was.

4. The assumption made by the Cambridge scientists, that the cathode rays consisted of particles, was seriously doubted at first by most researchers. However, the experimental results could not be disputed, and the concept of *electron mass* took hold. Later it turned out that there had been some basis for the hesitations, for it was demonstrated in 1926 that the electron did indeed behave like a light wave, in being capable of refraction by a crystal and exhibiting interference patterns, and so the paradox of wave vs. particle was reborn, never yet to be put to rest.

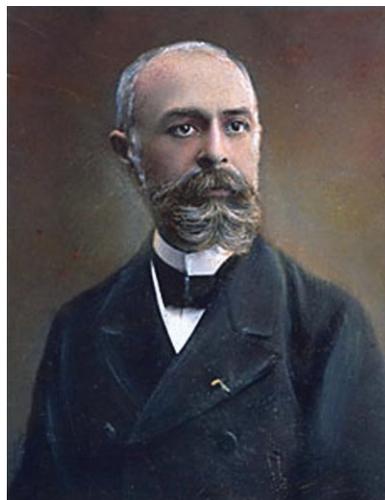
This experimental proof carried out by Davisson and Germer at the Bell Laboratories was confirmation of a hypothesis proposed several years earlier by Count Louis de Broglie. Later it was seen that not only the electron, but also the heavier particles, such as the proton and neutron, showed wavelike characteristics, and from then on had to be thought of in a somewhat ambiguous way as particle/waves.

From X-rays to Radioactivity

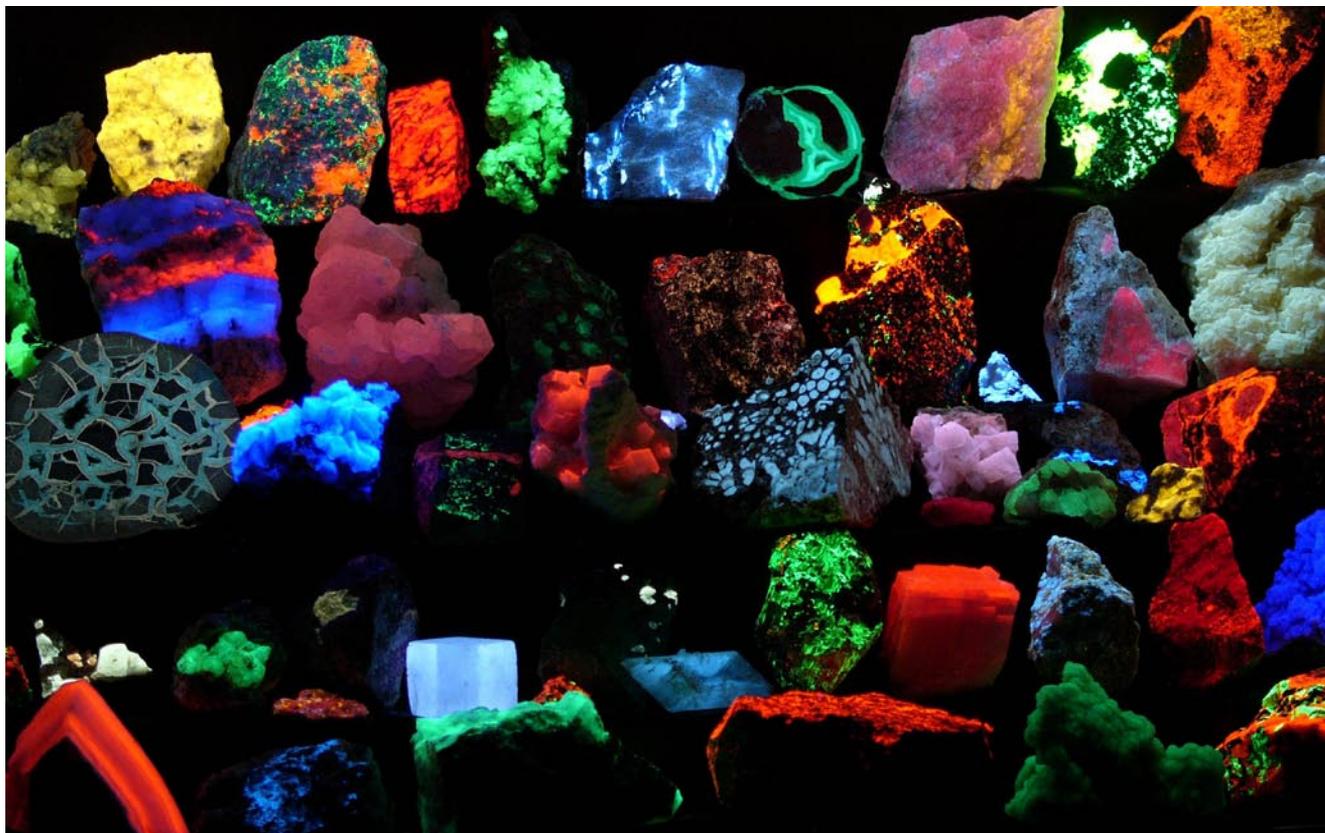
Slightly before the results just reported, a professor of physics at the University of Würzburg made an astounding discovery of both theoretical and immediate practical significance. While experimenting with various types of gas discharge tubes in November of 1895, Wilhelm Roentgen noticed that a screen painted with fluorescent material would light up when the tube was activated. A similar phenomenon had been noted by other observers back to 1875, but Roentgen was the first to thoroughly pursue it. He soon discovered that the rays could penetrate many materials. At the end of two weeks of intensive experimentation, eating and sleeping in his laboratory, he produced the world's first X-ray picture. It was an image of his wife's hand, showing the bones of the fingers and wedding ring.

Roentgen's discovery was quickly made known worldwide. Just weeks later, physicians in Dartmouth, New Hampshire, used photographs taken with an X-ray tube to set the broken arm of a boy. Roentgen also discovered in this early period that lead served as an effective shield against the radiation, and he used sheets of this metal to protect himself from direct exposure. Roentgen summarized his discoveries in a paper in 1896 calling them "Radiation X," or X-rays. They are also known as Roentgen-rays.

Excited by Roentgen's discovery, just months later Henri Becquerel in Paris discovered what was soon to become known as *radioactivity*. He found it while looking for something else. Henri Becquerel was the third member of his family to occupy the chair of physics at the Museum of Natural History in Paris. His father, Alexandre-Edmond Becquerel, had been the leading authority on the phenomenon of *luminescence*, the property of certain materials to glow in the dark, and Henri himself had written 20 scholarly papers on the topic. Observing an experimental apparatus for producing X-rays which was exhibited at a weekly meeting of the French Academy of Sciences, Becquerel thought that the unusual radiation might emanate from a part of the glass vacuum tube which glowed when struck by the cathode rays. He suspected that luminescence might be a prerequisite for the production of X-rays, and he thus began to examine various luminescent materials for X-ray production. Many rocks and minerals can be made to glow in the dark after exposure to sunlight, and others, by immediate exposure to ul-



Henri Becquerel, inspired by a demonstration of Roentgen's rays, suspected that luminescence might be involved, and thus investigated rocks and minerals that were known to glow in the dark after being exposed to sunlight. He inadvertently discovered that uranium rocks produced rays even when they were not exposed to sunlight!



Hannes Grobe

A collection of various fluorescent minerals under UV-A, UV-B, and UV-C light. At first, Becquerel thought luminescence might be the origin of X-rays. For identification of the minerals, see upload.wikimedia.org/wikipedia/commons/b/b5/UV_minerals-des_hg.png.

traviolet light. Today these phenomena are termed *phosphorescence* when the light emission is delayed, and *fluorescence* when it occurs immediately; *luminescence* is the general term.

Among the materials Becquerel examined for X-ray production, were rocks containing a uranium compound known to be phosphorescent. His procedure was to expose the uranium rocks to sunlight, then wrap them in black paper, place them on top of a photographic plate, and store them in a dark place for a time. If the photographic plate became exposed, he might assume that X-rays were somehow being generated, and penetrating through the black wrapping paper onto the photographic plate. Sometimes he placed a coin or other object next to the rock sample, in order to see if its outline would be imaged on the photograph. Samples of the uranium-bearing mineral potassium uranyl sulfate showed an exceptional capability to penetrate the black paper and leave an image on the photograph.

By chance, a spell of bad weather caused him to leave some of the rocks in a drawer, wrapped in black paper next to photographic plates, but not exposed to sunlight. When his curiosity provoked him to develop these, he found that they too showed a photographic image. Yet the rocks had not been stimulated to emission by previous exposure to sunlight.

Within a few months, Becquerel had become certain that previous exposure to sunlight was not required to cause the rocks to radiate. Furthermore, even samples of uranium compounds that did not exhibit any phosphorescence were able to

produce an image on the photographic plates. Finally, experimenting with a sample of nearly pure uranium metal, he found the power to expose photographs was greatly increased. That was convincing proof that the radiations were not related to luminescence, but were a property of the element uranium.

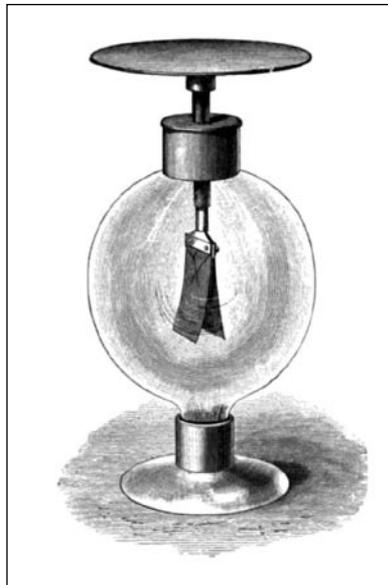
It was now late Spring of the year 1896. News of Becquerel's experiments travelled fast, and created a great conundrum among chemists and physicists. Where did the power of the rays come from? In phosphorescence, the energy for the light production was seen as coming from an external source of energy, the Sun. As long as the power to produce light seemed to derive from prior exposure to sunlight, the principle of the conservation of energy was not violated. The energy of the sunlight was stored in the rock and emitted later. Once that hypothesis was dashed, some new cause had to be found for the energy of the rays. Some began to suspect that some new power existed within the interior of matter. Perhaps the concept of the atom, the indivisible substance which had served chemistry so well for nearly a century, needed to be modified.

Some bold minds began already to suspect that perhaps the atom itself consisted of smaller parts. Perhaps the ordinary chemical means would not allow access to these, but by some other means not yet known, their powers could be released. But this was only speculation. Such a bold suggestion would first have to be proven experimentally.

It was not yet clear if the *Becquerel rays*, as they had come to

In a gold leaf electroscope, two thin strips of gold leaf are placed in contact with each other, and are hung from a metallic clip inside a glass container. The clip is electrically charged by a conductive ball or disk outside the container. When an electrically charged object is put in contact with the ball, the charge is communicated to the gold leaf, and the two strips, because they are of the same charge, repel each other, rising into the air in opposite directions. As the charge dissipates, the strips fall back to their original position.

Roentgen showed that his X-rays could discharge the electroscope, and later Becquerel showed that a uranium sample caused a discharge. But it was not known initially what caused the uranium to have this effect.



with the ball, the charge is communicated to the gold leaf, and the two strips, being of the same charge, repel each other, rising into the air in opposite directions like spreading wings.

Over time, the charge dissipates, and the strips fall back to the vertical position. When the air in the surrounding atmosphere is more conductive, the charge will dissipate faster, causing the strips of gold leaf to droop sooner. Roentgen had already shown that his X-rays had the power to discharge the electroscope, causing the gold leaf to droop. When Becquerel brought a uranium sample near to a charged electroscope, it too caused a discharge. Was the effect caused by X-rays, somehow produced within the uranium ore, or was it by some other power?

Two New Elements

be called, were X-rays, or some new kind of radiation. One of Becquerel's experiments had been to observe the effect of the uranium rays on an instrument known as an *electroscope*. Two thin strips of gold leaf, placed in contact with each other, are allowed to hang from a metallic clip which is placed within a glass container. Electrical contact is maintained from the metallic clip to a conductive ball or disk outside the container. (See drawing.) When an electrically charged object is put in contact

with the ball, the charge is communicated to the gold leaf, and the two strips, being of the same charge, repel each other, rising into the air in opposite directions like spreading wings. Over time, the charge dissipates, and the strips fall back to the vertical position. When the air in the surrounding atmosphere is more conductive, the charge will dissipate faster, causing the strips of gold leaf to droop sooner. Roentgen had already shown that his X-rays had the power to discharge the electroscope, causing the gold leaf to droop. When Becquerel brought a uranium sample near to a charged electroscope, it too caused a discharge. Was the effect caused by X-rays, somehow produced within the uranium ore, or was it by some other power?

It was going to take further investigation to determine the nature of the new Becquerel rays. By the Fall of 1896, another investigator, a young woman by the name of Marie Sklodowska Curie, had entered the search. Recently married to the physicist Pierre Curie, theirs was a marriage of true minds, built on an intellectual and scientific collaboration conjoined with the deepest love. She conceived the idea of applying a device, which her husband and his brother had invented 15 years earlier for another purpose, to the investigation of the *Becquerel rays*. The *electroscope* is capable only of a rough measurement of the strength of charge by the degree of deflection of the gold leaves. The ability of different substances to discharge the electroscope, known as the *ionizing power*, could be roughly estimated by the length of time it took for a sample held at a certain distance to accomplish this.



The Curie electrometer, invented by Pierre Curie and his brother, Jacques, used a quartz electrobalance to detect extremely small changes in electrical currents produced when rays from uranium ionize the surrounding air.

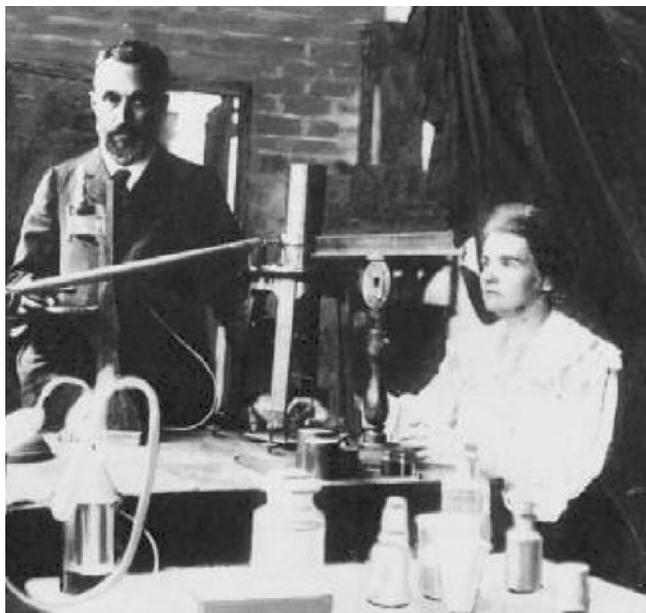


A sample of pitchblende, the ore containing uranium that Marie and Pierre Curie obtained from Bohemia. The Curies devised a way to separate out the uranium from the mass of pitchblende and were astonished to find that the remaining ore exhibited more radioactivity than did the pure uranium.



Cogema

Uranium oxide (known as yellowcake), is the raw material processed into nuclear fuel. It is converted to a gas and then "enriched" through gaseous diffusion or centrifuge processing to concentrate the fissionable uranium isotope, U-235. The non-fissionable isotope, U-238, constitutes all but 0.7 percent of natural uranium. Reactor fuel generally requires about 3-5 percent of U-235.



Roger Viollet

Pierre and Marie Curie in the unheated shed in the courtyard of the School of Physics and Chemistry, which they used as a laboratory to process the pitchblende ore. On the table is Pierre's quartz piezoelectrometer.

The inspiring story of the Curies' work on radioactivity can be found in "Marie Sklodowska Curie: The Woman Who Opened The Nuclear Age," by Denise Ham, 21st Century Science & Technology, Winter 2002-2003. http://www.21stcenturysciencetech.com/articles/wint02-03/Marie_Curie.pdf

However, with the new device known as the *Curie electrometer*, the measurement of the ionizing power of any material could be precisely measured.

By now the two Curies were partners in the quest to understand the curious powers of uranium. Pierre and Marie Curie soon began experiments with samples of uranium ore (pitchblende), most of them obtained from mines in Bohemia, then part of Austria. While still supposing that the effect might be due to the "Radiation X" identified by Roentgen, they soon came upon a crucial anomaly. Being accomplished chemists, the Curies tried experiments to remove the uranium from the pitchblende ore. By subjecting samples of the ore to acid, they could cause much of the uranium to precipitate out as a salt. When samples of the ore with most of the uranium removed were placed in the measuring device, a remarkable thing happened. They showed more ionizing power than the ore samples containing uranium.

The Curies then isolated pure uranium metal from the ore and compared its activity. The ore samples with the uranium removed showed an ionizing power three to

four times greater than the pure uranium. They became convinced that a new element, many times more active than uranium, must be present in the ore. To find it, they began a process of chemical separation. Aided by the Curie electrometer, they were able to separate out the portions of the ore which showed greatest ionizing power. By June 1898, they had separated a substance with 300 times the activity of uranium. They supposed they had found a new element which they named polonium, after Marie Sklodowska Curie's embattled Poland. There was still some doubt as to whether it was a new element. It had not been isolated yet, but always appeared together with the already known element bismuth. But continued work finally showed the polonium to be distinct.

By December of 1898, the Curies had separated another product from the Bohemian ores, which also showed strong ionizing power. This one appeared in combination with the known element barium, and behaved chemically much like barium. Again, it had not yet been isolated in a pure form, and there was uncertainty as to whether it was a distinct element. Spectral analysis showed mostly the spectral lines characteristic of barium, but their friend, the skilled spectroscopist Eugène-Anatole Demarçay, had detected a very faint indication of another line not seen before.⁵ On the basis of the chemical and spectral evidence, and its strong ionizing power, the Curies supposed it to be a new element, which fit in the empty space in the second column (Group II) of Mendeleev's periodic table, below barium. They named it radium.

The Curies now dedicated themselves to obtaining pure samples of these new elements. It took four years of dedicated la-

5. Upon heating, each chemical element shows a characteristic color. Most people have seen the green color produced in a flame by a copper-bottomed pot. If the light produced when the element is heated be passed through a prism, it is dispersed into a band of color, just as sunlight passing through a prism forms a rainbow. Within the colorful band, known as a spectrum, certain sharp and diffuse lines appear. Bunsen and Kirchoff began work in 1858 which established a means for identifying each element by its flame spectrum.

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He	Li	Be	B	C	N	O	F																								
4.00	6.94	9.01	10.8	12.0	14.0	16.0	19.0																								
Ne	Na	Mg	Al	Si	P	S	Cl																								
20.2	23.0	24.3	27.0	28.1	31.0	32.1	35.5																								
Ar	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni																					
40.0	39.1	40.1	45.0	47.9	50.9	52.0	54.9	55.9	58.9	58.7																					
	Cu	Zn	Ga	Ge	As	Se	Br																								
	63.5	65.4	69.7	72.6	74.9	79.0	79.9																								
Kr	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd																					
83.8	85.5	87.6	88.9	91.2	92.9	95.9	(99)	101	103	106																					
	Ag	Cd	In	Sn	Sb	Te	I																								
	108	112	115	119	122	128	127																								
Xe	Ce	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt																					
131	133	137	139	179	181	184	180	194	192	195																					
	Au	Hg	Tl	Pb	Bi	Po	At																								
	197	201	204	207	209	(210)	(210)																								
Rn	Fr	Ra	Ac	Th	Pa	U																									
(222)	(223)	(226)	(227)	232	(231)	238																									

Mendeleev had devised the Periodic Table arranging the elements known at that time into columns that sorted them by atomic weight into families with similar attributes. Later, new elements were discovered that fit into the "holes" left in Mendeleev's original design. The Curies were able to place their newly discovered elements into Mendeleev's Table.

bor, working in an unheated shed behind the University of Paris, to isolate the first sample of pure radium. Polonium proved even more difficult. While they were engaged in this effort, research was under way in other locations, sparked by the earlier papers of Becquerel, and by the Curies' announcement of two new elements with such extraordinary powers.

Some time in the course of these discoveries, it was felt that a new name ought to be given for the unusual ionizing power of these new elements. Marie Curie proposed the term *radioactivity*.

2. Transmutation and Radioactive Isotopes

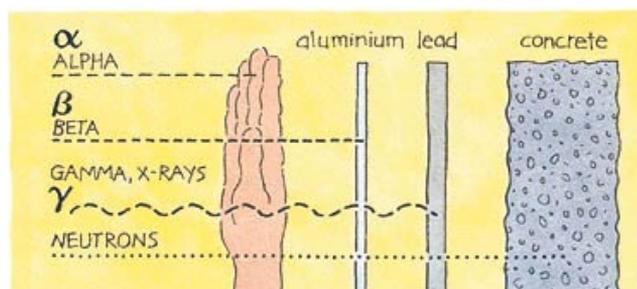
Alpha, Beta, and Gamma Rays

The Curies' work attracted worldwide attention. One of the most important lines of development led to the discovery that there was more than one type of radiation coming from the *radioactive* substances. Becquerel had already reported from his early experiments with uranium that he suspected this to be the case, and experiments by the Curies had also suggested it. In 1898 Ernest Rutherford, a young New Zealander working at the Cavendish Laboratory in England, used an apparatus based on the Curies' radiation detector to examine the radiation from uranium in a slightly different way. He placed powdered uranium compounds on the lower metallic plate of a Curie electrometer, and covered the powder with layers of aluminum or other metal foils.

It was found that most of the radiation, as measured by the charge collected on the upper plate, was stopped by a single thin layer of foil. But some of it got through and was only stopped after a considerable number of layers had been added. The conclusion, already suggested by earlier work of Becquerel, was that there were at least two different types of radiation, to which Rutherford gave the name *alpha rays* for the less penetrating, and *beta rays* for those which were stopped only by more layers of foil.

What were these two types of rays? In 1899, Becquerel and two separate groups of experimenters in Germany, all found that the radioactive emissions from radium could be bent by a magnetic field. Although the rays are invisible, their bending could be detected in the following way: A sample of the substance was placed in a lead container with a narrow mouth, so that radiation could only escape in one direction. The container was placed between the poles of a powerful electromagnet, and by detection on a fluorescent screen, it was found that the emerging radiation was curving in the same direction as had been observed with the cathode rays mentioned above. As further experiment confirmed, the *beta rays* emitted by radioactive substances were found to be identical with the *cathode rays* produced in gas discharge tubes. Both were nothing more than beams of electrons.

More careful experiments by Pierre and Marie Curie in 1900, showed that only a part of the radiation was deflected by the magnet in these experiments. Marie Curie then showed that the undeflected part of the radiation had a lesser penetrating power. It was thus likely that this other part was the so-called *alpha radiation*. Under a stronger magnetic field, the *alpha rays*, could be deflected as well, but by a lesser angle and in the opposite



World Nuclear Association

The types of ionizing radiation differ in their ability to penetrate matter. Alpha particles lose their energy quickly and can be stopped by a sheet of paper or the first layer of skin.

direction of the *beta rays*, indicating that they were more massive and positively charged. It was to take a few more years before the character of the *alpha rays* was discovered to be identical to the nucleus of the second element in the periodic table, helium. Thus, by the first decade of the 20th Century it was understood that these newly discovered radioactive substances were regularly emitting high-speed helium nuclei (*alpha particles*) and electrons (*beta particles*).

Yet a third type of radioactive emission was discovered in 1900 by the French physicist Paul Ulrich Villard. These had the power to penetrate through all the layers of aluminum foil that Rutherford had used to distinguish the *alpha* from the *beta* rays. They could only be stopped by a relatively thick piece of lead. They were not bent by the strongest magnetic or electric fields. This third type of radiation became known as *gamma rays*. Though some suspected that they too would correspond to some particle, it turned out that they more closely resembled light in having no detectable mass.⁶

They could be identified and measured by their wavelength, however, which was discovered in 1914 to be thousands of times shorter than visible light. A shorter wavelength means a higher frequency, and consequently higher energy for the radiation.⁷

We see thus that all the principal forms of radiation which

6. Whether a photon of light possesses mass or not remains a matter of controversy. By equating the expressions for energy of Planck ($E=h\nu$) and Einstein ($E=mc^2$), a value for the mass of a photon of any given frequency can be obtained.

7. We understand the properties of light by recourse to an analogy to waves in water, first proposed by Leonardo da Vinci. We measure light by the distance from crest to crest of each successive wave, a distance known as the *wavelength*. As we imagine the waves all to travel at a constant speed, if we were to count the number of wave crests passing a particular point in a second, we would find that light of shorter wavelength would squeeze in more crests in the course of a second than that of longer wavelength.

The number of wave crests passing a particular point in a second is known as the *frequency*, and thus is inversely proportional to the wavelength. It also turns out that at this higher frequency, or shorter wavelength, light does more work in the course of a second than that of lower frequency, and thus is described as more energetic.

Not only light, but heat, radio waves, and high-energy radiation, such as X-rays and gamma rays, can all be described by this wave analogy. The waves have both electrical and magnetic properties. Although a magnetic or electric field will not change their direction as it does that of electrons and protons, it will cause an internal change known as rotation of the plane of polarization. All these types of radiation are known generally as *electromagnetic waves*, and their vast range of frequencies is known as the electromagnetic spectrum.

emanate from radioactive substances were known by the year 1900. By 1914, their essential physical properties were known as well. These were the *alpha ray* or *alpha particle* (helium nucleus); the *beta ray* or *beta particle* (electron); and the *gamma ray* (a form of electromagnetic radiation, like light).

As we have seen, another kind of radiation, the X-ray, was also known, and had been found to be a form of electromagnetic radiation as well. The X-rays known at that time were of a lower frequency and thus less energetic than the gamma rays emitted from radioactive substances. Thus for a long time, X-rays were defined as any radiation having a frequency of from about 10^{16} to 10^{19} cycles per second, and gamma rays any frequency above that.⁸ Now however, more powerful X-rays can be produced, and less powerful gamma rays have been found. Gamma rays and X-rays are thus distinguished today by their origin. The gamma ray is thought to originate in the atomic nucleus, while the X-ray seems to arise from the outer parts of the atom.

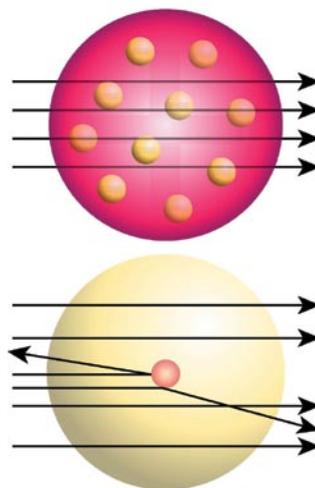
Transmutation of Elements

The separation of the radioactive elements, polonium and radium, by Marie and Pierre Curie soon led to the remarkable discovery that one element could be transformed into another. In 1898, Marie Curie and Gerhard Schmidt had independently discovered that a third heavy element, thorium, close to uranium in the periodic table, produced radioactive emissions.

Working at McGill University in Canada, the young chemists Ernest Rutherford and Frederick Soddy first recognized in 1901 that radioactive thorium was transforming itself into radium. Soddy called it *transmutation*, a term previously applied to the alchemists' hope of transmuting base metals into gold. Over the course of the next decade, it was discovered that all of the elements higher than lead (atomic number 82) in the periodic table were undergoing continuous transmutation. Eventually it was realized that it was usually not the whole sample of the element, but certain of its isotopic parts, that were changing. In



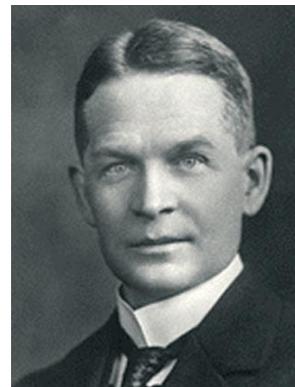
Ernest Rutherford's experiments in 1898 found two types of "rays" emanating from uranium, which he named alpha and beta.



In Rutherford's experiments, alpha particles from a radioactive substance were aimed at a very thin layer of gold foil. Most of the positively charged particles passed through the foil (top), but about 1 in 8,000 particles was deflected backward at an angle greater than 90 degrees (bottom). This indicated that there were tiny concentrations of positive charge in the gold foil. Rutherford called these concentrations the nucleus of the atom, and deduced from the experimental data a relative measurement of the nucleus.

undergoing this *transmutation*, a sample of a certain isotope would emit a characteristic radiation, the alpha, beta, or gamma ray. (A fourth mode of radiation, the positive electron or *positron*, was discovered later.)

By about 1910, the sequence of spontaneous changes of the elements from uranium to lead, known as *radioactive decay*, had been well mapped out by the careful chemical analysis of Soddy and other investigators. It turned out that there were, not one, but three different paths, known as *decay chains*, that the elements could follow. A fourth decay chain, not found in nature, was discovered several decades later, after the discovery of nuclear fission, and the creation of the first artificial elements. Then it was seen that the four decay chains could be categorized, like the arithmetic numbers, into series of $4n$, $4n+1$, $4n+2$, and $4n+3$. Further, the mass number of all the isotopes belonging to a particular decay chain must possess the same arithmetic residue modulus 4.⁹



Chemist Frederick Soddy, who worked with Rutherford, determined that radioactive thorium decayed into radium, a process he named transmutation. He and others later mapped out the types of spontaneous transmutation that occurred in the periodic table.

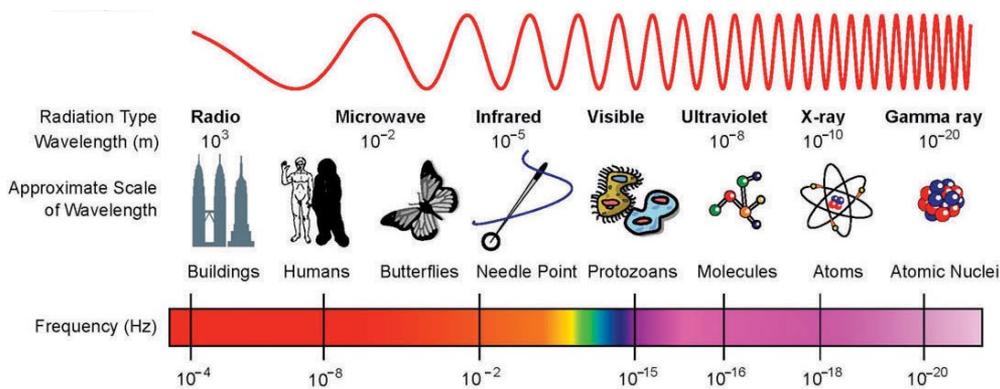
8. The notation 10^{16} means 1 followed by 16 zeroes, and thus is equal to 10,000,000,000,000,000 (10 quadrillion) cycles per second. The standard unit for the cycles per second of frequency is now known as the *hertz* (abbreviated Hz).

The first measurement of the wavelength of light was made in 1801 by Thomas Young, an English opponent of the Newtonian theory of optics. Young passed a ray of light through two slits, thus causing the two separated beams to interfere with each other, producing alternating bands of darkness and light. The interpretation, later elaborated in detail by Augustin Fresnel, was that, like waves in water, the crests of the two separated beams reinforced each other where they came together, while when a crest of one beam met the trough of the other, they cancelled each other, producing darkness.

9. Of the four principal types of radiation emitted in nuclear decay, only one, the alpha particle, significantly changes the mass of the substance. The alpha particle weighs approximately four times the mass of the proton, which is nearly the unit of mass number. (Recall that studies had shown the cathode ray particles [electrons or beta rays] had only $1/1,836$ the mass of the proton, and that the gamma ray was virtually massless.) Thus, whatever the mass number of the initial isotope in the decay chain (U-238, for example), the final one (Pb-206, in this case) and all of the intermediate ones would have a mass number of the form $4n+2$. The deeper significance of this correspondence is perhaps yet to be discovered.



In 1900, Paul Villard discovered gamma rays, which were able to penetrate to a greater depth than alpha or beta rays.



The various types of electromagnetic radiation are measured by their wavelength and frequency. As the graphic shows, the higher the frequency, the shorter the wavelength.

The amount of radiation emitted is always proportional to the amount of mass of the radioactive substance which is transmuted. The rate of disappearance of the original mass is measured by its *half-life*, which will be different for each isotope. The *half-life* is the amount of time it takes for one half of the mass of the radioactive substance to transmute into its new form. Whether the sample is large or small, the time it takes for half of it to disappear is always the same, but the amount that has transmuted (and thus the amount of radiation emitted) is proportional to the size of the sample. Radioactive decay is thus describable mathematically by an exponential function, like the compound interest on a mortgage or car loan, but in reverse. (Some might find an analogy to the present reverse-leveraged collapse of our financial system. The difference is that the products of radioactive decay can be very useful.)

The Nucleus and Radiations

Gradually, a theory emerged to explain the emission of radiation and transformation of the elements. Early experiments with the canal rays had suggested to Philipp Lenard in Germany that most of the space within a substance is empty (or at least transparent to rays), and the mass is concentrated in only a very small portion of the space. He called these concentrations of mass *dynamids*.

In 1909, Hans Geiger and Ernest Marsden, working in Rutherford's Manchester University laboratory, carried out experiments in which they aimed alpha particles from a radioactive substance at an extremely thin layer of gold foil. Most of the positively charged alpha particles passed right through the gold foil, supporting the notion that the space between the atoms of the seemingly solid substance was devoid of matter. About 1 in 8,000 alpha particles was deflected backwards, at angles greater than 90 degrees. This suggested that tiny concentrations of positive charge were spread throughout the substance of the gold foil. Rutherford called these concentrations of charge, the *nucleus* of the atom.¹⁰ By analyzing how the positively charged

alpha particles were deflected, it was possible to show that the nuclear charge was concentrated in a volume of less than one trillionth of a centimeter in radius, and occupied less than one three-thousandth of the total volume of each atom.

Over the course of subsequent decades, it was discovered that the nucleus could be viewed as a concentration of particle/waves, known as protons, and neutral particle/waves known as neutrons. The alpha, beta, and gamma rays were recognized as originating from this nucleus. The emission of each one of these particle/waves could be correlated to a change in the character of the nucleus, a transmutation of the element. So, for example, the emission of an alpha particle (a helium nucleus consisting of 2 protons and 2 neutrons) reduces the atomic mass of the substance by 4 units and the charge (atomic number) by 2 units.

Alpha emission is typical of the heavier elements. Another common form of radiation, the beta decay, can occur anywhere on the periodic table. The emission of a beta particle (electron), being only about 1/2,000 of the mass of a proton, scarcely changes the atomic mass of the substance. However, it causes an increase in the charge, or atomic number, of the element. Beta decay may occur from radioactive isotopes anywhere in the periodic table.

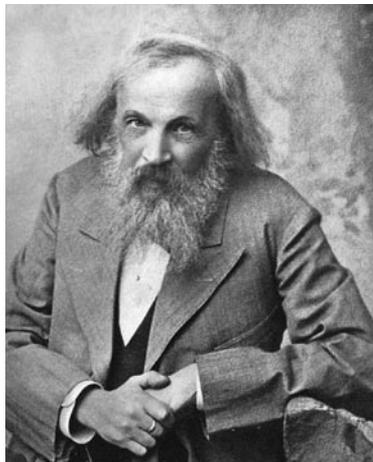
What Is an Isotope?

An isotope is a variation on an element, so named because all the isotopes of an element occupy the same position (*iso* + *topos*) within the periodic table. When Dmitri Mendeleev first

indicated that this scattering backward must be the result of a single collision, and when I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the greater part of the mass of the atom was concentrated in a minute nucleus. It was then that I had the idea of an atom with a minute massive centre, carrying a charge."

Rutherford's powers considerably deteriorated later in life. After his 1919 appointment as director of Cambridge University's Cavendish Laboratory, he increasingly adopted the role of controller of scientific discovery, rather than innovator. His relentless erroneous attacks on American physical chemist William D. Harkins, who had foreseen the neutron in 1915, among other innovations, were typical. Rutherford later became notorious for his statement that any idea of attaining power from the atomic nucleus was "moonshine." More than likely, he knew better, but made the statement in the interest of British imperial policy, not science.

10. Said Rutherford: "It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you. On consideration, I real-



Dmitri Mendeleev's work on the periodic table in the 1860s, and his prediction of future elements to be found, were an invaluable guide for later scientists.

deduced the periodic table of elements, the existence of isotopes was not known. The isotopes of a given element behave almost the same chemically, and thus are very difficult to detect by chemical means. The discovery of radioactivity, and studies of the radioactive decay process at the beginning of the 20th Century, led to the suspicion that elements may exist in different isotopic forms. However, the first proof of the existence of isotopes was not obtained until

the time of World War I.¹¹

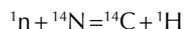
Now it is known that, of the 92 elements in the periodic table, the majority have at least one other naturally occurring isotopic variant, and the number of natural isotopes reaches 10 for the element tin.

An isotope may or may not be radioactive. However, by exposure to radiation, artificial isotopes of every element can now be created. As all species of a given element have the same number of protons, the isotopes differ by the number of neutrons found within their nucleus. The number appearing after the hyphen in an isotope's name (e.g., carbon-14) refers to the combined number of protons and neutrons in the isotope's nucleus.

To understand the meaning and use of isotopes, let us look more deeply into carbon-14. Most elements naturally appear in various isotopic forms. Carbon, for example, is found on Earth in two stable forms, carbon-12 (98.9 percent) and carbon-13 (1.1 percent), and the radioactive carbon-14 (.000000001 percent). The percentage distribution of the different isotopes of an element, which is almost the same anywhere on Earth that it is found, is known as its natural abundance.

Carbon-14 is thus a radioactive isotope of the common element carbon, often called the building block of life, because the molecules in every living thing must contain it. The isotope was discovered in 1940 by two chemists at the Berkeley Radiation Laboratory, Martin Kamen and Sam Ruben, who had been working for a decade to discover the path of carbon in photosynthesis. In 1942, they passed on the samples of carbon-14 which they had isolated to a young chemist, Andrew Benson, who used it in studies that first unraveled the secrets of the carbon pathway.¹²

Carbon-14 is produced in the upper layers of the atmosphere, when neutrons arising from cosmic ray collisions transmute atmospheric nitrogen. The nitrogen absorbs a neutron, yielding carbon-14 plus a proton (hydrogen nucleus). This is expressed by the formula



The carbon-14 then mixes in the atmosphere, and reacts with



A common form of carbon—anthracite coal.



USGS

The radioactive carbon-14 isotope is found in every living thing, and thus is often called a building block of life. Produced in the upper atmosphere layers, carbon-14 reacts with oxygen to produce carbon dioxide. About 1 in every trillion carbon dioxide molecules is formed of radioactive carbon-14. Although this is a small proportion of the total, its prevalence results in the occurrence of about 3,000 radioactive disintegrations per second of carbon-14 in the average human body.

Carbon-14's ubiquitousness and its long half-life enable it to be used by scientists to date artifacts.

Here, carbon samples are converted to acetylene gas by combustion in a vacuum line. The acetylene gas is then analyzed in a mass spectrometer to determine its carbon isotopic composition. The proportion of carbon-14 to other isotopes is used for dating objects.

11. The detection of two isotopes of neon in positive rays of the gas was reported in 1913 by J.J. Thomson of the Cavendish Laboratory in England, but only conclusively demonstrated after 1919 in Francis Aston's *mass spectrograph*. Evidence for the existence of two isotopes of chlorine was achieved by W.D. Harkins and collaborators at the University of Chicago between 1915 and 1920, using separation by diffusion of the gas through various membranes. Harkins was thus the first to obtain chemically significant samples of isotopically enriched species.

12. After the war, Kamen was falsely accused of leaking atomic secrets to the Russians. The charge arose after he helped an official of the Russian consulate in San Francisco in obtaining experimental leukemia treatment for a friend. Kamen, an amateur violinist, had met the Russian official in 1944 at a party given by his friend Isaac Stern, the world-famous violinist whom Kamen sometimes accompanied. Kamen later won a libel suit against the *Chicago Tribune* for naming him as a suspected spy. But for the false accusation, the groundbreaking discovery would most probably have led to greater fame and a Nobel prize.



Martin Kamen (left) and Sam Ruben (right), working at the Radiation Laboratory of what is now Lawrence Berkeley National Laboratory, discovered carbon-14 in 1940.



Lawrence Berkeley Laboratory

bodies, by the natural background radiation coming from radioactive elements in the Earth, and by the radiation from space such as from gamma ray bursts.

Cosmic rays and their by-products collide with us, all the time. In an experimental device known as the cloud chamber, the evidence for the existence of the cosmic rays can be demonstrated at any location on Earth. The first cloud chamber was perfected by C.T.R. Wilson in 1911.

A simplified cloud chamber is easy to build, often forming the subject of a high school science project. A closed container, like a small aquarium tank, and some dry ice are the principal materials required. When the proper conditions are created inside the tank, the collision of these high-speed protons from outer space with molecules of the air in the container, trigger condensation of the water vapor in the contained air. The vapor trails provide visual evidence that the cosmic rays have passed through. These cosmic rays also pass through our bodies, and are continuously producing radioactive by-products.

oxygen to produce carbon dioxide. About 1 in every trillion carbon dioxide molecules is formed of radioactive carbon-14. Although this is a small proportion of the total, the prevalence of carbon derived from the atmosphere in all living molecules leads to the result that about 3,000 radioactive disintegrations per second of carbon-14 occur in the average human body. The carbon-14 decays within your body by emitting a beta particle (electron), the same form of radiation produced by many of the reactions in a nuclear reactor. As a result of the decay, the carbon-14 is transmuted back to nitrogen.

The rate of decay of a radioactive isotope can be assessed by knowing the *half-life*. That is the time that it will take half of the substance to be transmuted into what is called its *daughter product*. The shorter the half-life, the more radiation is being emitted. Carbon-14 has a half-life of 5,730 years. Potassium-40, which is responsible for even more radioactive disintegrations within our body (averaging about 4,440 per second), has a half-life of 1.25 billion years. The potassium-40 produces more radioactivity than the carbon-14, because there is much more of it in the body. Radioactive potassium-40 makes up more than 1 part in 10,000 of naturally occurring potassium, compared to 1 part in 1 trillion for carbon-14. So, although the total mass of carbon in the body is about 100 times greater than the mass of potassium, the mass of radioactive potassium is almost 10 million times greater than that of radioactive carbon.

Natural Sources of Radiation

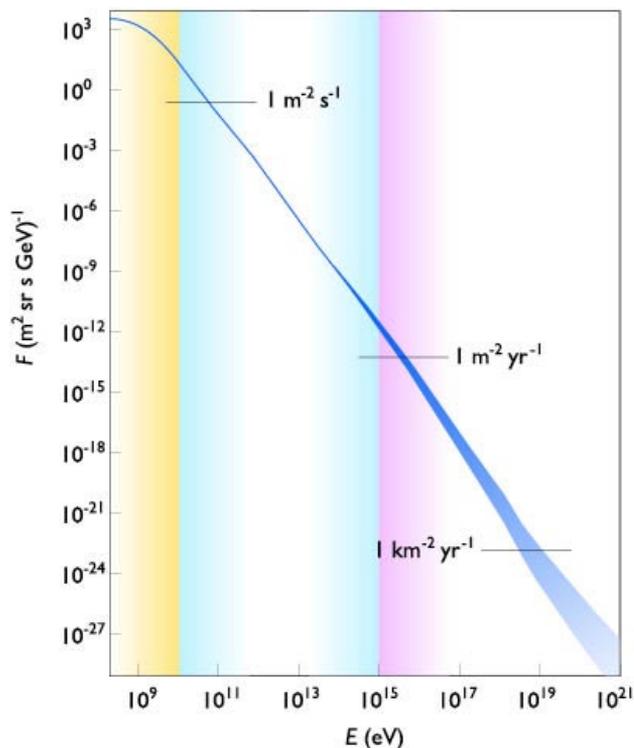
There are many other natural sources of radiation which reach us all the time. Some of the principal ones are shown in the accompanying table. These naturally occurring radioactive isotopes enter our bodies either through our food and water, or from the atmosphere. A certain amount of body radiation is also produced by collision of cosmic rays directly with our

Another major source of radiation is the Earth itself. Most of this radiation comes from the natural decay of uranium or thorium, which is contained in varying amounts in every portion of earth or rock. The average soil contains from 1 to 3 micrograms of uranium, rocks contain from 0.5 to 4 micrograms, and beach sand contains about 3 micrograms.

Some locations on Earth are much more radioactive than others. In some parts of the United States it is possible to obtain



Tracks of ionizing radiation from cosmic rays, in a cloud chamber. The thick, short tracks are alpha particles; the long, thin ones are beta particles. C.T.R. Wilson perfected the first cloud chamber in 1911.



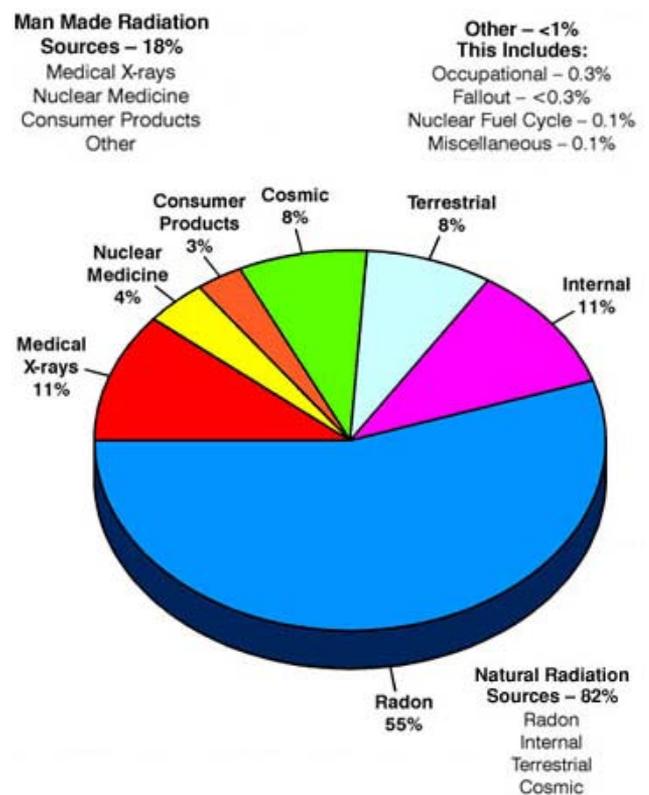
All natural cosmic rays are constantly colliding with atoms in our atmosphere, transforming elements and creating radioactive by-products. Depicted here is the flux of cosmic ray particles as a function of their energy. The flux for the lowest energies (yellow zone) are mainly attributed to solar cosmic rays, intermediate energies (blue) to galactic cosmic rays, and highest energies (purple) to extragalactic cosmic rays.

aeroradioactivity maps, showing the natural background radiation levels from the Earth. These maps are derived from surveys conducted during the time of atmospheric nuclear testing to try to determine base levels of radiation. But elevation can have an even greater effect on background radiation level than soil and subsoil content. People living at high elevations and airline pilots receive a considerably higher exposure than average.

But, before you decide to abandon your home in Denver or Albuquerque, or never fly again, consider that there is *no evidence whatsoever that higher background levels of radiation have a negative effect on health or longevity*. In fact, there is a substantial body of scientific evidence that people exposed to low-level background radiation live longer. The experimentally proven positive effect of low-dose radiation is known as *hormesis*.

Low-dose radiation has been shown to enhance biological responses for immune systems, enzymatic repair, physiological functions, and the removal of cellular damage, including prevention and removal of cancers and other diseases. In Japan, advanced medical research showed that preliminary treatment with low-dose, full-body radiation could drastically reduce the dose level required for patients undergoing high-level radiation therapy for various cancer treatments and increase the longevity of the patient.

Many healing springs and baths derive their benefits from



Source: National Council on Radiation Protection and Measurements (NCRP) Report No. 93, "Ionizing Radiation Exposure of the Population of the United States," 1987.

Where your radiation comes from: Natural sources account for about 82 percent of the average radiation dose to individuals. The remaining 18 percent comes from man-made sources, mostly from medical procedures. Radiation from nuclear plants is less than one-tenth of a percent.

low-dose radiation in the water, usually in the form of absorbed radon gas. In Germany, a nation which suffered an anti-radiation hysteria in the 1980s, causing the shutdown of numerous nuclear construction projects, people still flock to the traditional radioactive healing spas to bathe in radon-containing waters. In the Soviet Union, treatment with controlled doses of artificially produced radon was a standard and highly successful therapy for tuberculosis and other lung conditions.

3. So, Why Are You Afraid?

The principal cover story for promoting radiation fears is a piece of pseudoscience known as the Linear No-Threshold (LNT) hypothesis. To call it a hypothesis may be gross exaggeration. According to the Linear No-Threshold argument, unlike any other known biological process, the response of the body to radiation is directly proportional to dose. Because radiation in large doses is dangerous or deadly, the LNT argument is simply that radiation in any dose is therefore dangerous or deadly. Thus, if a certain exposure to radiation produces 1 cancer in a population of 100 people, then, according to the Linear No-Threshold view, one-tenth that amount of radiation will produce 1 cancer in a population of 1,000.

By the same type of reasoning one could argue that, if 25 cups of water forced down the throat will generally cause a person to die of drowning, then drinking 1 cup of water would produce a 1 in 25 chance of drowning. At root, the LNT argument is that simple—and ridiculous. Yet LNT is the basis on which decisions are made as to what levels of radiation are safe, or what levels might even be beneficial (*none*, according to the LNT proponents).

The data for estimating radiation cancer risks come from long-term studies of survivors of the atomic bombings in Hiroshima and Nagasaki, as well as studies of smaller human populations accidentally exposed to high doses of radiation. After plotting the statistics available from these cases of high exposure, a straight line is drawn on the graph back toward zero. The assumption is thus made—not deduced from the data, but imposed on it—that any lesser dosage will produce the same deadly results in a proportionally smaller number of people. The massive evidence that radiation dosage below a certain threshold is beneficial, not harmful, is ignored, as are the experimental data showing that some level of radiation may be necessary for life to exist at all.

Naturally, LNT has not gone unchallenged. Every review of the issue produces opposition from specialists in the field who raise cogent arguments but are ultimately overridden. A hypothesis which makes no sense is sustained by the popular fear of radiation.

Radiation Hormesis

A great number of human and animal studies show that not only is radiation at low levels not dangerous, but it is actually beneficial. Studies of large populations exposed to higher than average levels of radiation show increased longevity and lower mortality from cancers.

In the May 1961 *Journal of the American Medical Association (JAMA)*, Dr. Hugh Henry, then at Oak Ridge National Laboratory, reported on all low-dose studies, saying that the results show consistent life-lengthening. He reported on early animal studies that showed hormetic (beneficial) effects from uranium and plutonium injections, feeding of uranium compounds, and exposure to external gamma and X-radiation. Henry concluded:

The preponderance of data better supports the hypothesis that low chronic exposures result in an increased longevity than it supports the opposite hypothesis of decreased longevity. . . . Increased vitality at low exposures to materials that are toxic at high exposures is a well-recognized phenomenon.¹³

In a 1990 study of nuclear medicine, Marshall Brucer, M.D., reported:

During the 1960s and 1970s about 40 articles per year described hormesis. In 1963, the AEC [Atomic Energy Commission] repeatedly confirmed lower mortality in guinea pigs, rats, and mice irradiated at low dose. In 1964, the cows exposed to about 150 rads after the Trinity

A-bomb in 1946 were quietly euthanized because of extreme old age. . . . No experimental evidence of damage at low doses existed; self-serving extrapolations from high dose-data dominated health physics.¹⁴

There is voluminous peer-reviewed scientific literature documenting the evidence for radiation hormesis. Dr. T.D. Luckey, Professor Emeritus of the University of Missouri School of Medicine, compiled more than 2,000 references.¹⁵ Yet, the regulatory agencies ignore this evidence.

One of the largest and most thorough studies of the effects of low-level radiation was the Nuclear Shipyard Workers Study, funded by the Department of Energy, but never published. As reported by James Muckerheide, State Nuclear Engineer for the Commonwealth of Massachusetts:

This 10-year, \$10-million study of 39,004 nuclear workers, carefully matched with 33,352 non-nuclear workers, was completed in 1987.¹⁶ After pressure on the DOE, which had chosen not to publish the data and conclusions, the Department finally, in 1991, issued a contractor's report on the study, with a two-page press release. . . . In the summary, the Nuclear Shipyard Workers Study reports that the high-dose mortality rate of the nuclear workers was 0.76 that of the non-nuclear workers in the control group. Of special significance is the fact that the summary report did not include "all cancer" mortality, which is a most common factor, and of most interest in any such study. However, Myron Pollycove, M.D., of the Nuclear Regulatory Commission, documented that the "all cancer" mortality in the detailed tables is also statistically significantly lower among nuclear workers than among the non-nuclear workers.¹⁷

The Radon Follies

The Linear No-Threshold Hypothesis was put to an extensive statistical test beginning in the 1980s by Dr. Bernard Cohen of the University of Pittsburgh. Cohen carried out a massive data

14. M. Brucer, 1990. *A Chronology of Nuclear Medicine* (St. Louis: Heritage Publications).

15. T.D. Luckey, 1990. *Hormesis with Ionizing Radiation* (Boca Raton, Fla.: CRC Press). Also in Japanese (Tokyo: Soft Science, Inc., 1980). In addition, see T.D. Luckey, 1995. "Test of the Linear-No Threshold Theory of Radiation Carcinogenesis for Inhaled Radon Decay Products," *Health Phys.*, Vol. 68, pp. 157-174.

16. J.R. Cameron, 1992. "The Good News about Low Level Radiation Exposure: Health Effects of Low Level Radiation in Shipyard Workers," *Health Phys. Soc. Newsletter*, Vol. 20, p. 9.

17. James Muckerheide, "It's Time to Tell the Truth About the Health Benefits of Low-Dose Radiation," *21st Century Science & Technology* (Summer 2000) www.21stcenturysciencetech.com/articles/nuclear.html

Muckerheide continued in his report of Summer 2000: "After long negotiations, Dr. Genevieve Matanoski, Principal Investigator for the shipyard worker study, received another substantial contract from DOE in 1994, and retired as Head of Epidemiology at Johns Hopkins University. Now, more than 5 years later (and about 12 years since the completion of the study), no papers have been published. There is no report to Congress, the shipyard workers, radiation protection agencies, or to the public. There is substantial concern about the integrity of the data, which have been kept under wraps. Further, this most definitive nuclear workers study was not included in a study of "all" U.S., U.K., and Canadian nuclear workers, contracted by DOE with the International Association for Research on Cancer (IARC)."

13. H.F. Henry, 1961. "Is All Nuclear Radiation Harmful?," *J. Am. Med. Assoc.*, Vol. 176, p. 671.

collection effort, analyzing radon levels in 272,000 homes in the most populous U.S. counties and comparing them to lung cancer incidence.

The basis of the great household radon scare was (and remains) that high levels of this radioactive gas, released during the natural decay of uranium in the ground, would contribute to increased risk of lung cancer. Cohen's results showed the opposite: the higher the radon levels, the lower the incidence of lung cancer!¹⁸

Dr. Graham Colditz of Harvard University, a world renowned epidemiologist, contributed to an interim analysis of the same data by counties. He confirmed the validity of the epidemiological analysis of these data.¹⁹

Dr. Kenneth Bogen at Lawrence Livermore National Laboratory independently compared 1950-1954 lung cancer mortality for women of ages 40 to 80 and 60 to 80 (who had smoked little), by county, with EPA county environmental radon data. Bogen also confirmed the inverse correlation between lung cancer and radon.²⁰

Health Benefits of Radiation

Proponents of the Linear No-Threshold theory argue from a very simplistic model, that every particle or quantum of ionizing radiation (e.g., alpha, beta, gamma, or X-ray) is likely to damage the DNA within the cell, producing mutations which lead to cancer. As there are about 1 billion radioactive decays every day within the average adult body, it is hard to imagine why we are not all sick from cancer from a very young age.

However, knowledge gained in recent decades has shown that there is a natural process of DNA repair. It turns out that radiation is not the principal cause of damage to the DNA. Body heat is. The mutations from unrepaired or misrepaired damage to the DNA caused by the natural metabolism outnumber those caused by natural radiation by 10-million fold.²¹ Every time you exercise, digest your food, or just breathe, you are generating atoms or molecules with unpaired electrons (known as free radicals), active little creatures ardently in search of something to combine with by donating their free electrons. One of the things they will combine with are the molecular

components of the DNA known as nucleotides. The marriage (known as *oxidation*) causes a change of the DNA chain, a mutation, which sometimes cannot be properly repaired.

Normal cell division and DNA replication also contribute somewhat to the number of mutations. If you want to stop this process, just stop eating, breathing, and exercising (in whatever order you choose).

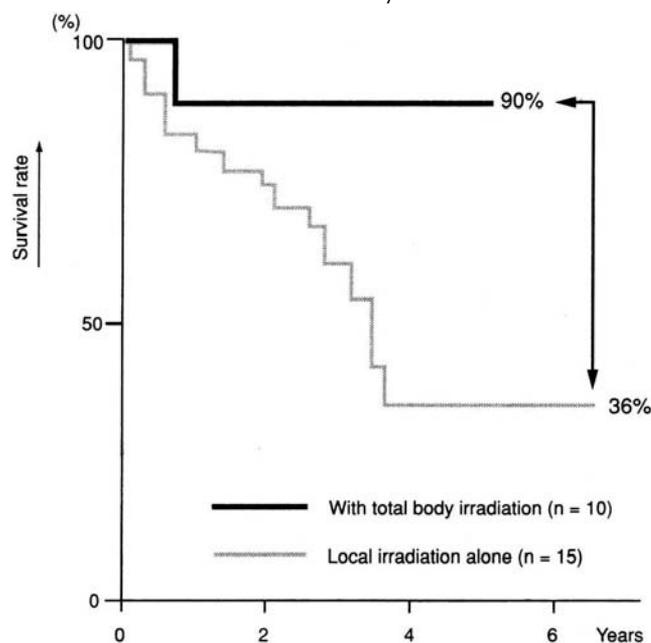
Fortunately it isn't necessary to take such extreme measures. A great variety of molecules, known as anti-oxidants, are always present to prevent the damage. These may be vitamins, enzymes, or other natural substances. Some enzymes are present to aid in continually repairing damaged nucleotides in the DNA, and a process of removal of the irreparably damaged chains is also at work.



Dr. Sadao Hattori, a leader in Japan's research into low-dose radiation.

Studies of specific immune responses in animals suggest that low-dose radiation helps

Survival Rates of Non-Hodgkin's Lymphoma Patients With and Without Total Body Irradiation



Source: Dr. K. Sakamoto, Tohoku University

Lymphoma patients who were given a total body irradiation of 10 centigray by X-ray, three times a week, in addition to the standard local high-dose irradiation treatment for this cancer, had a 90% six-year survival rate as of 1997. The control group, which received only the local high-dose treatment, had a 36% six-year survival rate.

The benefits of this treatment are prevented from being used in the United States and elsewhere in order to protect the myth that radiation is dangerous at any dose.

18. B.L. Cohen, 1987. "Tests of the Linear, No-Threshold Dose-Response Relationship for High-Level Radiation," *Health Phys.*, Vol. 52, p. 629. See also: B.L. Cohen, 1989. "Expected Indoor ²²²Rn Levels in Counties with Very High and Very Low Lung Cancer Rates," *Health Phys.*, Vol. 57, p. 897; and B.L. Cohen, 1995, "Test of the Linear-No Threshold Theory of Radiation Carcinogenesis for Inhaled Radon Decay Products," *Health Phys.*, Vol. 68, pp. 157-174.

19. B.L. Cohen, and G.A. Colditz, 1994. "Tests of the Linear-No Threshold Theory for Lung Cancer Induced by Exposure to Radon," *Environmental Res.*, Vol. 64, p. 65.

20. K. Bogen, 1996. "A Cytodynamic Two-Stage Model That Predicts Radon Hormesis (Decreased, then Increased Lung-Cancer Risk vs. Exposure)" (Livermore, Calif.: Lawrence Livermore National Laboratory), Preprint UCRL-JC-123219 (40 pp. with 150 references).

21. D. Billen, 1990. "Spontaneous DNA Damage and Its Significance for the 'Negligible Dose' Controversy in Radiation Protection," *Radiation Research*, Vol. 124, pp. 242-245.

Even high-level radiation adds only a few more mutations to the millions that are occurring each day from natural metabolism. Radiation causes more double breaks per event than normal metabolism, but even given this difference, the mutations caused by metabolism are 10-million fold greater.

to stimulate the immune system. Positive results in cancer treatment using low-dose radiation have been reported by Dr. Sadao Hattori of Japan from the work of Drs. Sakamoto, Miyamoto, Takai, and others. Work in Japan, and in the United States, has shown that 10 to 15 cGy full-body or half-body X-ray doses, delivered in 1 to 2 minutes, several days apart, stimulate the body's defense mechanisms. (The cGy, or *centigray*, is the modern unit used to measure the estimated absorbed dose of radiation, equal to 1 *rad* in the older units.)

A long-term clinical trial of non-Hodgkin's lymphoma patients has confirmed that the group that received low-dose radiation substantially outlived the control group at 5 years and 10 years.²²

No Life Without Radiation

As radiation is a natural part of our environment—and life has never existed without it—might it be possible that the potassium-40, carbon-14, and other radioactive isotopes found within our bodies are performing a necessary function? An important question, but one that has never been permitted to be freely explored. The hysterical insistence on the Linear No-Threshold hypothesis has actually shut off productive lines of research in this direction. Yet, all the evidence points to the fact that there is no life without radiation.

In the 1950s, samples of natural potassium were processed at Oak Ridge National Laboratory to separate out the radioactive potassium in order to conduct radiobiology experiments. Animals were then fed a diet containing the processed potassium which lacked the radioactive component. The animals did poorly, but they recovered when the extracted potassium-40 or natural potassium was added back to the diet.

Forty years later, Charles Willis, who had participated in those experiments, spoke of them before a March 1996 meeting of the U.S. Nuclear Regulatory Commission of which he was a member:

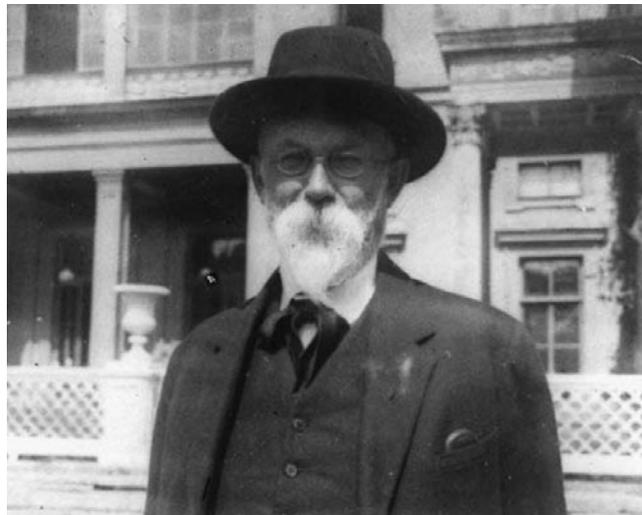
... [I]t's clear to many of us that we are not seeing the predicted ill effects at low doses, as has been pointed out to you. I personally came to this hormesis observation fairly late in the game. It wasn't until 1958 that I was working with the laboratory [Oak Ridge National Laboratory] situation where we were doing experiments with below background levels of radiation, taking the potassium-40 out and seeing what the effects would be on the cellular level, when we saw that the cells looked good but they didn't function. So we couldn't publish the results, another ill effect of the paradigm about the linear hypothesis.²³

22. Interview with Sadao Hattori, "Using Low-dose Radiation for Cancer Suppression and Revitalization," *21st Century Science & Technology*, Summer 1997. Also, the following references:

Y. Takai, 1990. "Direct Anti-Tumor Effect of Low Dose Total (or Half) Body Irradiation and Changes of the Functional Subset of Peripheral Blood Lymphocytes in Non-Hodgkin's Lymphoma Patients after TBI (HBI)," *J. Jpn. Soc. Ther. Radiol. Oncol.*, Vol. 3, pp. 9-18.

S. Hattori, 1997. "State of Research and Perspective on Adaptive Response to Low Doses of Ionizing Radiation in Japan," in *Low Doses of Ionizing Radiation: Biological Effects and Regulatory Control*, IAEA-TECDOC-976, IAEA-CN-67/126, pp. 402-405.

23. ACRS/ACNW, 1996. U.S. Nuclear Regulatory Commission, Advisory Committee on Reactor Safeguards and Advisory Committee on Nuclear Waste Joint



Vladimir Ivanovich Vernadsky. *The most crucial unanswered question of 20th Century science remains the proper understanding of the relationship of the biotic to the abiotic domain, as that question was first defined nearly a century ago by the Ukrainian-Russian Academician Vernadsky.*

The Oak Ridge finding is consistent with a wide variety of experiments with organisms that were shielded from background radiation. For example, organisms grown on glass slides were repeatedly found to grow differently. It was eventually found that organisms grown on glass slides that contained lesser quantities of the naturally occurring radioactive element thorium were deficient.²⁴

There are now indications that natural radiation may serve as a substitute for sunlight for deep sea and sub-surface organisms. For example, laboratory evidence indicates that gamma radiation can stimulate photosynthesis in algae denied natural light.²⁵

Life is now thought to have appeared on our planet at least 3 billion years ago. At that time the radiation dose from ingested potassium would have been 6 to 7 times higher than present levels. Doses from the decay of uranium-238 would have been nearly twice present levels. This can be deduced from the known half-life of potassium-40 and uranium-238. Similar analysis of the periodic table shows that many other radioactive substances were also more abundant in the early Earth.²⁶

The evidence is clear enough: Life has never existed without radiation, and probably cannot exist without it. Shall we run around like Chicken Little, in perpetual fear of natural phenomena, or shall we try to understand and master them? The decision is a very important one, as it touches on the distinction of

Subcommittee: First Meeting, Rockville, Maryland, March 26, 1996.

24. *Op. cit.*, footnote 17.

25. T.D. Luckey, "Evidence for Gamma Ray Photosynthesis," *21st Century Science & Technology* (Fall-Winter 2008) http://www.21stcenturysciencetech.com/Articlesn%202008/F-W_2008/Research_Communication.pdf

26. The existence of species of radioresistant bacteria, such as *D. radiourans*, discovered as a survivor in foods thought to have been sterilized by high doses of gamma radiation, may be leftovers of an earlier epoch of high radiation.



www.thermaltours.hu

The water in this thermal bath at Miskolctapolca, Hungary, contains calcium, magnesium-hydrogen-carbonic, iodine, bromide, and radon (which provides the heat). Since the Middle Ages, people have come to this radioactive bath to treat health problems.



Harper's magazine, 1878

For 200 years, people have visited Hot Springs, Arkansas, to bathe in the therapeutic waters from its radon/radium thermal springs. The Hot Springs Reservation was created by Congress in 1832, and the government provided for free baths until the 1950s. Depicted here is the public bathhouse.

man from the beast. The application of nuclear power to human need, is but the most obvious of the benefits which the discovery of atomic and nuclear science has bequeathed mankind. Beyond the promise of nuclear power, for lifting the presently immiserated majority of humankind out of a life of perpetual poverty, lies the promise of future discovery.

The most crucial unanswered question of 20th-Century science remains the proper understanding of the relationship of the biotic to the abiotic domain, as that question was first defined nearly a century ago by the Ukrainian-Russian Academician Vladimir Ivanovich Vernadsky.²⁷ One of the crucial and still insufficiently explored paths to understanding involves the study of the fractionation of isotopes, not necessarily radioactive, by living processes.

Since the mass spectroscopic studies of American spectroscopist A.K. Brewer in the 1930s, which suggested a fractionation of the potassium isotopes in species of kelp, this subject has been a topic of controversy among biologists and physical chemists.²⁸ Despite attempts to disprove Brewer's original work with more advanced techniques of mass spectroscopy, more recent evidence continues to confirm the existence of significant isotopic fractionation in living processes. Among the most conclusive are the studies carried out at the Swiss Federal Institute of Technology, showing a high degree of enrichment of the lighter isotopes of iron in the human blood, as compared to non-biological sam-

ples.²⁹ Variations as high as 5 percent in the ratios of deuterium to ordinary hydrogen found among different fractions of water in the leaves of ivy and sunflower plants are also highly suggestive.³⁰ Similarly, the evidence for calcium isotope fractionation in bone and shell as compared to the dietary sources.³¹

Whether or not the fractionation can ultimately be explained as a result of a physical chemical process, the question remains, in what way is the living organism making use of the isotopic variation? What might careful observations of such isotopic shifts teach us about that scientifically crucial distinction among the three domains of the non-living, living, and noëtic, as first clearly enunciated for modern science by Academician V.I. Vernadsky? What fundamental distinction between the living and non-living domains demands a shift in the abundance distribution of the isotopes from that observed in the abiotic domain, and what insight into the still unresolved questions of atomic science might be gained from knowing it?

Herein lies the importance of overcoming the fear of radiation.

Laurence Hecht is editor-in-chief of 21st Century. This article was completed on March 11, 2009, and a version of it appeared in the Executive Intelligence Review, May 29, 2009.

27. See for example: V.I. Vernadsky, "On the Fundamental Material-energetic Distinction between Living and Nonliving Natural Bodies of the Biosphere," English translation in *21st Century Science & Technology* (Winter 2000-2001), pp. 20-39. <http://www.21stcenturysciencetech.com/articles/ProblemsBiogeochemistry.pdf>

28. Cf. Lasnitzki and Brewer, "A Study of the Isotopic Constitution of Potassium in Various Rat Tissues," *Biochem J.*, January 1941, Vol. 35, Nos. 1-2, pp. 144-151. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1265476>

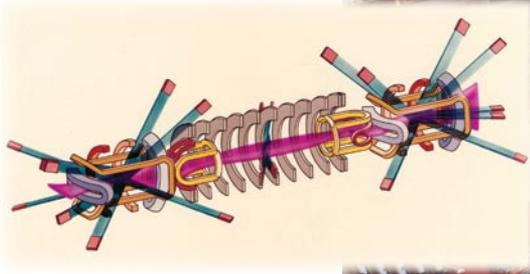
29. Walczyk and von Blanckenburg, 2005. "Deciphering the iron isotope message of the human body," *International Journal of Mass Spectrometry*, Vol. 242, pp. 117-134. http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VND-4FC3S60-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=f6d1c44806d1b47e28801df759d9606b

30. Yakir, DeNiro, and Rundel, 1989. "Isotopic inhomogeneity of leaf water: evidence and implications for the use of isotopic signals transduced by plants," *Geochimica et Cosmochimica Acta*, Vol. 53, pp. 2769-2773.

31. Skulan and DePaolo, 1999. "Calcium isotope fractionation between soft and mineralized tissues as a monitor of calcium use in vertebrates," *PNAS*, Vol. 96, no. 24 (Nov. 23), pp. 13709-13713. <http://www.pnas.org/content/96/24/13709.full.pdf+html>

Thoughts on Fusion Energy Development After a Six-Decades-Long Love Affair

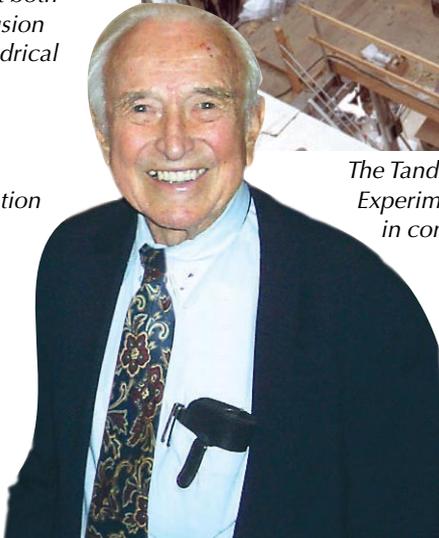
by Richard F. Post



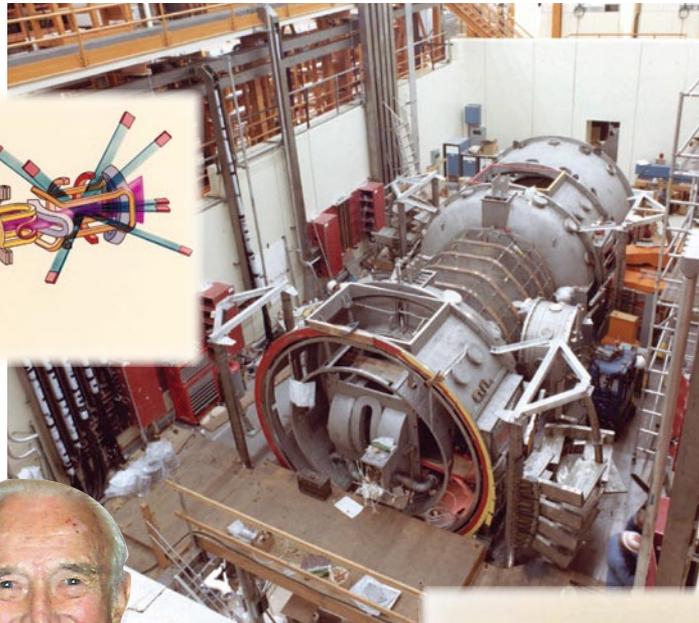
LLNL

A schematic of the Tandem Mirror Experiment. The magnetic mirrors at both ends confine the fusion plasma in the cylindrical reactor chamber.

Richard F. Post at Fusion Power Associates' celebration honoring his 90th birthday.

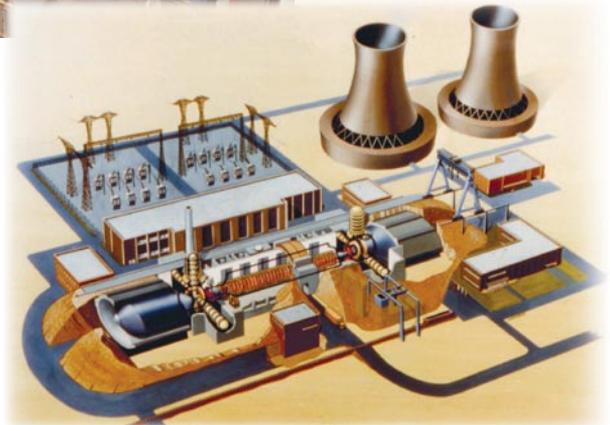


Courtesy of Fusion Power Associates



The Tandem Mirror Experiment (TMX) in construction.

A fusion pioneer reviews 60 years of fusion history, and proposes the axisymmetric tandem mirror as a fast track to achieving ignition with magnetic confinement fusion, bypassing some of the problems with large tokamaks.



LLNL

Artist's conception in the 1980s of what the larger MFTF tandem mirror power plant would look like in 1990. As Dr. Post explains, the fully built MFTF was mothballed just after it was completed, and tandem mirror work was terminated.

Dr. Richard F. Post, a pioneer in fusion research., made these remarks at the the Fusion Power Associates Annual Meeting and Symposium, Dec. 3-4, 2008, "Fusion Energy: Countdown to Ignition and Gain."

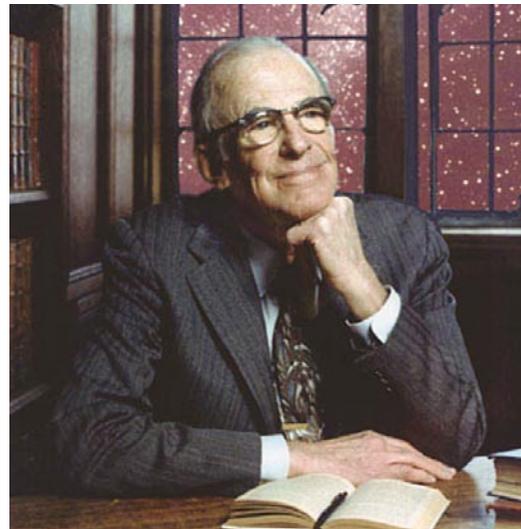
The two-day meeting in Livermore, Calif., included awards to fusion pioneers Post and John H. Nuckolls, Director Emeritus of Lawrence Livermore National Laboratory (LLNL). There were also a celebration of Dr. Post's 90th birthday and presentations by researchers in magnetic and inertial confinement fusion. (See http://fire.pppl.gov/fpa_annual_meet.html#2008 for more details.)

First, I wish to thank Steve Dean and his Fusion Power Associates for honoring John Nuckolls and me, and for giving us this opportunity to comment on a field of research that has been our passion for decades. In my case, I would also like to thank [former associate director for magnetic fusion energy at LLNL] Ken Fowler for proposing the theme of the symposium to Steve Dean [president of Fusion Power Associ-



LLNL

The men most responsible for organizing the new laboratory at Livermore in the early 1950s: Herbert York (right) with Ernest Lawrence (left), and Edward Teller, in 1957.



NASA

Lyman Spitzer, Jr. (1914-1997). Spitzer began work on controlled thermonuclear reactions in 1950, with a Stellarator configuration, in a classified program code-named Project Matterhorn.

ates] many months ago and then diligently following through on its details..

In what I have to say, I will be talking about paths to fusion and about fusion's history as I recall it. Not about the negative aspects of history, as in those who forget history are doomed

to repeat it, but the positive view that: If we remember that in the past we had a clearer vision of the path to fusion, and if we have gotten off that path, we know that the path exists and that we can find it again if we try.

Where to begin? And what to highlight about the six-decades-long love affair that I have had with fusion research? My fascination with fusion really began early in 1952, as a result of three classified lectures given by Herb York. I was then a year out of graduate school and working at the Radiation Laboratory (now Lawrence Berkeley National Laboratory). Herb's series of lectures covered the physics issues of controlled thermonuclear reactions (CTR) and described the U.S. fusion programs at Princeton University, headed by Lyman Spitzer, and at Los Alamos, headed by Jim Tuck. Both groups were working on

Richard F. Post: A Brief Biography

Richard Freeman Post was born in Pomona, California, and received his B.A. from Pomona College in 1940 and a Ph.D. in Physics from Stanford in 1950, with intervening years at the Naval Research Laboratory. He also received an honorary Sc.D. from Pomona. At the Lawrence Livermore National Laboratory, he was appointed group leader in Controlled Thermonuclear Research in 1951, as the lab was being founded; then Deputy Associate Director for Magnetic Fusion Energy in 1974, and Senior Scientist in 1987.

Post has (thus far) authored over 25 patents in fusion, accelerators, electronics, and mechanical energy storage. He is a Fellow of the American Physical Society, the American Nuclear Society, and the American Association for the Advancement of Science. His many fusion honors include the American Nuclear Society Outstanding Achievement Award in 1977, the American Physical Society James Clerk Maxwell Prize in 1978, and the Fusion Power Associates Distinguished Career Award in 1987. His magnetics work has been recognized by a Popular Science Design and Engineering Award for passively stabilized magnetic bearings in 2000 and an R&D 100 Award for Induc-Track (Maglev) in 2004.

Excerpted from a tribute to Dr. Post on his 90th birthday, written by Ken Fowler.



LLNL

John Nuckolls (center), the seventh director of LLNL, with Roger Batzel his predecessor at left and Carl Haussmann at right. Nuckolls pioneered work on inertial confinement fusion with lasers.

versions of the only game in town at that time: trying to use specially shaped magnetic fields to stably contain a 100-million-degree hot, ionized gas—plasma—composed of electrons and fusion fuel nuclei, heavy hydrogen isotopes.

For the benefit of the non-scientists, getting power from a magnetically confined fusion plasma is the nuclear equivalent of burning natural gas in a furnace, except that here the furnace liner is to be made up of non-material magnetic field lines. The other main present approach to fusion—using lasers to heat a tiny pellet of fusion fuel to ignition—did not exist. The laser had not yet been invented and John Nuckolls' pioneering work in the area of laser-based fusion research was yet to come.

Herb York's lectures on magnetic fusion had a specific goal in mind, to stimulate the interest of us physicists to join him in forming a new laboratory on a site near Livermore. This new lab was to have fusion research as one of its main goals.

A New Laboratory Formed

To make a long story short, after Herb's lectures there was ferment among many of us—trying to think of ways to solve the controlled fusion problem. Several of us then joined the new lab, some to work on controlled fusion, and others to work on classified military applications.

At this point, I think it is important to make clear the underlying source of our fascination with fusion research—then and now. Even before 1952, it was beginning to be evident that within perhaps less than a century, the world could no longer count on fossil fuels for its ever-increasing energy demands. In the long term, it would have to rely on energy released in nuclear reactions, that is, either fission or fusion.

To those of us who went to Livermore with Herb, it seemed obvious that the fusion of heavy hydrogen was the way to go, and we pointed to the world's huge fusion fuel reserve—the fact that 1 in every 6,500 atoms of hydrogen in water was a deuterium atom. Here was a fuel reserve that was not only virtually inexhaustible, but one that would be cheap and universally available; no fusion OPECs, and no future conflicts born of competition for limited fuel resources.

To emphasize the significance of fusion's fuel reserves, here is a thought experiment: Think about the amount of ordinary water— H_2O —that would flow through a city water main about a foot and half in diameter at normal pressures. Then think about putting that flow of water into a deuterium separation plant, using well-known energy-efficient separation techniques. From that input of ordinary water, there would come out of the separation plant a small stream of heavy hydrogen—deuterium.



IAEA

The 1958 Atoms for Peace conference in Geneva, where the United States, Soviet Union, and United Kingdom declassified their fusion research and made it available to all nations. Here, the top officials of the conference (from left): Sir John Cockcroft (U.K.), Dr. Homi Bhabha (India), Dr. V.S. Emelyanov (USSR), Professor S. Eklund (Sweden), Professor F. Perrin (France), Dr. Homi M. Sethna (India), Contreadmiral Otacilio Cunha (Brazil), Dr. W.B. Lewis (Canada), and Dr. I.I. Rabi (U.S.)

This deuterium, if distributed to fusion power plants and fused to completion, would represent a fuel energy input rate equal to the entire world's energy input rate today: all the oil and natural gas wells, all the coal mines, all the hydroelectric plants—everything!

And as to inexhaustibility, how long do you think it would take to pump all the water in the oceans through an 18-inch water main?

Magnetic Fusion Research Begins

A bit more fusion history: Serious effort on magnetic fusion research began in about 1950, in classified research programs in the U.K., the U.S., and the Soviet Union. By 1955, it was apparent that magnetic confinement of a hot plasma was a much more complex process than first thought, so that at the 1958 Geneva Atoms for Peace Conference, these three countries declassified and described all of their fusion research results in order that the fusion quest could be pursued by all the nations.

To achieve net fusion power it is necessary to heat and then to confine a fusion plasma long enough for the fusion energy released to exceed the energy required to heat the fuel to fusion temperatures. However, as of Geneva 1958, it was clear that the plasmas in every magnetic configuration that had been tried, exhibited plasma instability and turbulence, leading to unacceptably rapid loss of the plasma. This universal observation of the negative effects of turbulence on magnetic confinement defined the central problem for magnetic fusion research from that day forward, up to and including today.

First, some basics of the magnetic confinement for the non-



T. Kenneth Fowler (left), Associate Director of LLNL from 1970 to 1987, was a co-inventor of the tandem mirror concept in 1976. Here he discusses the MFTF plasma guns with Project Manager Victor Karpenko (center) and Program Leader Fred Coengsen.

scientists: Strong magnetic fields change the straight-line orbits of the ions and electrons of a plasma into tight spirals moving along the field lines. This inhibits escape of the particles across the field lines, but unless something is done about it, does not restrict their motion along the field lines.

In magnetic fusion research, the choice of what that something should be has from its beginning separated magnetic fusion researchers into two distinct groups: those solving the problem of the ends by using closed-field systems—field lines chasing their tails inside a doughnut-shaped chamber—or those studying open-field systems, that is, using a tube-shaped bundle of field lines and then plugging the end leaks by strengthening the field at the ends to form magnetic mirrors.

But the plasma physics issues introduced by making one or the other of these choices are profoundly different, and (here comes the personal bias) the choice that was actually made, in the late 1980s, by most of the world's fusion programs—to restrict their research to closed-field systems—has severely slowed our progress toward the fusion goal.

From Broad-Based Program to Tokamak Only

Up to the mid-1980s, the world's magnetic fusion energy program was on the right path. The program was a broadly based one, with sizable experiments investigating a variety of both closed and open systems, backed up by an extensive theoretical and computational effort. But, not surprisingly, the criterion that was adopted by the policy-makers at that time for judging the merit of one approach over another was how close the magic fusion numbers—plasma confinement time, plasma den-

sity, and plasma temperature—that had been achieved experimentally, came to the numbers required for net fusion power.

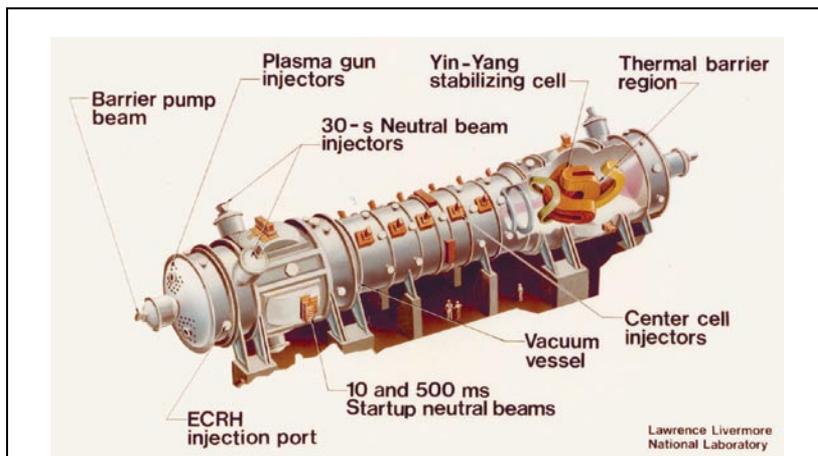
By the middle 1980s, one closed-field system, the tokamak, was the clear winner by this criterion. Why? Because early on, starting with experiments by its Russian inventors, it was found that all you needed to do to get better numbers out of a tokamak was to build a bigger one. Though the tokamak was very difficult to analyze theoretically, and was clearly plagued by a variety of plasma instabilities, nevertheless when one plotted the confinement times of succeeding generations of ever-larger tokamaks against the square of their plasma radius, the data lay on an upward-sloping straight line, aiming directly at plasma fusion ignition in some future, necessarily very large, tokamak.

As I see fusion's history, this simple curve sounded the death knell for all approaches that did not resemble or support the tokamak in some way. Specifically, it virtually terminated the study of open-ended systems, apart from some pockets of resistance at Tsukuba in Japan and at Novosibirsk in Russia.

This shift in program breadth happened even though great progress had been made in open-ended mirror systems, following the invention of the tandem mirror in 1976 by Ken Fowler and Grant Logan, here at the Laboratory, simultaneously with its invention in Novosibirsk, Russia, by Gennady Dimov.

In that heyday for mirror research, a large tandem mirror experiment here at Livermore, TMX, was proposed and construction was completed in 18 months. Tandem mirror systems were also built with similar speed at MIT and the University of Wisconsin in the United States, and at Tsukuba in Japan. At Livermore, TMX was followed by an upgrade, TMXU, and then by the construction of a really large tandem mirror, MFTF.

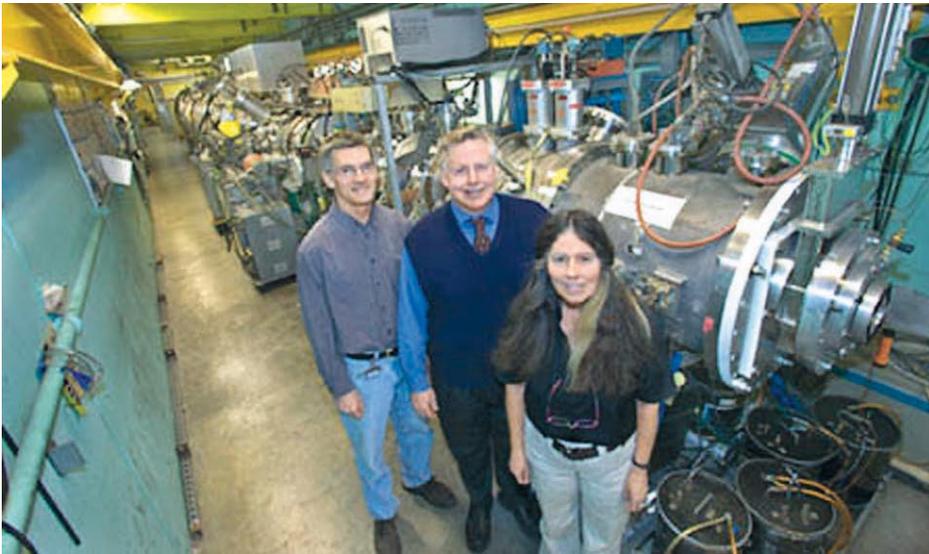
Days after its completion and first shakedown tests, MFTF



THE MFTF TANDEM MIRROR CONFIGURATION

The tandem mirror is a linear system with modular magnetic coils, which is simpler from an engineering standpoint than the tokamak. The plasma flux lines run axially, contained at each end of the reactor by magnetic mirrors.

Source: LLNL



Lawrence Berkeley National Laboratory

Grant Logan (center) the other co-inventor of the tandem mirror, shown here at the High Current Experiment with Peter Seidl (left), and Christine Celata.



Fusion Power Associates

Tom Simonen, former mirror group leader at LLNL, chairs a committee that is investigating the Axisymmetric Tandem Mirror.

was mothballed and all mirror-based work in the United States was terminated.

Where Are We Today?

Where are we in magnetic fusion research today? We are partway down a long trail that dates back to 1985, when a proposal for a really large, internationally sponsored, tokamak, ITER, was made. It then took 20 years—until 2006—before funding agreements (\$10 billion) and a site was chosen by the international partners. Another 10 years will be required for construction, and 20 years of operation are planned, after which a demonstration tokamak, one actually generating electricity, would be considered (since the ITER experiment will generate only heat).

To wrap up (here comes the personal bias): Can we afford to wait that long for fusion? Are there faster, better, ways to get there? Here I'll be discussing magnetic fusion only. I'll not talk about the impressive progress in laser-based fusion towards fusion ignition. [National Ignition Facility director] Ed Moses and his co-workers will certainly be covering that in their talks.

First, about ITER: I give ITER high marks for keeping magnetic fusion from dying on the vine, for the international cooperation it has fostered, and for the

fusion-related science and technology that was developed and is being developed to implement it. But ITER is like the TV ads for a new wonder drug: If you are patient, this drug will do wonders, but look out for those side effects!

The side-effects of ITER, in my opinion, have been catastrophic for magnetic fusion research. They include: (1) narrowing a program that cries out for breadth to insure success, (2) turning away bright young researchers from magnetic fusion research because its course is already a done deal, and (3) drying



LLNL

The huge Yin-Yang superconducting magnet for the MFTF, en route from its fabrication site to the construction site.



PPPL

The Gas Dynamic Trap axisymmetric mirror machine at Novosibirsk, Russia, which has demonstrated plasma confinement with no turbulence.

up funding for anything that does not support, or at least resemble, a tokamak.

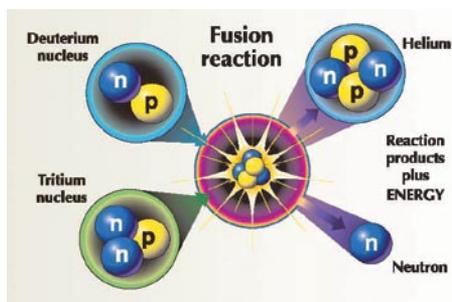
Enough of negativity! I would like very much to finish this talk on a positive note.

First, our critical need for clean and sustainable sources of energy represents a real opportunity for fusion research, if we take advantage of it. One way to put the situation today is to talk of it in terms of present reality and future reality. Present reality says: In the present economic climate and with our prior commitments there is no way we can support a new effort.

The prime example of future reality was when John F. Kennedy said we are going to put a man on the Moon in 10 years. He knew that the science and rocket technology needed for a Moon landing was there, along with the money to pay for it.

I believe that we are in a similar situation today with respect to the magnetic approach to fusion power. We have the basic scientific understanding, the computational horsepower, and the technology to take a new, broader, look at the problem.

And we certainly have the financial wherewithal. For example, we are spending \$700 billion a year to import oil. One week of that rate of expenditure—\$11 billion—is equal to the entire U.S. magnetic fusion funding over its 56-plus years of existence. A 4/10th percent tax on that oil could

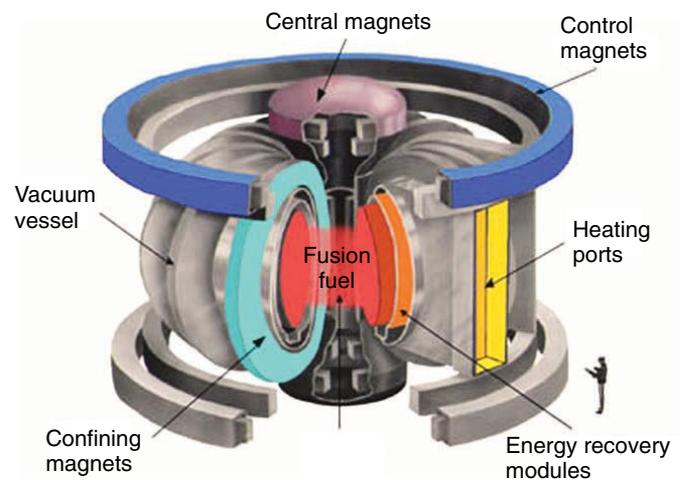


LLNL

THE FUSION PROCESS

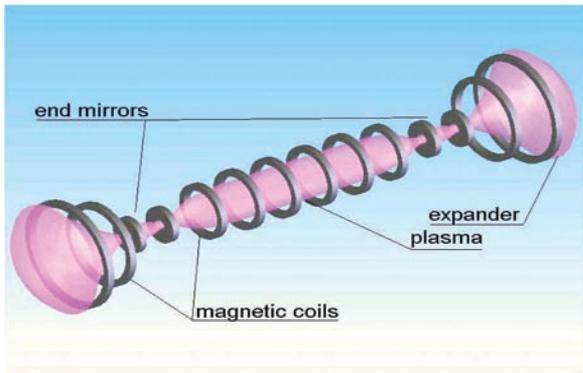
A fusion reaction takes place when two isotopes of hydrogen, deuterium and tritium, are combined to form a larger atom, releasing energy in the process. The products are energetic helium-4 (He-4), the common isotope of helium (which is also called an alpha particle), and a more highly energetic free neutron (n). The helium nucleus carries one-fifth of the total energy released, and the neutron carries the remaining four fifths.

Fusion fuels the Sun and stars, but in the laboratory, atoms must be heated to at least 100 million degrees under sufficient pressure, to produce fusion. Other light elements can also be fused.



MAGNETIC CONFINEMENT FUSION IN A TOKAMAK

In the tokamak, the fusion plasma is contained using a strong magnetic field created by the combination of toroidal and poloidal magnetic fields (the first refers to the long way round the torus, and the other, the short way). The resulting magnetic field forces the fusion particles to take spiral paths around the field lines. This prevents them from hitting the walls of the reactor vessel, which would cool the plasma and inhibit the reaction.



THE AXISYMMETRIC TANDEM MIRROR

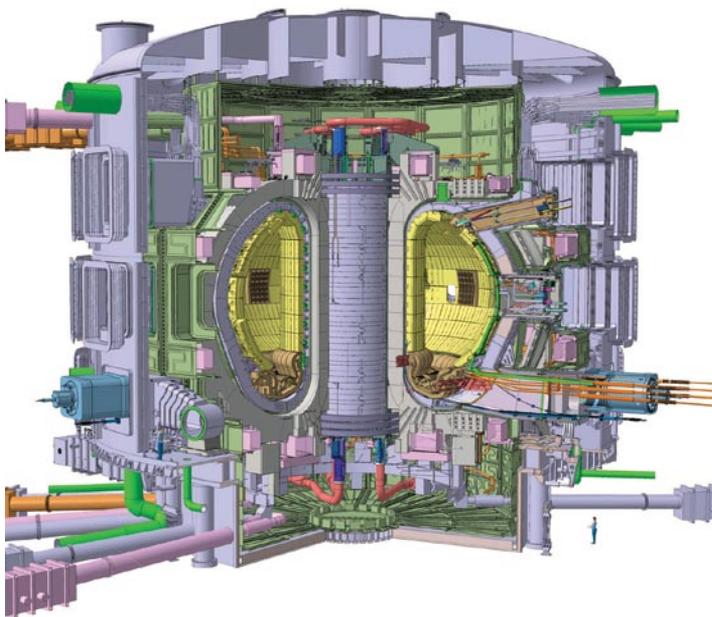
In the ATM configuration, end mirrors and magnetic coils confine the fusion plasma. The system is more stable, and no new technologies are required.

T.C. Simonen

pay for a fusion budget that is a factor of 10 larger than the present budget.

A Better Bet: The Fusion ATM

Are there better, faster-to-develop, approaches to magnetic fusion than the tokamak? Yes, there are! As an example, I



THE ITER DESIGN

The internationally supported ITER tokamak, now under construction in Cadarache, France, will take 10 years to build, and has a planned 20-year operation. After that, a demonstration tokamak to generate electricity will be considered. Dr. Post makes the case that the tandem mirror is faster and easier to develop.

Source: ITER

would cite the recent findings of a Department of Energy-sponsored committee that is taking a new look at open-ended systems, in particular at new forms of the tandem mirror that we call ATMs (for Axisymmetric Tandem Mirror, not for machines for getting money—yet). The committee is chaired by a former Lab employee and mirror group leader Tom Simonen (who is doing a great job). Its members include several Lab employees and retirees, plus researchers from other labs, including MIT, Princeton, the University of Texas, and Los Alamos.

We are now writing the final report. It concludes that the open-ended ATM represents a simpler, and easier-to-engineer, approach to magnetic fusion than ITER, since it is modular in nature and, being axisymmetric, it employs only simple circular coils to create its confining magnetic fields.

What is even more important is that we believe that the ATM could be free of the plasma turbulence that haunts the tokamak and that dictates its huge size. In support of this possibility is a plasma stabilization concept analyzed theoretically by Lab physicist Dmitri Ryutov (when he was at Novosibirsk in the 1980s).

His theory has been confirmed in detail by a series of experiments in the Gas Dynamic Trap axisymmetric mirror machine at Novosibirsk. In the GDT a hot, dense, plasma is confined stably for times in agreement with theoretical predictions, and the plasma shows no evidence of turbulence.

Do I think that the ATM could be a future reality? Yes I do! Do

I think that it is the only worthwhile new approach to magnetic fusion? Definitely not! Do I think this country should rapidly re-invigorate its magnetic fusion program? You bet I do!

A 'Yes We Can' 10-Year Plan for Fusion

John Nuckolls, director emeritus of LLNL, proposed a 10-year strategy for achieving laser fusion, which he said could be accomplished with only 10 percent of President Obama's \$150-billion projected energy program. Nuckolls made his presentation at the December 2008 Fusion Power Associates meeting, where he and Dick Post received awards.

Nuckolls, who led research on laser fusion at LLNL for many years, proposed "four steps to fusion power": (1) build an efficient high-average power laser module, a factory for producing laser targets, and a fusion chamber; (2) build a surged, heat capacity inertial fusion energy system; (3) build a fusion engine; (4) build a fusion power plant.

His presentation is available on the FPA website.

INTERVIEW: RICHARD F. POST

A Fusion Pioneer Talks About Fusion and How to Get There



Dr. Post was interviewed by Managing Editor Marjorie Mazel Hecht on June 12, 2009.

Question: I'm honored to interview you Dr. Post. Reading over all your accomplishments, I think we might need two interviews in order to ask you all the questions I have!

Our magazine, as you know, is the successor to *Fusion* magazine, and we have promoted fusion and advanced technologies for many years now, so what I would like to cover in the interview is the fusion question, the Inductrack maglev, the

magnetic bearing, and your flywheel idea—and anything else you'd like to talk about.

Well, fire away.

Question: We also work with a Youth Movement, and I want to have the youth get acquainted with some of these technologies that have been your mission in your career. I'd like to start with fusion, and have you talk about your idea for the ATM, the Axisymmetric Tandem Mirror fusion reactor. You've been working on this for a long time. How do we bring this into being?

In the first place, I would not call it my idea. I did come up with a way of doing it, but there are many ways to skin a cat. The basic concept, that is not what I came up with. I'd been looking at a way of making an ATM, based on theory by [Dmitri] Ryutov but as we learned, there are also many other ways to stabilize the MHD [magnetohydrodynamic] instability mode of an Axisymmetric Tandem Mirror. All I was doing is taking one particular way of trying to see how one would implement that.

But I think that what we start out with, and take as a scientific given, is that an ATM can be MHD stabilized, and then go from there. The details of which particular technique, or combination of techniques, is left for the future. The real point is that what was once considered a bar to the use of axisymmetric fields in tandem mirrors is no longer relevant.



Artist's drawing of the Mirror Fusion Test Facility (MFTF), built at Lawrence Livermore National Laboratory in the 1980s. The vacuum vessel at center is shielded in a seven-story-high concrete vault. The MFTF was forced to shut down soon after it was fully completed because of budget cuts. The U.S. magnetic fusion program was then narrowed to concentrate on tokamaks.

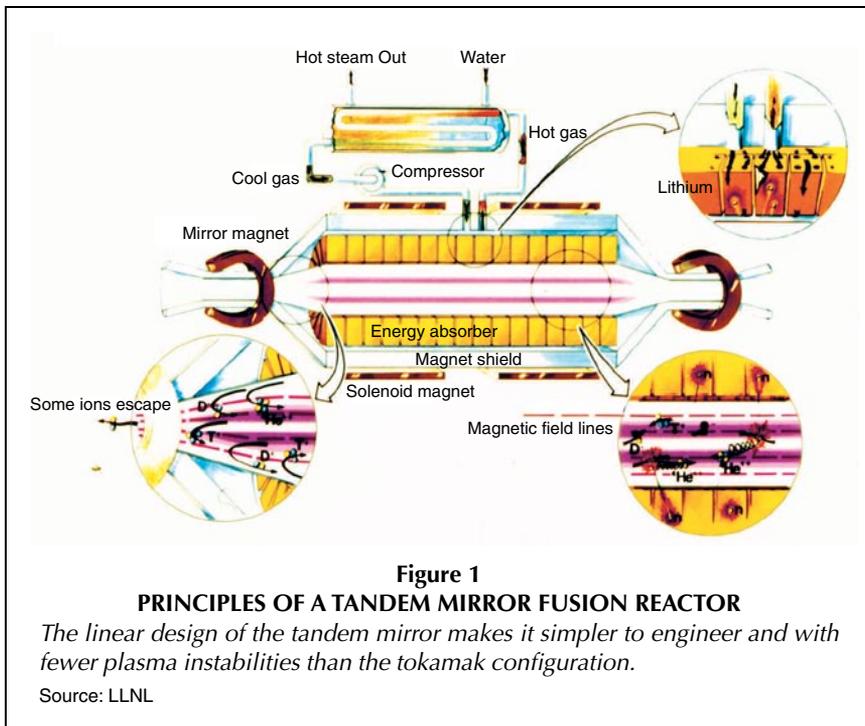


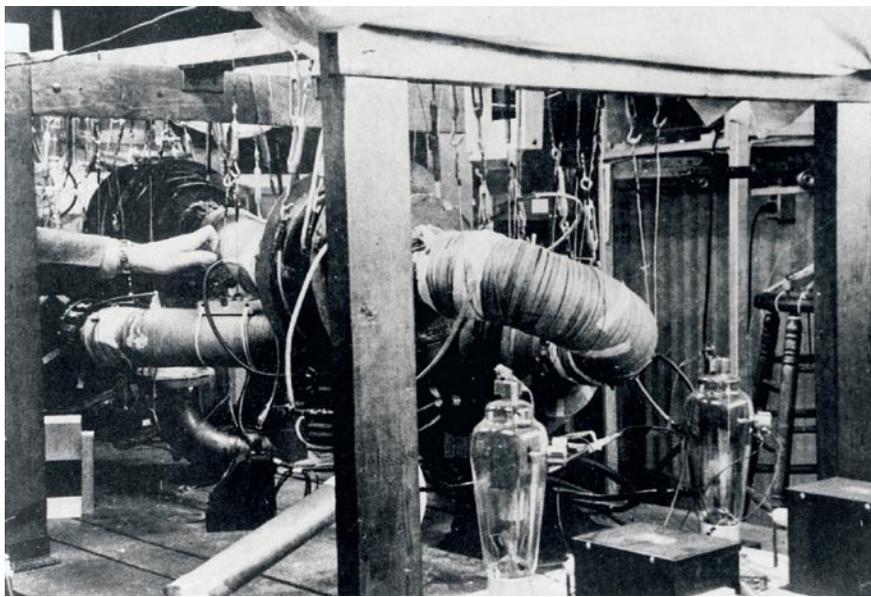
Figure 1
PRINCIPLES OF A TANDEM MIRROR FUSION REACTOR

The linear design of the tandem mirror makes it simpler to engineer and with fewer plasma instabilities than the tokamak configuration.

Source: LLNL

The early history of mirrors involved discovering this drift mode, MHD mode, and the quick fix for it, the genius fix for it, was the Ioffe work in Russia. And the abandonment of axisymmetry, which did solve that problem, introduced a whole host of new problems—

Question: What year was the Ioffe work?



The Stellarator A, built at the Princeton Plasma Physics Laboratory in 1952, was Lyman Spitzer's first fusion machine. Its small size can be gauged by the hand at left. The early stellarators bent the torus into a figure eight. Later stellarators were larger, and had more instabilities than the early tandem mirrors.

That was reported in Salzburg around 1961 by Artimovich, who was the head of the Soviet program. It came at a time when we were encountering that instability and reporting results, and so forth, and he came up with this discussion of the Ioffe experiment, which proved the theory of that. Ingenious, but a double-edged sword in the sense that it brought along a complexity and an introduction of new drift modes for the particles that were not present in axisymmetry.

Now, earliest on, in our ignorance, we had tried axisymmetric systems and found them to be stable, in those particular experiments. We didn't understand why, because we knew from the theory that they should be drifting sideways, but they did not; and so we reported in *Physical Review Letters* the fact that one of these experiments would produce a little spindle of very hot electrons.

We found that the transverse diffusion in this little spindle, which was a couple of centimeters in diameter and maybe 10-20 centimeters long—even though the electrons were very hot—was five orders of magnitude slower than the so-called Bohm rate that was simultaneously being encountered in the big model-C Stellarator at Princeton.

This is a very impressive difference. For the electron spin to drift across a field in that Stellarator experiment required the presence of fluctuations, characterized by the Bohm diffusion rate, and we simply were five orders of magnitude below it. Well, had we pursued this lead, and understood the stabilizing mechanism, which we think we understand years later now, I think we would have gone down a very different path, in terms of mirror research.

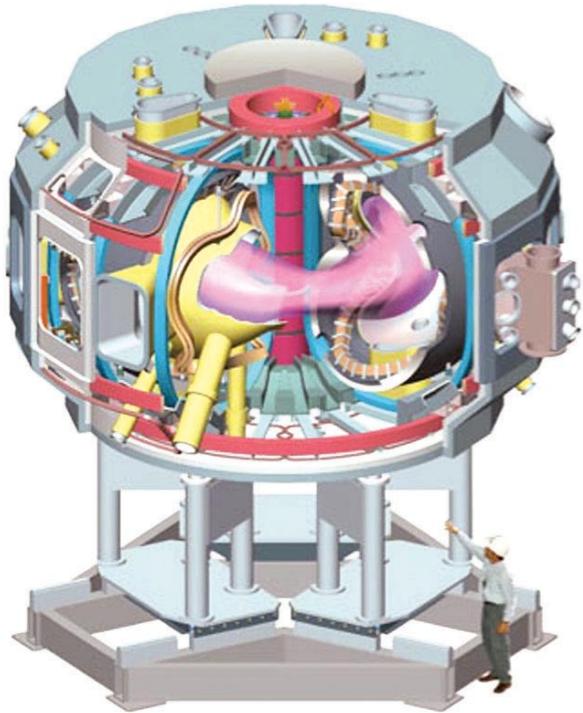
The Importance of Axisymmetry

There are many reasons why axisymmetry is important in this context. What I mean by axisymmetry is basically the shape of a cigar, or party-popper, or something—a cylinder, a cylindrical system with the flux lines running axially [see Figure 1].

Now, there are both physics reasons and engineering reasons why this open-ended axisymmetric system is very, very advantageous. In the first place, as was shown by Teller and Northrup way back when, in the 1950s practically, when you have an axisymmetric system, and particles are trapped in that axisymmetric system of the kind I just described, with a couple of mirrors at either end, the drift surfaces of the particles as they move back and forth, are reflected back and forth, and are drifting around, these drift surfaces are themselves cylinders, closing themselves.

The particle bounces back and forth and drifts sideways slowly. So its orbit generates a surface, and this surface is also axisymmetric.

If you take a Stellarator and put a particle in that, some classes of particles simply drift sideways out of the system. The only reason to confine them, it is maintained, is that those particles are knocked out of those special regions by collisions, so the diffusion



PPPL

The large stellarator project, the National Compact Stellarator Experiment, began construction in 2003 at the Princeton Plasma Physics Laboratory, but was cancelled in 2008 for budgetary reasons. The Lab's remaining project is the National Spherical Torus Experiment (NSTX), which is similar to a tokamak.

rate is enhanced if they weren't doing that. So axisymmetry produced closed surfaces.

There was a classic experiment, that you may be aware of, proposed by Nicholas Christofilos of the Laboratory (LLNL)—an experiment that could never be performed today—which was to use the Earth's axisymmetric magnetic field as a test for confinement of hot electrons, by taking a rocket and blowing off a nuclear weapon in upper space, which released a cloud of hot electrons. And this cloud of hot electrons then was detected and remained being detected for a decade.

There are an enormous number of reflections implied by that number, and I'm just referring back to it, to give you some of the evidence why axisymmetric symmetry is important.

There's also a whole class of instability modes of other kinds that simply are not present in axisymmetric systems. That's because we have no parallel currents, no electrical currents flowing parallel to the field lines, as there must be in a tokamak, for example, for it to work. That's the way the tokamak works. You induce a very strong current around a donut, and that curls up the current into helices, and that's why the tokamak is able to contain a plasma. Otherwise, there's no equilibrium, and if you didn't have that current, the particles would simply drift promptly to the wall.

In any event, there's no parallel current in the axisymmetric systems, and so that source of instabilities is not present. I could list other physics reasons for the better stability for axisymmet-



LLNL

Nicholas Christofilos, a Livermore physicist during the 1960s, designed the ASTRON Machine to produce controlled thermonuclear energy. He proposed a classic experiment using the Earth's axisymmetric magnetic field to test electron behavior.

ric systems, but I think the one I mentioned makes the point.

The main engineering reasons in favor of the ATM are that a linear system with modular coils is far easier to execute than a toroidal system. In the tokamak, all the interior parts are ex-

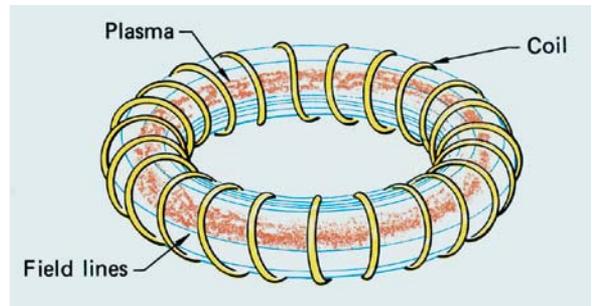


Figure 2

CLOSED TOROIDAL GEOMETRY

A closed toroidal configuration for magnetic confinement of a plasma. The plasma is contained by the fields produced by the magnetic coils and the electric current induced in the torus. This geometry has more instability modes than an axisymmetric system, which has no electrical currents flowing.

posed to neutron fluxes and separated from the exterior. In addition, there is all the complexity that goes with the shape of the magnet coils, and what have you. It's a far more complex device from an engineering standpoint than an axisymmetric linear system would be.

And, the sort of copper in my mind, in the long term, is that an open, axisymmetric system is ideally suited for a direct conversion of these charged particles to electricity.

Direct Conversion to Electricity

Question: Can you explain how the direct conversion works?

We did experiments here, way back when, and validated the theory of this concept. What it amounts to is: Suppose you have a fusion reaction going, and you have particles escaping, which are a mixture of the slowly leaking fusion fuel and the charged reaction products, the alpha products, for example. They escape out the end, and they are directed by the shape of the flux lines.

You can—as we showed in our experiment, and as other people did in other types of experiments—selectively separate the electrons and ions from this stream of particles, and generate an electric current directly from this system, and at very high efficiency. In our experiments, we exceeded 90 percent efficiency of conversion of the thermal energy of those escaping particles into direct DC electric power.

So, in the long term, when I believe fusion power plants will be going to the primary fuel D-D [deuterium], and using the D-helium-3 end products of the D-D reaction. Most of the energy from that fuel cycle will be coming out in the form of charged particles. If you have a direct conversion system, then you're ideally suited to use these types of fusion fuels, some of which are neutron-free. So in the long term, really long term, fusion can aim toward being about the most ideal system you can think of, in terms of its ability to generate energy from an inexhaustible fuel source.

So if you really want to take a look down the century, so to speak, that potential exists there. It simply is not credible to do it with a tokamak. The field lines don't go out of the system in a way that would allow direct conversion. It's just not credible to me.

High Beta Value with the ATM

Another engineering aspect of the axisymmetric system is, as is shown in the gas dynamic trap experiments in Russia, the so-called beta value, or ratio of plasma pressure to the confining magnetic pressure, which can be very high. Beta values have gone as high as 60 percent in that experiment. Typically in a tokamak, it's about 10 percent. The power density increases with the fourth power of beta. So, being able to achieve that high a beta value makes a huge difference.

What I'm talking about concerning that fourth power variation of power density with beta, is that the plasma pressure



PPPL

Inside a large tokamak. The tokamak geometry is more complex than an axisymmetric linear system, because of the shape of the magnet coils. Also, the interior parts are exposed to neutron fluxes. This is the PDX tokamak at Princeton, constructed in 1978.



Stuart Lewis/EIRNS

A major advantage of the axisymmetric system is that it can directly generate an electric current at high efficiency. With advanced fusion fuel cycles, which are neutron-free, this could be an ideal system for supplying electric power. The tokamak geometry does not allow for direct conversion.

is proportional to the square of the magnetic field and to the square of beta, the pressure of the plasma. And the pressure squared is what gives you the power density.

In other words, the particle density squared is the fourth power of the beta parameter. So as far as utilization of the magnetic fields for confinement, you have a fourth power of the difference between 10 percent and 50 percent, in your favor, from an engineering standpoint, with the ATM as compared to a tokamak. . . .

There are other uses of the ATM which are being considered, a whole spectrum of uses. One of them is related, in a certain sense, with the work being done in lasers here at the Laboratory. That is, it is proposed to utilize the fusion neutrons from the D-T [deuterium-tritium] reaction to impact the spent uranium fuel and in the process get energy from it. Energetic neutrons can do this. You don't have to utilize a chain reaction at all.

You can also create a situation where you're burning up the radioactive products from the reactions, which means less radioactive waste.

Question: You're talking about a hybrid fission/fusion reactor.

Yes, a hybrid system. And then, of course, the direct use for it is simply incinerating radioactive fission products, which is another possibility. Use the 14-MeV neutrons to transmute the radioactive products from fission reactors into non-radioactive or fast-decaying radioactive materials. These are secondary uses; of course, my main interest is the long-term use of fusion power, but I just want to mention the hybrid concept.

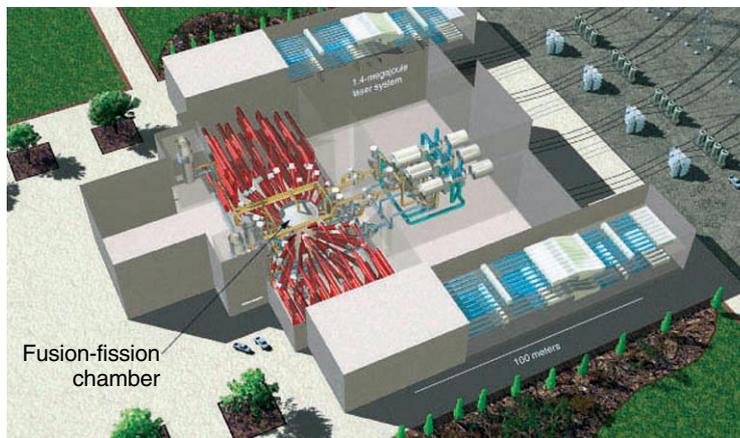
Energy Is the Ultimate Raw Material

Question: I think the fusion torch idea is related to the incineration of used fuel. Just to be able to "mine" garbage or rock would be extremely useful.

Yes. And by the way, there is a quote from a very wise scientist, the man who was the director of Oak Ridge National Laboratory several years ago, Alvin Weinberg. In a speech, he said something which I've really thought about, something that was very perceptive, and I'll tell you why I think that is the case. His remark was, "Energy is the ultimate raw material." And the reason that he was so prescient on this is that in the long term, mankind is essentially going to have to recycle things completely. You simply cannot continue to use the garbage dump—you can't continue to throw away valuable materials, aluminum, copper, what have you; these are not limitless resources. And what it takes to recycle these materials, that is energy.

If you have energy available, you can do it. You can do it by chemical processes, what have you, but it always takes energy to do it. And so, what Weinberg meant was, that we should take a long-term view of a sustainable society. Mankind is going to have to use energy to reprocess essential materials, which have been used in the past, into a useful form. And that just takes plain energy. So that's why he made the remark.

That's why, if you really want to take a view down the centuries, I think that fusion is what's going to be our primary energy



LLNL

A fusion-fission hybrid design would use 14-MeV fusion neutrons to burn spent uranium as fuel, or to transmute the radioactive fission products into non-radioactive or shorter-lived elements.

This is the LLNL design for a fusion-fission hybrid using a laser-fusion system. The fusion neutrons hit a subcritical fission "blanket," generating additional energy. The blanket could be composed of depleted uranium, unprocessed spent fuel, natural uranium or thorium, or fission products (like plutonium-239) that are separated out of reprocessed spent nuclear fuel.

source—and what I meant in that talk [see accompanying article], is what I'm very serious about: If you have an inexhaustible fuel, and essentially, one of very low cost and one that is universally available, the political implications of that, in a positive sense, are great, really significant.

Question: I certainly agree. I think the question is, how do we get there? How do we take the society we have now, which is really an anti-scientific culture—

Yes, I know—

Question: And turn it into the kind of forward-looking scientific culture that is necessary, where you look at projects in terms of 50 and 100 years, not 2 minutes.

Well, I think we're moving in that direction with the present administration. . . . But you're exactly right. How do we get to create that mindset, particularly since we have this threat of global warming hanging over us. And that's not trivial.

Question: That's a whole other discussion! Our temperature has actually been cooling for the last eight years, and I don't really think we have this problem with global warming.

Well, we have at least some subsidiary problems, like ocean acidity, and what have you.

We Need a Broad Scientific Path

Question: Perhaps, but if you have the perspective that man's mind can solve any problem that comes its way, then you don't worry about it, and you don't cut back and say we need fewer people. You move ahead.

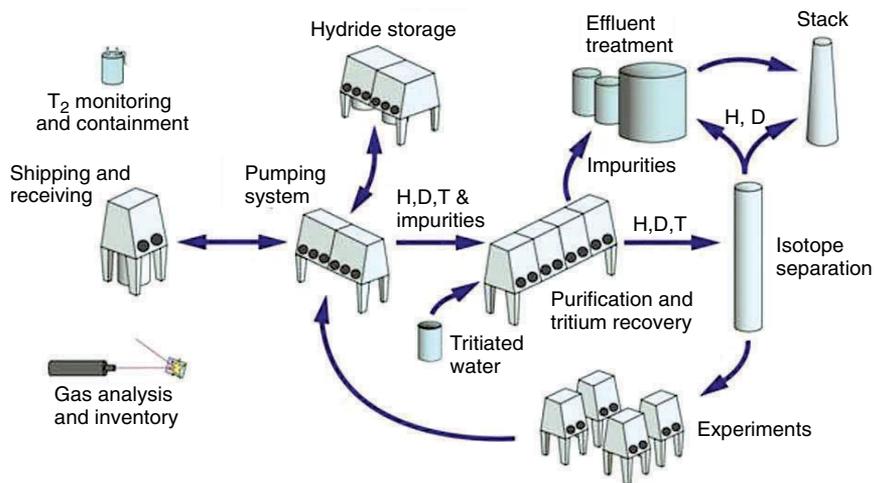
I agree. I think it's a solvable problem. In any event, I think the point is, you asked a specific question, and I can give you an answer to it. I tried to say it in my talk, that we had gotten off the

path when the tokamak took over. The path we had before in fusion research was a broad scientific path, and my analogy to what happened is, what would happen to cancer research if there was a dictum that we should only work on chemotherapy and forget all the rest of this stuff in medicine. That's all you're allowed to work on.

Question: Ah, well, that's almost what we've got now with cancer research. That would be very bad, yes.

What I'm getting at is, that fusion is such an important topic, and involves questions of an important scientific nature that you'd better understand, that you must maintain a sufficient breadth of the program. You don't say, "I know what the answer is, and this is what you've got to do, by gosh." But that's what's happened. That's what I tried to say in the talk had happened. I wasn't poor-mouthing the tokamak per se, I was saying that the by-product of that policy, like the side-effects that can occur with some new medicines, is that concentration on the tokamak has had side effects that have been harmful to fusion research.

And so, what we can do about it, and without even a huge expenditure of money, is to reinvigorate the breadth of the fusion program. Let many flowers bloom, so to speak. I mean really to take a serious look at other approaches, and that will bring in bright ideas from young people. They look at fusion now and say, okay, the tokamak, 10 years from now, we'll know



LANL

Fusion fuel—the heavy isotopes of hydrogen in seawater—is virtually inexhaustible. Here a schematic of the Tritium Systems Test Assembly facility (TSTA) at Los Alamos National Laboratory. The TSTA was dedicated to developing, demonstrating, and integrating technologies related to the deuterium-tritium fuel cycle for large-scale fusion reactor systems. The facility was unique in that it contained all of the systems required to process fusion fuel, sized at full-scale, and fully integrated for a complete tritium-processing “loop.”

The site operated from 1984 to 1999, when it was shut down, after the DOE determined that the TSTA mission had been completed.

if it's going to work or not. And they'll go back to school and study something else, instead of saying, "Gosh, I had this idea for fusion, and where can I work on it?"

Question: I think we've gotten away from that approach, not just in the fusion program, but it's a way of looking at a scientific problem that we don't really have any more, and certainly not to the extent that it's necessary.

Post: Well, there needs to be something like the John Kennedy statement about the Moon.

Question: Yes, I think that Apollo idea is very important. FDR had that idea, as I'm sure you remember the power of his ideas, and what he was able to do with the TVA, which wasn't an overnight "cost-effective" type program; it was looking 50 to 100 years in the future, which is what we have to do.

Sure, yes. I agree with you. That's basically optimistic. What we need to do is find ways of having the innovative side of humanity being favored.

Question: And to have the policy makers see how this is the only way to get the economy going, just as the Apollo Pro-
(Text continues on p. 43.)



NASA

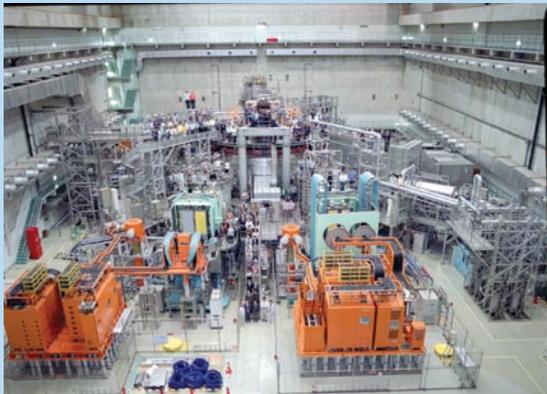
Helium-3 is another potential fusion fuel. He-3, a decay product of tritium, is rare on Earth, but can be found in greater quantity on the Moon. Here, an artist's conception of mining on the Moon.

Many Paths to Fusion Power



Carlos de Hoyos

The plasma focus fusion device, created by Winston Bostick and Victorio Nardi at the Stevens Institute of Technology, in Hoboken, N.J. Bostick developed the basic theory of the plasma focus, showing that energy is concentrated into tiny hot-spots or “plasmoids,” coherent structures of magnetized plasma. These force-free structures carry current.



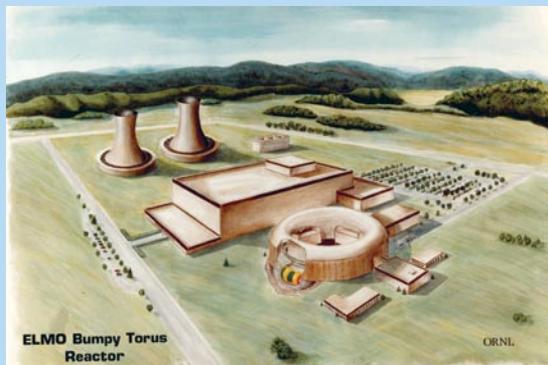
Japan National Institute for Fusion Science

Japan’s Large Helical Device (LHD) project involved construction of the world’s largest superconducting helical device, which uses a heliotron magnetic field, developed in Japan. To obtain fusion-plasma confinement in a steady-state machine, the LHD uses superconducting coils and plasma heating systems



Korea National Fusion Research

Korea’s KSTAR fusion reactor at the National Fusion Research Institute in Daejeon, which reached its first plasma on July 15, 2008. It features fully superconductive magnets.



ELMO Bumpy Torus Reactor

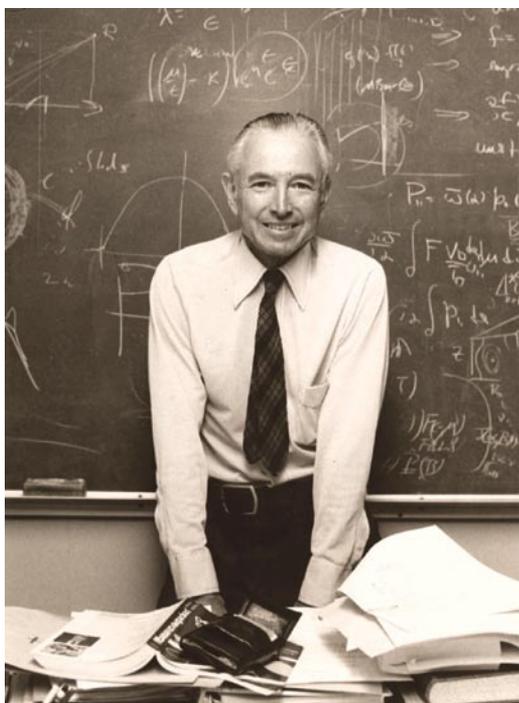
ORNL

An artist’s drawing of an Elmo Bumpy Torus fusion power plant. The EBT uses steady-state electron cyclotron resonance heating to produce a steady-state plasma in a current-free geometry. The design features a hybrid magnetic trap formed by a series of toroidally connected simple mirrors. Operated at Oak Ridge National Laboratory in the early 1980s, the EBT’s electron confinement agreed with theoretical predictions. The program was abandoned in 1985.



Sandia National Laboratory 1068

Sandia’s Z-pinch machine during its renovation process. Its huge conduits focus a massive electrical current on a target the size of a spool of thread. The Z-pinch gets its name from the large current passing in the vertical direction—the Z direction in cylindrical geometry—which creates a magnetic field that pinches together the ions of thin wires that serve as electrical conductors until the current vaporizes them.



LLNL

Dick Post: "There needs to be something like the John Kennedy statement about the Moon." Here, Post teaching.

gram put back, conservatively, \$10 for every \$1 that was invested in it, fusion would do much more than that. And advanced nuclear would. You get a transformative capability for the whole economy, for the whole society.

The U.S. is in a very good position to do this.

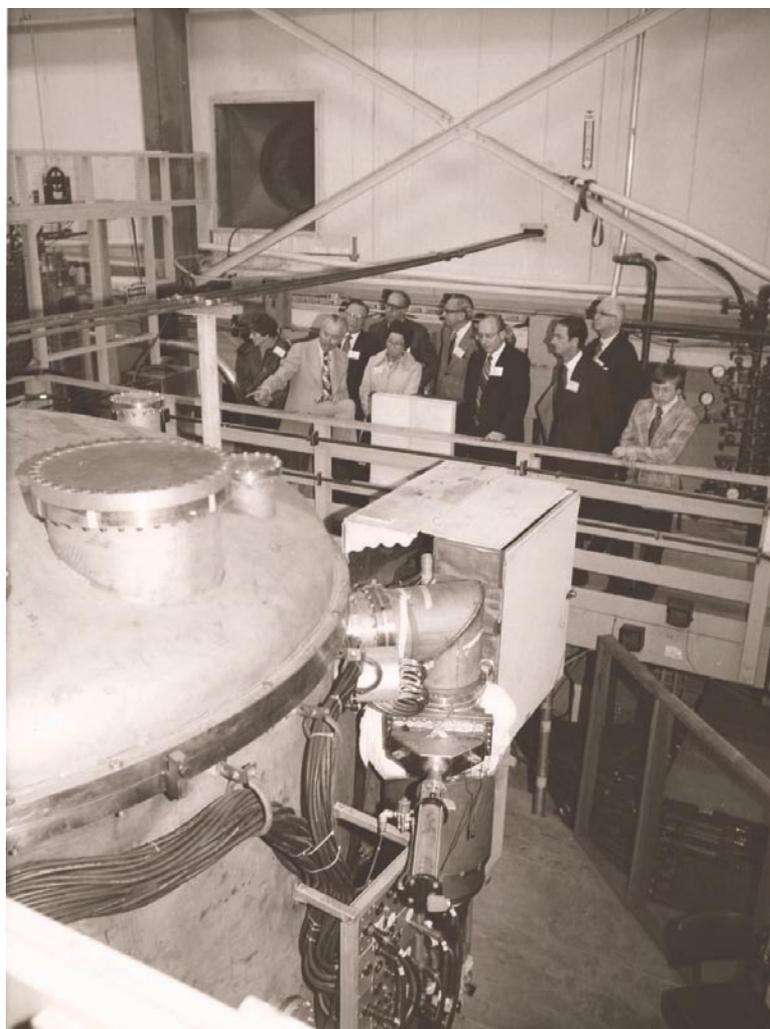
Something I didn't mention, which is relevant: Here at the Laboratory, we now have computational power, and when you combine that computational power with the relative simplicity of the ATM, you have something which could be simulated in exquisite detail, in my opinion, on a computer. Not that you wouldn't do experiments, but that you would have a much firmer correlation between experiment and theory, because you could say in advance, "this is what I'm going to see," so to speak.

The combination has been used in other technological areas, as a very powerful tool, one leap-frogging computation, leading one into an experiment and the experiment leading to new computation, and so forth, and thereby speeding up the whole process.

The Shut Down of Fusion Research

Question: After the Livermore Laboratory built the MFTF, the Mirror Fusion Test Facility—it was shut down. I don't remember the year it was shut down, but are any pieces of that still around?

No, it was literally cut up into pieces and salvaged. There's nothing left.



LLNL

Dick Post showing visitors at Livermore the Tandem Mirror Experiment (TMX), the reactor that preceded the larger MFTF.

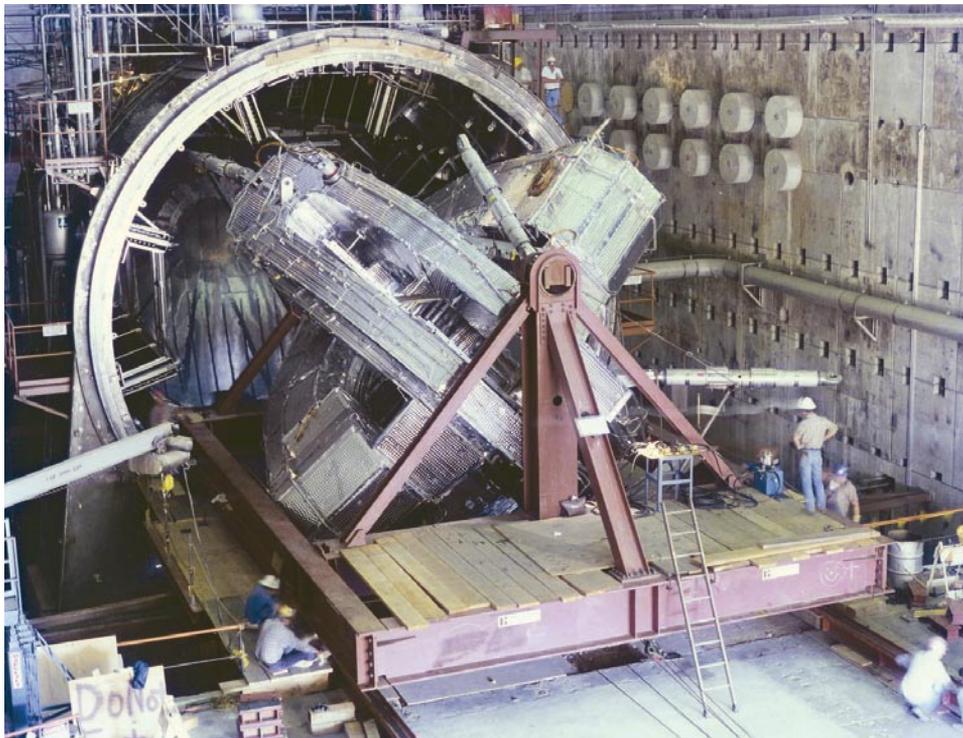
Question: I don't recall exactly the circumstances, but can you briefly say what happened?

Yes, the circumstances were that the U.S. fusion program was flying high as a result of the 1970s oil crisis. We got extra funding, and there was a call for new ideas. There was an ambitious call, an ambitious program here at the Laboratory when the tandem mirror was invented, to explore that concept as fast as possible. And there was authorization put through for this experiment, even though it would be very expensive.

MFTF was built, and then, all of a sudden, interest in fusion research collapsed politically in fusion and the fusion budget was cut. But the national fusion directorate, for whatever reason, decided that that was a signal to center down on one approach, rather than a signal to cut back but still maintain breadth. So they, by dictum said, there would be no support for anything other than the tokamak in this country.

That was not just a casualty, but it was a dictum. So that's what happened.

Question: What year was that?



LLNL

The MFTF in construction, 1981. The reactor was fully completed, but it was shut down before it could begin operating, and then dismantled, and sold for scrap.

The reactor vessel and structures weigh 8 million pounds, including 3 million pounds of superconducting magnets which are cooled by liquid helium to 4.5°C above absolute zero, to confine a fully ionized plasma of deuterium (heavy hydrogen) at more than 100 million degrees. As LLNL described it, "This experiment includes the coolest large body of material to contain the hottest gas on Earth in large amounts at about 8 times the temperature of the surface of the Sun."

Late 1980s, as I remember.

Question: A lot of other programs suffered the same fate at that same time.

That's right. It was a major policy decision which I think, in retrospect, was just plain wrong. But unfortunately, there was also kind of a bandwagon effect. The same thing happened worldwide. The U.S. did it, so others did it. It was a real bandwagon effect. There were only a couple of holdouts—the Japanese with their Gamma-10 Tandem Mirror experiment, and the Russians at Novosibirsk also hung on to the mirror idea. [Gersh Itskovich] Budker—the institute is named after him—was the Russian inventor of the mirror machine, for example. And they have done, on a very tiny scale financially, some beautiful experimental work there, and have continued in that work.

So, the mirror concept didn't completely disappear in the world, but if you look at the scientific papers presented at the international scientific meetings—and I did this for writing up a history of plasma physics for a review; you might like to look at that for fun. It was for a series of books on the history of physics in the 20th Century. I did a tabulation of the number of papers on tokamaks and related things on mirrors over the period, and there's a colossal collapse of papers on mirrors about the time that this happened. You don't even see the word "mirror ma-

chine" in a present-day IAEA (International Atomic Energy Agency) meeting, nothing but tokamaks or possibly stellarators.

Question: I know that we reported the MFTF closure, but our last extensive coverage of the mirror machine was at the height of the program.

I wrote a *Nuclear Fusion* survey article back in that time, that tried to collect all of the mirror stuff. If you haven't seen the article, you might just take a look at it. . . . It's the whole issue of *Nuclear Fusion*—it was such a long article, they made it the whole issue.

Question: So, where are we now with your ATM idea? You had mentioned that there's a group discussing it.

Well, after the workshop, which is actually funded by the DOE, Dmitri Ryutov suggested that we have what he calls a mirror forum, which has been "meeting" regularly—meeting in quotes, because it's by phone primarily. Participants make presentations, and send their viewgraphs beforehand, so other

participants will know what they are, or some of them are on a TV link, so that they can see the viewgraphs.

There have been a series of papers on various aspects. I had to miss the last meeting, which was a report by Tom Simonen of his trip to China and to Novosibirsk. In his paper, he cited in depth what they are doing at Novosibirsk in mirrors, came back and reported on it. It's surprising the number of participants in the forum; Dmitri issues a list of who attended, and here must be 20 people across the country who were interested—Texas, MIT, someone at Princeton, University of Maryland. All get in on the meeting and toss in their two bits worth. So it's a very informal thing, but there's clear interest here in the country.

Question: Do you have a specific proposal for the U.S. Office of Fusion at DOE, for instance, to go ahead with?

Many specific proposals have been submitted, but none of them have been honored. There's no present one, but I think that will happen perhaps. I think the nearest thing to it is an upcoming meeting which is on neutron sources for material studies. That is a possible use of mirror systems as a neutron source, to do material studies for the tokamak.

Question: That's ironic. . . .

Yes, ironic. I'm not aware that it's gone to a full proposal yet,

Magnetic Levitation

Question: I'd like to switch from the fusion subject to the maglev Inductrack. My husband and a young friend built a small model maglev Inductrack in our garage, and he reminded me of this when we talked about interviewing you. Can you tell us how you got involved with the Inductrack, and what you see as its future?

Well, way back in the 1990s, and much earlier in the 1970s, my son and I worked on flywheel energy storage, and we wrote a *Scientific American* article in 1973 on what we were thinking about. This was quite outside the Lab work. And then we toyed with licensing the patents that we got, and that was not a very successful enterprise. So, I didn't do anything on flywheels for maybe 10 years, but later on, there was an interest at the Lab in reviving such work, so we launched a program within the Lab to develop flywheels.

As part of that investigation, I was working on passive magnetic bearings, and so we came up with some ideas for a passive magnetic bearing. But if you sit down and look at a passive magnetic bearing—which in this case was a circular Halbach array—and look at the set of

conductors with which it's interactive, and if in your mind you unroll this thing into a flat track, then you've got the Inductrack maglev system, identically. One is rolled up into a circle, and the other one is laid out flat.

And so I had this idea, and I went to John Holzrichter here, who was running a Laboratory Directed Research and Development Program (LDRD) at the Lab. This LDRD program was set up by Congress so that a director of the national laboratories could take a certain percentage of the budget and devote it to internal support for research into new ideas. It's either done by divisions or there's also an individual way to do it. You can sub-

(Text continues on p. 47.)

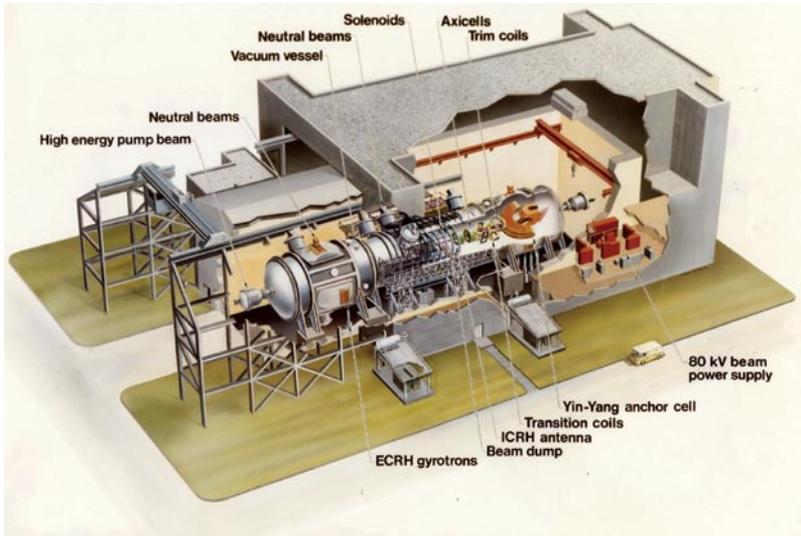


Figure 3
SCHEMATIC OF THE MFTF REACTOR

A cutaway view of the large tandem mirror magnetic fusion reactor. In this configuration, the MFTF has a high magnetic field axicell on either end of 12 solenoid coils. It includes ion heating in the central cell by radio frequency, 16 superconducting trim coils, and pumping with a high energy beam and magnetic field drift pumps. The main magnet coil system includes 26 large superconducting coils with a maximum magnetic field strength of 120,000 gauss at the center of the outer axicell coil.

but there have been such proposals made in the past. You might like to have a conversation with Dmitri Ryutov. He's here at the Lab. And Tom Simonen would be a very fine source for you to talk to. He's living in Berkeley now....



Teruji Cho, University of Tsukuba Plasma Research Center

The Gamma 10 Tandem Mirror at Tsukuba University. Japan has kept the mirror concept alive in this ongoing experiment. The Gamma 10 is 27 meters long, with large end tanks.

The Russians also are pursuing the mirror idea. See p. 34 for a photo.

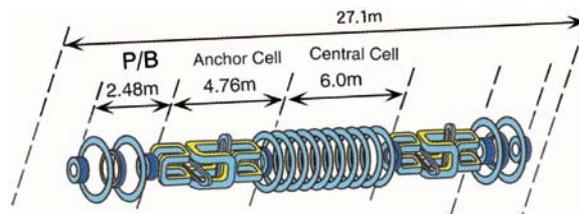


Figure 4
GAMMA 10 MAGNET GEOMETRY

The axisymmetric geometry in Japan's Gamma 10 Tandem Mirror. It is powered by ion cyclotron resonant frequency and Electron Cyclotron Heating.

Laser Fusion: 'Yes We Can'

John Nuckolls, director emeritus of Lawrence Livermore National Laboratory, has proposed a 10-year strategy for achieving laser fusion, which he said could be accomplished with 10 percent of President Obama's \$150-billion projected energy program. The contents of Nuckolls's proposal addresses issues of science not well-known to today's general public, but which should be better known.

In laser fusion, a tiny target of deuterium, sometimes combined with tritium, is compressed by a shock wave which is produced by focussed laser beams. The shock causes the deuterium, a naturally occurring isotope of hydrogen present in seawater, and tritium to combine, forming a nucleus of helium and a neutron. The mass of the resulting helium nucleus is less than the component nuclei, and the mass difference is released as energy, according to the famous equation $E = mc^2$. The energy release per fusion is several times greater than that produced by the fission of a uranium nucleus, which is millions of times greater than the energy released by burning of a molecule of oil or natural gas. The heat of fusion energy can thus drive electrical turbines with far greater efficacy than any known power source, and can also be utilized in a device known as the fusion torch, to break down raw ore and even garbage into its constituent elements.

Dr. Nuckolls, who led research on laser fusion at the national laboratory for many years, proposed "four steps to fusion power":

- (1) build an efficient high-average power laser module, a factory for producing laser targets, and a fusion chamber;
- (2) build a surged, heat capacity inertial fusion energy system;
- (3) build a fusion engine;
- (4) build a fusion power plant.

Inertial Confinement Methods

Fusion energy by laser ignition, known more generally as inertial confinement, has already been repeatedly demonstrated, and was one of the leading paths being pursued when the national fusion energy program was effectively dismantled in the 1980s. Nuckolls was addressing the means needed to develop a laboratory proof-of-principle demonstration into a commercially workable energy generation project.

Inertial confinement production of fusion energy is related to the means by which a hydrogen bomb is detonated, and thus emerged from the national laboratories as one of the peaceful spin-offs of military research. In one method of laser fusion known as indirect drive, a closed chamber known as a hohlraum is used to focus thermal X-rays produced by the laser heating, which in turn can drive the nuclear fusion.

Indirect drive hohlraum targets are used to simulate thermonuclear weapons tests. A key to the technique involves



LLNL

Construction workers install equipment inside the 10-meter diameter target chamber at the National Ignition Facility. The spherical chamber, 10 meters in diameter, is constructed of aluminum panels covered in concrete that has been injected with boron to absorb neutrons from the fusion reaction. The holes in the target chamber permit the laser beams to enter the chamber and provide viewing ports for all of the diagnostics.

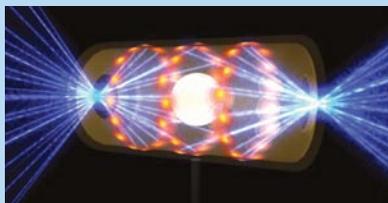
understanding the singularity which occurs upon formation of a shock wave. Soviet research in the field was stimulated by study of the famous paper by the 19th Century mathematical physicist Bernhard Riemann, which had predicted the appearance of sonic shock waves decades before their experimental verification.

Other methods of inertial confinement fusion do not require lasers. These include the Z-pinch, in which the vaporization of fine wires by an intense electrical current causes a compression of the wire (Z-pinch) that produces X-rays which drive the fusion of the target. In another method, recently proposed by Dr. Friedwardt Winterberg, the high-voltage discharge of an early type accelerator known as a Marx Generator produces a very powerful instantaneous magnetic field pressure which compresses a cone-shaped deuterium-tritium target, using an ingenious geometry.

Nuckolls made his "Yes we can" proposal at the annual meeting of Fusion Power Associates held in Livermore, Dec. 3-4, 2008.

Lyndon LaRouche has been promoting efforts to develop thermonuclear fusion power since the 1970s. His energy policy calls for immediate deployment of nuclear power, including a rapid gear-up of the new fourth generation high-temperature reactors, expanded research and development of thermonuclear fusion energy, and broadened support for investigation into the anomalous nuclear effects implied by the phenomenon of cold fusion.

—Laurence Hecht



LLNL

Artist's rendering of a NIF target pellet inside a hohlraum capsule, with laser beams entering through openings on either end. The beams compress and heat the target to the necessary conditions for nuclear fusion to occur.



LLNL

The Livermore members of the Inductrack team: (standing, from left) J. Ray Smith, Louann Tung, Richard Post, Don Podesta, William Kent, and Edward Cook; (kneeling, from left) Joel Martinez-Frias and Dmitri Ryutov.

mit a proposal as an individual, working with other individuals, to try out a new idea.

So, I took this Inductrack idea—Dmitri Ryutov helped me with the theory of it—and submitted it as an LDRD proposal, and we actually got a substantial amount of money—I forget how much—to build a larger scale model of it, and test it.

Our model actually worked very well. And we reported our work at scientific meetings. NASA people were at the meetings, and they had a project called Mag-Launch, which is the launching of rockets by maglev methods, in order to avoid double staging. So they gave us a very substantial contract to build a small model to demonstrate a technology that might be used in Mag-Launch. We built the model and we operated it, but then their budget was cut, so we had to take the model apart, and ship it back to Florida, for some university to put together and try it in the future.

But, while the model was working, General Atomics had received a substantial contract from the Federal Transportation Administration to develop a generic urban maglev system. GA had looked at the Japanese superconducting system, and the German system, Transrapid.

And they decided that neither of them was really suitable economically or otherwise for an urban system.

So they came up and looked at our Inductrack, and adopted the idea. Following that we've had a series of contracts for several years now with GA. We helped them with the magnetics of it. We actually built a little model to test the laminated track idea here at the Lab, and we got a very close correlation with theory and experiment on that. So we've had an affiliation with GA since their maglev program started. We're a member of the team of engineering companies in Pennsylvania—General Atomics and the Laboratory. And GA has now, as you know, built a full-scale test track. And most recently they built a brand new chassis using a new magnetics design that we provided for them. It works very well, and they are hoping to be en route to building a demonstration maglev system at the University of California in Pennsylvania (!).

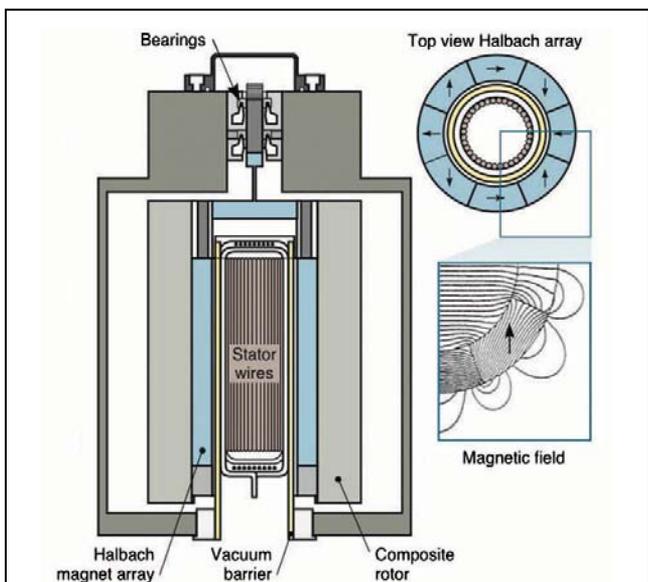


Figure 5

THE FLYWHEEL BATTERY

The LLNL flywheel battery, developed by Dick Post, is a high-tech version of an ancient concept: using a rotating wheel to store kinetic energy, as in a potter's wheel. Here, the energy is stored in a rotor made of a high tech fiber material that spins above a magnetic bearing at about 40,000 to 50,000 revolutions per minute. The flywheel is used for the bulk storage of electricity.

Post's complement to the flywheel, an electrostatic generator/motor, is useful for generating electricity.

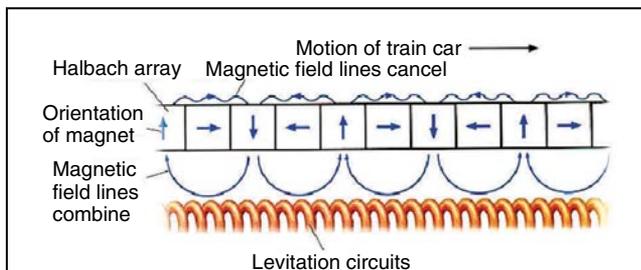
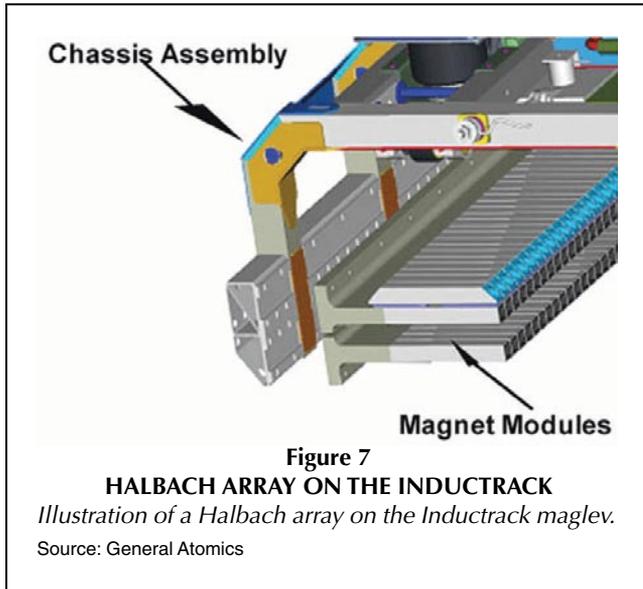


Figure 6

HALBACH ARRAY ON A MAGLEV TRACK

Post's idea was to unroll a Halbach array of magnets into a flat track, for use with a maglev train.



Question: Yes, the name is incongruous.

It's ironic. They also did a study for adopting another form of our Inductrack, aimed at heavy loads for cargo transport, that is, container cargo transport in the Los Angeles port area, where they are now using diesel trucks to haul the containers inland, and they have a very serious pollution problem. It's also an expensive way to transport the containers. It could be replaced by a maglev system with no pollution and a lot less energy use. I don't know whether that project will be funded or not, but GA did a very good study in which we cooperated and were able to come up with a redesign of the magnetics for the Inductrack that made it suitable for very high loads.

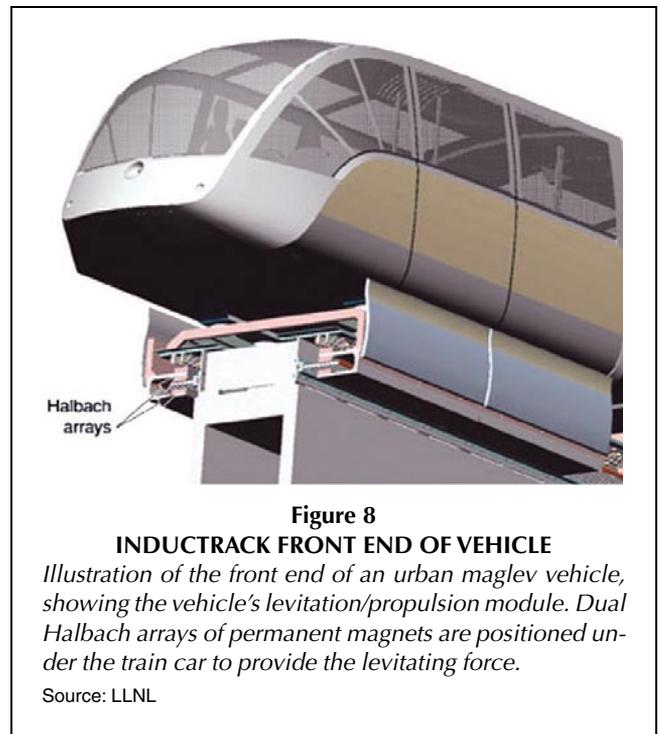
Question: What is the difference between the high load and the passenger system?

It's a matter of the design of the Halbach arrays, how they are configured. They are configured in such a way that we were able to use a track which did not have to be cantilevered. It would lay flat on a piece of concrete, so that it would absorb the high loads. We were able to do this, at the same time, by keeping the losses very low. So the magnets were redesigned, basically the magnetic configuration was redesigned to accomplish the result.

Question: It seems to me that the Inductrack and maglev in general have suffered the same fate as fusion. It's a wonderful idea, it's certainly the way to go for the future, and it hasn't been funded in this country.

That's right. I think that might be changing. There may be more reception now. By the way, I didn't mention this, but even though the Inductrack was developed for an urban system, it works perfectly well at high speed, and is thus a good candidate for high speed maglev systems.

Question: Our organization has proposed a Eur-



asian Land-Bridge, which would go from the east coast of China to Rotterdam in the west, with a northern and a southern route (large sections of this have already been built), and we have been urging the governments involved that maglev be chosen for the rail part of this.

Well, there are several different maglev systems, but the Inductrack is so simple, and also fail-safe.

Question: I know from reading what you've written on this, that it's also considerably cheaper, because you don't have to super cool the magnets.

It can be cheaper, that's correct.



LLNL

The 20-meter, scale-model test track used to test the Inductrack concept at LLNL. The test cart and electric drive circuit are in the foreground.

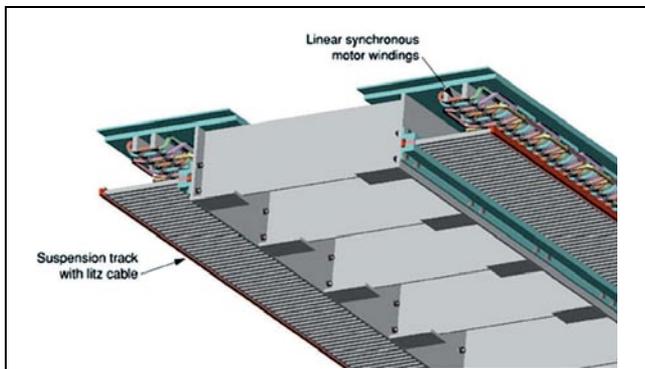


Figure 9

The GENERAL ATOMICS TEST TRACK

Illustration of the Inductrack maglev test track, showing motor windings embedded in the track. The windings are used with a linear synchronous motor to power and brake the train. Train cars ride on a suspension track of ladder-like construction, which consists of closely spaced rungs composed of tightly packed bundles of insulated wire. When the train starts to move, the magnets induce electrical currents in the track's circuits that produce a magnetic field. This magnetic field repels the array, thus levitating the train car 2.5 centimeters above the track.



LLNL

The General Atomics full-scale Inductrack test vehicle on the first section of its test track.

gies interested in what we call our new-generation flywheels. And the new-generation flywheels are different, in the sense that we've abandoned the electromagnetic generator and are going to a modified form of electrostatic generator, the pioneering work for which was done by Trump at MIT in the 1950s. However, we modified his ideas to make the electrostatic generator more suitable for our purpose. The point of the electrostatic generator is that it has extremely low parasitic losses. That is, if it's just sitting there, no losses.

On the other hand, if you have an electromagnetic generator with the permanent magnets, there are always eddy current losses and hysteresis losses going on, even though it's not drawing any power. So it's very difficult to reduce those losses. And also, electromagnetic generators are usually very heavy. Our

Now you also wanted to hear about energy storage? Well, we're right in the middle of trying to launch a new generation of flywheel-based energy storage systems aimed at bulk storage. The former work we did in the 1990s was aimed at a niche market which consists of essentially uninterruptible power supplies. In these systems you have them floating on the line when the power goes off, and it takes 15 seconds to start your diesel generators. So, the flywheel comes up with a burst of power for that period of time, until the diesel can come on. It's high power for a short time.

However, the solar and wind power industry in particular, needs a different kind of energy storage. It needs something where they can slowly charge it up during a few hours, and then, it can sit there charged until later it's used to deliver power. This creates the possibility of having what's called "dispatchable power" from wind and solar systems. It means that it could provide power at any time of the day, independent of whether the Sun is shining or not, so long as you have stored the energy.

So, there are several compa-

A New Look at an Old Idea
The Electromechanical Battery

Laboratory researchers are integrating innovative materials and designs to develop highly efficient and cost-effective energy storage.

SPINNING at 60,000 revolutions per minute, a cylinder about the size of a large coffee can may hold the key to the long-awaited realization of practical electric cars and trucks. The angular, fiber composite cylinder belongs to a new breed of LLNL-developed, flywheel-based, energy storage systems with new materials, new technologies, and new thinking about the most efficient ways to store energy.

Called an electromechanical battery (EMB) by its Laboratory creators, the modular device contains a modern flywheel stabilized by newly frictionless magnetic bearings. Integrated with a special inductive generator motor, and housed in a cooled vacuum enclosure, the EMB is "charged" by spinning its rotor to maximum speed with an electrical generator motor in its "motor mode." It is "discharged" by allowing the rotor of the same generator motor to draw out the kinetically stored energy in its "generator mode." The advanced design features a special array of permanent magnets (called a Halbach array) in the generator motor to perform these charging and discharging functions efficiently.

The EMB offers significant advantages over other kinds of energy storage systems (see box, next page). For example, the efficiency of energy recovery (discharge) losses out versus kilowatt hours (k) is projected to exceed 95%, considerably better than any electrochemical battery such as a lead-acid battery. Power densities can reach 5 to 10 kWh/kg, several times that of typical gasoline-powered engines and up to 100 times that of typical electrochemical batteries. And because of its simple design and advanced materials, an EMB is expected to run without maintenance for at least a decade.

Laboratory researchers envision several small, maintenance-free modules, each with a kilowatt-hour of energy storage, for use in electric or hybrid electric vehicles. See the prototype in Figure 1 (also see box, p. 18). Larger modules with up to 25 kWh of storage capacity could be employed by electrical utilities for more efficient use of their transmission lines, and by factories for power conditioning. These large units could also be used in wind and solar electric power systems to make them deliver power whenever it is needed, rather than only when it is generated.

The conceptual potential of the Laboratory design has not gone unnoticed by American industry. Triady Electrical Batteries, Westborough Electric, and General Motors have all sponsored researchers at Livermore for vehicular and industrial applications. The offices, which include the expertise of researchers throughout the Laboratory, involve

Figure 1: Prototype of the LLNL electromechanical battery, which is based on the flywheel storage of energy. Left to right: high-speed motor, rotor in vacuum, and recirculated battery (20 centimeter by 30 centimeter).

Source: Science & Technology Review April 1996

LLNL

Dick Post with his electromechanical battery, as featured in the LLNL Science & Technology Review, April 1996. https://www.llnl.gov/str/pdfs/04_96.2.pdf

electrostatic generator is very light, and that helps.

Question: What does it look like, and how does it work?

Ours looks something like Trump's but is a different design. Trump used a system that resembled two sets of fan blades, one of them stationary, one rotating, facing each other. So as you rotate one fan blade, first it matches up with the other fan blade and the electrical capacity is high. When it rotates to a notch in between, where the plates don't match, the electrical capacity is low. And that's all it takes to make an electrostatic generator.

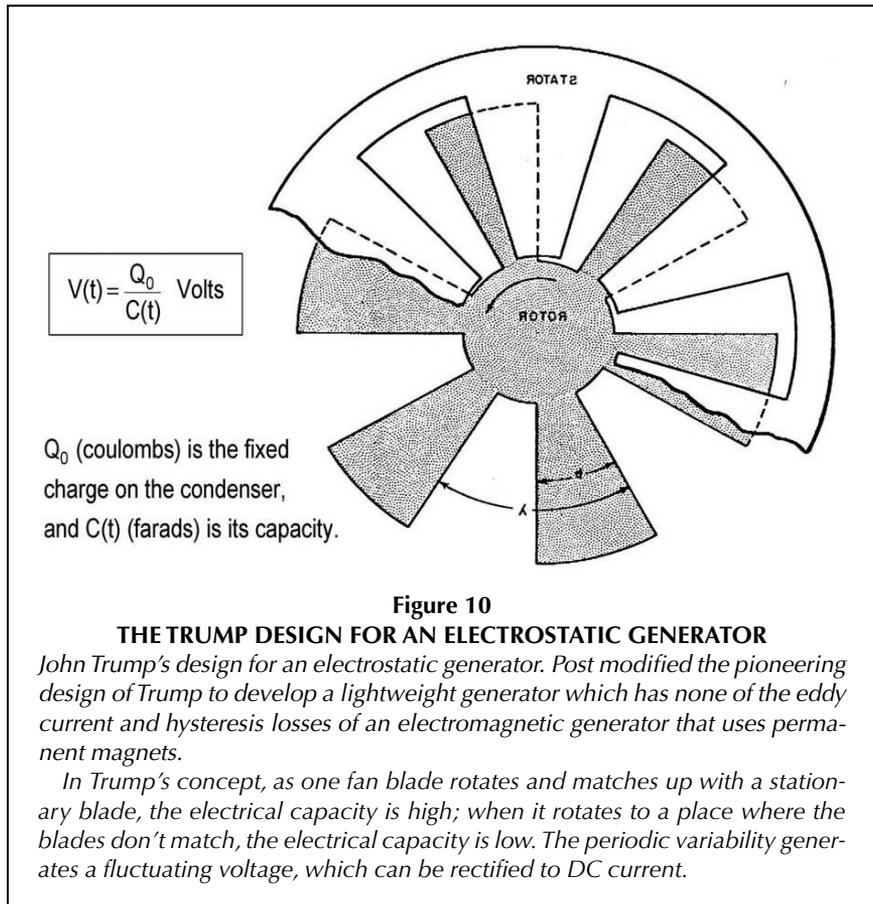
It works this way: If you charge any condenser with a fixed amount of charge and then you vary the value of that condenser, the voltage varies inversely with the capacity. In other words, charge divided by capacity is the formula. And so the capacity is a function of time. The voltage across the capacity is a function of time. So if it's periodically varying, then you're going to generate an AC-like wave form. From this simple process, having the capacity increase and decrease with time. We've done some additional modifications of Trump's designs, but that's the basic idea.

And so you take this fluctuating voltage and couple it out through condensers to a rectifier system, and rectify it to DC current, and then transform the DC power to whatever you want. So the idea is to simplify matters, and reduce the para-



LLNL

In this device, LLNL-designed Halbach-array generators are incorporated in AFS-Trinity Flywheel modules, producing 350-kilowatts output from 25-centimeter diameter rotors.



sitic losses. In an electrostatic generator, the internal losses are essentially zero.

In a flywheel system, it's important to minimize internal heat losses, because it's very hard to carry away heat in a vacuum. The electrostatic generator has essentially zero heat losses internally, and the only inefficiency that's associated with it is whatever inefficiency there is in the rectification and power electronics, not in the generator. Whereas, electromagnetic generators always have hysteresis losses and eddy current losses, internally. And there's heat to be dissipated, for one thing, internally...

Question: You are still carrying out what seems to me to be a mission in life. You're coming to work four days a week, at age 90.

As my wife says, "Friday's your retirement day."

Question: But that's good! We need to get more people like you in the younger generations, to get that kind of spark.

Well, I really do want to see something come of my knowledge of physics in my lifetime, with some of these things. I have no hope that fusion will be in my lifetime, but I think that the work that all the fusion people have done is money in the bank, and fusion power will come to pass. But it would be really nice if the Inductrack or the energy storage systems actually happen before I kick the bucket.



NASA

A magnetic bearing uses magnetic levitation to support a load in moving machinery without any physical contact. Magnetic bearings are an essential part of Post's flywheel system.

Question: Well, I think that human beings have immortality in the sense that their ideas live on, and that the effect is felt long after the person is gone.

There certainly are some occasions where that is true. Also, what the heck, I like to work on the things that I think are going to help problems.

Question: That's a good thing. Youth today don't know how



LLNL

Livermore's UNIVAC computer, on its last run in 1959. Today the Lab's high-performance computing capability enhances experimental work, such as that for the ATM, by previewing design results and potential problems.

things work. They are in the digital age. They press buttons. . . .

That's a very interesting comment. When I was a kid, 12 years old, I was a radio ham, and I had to build all my own stuff—transmitter, receiver, the whole shmeer. And where I got my parts was going out to the back, behind radio stores, where they'd thrown out old radio sets. And I picked them up, took the parts out of them.

Question: But that's the way you learn; that gets you going on a project, and I don't think that many youth have that experience today.

No, they don't. My son has a very interesting observation. My son Steve is a very fine engineer. He runs a little company near Livermore that builds electronic controllers for electric vehicles. And his kids are in the Athenian school, a very fine private school here in the area. The school entered the robotics contest. . . .

This is the contest for schools where they go and compete against other robots, doing various called-out tasks and games. They had to build the stuff from a kit that's supplied to them, plus manufacture their own parts. So Steve had the school kids come to his own home shop to do the building. And he said that the girls were much better than the boys. The girls really learn to do these things. The boys are so tied up in video games and so forth, that they just didn't know what to do. I'm making an overall generalization, which is probably not completely true, but he certainly noticed the difference.

Question: That's very interesting. I do know the problem of the video games. It's like an addiction that keeps these children out of reality and out of the real world, the nuts and bolts of how things work.

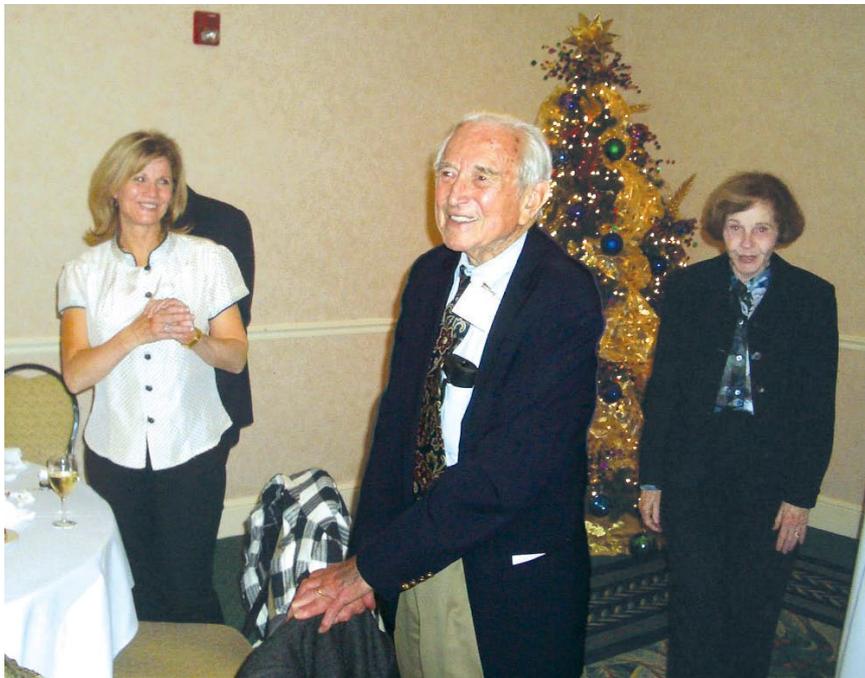
You know tinkering is somewhat of a lost art, except when it's particularly pushed, as Steve did with these kids and robotics. They did a beautiful job. (They won, actually.)

Question: What the Youth Movement is working on, in small groups, is going through the basic experiments and work of Kepler, Gauss, Riemann, and other scientists, and redoing them, just to know what the thinking process was; that's the way they've been approaching it.

That's wonderful.

Question: We're trying to spread that idea and so I think this interview, which we'll publish with your talk, will give people some ideas about how you go about solving some of these problems. What impressed me was the magnetic bearing, and how important that can be in so many applications.

Yes, there are many applications. They are an essential part of the new flywheel



FPA

Richard Post with his daughter, Markie Post Ross (left), and his wife, Marylee, at the 90th birthday celebration hosted by Fusion Power Associates.

Question: That sounds like an important factor in the trajectory of your whole career.

I had some wonderful teachers, and Hansen was one of them. He died about halfway through my thesis, which was experimental, and so I had to shift to a theory—inadvertent pun—Leonard Schiff was the theorist, and so half my thesis is experimental, and half is theoretical. That was a tragedy, Hansen's death, but there was a fortunate consequence of it...

I know I have very little brain when it comes to some areas. Dmitri Ryutov can run rings around me in theory. I'm sort of a funny half-mixture, but anyway, it works!

Question: It's not funny—it's very useful.

system that we have.

And the other thing, just a general comment is—and I think you've already said it, but I'm going to say it again because it's so important: It's such an important thing to have a combination of computing and hardware, because the devil is in the details. You get sobered by the fact that when you are actually trying to do something, you've got to work out all the things that you hadn't thought of. And there's a very powerful way of coordinating theory, and computation, and experiment—but the experiment has got to be there; it's an essential part of it.

And so what you said a minute ago is exactly right: Repeating some of these experiments, because the actual doing of them, and the actual finding out what's what, is very important.

Question: The whole thinking process that goes on....

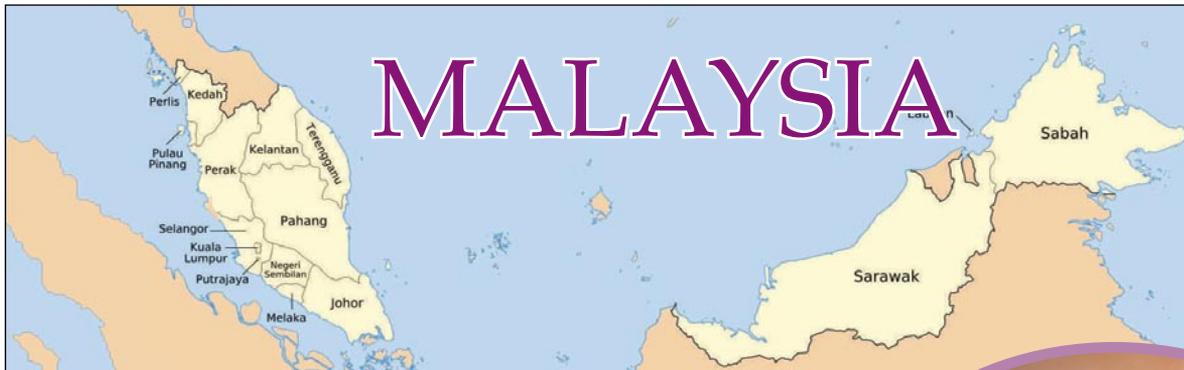
I had a wonderful physics professor in graduate school, Professor Hansen, who is one of the co-inventors of the linear accelerator at Stanford and also one of the coinventors of the klystron [a linear beam vacuum tube]. Anyway, Professor Hansen had what he called a modern physics lab, and one of the experiments I particularly remember, was measuring the gravitational constant, and the very clever way he did it with a torsion pendulum with big balls of lead.

You had a torsion pendulum, with the ball of lead hanging on an arm so that it could torque. And then you would bring up a big mass at a particular time, and you would leave it there for a particular time. And those two masses would attract each other ever so tiny a bit, and move that torsion pendulum. And so you took the data from that and then calculated the universal gravitational constant, and you darn well better be within 10 percent. That was among the very clever experiments that were done in that lab.

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With DDT Spraying,



Can Show the World How to Control Dengue

by Mohd Peter Davis

The official announcement by the World Health Organization in September 2006 giving a clean bill of health to the use of DDT for indoor spraying for controlling malaria,¹ reversed WHO's 30-year ban on DDT and offered a promising way forward for also controlling the spread of mosquito-borne dengue fever. The dengue fever virus, which is transmitted to human beings by the *Aedes* mosquito, has increased alarmingly in recent decades to 50 million cases per year, subjecting about two fifths of the world's population to risk of infection, particularly in urban and semi-urban areas in the tropics and subtropics.²

A severe form of the disease, dengue haemorrhagic fever, is a leading cause of illness and death among children in some Asian countries. Malaysia is a typical example, with dengue now rampant. Dengue virus usually causes an incapacitating flu-like illness with sudden onset and high fever, severe headache, pain behind the eyes, muscle and joint pains, and rash. Dengue haemorrhagic fever, the WHO reports, affects 500,000 people per year and

A Malaysian scientist proposes a pilot project to test a program using DDT to control dengue.

transmission is to combat the disease-carrying mosquitoes.

A Proposed Malaysian DDT Experiment

Malaysia, a small nation that has developed well in 52 years of independence, with a population of 27 million and 65 percent urbanization, is in an excellent position to test the effectiveness of spraying the indoor walls of houses with DDT, as recommended by WHO. Only minute quantities, 0.3 parts per million in a water spray, need to be used, which is sufficient to repel mosquitoes from homes for up to six months when the spraying can be repeated.

Female mosquitoes in search of a blood meal to support egg production are attracted to houses by the



*The Asian tiger mosquito (*Aedes albopictus*), is one of the vectors for dengue. Here the female feeds on the blood of a human host.*



Sixty-five percent of Malaysia's population is urban. Here a view of the capital city, Kuala Lumpur.

Malaysia's independence celebration on Sept. 16, 1963. The Federation of Malaysia was formed by the merger of Malaya, Sabah, Sarawak, and Singapore. The Malay words "Majulah Malaysia" mean "Onward Malaysia."



carbon dioxide and pheromones emitted by humans, but the smell of DDT is abhorrent to mosquitoes. This fighting-fire-with-fire approach at the molecular level greatly reduces the chances of getting bitten by mosquito inside the home, and was the hidden basis for the highly successful anti-malaria strategy used throughout the world before DDT was unjustly banned.

Similar low-dose DDT spraying of potential mosquito breeding sites immediately outside each house, and in the gardens

and streets of dense urban areas, serves to prevent {Aedes} mosquitoes from laying eggs in rainwater traps, whether in man-made habitats or natural ones, such as the water that collects in leaves and branch nodes.

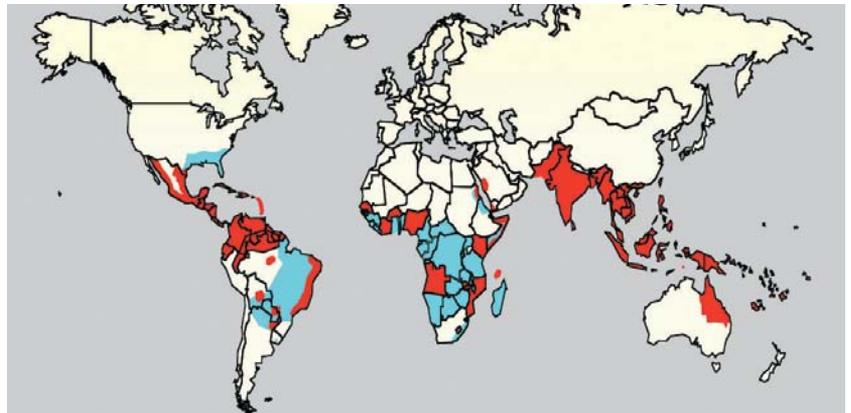
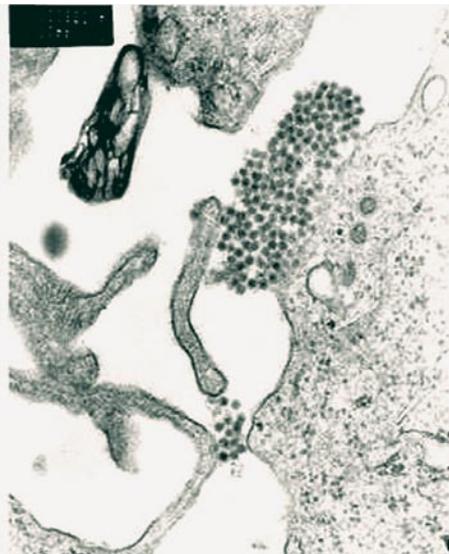
This outdoor urban strategy, termed perifocal spraying, was used to virtually eradicate dengue in South America in the 1950s. Unlike the present fogging strategy, with short-lived pesticides that kill mosquitoes on contact, the aim of perifocal spraying with minute quantities of long-acting DDT is to repel mosquitoes from their natural and man-made breeding sites in dense urban areas. Life in the city and suburbs protected by ridiculously small quantities of DDT becomes tough for mosquitoes. They are denied human blood meals and good breeding sites and have to go back to nature to breed! This is where mosquitoes rightly belong, in low numbers, as part of the natural ecosystem of the biosphere.

Trying to exterminate mosquitoes with the crude pesticides currently used in fogging campaigns is a stupid dengue control strategy that has repeatedly failed and should be compared with the elegance of proposed combined indoor/outdoor DDT strategy that aims simply to repel mosquitoes (also killing some of them) from dengue-affected urban areas.

If the Malaysian government, via the Ministry of Health, were to give its full support to this program, Malaysia under the watchful eye of WHO, could test and scientifically evaluate the DDT proposal in pilot project in dengue hot spot suburbs. Armed with DDT, the Public

Health spraying teams will again have the decisive weapon against dengue. It will be an exciting live experiment for long-suffering Malaysians to observe and follow, and will serve to counter the anti-DDT brainwashing the population has been subjected to by the green environmental movement.

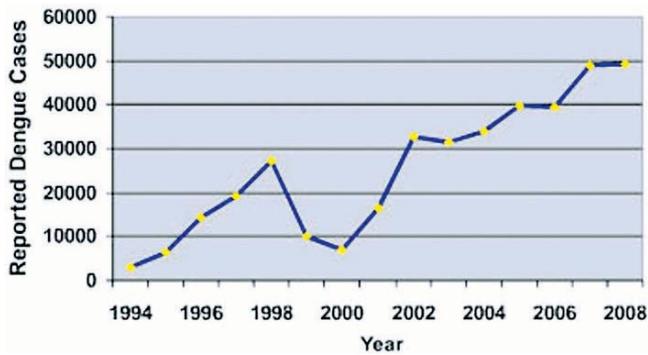
Most important, it could be a world-class national experiment, with leading dengue and DDT experts as advisors, for the benefit of 40 percent of the world's population now at risk from dengue.



Source: The Agricultural Research Service of the U.S. Department of Agriculture.

The distribution of dengue fever in the world, as of 2006. Dengue is transmitted by the Aedes mosquito, in particular *A. aegypti* and *A. albopictus*. The blue color indicates areas where *Aedes aegypti* is the vector. At left: An up-close look at the dengue virus, with a magnification of 123,000 times.

REPORTED DENGUE CASES IN MALAYSIA



From bad to worse: Dengue cases increased nearly 700 percent from 2000 to 2008.

A similar national experiment concerning the general welfare occurred in 1970 in Australia. While the rest of the world agonized over the compulsory wearing of front seatbelts in automobiles, Australia boldly cut through all the individual rights objections and made it compulsory, to address the slaughter on the roads. By 1974, Australia's decrease of 37 percent in deaths and 41 percent in injuries convinced the rest of the world to quickly adopt similar mandatory seatbelt legislation.

Now that WHO has underlined the efficacy of the indoor spraying of DDT, Malaysia can conduct a national scientific experiment that hopefully will convince a world that has forgotten how the use of DDT in the 1950s and 1960s was successfully combating malaria and dengue. We must not miss this golden opportunity to again control these diseases, especially as the world economy disintegrates. The lesson of history is that economic collapse and rapid increase in diseases go hand in hand. Recall the Black Death following the 14th Century disintegration of the European financial system, or more recently the 50 million deaths from the 1918 influenza pandemic following the social and economic breakdown unleashed by the First World War.

The Malaysian Dengue Situation

The reported number of cases of Dengue Fever in Malaysia continues to go from bad to worse, rising each year—from 7,103 cases in 2000 to 49,335 in 2008, an increase of nearly 700 percent. This increase occurred despite energetic outdoor insecticide fogging campaigns conducted by the Ministry of Health³ to control the *Aedes* mosquito population in urban areas.

The lack of success with outdoor spraying has been noted worldwide. The Head of Insects and Infectious Diseases Unit at the Pasteur Institute in Paris, Professor Paul Reiter, in a 2009 letter to the Malaysian *New Straits Times* sums up the practice: "Fogging with insecticides from road vehicles has little or no impact in urban areas." Reiter goes on to state: "Search-and-destroy missions (against mosquito larvae) can be effective if people are vigi-



This is an "Ovitrap," used to monitor the Asian Tiger Mosquito by collecting its eggs.



United Nations University

The Malaysian Ministry of Health's pesticide fogging program for dengue has failed to stop the spread of dengue.

lant, but many sites are hard to find, even by professional entomologists."⁴

Another epidemiologist who has experience in fighting dengue has documented how perifocal spraying with DDT around the outside of the houses in the dengue area has been effective in the past. Malaysia should include this in its pilot project.

The limited success of the current method used in Malaysia is borne out by a large campaign in 2008 to control the spread of dengue, conducted by the Ministry of Health, which mobilized 11,892 volunteer residents in 598 suburbs (around 20 residents per suburb) in weekly search-and-destroy activities of *Aedes* breeding sites. The Health Ministry reported considerable success with an 84 percent reduction in dengue cases in these suburbs.⁵ However, the number of reported cases throughout Malaysia in 2008 still rose by 1 percent. Clearly, it would require the constant mobilization of huge numbers of volunteers in *Aedes* search-and-destroy missions in every urban suburb and indeed rural areas throughout the country to effectively control the spread of dengue.

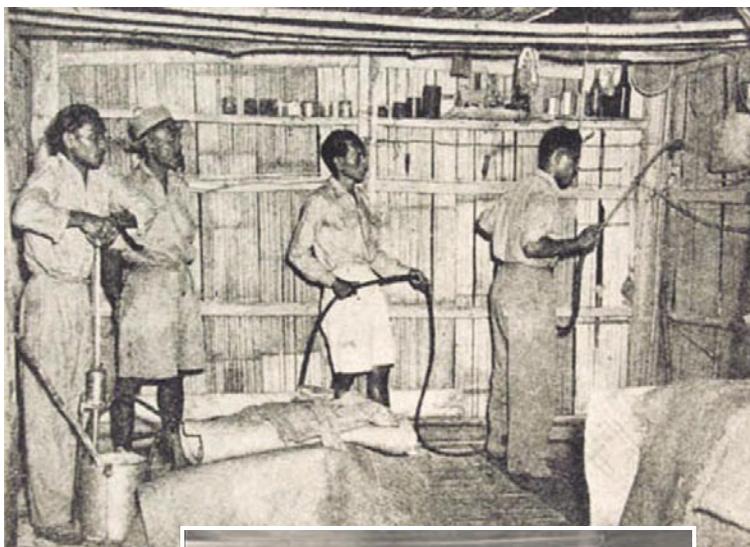
Faced with this daunting task, the Ministry of Health has instead placed the responsibility on every resident and factory owner to control *Aedes* breeding sites in their compounds by regularly emptying the base of flower pots and other water containers,

including cleaning storage water tanks every week. There are heavy fines if the patrolling health teams discover mosquito larvae in a factory or household. Yet dengue cases have increased seven-fold in eight years. The sad truth is that the Ministry of Health has been transformed from a top-down body of highly trained and dedicated disease control professionals protecting the public health to become a low-grade and resented police force, which increasingly blames the public for spreading dengue.

Again, Professor Reiter hits the nail on the head: "There is no country in the world where dengue is under control. We

Before the ban on DDT, Malaysia used it in a house spraying campaign against malaria.

The United States began spraying with DDT for malaria control shortly after the pesticide was introduced. Below, spraying of a military facility in the Southeast.



Institute for Medical Research

need original ideas to win the battle.”

Rethinking the Dengue Problem

We have reached a dead end and need to go back to basics. Trying to exterminate the *Aedes* mosquito in Malaysia or worldwide to control dengue or malaria is “mission impossible,” rather like trying to eliminate cockroaches or termites from the biosphere. No matter how sophisticated the technique, from new insecticides to kill larvae, biological control to eat them, or the release of male *Aedes* mosquitoes with transgenic sterility genes, insect extermination is not the answer.

This is because the female *Aedes* mosquito is not the source of the dengue virus but merely the transmitter of the disease: the flying syringe which picks up dengue virus in the blood of infected humans. Although limited reproduction of dengue virus occurs in mosquitoes, they have a short life and die within 50 days, along with the virus. It is human beings and monkeys, not flower pots and dirty drains, that are the main breeding grounds, producers, and reservoirs of the dengue virus.

We must stop thinking of other species as aliens from another planet, threatening mankind. Killing every species that spreads disease to humans would soon entail the extermination of all life on Earth. Although it is often hard to accept, mosquitoes do serve a useful and necessary purpose in the Earth’s biosphere, which contains perhaps 50 million interdependent species. The highly cursed mosquito does not have an evil intent against humans. The only reason female *Aedes* mosquitoes bite humans is for blood meals to complete their reproductive cycle. The wrong public health strategy of trying to exterminate *Aedes*



CDC

mosquitoes has in fact allowed the pool of humans infected with dengue virus to dramatically increase in recent decades and get dangerously out of control.

The War against DDT

Can we stop mosquitoes biting humans? That would stop the spread of dengue in its tracks. The good news is, yes we can! As the World Health Organization advised in 2006: Go back to when DDT was effectively controlling malaria and other mosquito-borne diseases including dengue from the mid 1940s to the early 1970s before it was unjustly banned worldwide.

The green environmental movement ran a 10-year fear campaign, remarkably similar to today’s global warming hysteria, claiming that the life-saving DDT was a dangerous environmental poison. The fraudulent campaign took off in 1962, when Rachel Carson, a marine biologist and well-known science writer, claimed that the use of DDT in households and agriculture was killing wildlife, especially birds. Hence the title of her book, *Silent Spring*, which shocked an innocent world into believing that DDT and man-made chemicals were threatening life on Earth. Carson falsely reported many of the results of DDT studies in order to make her case, as U.S.

entomologist Dr. J. Gordon Edwards has documented.⁶

Sound familiar? The misinformation against DDT was united with zero population growth, and the imminent exhaustion of resources on spaceship Earth claimed by the Club of Rome, into a giant fear campaign that became the fanatical battle cry of the green environmental movement. The 1968ers from the universities, those anti-Vietnam war, anti-blue collar, drugs/sex/and rock ‘n roll white-collar baby boomers, became the shock troopers who turned the optimistic postwar public culture, which supported progress driven by science and technology, into green scientific pessimists.

Many scientists internationally fought back with convincing evidence. The U.S. Environmental Protection Agency conducted seven months of hearings on DDT in 1972, producing more than 9,000 pages of transcript. At the end, the EPA hearing examiner, Edmund Sweeney, ruled that on the basis of the scientific evidence, DDT should not be banned. “DDT is not carcinogenic, mutagenic, or teratogenic to man [and] these uses of



EPA

President Nixon (left) and Chief Justice Warren Burger (right) at the swearing in ceremony for EPA administrator William Ruckelshaus, Dec. 4, 1970. Two years later, Ruckelshaus's ban on DDT launched the growth of U.S. green groups—and the increase of malaria.

DDT do not have a deleterious effect on fish, birds, wildlife, or estuarine organisms.”⁷

But the EPA administrator, Nixon appointee William Ruckelshaus, ignored these hearings and banned DDT anyway, later admitting that he did so for “political reasons.”

The U.S. ban on DDT, in effect banned it in the areas of the world that need it most. The U.S. State Department, other governments, and NGOs then refused to fund any aid program that involved the use of DDT. Poor countries could not afford to lose this aid.

The ban on DDT, against all the scientific evidence establishing its human safety, proved over the years to be a crime against humanity. The LaRouche movement, which has championed the reintroduction of DDT for decades, estimates that the banning of DDT since 1972 has led to 60 million needless deaths, mainly from malaria in developing countries, especially in Africa. To grasp the magnitude of this crime, in the whole of the 20th Century, road accidents worldwide claimed half this number, 30 million lives.

The responsibility for the unjust ban on DDT, lies with Prince Philip and the environmental movement that he launched and controlled through his World Wildlife Fund for Nature, and its poisonous offshoots such as Greenpeace. These share an evil belief, as followers of Malthus and Hitler, that the Earth is grossly overpopulated and needs to be reduced from 6.7 billion to less than 2 billion. They have certainly practiced what they preached. The environmentalists' war against DDT was a war against humanity. Put to the test,

and animal metabolism. When the mosquito's antennae also start to pick up the molecules of DDT coming from a house, its effect is repulsive, and the hungry mosquitoes are compelled to go elsewhere for their blood meal.

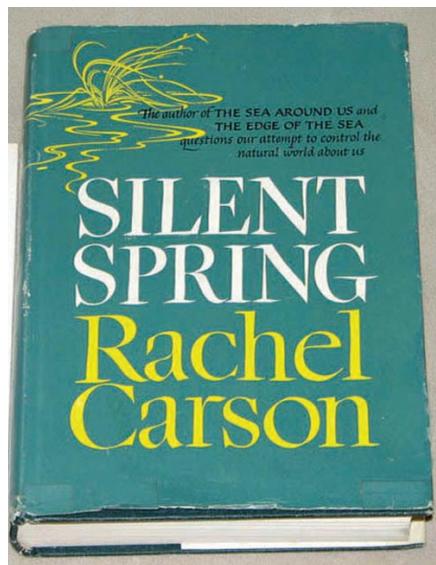
For humans, DDT is almost odorless. It has been found from long practice that spraying the indoor walls of houses just once with DDT gives the inhabitants good protection against mosquito bites for 6 months or more. In contrast, mosquito coils, vapor mats, and aerosol sprays have to be used daily and contain insecticide chemicals such as prallethrin and allethrin, which kill rather than repel mosquitoes. So, large amounts of these more expensive insecticide chemicals have to be used, yet they are far less effective than a few grams of cheap DDT repellent.

a team of fresh young lawyers and scientists, armed with the historic record, could today prove that case in any fair court. By natural law, the trial should be held in Africa. Like the Nazi trials in Nuremberg Germany, such trials are held close where the genocide occurred.

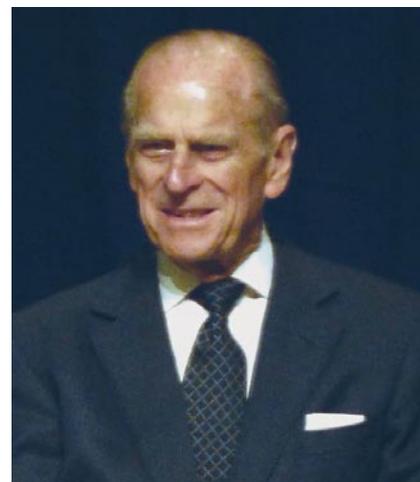
How DDT Works

The beauty of DDT is that it not only kills mosquitoes, but it is still by far the most effective mosquito repellent ever invented by man and is amazingly cheap to produce. A few grams of DDT in a solution sprayed on the inside walls of a house will keep most mosquitoes away, as if by magic, for about 6 months. (The effect is known as excito-repellency.) Then the walls can be re-sprayed with DDT. Imagine a giant mosquito net over the whole house; that is the effect that DDT provides.

Aedes mosquitoes can fly many kilometers to feed and find their victims by following an increasing gradient of molecules in the air, such as carbon dioxide and other products of human



Rachel Carson's *Silent Spring*, the “bible” of the anti-DDT Malthusians.



Britain's Prince Philip founded the environmentalist movement to carry out his depopulation wishes. He has often stated his desire to be reincarnated as a royal virus to help with the killing.



Courtesy of Kathy Keatley Garvey, University of California Agriculture and Natural Resources

University of California Davis researcher Zain Syed (right) sprays DEET on the arm of chemical ecologist Walter Leal. Their research shows that DEET, like DDT, repels mosquitoes.

Despite 60 years of organic synthesis to find a better mosquito repellent, DDT is still in a class of its own as the world's best and

safest mosquito repellent. Although DDT is not 100 percent effective in preventing mosquito bites, it nonetheless has a remarkable effect in reducing the spread of mosquito-borne diseases such as malaria, yellow fever, and dengue. It is important that the inside of every house and public building in the community is sprayed with DDT. This is a public health measure like chlorinated tap water, rubbish collection, and household sewage, which is carried out to promote the general welfare.

Given the irrational fear factor promoted by the greens, any objections must first be overcome with an intensive campaign of public education conducted nationally in the media, and especially in the suburbs, by disease control professionals, to win the confidence and support of the community. On the appointed days, the same health officials will then go on to actually spray the inside walls of every dwelling and public and commercial building with DDT.

Disease control is a government responsibility handled by professionals and must not be left to volunteers. With the whole community in effect quarantined, in what might be called DDT "safe houses" during much of the *Aedes* mosquito's biting hours around dawn and dusk, the spread of dengue by mosquitoes from a human carrier to other humans is great-

Update: Malaysia Declares War on Dengue!

Malaysia held its first ever National Dengue Conference on July 28-29, 2009 and completely surprised the organizers, the Public Health Specialist Association of Malaysia, 90 percent of whose members are medical doctors, largely employed in the government sector. The organizers expected 100 delegates, and would have been delighted with 200, but were swamped with 300 attendees, including top Ministry of Health officials, university groups, and dengue fogging teams came from all 14 states of Malaysia.

As dengue cases and deaths rise alarmingly, creating fear in dense urban areas, this was a war council determined to explore better strategies. I realized this as soon as I arrived at the conference and was whisked in to see the organizers. I cautiously explained that the talk I had been invited to give, "Is Fogging a Waste of Time?" would be very controversial, since I had been advocating for six years the re-introduction of DDT, claimed to be just about the most dangerous chemical on earth by the green environmentalists for the last 45 years.

"We know, we know, we've been reading your DDT letters in the newspapers," exclaimed a top government health official conspiratorially. "That's why we invited you and other researchers who think differently from us. We are not getting anywhere with conventional fogging; we need to think out of the box."

As the conference progressed, it became clear that Malaysia's War against Dengue was having a positive intellectual effect, despite the escalating national dengue cases. The presented reports and the many innovative posters showed a determination to control dengue outbreaks. The new ideas were coming not from so much from the Health Ministry, but from the troops on the ground. The real strategic problem became obvious. The troops were fighting enthusiastically but with lousy weapons.

Now it was time for the researchers. Professor Abu Hassan Ahmad from Universiti Science Malaysia amazed the delegates with photo after photo of how *Aedes* mosquitoes actually breed in dense urban areas where dengue is rampant. Although the fogging teams were diligently fogging the open drains and checking large household water containers, the *Aedes* mosquitoes were laying their eggs in seemingly insignificant quantities of water, trapped naturally by the leaves of plants and in the hollows of trees and branch nodes, their natural habitat. Much more important, the researchers found, *Aedes* had adapted to laying eggs in the flotsam of modern urban communities and was colonizing discarded drink tins, food containers, and even empty cigarette packets. Anything, that could collect rain water, no matter how small the volume, was suitable for *Aedes* to lay eggs and hatch larvae.

Mosquitoes were demonstrating the successful cockroach survival strategy for outwitting man's extermination attempts by exploiting any possible habitat, whether natural or man-made. The *Aedes* mosquitoes had found the perfect breeding sites supplied regularly to every family with the growth of the plastics industry, which has replaced wood, glass, and metal as the dominant household material.

Take a look at how a plastic bucket is constructed to provide strength to compensate for its ultra-light weight. The water that collects in the rim of an upturned bucket has become the number one breeding site of *Aedes* mosquitoes in urban areas. The plastic lid of a bucket, with its engineered water trap, is preferred to the bucket itself.

Now investigate the underside of other plastic items, especially those that tend to get stored outdoors, exposed to the rain, such as plastic toys and containers, children's bicycles, plastic gardening items, and plastic mats and bath-

ly reduced. Indeed, Donald R. Roberts, a retired Professor of Tropical Public Health in the Uniformed Service University in Bethesda, Maryland, reports that in the 1960s, the malaria outbreaks in the Amazon Basin were usually brought under control by the DDT spraying teams *before* his scientific team arrived to investigate the disease.⁸ Could Malaysia expect a similar result today if it were to embark on a national experiment to evaluate indoor spraying with DDT to control the spread of dengue?

Another example is South Africa, which bravely withstood the international greenie pressure and re-introduced DDT in 2003 to fight an out-of-control malaria epidemic. Within one year of the reintroduction of DDT house spraying, the incidence of malaria in the worst-hit province, KwaZulu-Natal, fell by 80 percent. In two years, the number of malaria cases and deaths dropped by 93 percent.⁹ As the WHO has stressed, there are no environmental effects when small amounts of DDT are sprayed on the inside walls of houses.

Despite these crystal clear benefits and the subsequent reversal of its DDT ban internationally by WHO, the world still does not take action. Malaysia should take the lead and bring the

world to its senses. With DDT, mosquito-transmitted diseases such as malaria and dengue can be brought almost completely under control.

The Danger of DEET Insecticides

DDT has been replaced by insecticides that kill rather than repel mosquitoes. The most common chemicals are prallethrin and allethrin, which are used separately or in combination in mosquito coils, vapor maps, and mosquito aerosol spray cans. In Malaysia, these products are readily available in shops, and are used almost daily in virtually all homes in the country. A simple calculation by the present author suggests that the common daily use of these reasonably safe (but not cheap) insecticides could be as high as 95 grams of prallethrin and allethrin per household per year or about 20 times more than, say, the 5 grams of very cheap DDT required per year for indoor wall spraying.

The household insecticides presently used as substitutes for the DDT repellent, however, are very poor substitutes, and for extra protection against mosquito bites there is a danger that families may also resort to personal insect repellents containing DEET (diethyltoluamide), which is directly applied to exposed

room tiles. The myriad tiny unlikely water cavities in plastic goods, in and around the home, are responsible, according to the estimates of Professor Hassan and his diligent students, for breeding perhaps 75 percent of urban *Aedes* mosquitoes. As the session chairlady commented: "What the mind does not know the eye does not see."

We need an educational video alerting the 40 percent of the world's population at risk from dengue to the secret *Aedes* mosquito breeding sites in and around the house.

Enter DDT...

I could not have wished for more appropriate new evidence for my seemingly outrageous proposal to once again spray inside and outside houses with DDT, regarded almost universally (and erroneously) as a dangerous cancer-causing environmental poison. I had one hour and 45 slides (posted on my Biosphere Technology website www.mohdpeterdavis.com) to convince a packed audience of intelligent professionals who had been brainwashed against DDT.

Drawing on the decades-long campaign in the pages of {21st Century Science & Technology} to lift the ban on DDT, I presented the complete DDT story from World War II: the near eradication of malaria and yellow fever, the unjustified DDT banning in 1972 against overwhelming scientific evidence on its safety from 30 years of worldwide use, the hidden genocide agenda, and the 2006 reversal of the DDT ban by WHO.

The presentation was received with intense interest, and the photo of Professor Gordon Edwards bravely eating DDT to prove its safety set many talking. Then the whole hall began animatedly discussing one quotation after the other of Prince Philip's World Wildlife Fund and other green environmentalists, showing what's behind the opposition to DDT. It was just too successful in saving hundred of millions of lives, they complained.

Against this outrageous deliberate genocide by the Malthusians of the green environmental movement, which few have realized, my simple proposals to scientifically evaluate spraying dengue hotspots with DDT seemed to be accepted with a sigh of relief.

The chairman of my session, a senior government health official, told me that throughout his career he had regarded DDT as an unacceptable environmental and human poison, but that my one-hour talk had turned him around 180 degrees. At lunch he said that his state would like to be the first to reintroduce DDT with a pilot study in a dengue hot spot. I willingly conspired with a plan to make this happen!

Many others offered agreement with my pro-DDT presentation and supported my final suggestion to hold an expert workshop to jointly propose new strategies for quickly winning the "Little Dengue War" with DDT in order to focus on the "Big Influenza War" that we must wage against a dangerously evolving 1957, or the far worse 1918-type virulent influenza pandemic.

In a break, a longtime mosquito researcher asked me how I came to be so passionate about DDT, adding that his real concern that DDT was proven to accumulate in the body (yes, but due entirely to the blatant overuse of DDT for pest control by lazy farmers and large agricultural enterprises such as cotton growers). His other concern was that it would cause cancer. (No, this is not true).

So we still have a long way to go in dispelling the brainwashing and outright lies spread relentlessly by the green environmental movement ever since Rachel Carson's poisonous 1962 anti-DDT book, *Silent Spring*.

But now, 300 Malaysian doctors and health officials have received, for the first time, a truthful briefing on the history and wonderful disease-control properties of DDT, the most life-saving chemical ever invented by man.

—Mohd Peter Davis

skin. According to a Duke University study in 2004, every year, approximately one-third of the U.S. population uses insect repellents containing DEET, available in more than 230 products with concentrations up to 100 percent.¹⁰

The mode of action DEET in repelling mosquitoes appears to be similar to DDT. In a rigorous research paper from University of California-Davis, involving human subjects who exposed their arms to mosquitoes under a wide variety of experimental conditions, Syed and Leal settled a long debate on the issue, stating that “these results lead us to clearly conclude that the mosquitoes smell and avoid DEET.”¹¹ But there the similarities with DDT end.

A pharmacologist with Duke University, Dr. Mohamed Abou-Dona, has spent the last 30 years researching the effect of pesticides in rats, the laboratory animal closest to humans for metabolic investigations. His numerous studies in rats clearly demonstrate that frequent and prolonged application of DEET causes neurons to die in regions of the brain that control muscle movement, learning, memory, and concentration.¹⁰ Moreover, rats treated with an average human dose of DEET (40mg/kg body weight) performed far worse than control rats when challenged with physical tasks requiring muscle control, strength, and coordination.

Such effects are consistent with physical symptoms in human beings reported in the medical literature, especially by Persian Gulf War veterans. American troops in Iraq are issued DEET skin repellent cream to protect them from the biting flies which cause “Baghdad boils” and also spread Leishmaniasis, a parasitic disease affecting the liver, spleen, and bone marrow. Returning soldiers suffer similar symptoms to experimental chickens treated with DEET. These symptoms in humans include memory loss, headache, weakness, muscle and joint pains, tremors, and shortness of breath, which can occur months or years after exposure to the chemicals.

The take-home message, says Dr. Mohamed Abou-Dona, is “never use [DEET] insect repellents on infants, and be very wary of using them on children in general. Never combine insecticides with each other or use them with other medications. Even so simple a drug as an antihistamine could interact with DEET to cause toxic side effects.” These personal insect repellents are intended to be used “sparingly and infrequently” for outdoor recreational use and are very effective for about 12 hours.

However, a dangerous scenario can now be anticipated in urban areas in Malaysia and other countries, where dengue epidemics are creating a climate of fear as the disease spreads to new regions. Those families that can afford to do so may go overboard, combining the whole arsenal of readily available mosquito coils, aerosol insecticide sprays, and now DEET personal repellents—exactly the practice Duke University is trying to avoid with its warning. It seems that in a desperate attempt to protect against dengue, parents could stand a very real possibility of poisoning themselves and their children with a dangerous cocktail of insecticides and repellents.

The daily overuse of these inferior and potentially dangerous insecticides can be completely replaced by indoor spraying with a few grams of DDT every 6 months. For outdoor protection from mosquito bites for building and agricultural workers, and even home gardeners and picnickers, a range of

innovative DDT-impregnated hats and outer clothing can be developed.

Malaysia’s Role in Stopping Dengue Worldwide

The only valid argument against DDT is that in widespread use in agriculture, it can produce resistance within the targeted insect populations. The introduction of DDT exclusively for control of human diseases, restricting its use for agriculture, and under the strict supervision of the health authorities, may well be able to completely replace the unregulated use of all present household and personal insecticides. Dr. Pierre Guillet, a medical entomologist who spent 10 years on malaria control in Africa and who coordinates the WHO Vector Control and Prevention Team in Geneva, acknowledged in an interview: “There is no direct evidence of toxic effects of DDT on human health. If we haven’t found any such evidence after 60 years,” he said, “It is bloody safe.”¹²

Malaysia, in collaboration with the World Health Organization, has the ability to conduct the proper DDT indoor spraying of all houses and public buildings and also the outdoor mosquito breeding sites in selected dengue hot spot suburbs, and to compare the number of dengue cases with similar, conventionally fogged suburbs. Like the bold Australian compulsory car seat experiment in the 1970s, which dramatically saved lives and injuries, this could be a world-class national experiment, with leading dengue and DDT experts as advisors, for the benefit of 40 percent of the world’s population now at risk from this disease. Malaysia’s adoption of indoor and perifocal spraying with DDT to protect the population could show the world, brainwashed for 47 years against DDT, the way forward in the control of dengue.

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The True Story of DDT

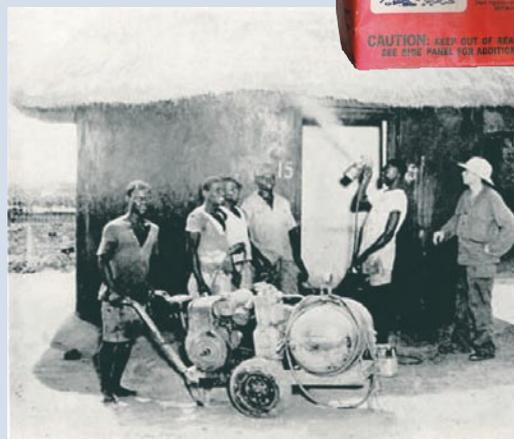
by Przemyslaw Mastalerz



U.S. Army

DDT: Then ...

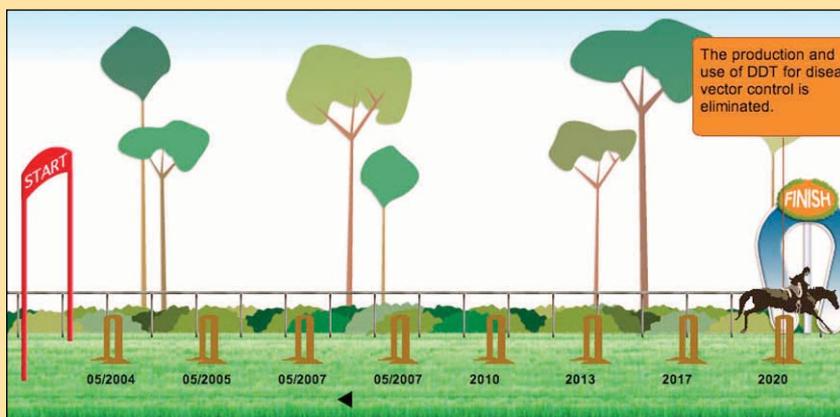
During the war, DDT was used to save the lives of millions of soldiers and civilians from insect-borne disease, making this the first war in which disease did not kill more people than the war itself. Right: DDT residual spraying of a hut with a mobile power spray. Left: DDT dusting in World War II.



U.S. Army

... And Now

The race to eliminate DDT. The Stockholm Convention is racing "toward achieving the elimination of DDT for disease vector control" by 2020. You can click on the button to enlarge the graphic and see how the Convention is progressing in its disease-supporting race to eliminate DDT. <http://chm.pops.int/Programmes/DDT/Overview/tabid/378/language/en-US/Default.aspx>



A chemist looks at the voluminous scientific literature, and concludes that DDT is not hazardous to human health.

1. The Stockholm POP Convention

The letters POP as the acronym for Persistent Organic Pollutants appeared first in U.N. documents during the last decade of the 20th Century. For example, we find POP in the UNEP (United Nations Environmental Programme) document dealing with the preparations preceding the imposition of a ban on the production and application of chemical compounds classified as belonging to the POP group.¹ In a manner typical for the various activities of the UN, the preparations included numerous international conferences. The preparatory activities were finalized at the conference in Stockholm in May 2001 where the representatives of 127 countries signed the document which is known as The Stockholm POP Convention.²

The convention explicitly bans or imposes severe limitations on production and use of 12 chloroorganic compounds (DDT, Aldrin, Dieldrin, Endrin, Chlordane Heptachlor, decachlorobi-phenyl, tetrachlorodibenzodioxin, tetrachlorodibenzofuran). In

the English ecological literature, the POPs are sometimes called “the dirty dozen.”^{3,4} That phrase alone tells what is the “ecologically correct” attitude towards the POP family of chemicals....

The main reason why environmentalists wage war against POPs, is that all POPs are organochlorine compounds and the environmentalists stubbornly believe that all organochlorines are harmful and should be totally eliminated. Skeptics who do not believe that there are people harboring such ridiculous views are referred to the book by Thornton,⁵ pages 1-11 and others.

The POPs were selected for a frontal assault because previous successful bans of organochlorine insecticides and PCBs opened a breach in society’s defense against environmentalists and made it more probable that their future victories will be easier to achieve....

The Stockholm Convention is most aptly described as a betrayal of science and reason. It is not without irony that the same phrase was used by Paul R. Ehrlich and Anne H. Ehrlich in the title of their book in which they acidly criticize all efforts to counteract environmentalist propaganda.⁶

Common sense and even a cursory survey of literature indicate that the POP Convention does indeed betray science and reason. It is very difficult to understand why and how science became so totally overshadowed by environmentalist opinions that it was possible to create such a document as the Stockholm Convention.

2. Ideological and Historical Background of the War Against DDT

The history of DDT abounds with important scientific and political events, but the main reason why it should be more widely remembered is that it presents a very instructive picture of the conflict of science and common sense with politics and propaganda. It is a very sad and depressing picture with numerous examples of:

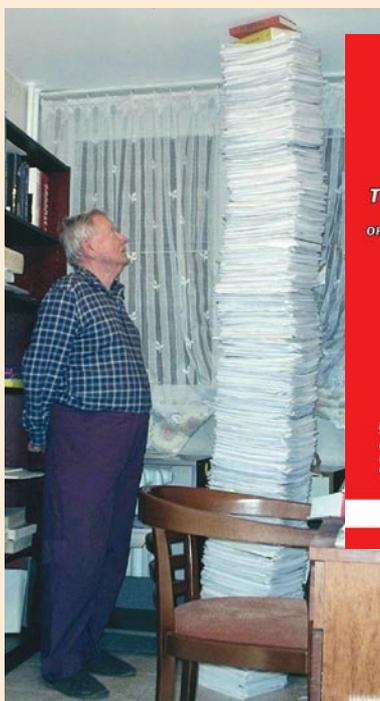
- cheating public opinion,
- contempt of scientific information,
- dishonesty of scientists,
- simple human stupidity,
- domination of ideology and politics over science.

In view of the ongoing confrontation of science with politics and obscurantism, it would be dishonest and even dangerous to put a lid of silence upon that picture.

There are known at present more than 20 million organic compounds and most of them are more or less toxic, but the environmentalists have chosen DDT as the target of their most violent attacks. Their reasons are very difficult to understand, in view of the fact that DDT has extremely low toxicity for most warm-blooded animals and is one of the most safe and most effective insecticides. Probably no antibiotic saved so many people from unnecessary and avoidable death as did DDT, through its use in the fight against malaria.

The campaign against DDT has no rational explanation. It culminated in the 1970s with the DDT ban, but the ugly marks it left in human minds remain to the present day. The campaign against DDT was a political and ideological act without any scientific reasons. However, there were tactical reasons.

From many organochlorine insecticides, which were in common use from late 1940s to early 1970s, the environmentalists chose DDT as the target of their first broadside attack on organochlorines. The reason of their choice was that DDT already was publicized very extensively by the mass media. Most people in North America and Europe knew what DDT was, while only few were aware



THE TRUE STORY OF DDT, PCB, AND DIOXIN

Ecologists claim that dioxin is more toxic than other man-made poisons. It is a false claim. Nobody ever died of dioxin, not even Viktor Yushchenko, the Ukrainian politician who was given a huge dose of dioxin in a failed attempt to remove him from the political scene. It follows that even would-be assassins should be advised not to take ecological claims at the face value.

Przemysław Mastalerz

Prof. Mastalerz stands next to a stack of the 2,000 papers on DDT which he reviewed as documentation for his book.

Editor’s Note

Prof. Mastalerz is Professor Emeritus of Organic Chemistry and Biochemistry at the Technical University of Wrocław, Poland. He wrote The True Story of DDT, PCB, and Dioxin in 2005 in an attempt to unearth the relevant facts about these chemicals to put before the public. The book covers the technical details of these chemicals, and presents his findings from a review of more than 2,000 scientific papers on topics like toxicity to birds, fish, domestic and wild animals, and human beings. It includes an examination of the major environmental issues, such as the alleged carcinogenesis, hormonal effects, and decreasing male fertility of DDT.

The book, published by Wydawnictwo Chemiczne in Wrocław, is available for \$20.00 at <http://www.chemia.org/id12.html>. We have excerpted a small part of the 226-page book here, with minor editorial changes to aid the continuity of the excerpts and footnotes.

STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS

The Parties to this Convention,

Recognizing that persistent organic pollutants possess toxic properties, resist degradation, bioaccumulate and are transported, through air, water and migratory species, across international boundaries and deposited far from their place of release, where they accumulate in terrestrial and aquatic ecosystems,

Aware of the health concerns, especially in developing countries, resulting from local exposure to persistent organic pollutants, in particular impacts upon women and, through them, upon future generations,

Acknowledging that the Arctic ecosystems and indigenous communities are particularly at risk because of the biomagnification of persistent organic pollutants and that contamination of their traditional foods is a public health issue,

Conscious of the need for g

Mindful of decision 19/13 United Nations Environment Programme health and the environment through and discharges of persistent organ

Recalling the pertinent conventions, especially the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Basel



The first page of the 2001 Stockholm Convention. To read the rest of the document, see http://chm.pops.int/Portals/0/Repository/convention_text/UNEP-POPS-COP-CONVTEXT-FULL.English.PDF

the Stockholm Convention.

One of the possible explanations of the hostile attitude towards DDT appears to have its roots in the fact that environmentalists reject scientific opinions whenever these opinions do not agree with their canons of faith. For example, the environmentalists do not agree with the results of toxicological and epidemiological studies which demonstrate very clearly that DDT is harmless to humans and other mammals. They also refuse to accept the fact that there is nothing better than DDT to fight the malaria-spreading mosquitoes.⁷⁻⁹

We shall return in later chapters to various aspects of the war of environmentalists with DDT, but it is worth mentioning here that the Stockholm Convention exempted DDT from immediate total ban by permitting its use in malaria eradication programs. Unfortunately, this exemption did not help the poor nations very much, because many relief agencies refuse to sponsor programs in which DDT is to be used, or refuse to sponsor any relief programs in countries which decide to return to DDT in their struggle against malaria.

Fierce attacks on DDT continued from the earli-

est years of the history of that insecticide, and its opponents have used all conceivable lies as their weapon. One of the earliest examples is provided by a book published in 1955 where the author said that the annual production of DDT in the USA (about 150,000 tons at that time) would be enough to kill all people on our planet.¹⁰ It is an exceptionally crass lie, because it was well known in 1955, or even earlier, that DDT is not toxic to humans. I cite that book to show how difficult it is to argue with environmentalists with their total disregard of truth. An earlier example of a stupendous lie told in a paper published in a scientific journal will be discussed later.

About 20 years after the beginning of DDT history the American author Rachel Carson published her famous book *Silent Spring*. Carson presents there a dramatic

picture of a world ravaged by DDT, which indiscriminately brings death to people and animals.¹¹ The book is now almost forgotten, but in its time it served to establish in the public opinion the picture of DDT as a deadly poison which kills even when applied in very small amounts. The Carson book marks the beginning of chemophobia which now dominates the public attitude towards all chemicals.

It should be stressed that *Silent Spring* must not be totally condemned because it helped to develop ecological awareness in the society. However, one has to remember that Carson's



Stockholm POPs Convention

"A betrayal of science and reason": The Stockholm POP Convention meeting in May 2006.

of dieldrin, chlordane, or heptachlor, with their difficult-to-remember names. The environmentalists knew very well that only by attacking the most popular insecticide would they attract sufficient public attention and secure financial support from society. DDT appears to be the most prominent case of using chemophobia to earn money from scared people.

Attacks on other POPs came later, when environmentalist organizations strengthened their position by having achieved the ban of DDT. That ban was their biggest ever victory. Their campaign against other organochlorines found its culmination in

book is full of lies and exaggerations. A severe critique by professor Gordon Edwards¹² appeared 30 years after the publication of the first edition of *Silent Spring*. With reactions delayed by 30 years there is no chance that professors shall ever win the upper hand in their discussion with environmentalists.

In later chapters, I discuss many examples of false information on DDT taken from scientific journals and popular books. . . .

The Triumph, the Demise, and the Return of DDT

DDT was first synthesized 130 years ago, but did not attract any attention until 1939, when Paul Müller discovered its amazing insecticidal properties. For reasons to be explained later, the date of Müller's discovery, now largely forgotten, should be inscribed in the annals of humanity as one of the greatest scientific achievements. Contemporaries very soon recognized the merits of the new insecticide and Müller received the Nobel Prize in 1948, less than 10 years after the first agricultural applications of DDT. Details of work leading to that discovery are described in papers by Müller et al.^{13,14} and in the book by West and Campbell.¹⁵

Very soon the newly discovered DDT was successfully applied in Switzerland to combat the Colorado beetle, but because of the war, the agricultural applications were not in the foreground before 1946. Instead, the attention was then focussed on eradication of disease-carrying insects. Being aware of the importance of an extremely potent insecticide, the Swiss government made DDT available to the Allies. That gesture made possible a large-scale utilization of DDT for protection of allied soldiers from malaria-spreading mosquitoes and from typhus-carrying human lice.

It is a telling and little known fact that the Swiss government made DDT available not only to the Allies but also to Nazi Germany. The Swiss argued that this was required by their neutrality.¹⁶ The Swiss thus demonstrated a rather queer understanding of neutrality.

The success of DDT against malaria and other diseases carried by insects was truly phenomenal and was the reason why Müller was honored with the Nobel prize in medicine so soon after the first practical applications of DDT. Unfortunately, due to tremendous pressure from ecological organizations, the early successes were soon forgotten and are almost never mentioned in newer literature. A striking exception to this is provided by A.G. Smith in a review article where the early history of DDT is objectively presented.¹⁷ Environmentalist books either do not mention, or try to belittle the successes of



Novartis

Nobel Prize winner Paul Müller in his laboratory, where he discovered the insecticidal properties of DDT in 1939.

DDT.^{18, 19}

Mosquitoes bite when their victims are sleeping and before or after feeding, they rest on the walls of human homes. This behavioral peculiarity made possible the phenomenal success of the fight against malaria, because only one spraying of inside walls with minute quantities of DDT protects the homes for several months.²⁰ The effectiveness of such an approach is very well documented in the literature.^{21, 22}

Between 1945 and 1971, malaria was eradicated in 27 countries with a total population of over 700 million, but it returned in later years when the use of DDT was prohibited worldwide. The sponsors from the United States and rich European countries decided that because of the ban, it is unlawful to support the eradication of malaria with DDT. Without financial support, DDT was withdrawn from malaria programs and the results were immediate and disastrous. Millions of poor people in tropical countries again were dying from malaria.

It is true that in some isolated cases DDT was withdrawn because of the appearance of resistant mosquitoes, but the ban was prompted not by insect resistance but for purely political and ideological reasons. Resistance is not a big problem, because even the resistant mosquitoes are repelled by DDT and do not enter sprayed homes. Without being highly effective against mosquitoes and some crop-damaging insects, DDT would not be as popular as it is now in Third world countries. The amount of DDT used globally after the ban, mostly in Asian countries, was estimated in 2001 to approach 50,000 tons annually.²³

Poor, malaria-threatened nations are often unable to afford other, more expensive methods of fighting mosquitoes and thus turn to DDT even if that means a loss of financial help from the United States and Europe. It is truly disgusting that the environmentalists from rich countries condemn poor people to death from malaria, by denying funds only because the use of DDT is against their canon of faith.²⁴

From the earliest days, the successes of DDT did not prevent scientists from noticing some disturbing symptoms. The first papers on the toxicity of DDT to fishes, frogs, and laboratory animals appeared in 1944²⁵⁻²⁷ and the toxicity to humans was first mentioned in 1945.²⁸ The accumulation of DDT in animal fat and its appearance in milk were also described in 1945.^{29, 30}

The earliest studies were carried out in the laboratories of the U.S. Army and published with much delay because of the secrecy enforced by war. The details were described a quarter-century later by W.B. Deichman, who had supervised some of



U.S. Army

The Army routinely dusted displaced persons and others in Europe with DDT to protect civilians and the Army from typhus, a louse-borne killer disease. The Supreme Headquarters of the Allied Expeditionary Force (SHAEF) made public health a command responsibility, setting up DDT dusting at border control stations and elsewhere.

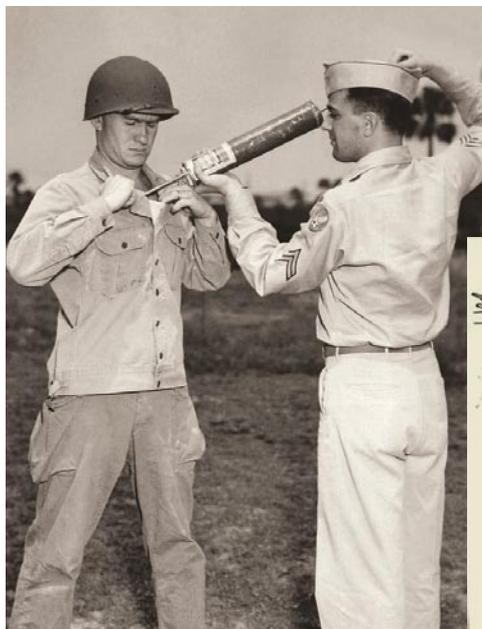
the early work.³¹ Since the appearance of the first papers, thousands of scientific papers on biological properties of DDT have been published, but the early publications are now forgotten and are hardly ever cited.

The developments during the first years of DDT history were described by E. Russell in an article published in 1999. It is a very interesting article based on documents from American governmental archives. Unfortunately, the Russell article is heavily biased, with focus upon the harmful properties and omission of the useful properties of DDT. For example, Russell



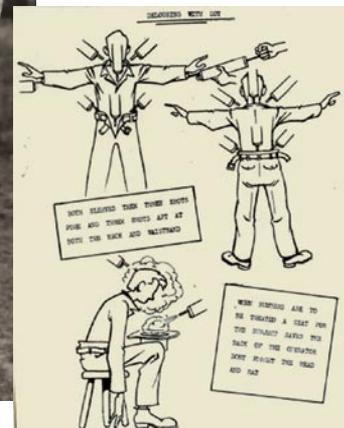
U.S. Army

DDT spraying was carried out by the Army around the world. Here residual spraying of living quarters in Assam, northeast India.



U.S. Army

U.S. troops were routinely dusted with DDT for disease control. Here a soldier demonstrates how to spray, and an World War II Army poster describes the process of delousing new recruits.



National Museum of Health and Medicine at Walter Reed Army Medical Center

does not at all mention the eradication of malaria.³² I refer to his article only to remind the readers that reviews are not a good source of objective information on matters contested by environmentalists.

The Toxicity Question

The very low toxicity to humans and other mammals was noticed at the very beginning of wide-scale application of DDT. For example, people infected with lice were literally sprinkled with copious amounts of powders containing several percent of DDT without harmful effects³³ (see photographs).

Evidence that DDT is very safe to use was provided also by its application on a very large scale in agriculture, without any indication of harm to humans.

Unfortunately, the excellent safety records of DDT encouraged its indiscriminate use on fields and in forests, which resulted in isolated cases of poisoning of fish and birds. At the same time, it was learned that DDT is very persistent in the environment and is present in detectable amounts in animal and human tissues.

Toxicity and persistence were very much exaggerated by environmentalists, who from the earliest days of DDT history claimed that it is too dangerous to be used and should be banned. Soon a very heated public discussion began of the merits and hazards of DDT.

Unfortunately, it was always a political discussion, which proceeded with total disregard of science. The following two examples of argumentation illustrate the extremity of positions taken by the participants of these discussions. Both quotations come from medical journals:

“DDT is a deadly poison for humans and for all animal species.”³⁴

"It was incontrovertibly shown that DDT prevents human illness on a scale hitherto achieved by no other public health measures entailing the use of a chemical."³⁵

It is difficult to believe that these two so radically different statements refer to the same chemical compound. We shall see later that in the literature on DDT there is no shortage of contradictory opinions and information. Here I shall only comment briefly on the situation in 1960-1970 when there were heated discussions in the media and in courts of law. The discussion finally resulted in the worldwide ban on DDT. The most important and influential were the protests of environmentalist organizations and discussion in the media which drove the society to hysterical fear of DDT and of the chemical industry. The most important legacy of those years is the chemophobia and the common belief that chemistry is poisonous. A popular account of the origins of chemophobia is given by E.M. Whelan.³⁶

For a popular and very competent presentation of the DDT problem as it was at the beginning of the 1960s, the reader is referred to the book by the American politician J.M. Whitten, who participated in public discussion during the 1960s.³⁷

Environmentalists most often used the following three accusations to support their attacks on DDT³⁸:

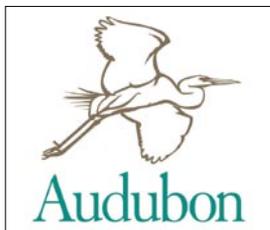
- DDT brings a hazard of bird extinction.
- DDT is so persistent that its removal from the environment is practically impossible.
- DDT is a hazard to humans because it is carcinogenic.

In later chapters I present detailed and compelling evidence that all these accusations are without scientific foundations.

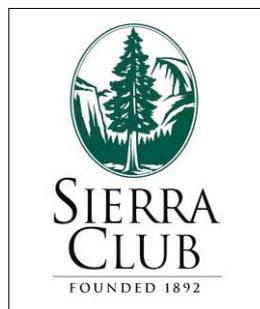
The Attacks Escalate

The truly dangerous attacks on DDT begun in 1969, when three potent environmentalist organizations (Environmental Defense Fund, Sierra Club, and National Audubon Society) submitted to the Department of Agriculture a petition demanding a ban on DDT. The main argument of these organizations was that DDT is carcinogenic.³⁹ In response to the petition, the Department of Agriculture issued a partial ban prohibiting DDT use in human habitats, tobacco plantations, and water areas.

But this decision was not satisfactory for the environmentalists, who brought the matter to a



The three leading environmental groups in the crusade against DDT, which gained them both fame and funds.



court of appeal, which ruled that the DDT problem should be considered by a court appointed by the Environment Protection Agency (EPA). In sessions lasting from August 1971 to the Spring of 1972, this court heard the testimony of over 100 witnesses, representing both the opponents and supporters of DDT.

In April 1972, the EPA hearing examiner Edmund Sweeney, after reviewing 9,300 pages of testimony, recommended to the EPA that a more extensive ban on DDT than that already in force was not necessary or desirable. The highlights of Sweeney's verdict are as follows:⁴⁰⁻⁴²

- DDT has extremely low toxicity to man and is not hazardous when used as directed in registration documents.
- DDT is not carcinogenic to man.
- DDT uses according to registration do not have a deleterious effect on fish and wildlife.

One would assume that such clear verdict should save DDT for continued use. However, EPA administrator William Ruckelshaus ignored Sweeney's recommendation and imposed a ban of DDT. In doing so, Ruckelshaus declared that the wealth of scientific data presented during court sessions was irrelevant and started a long chain of irresponsible decisions made by EPA.

The Ruckelshaus decision belongs to the biggest scandals in the history of science and politics. Details of the background of this infamous decision are not known. There are reasons to be-



EPA

EPA administrator William Ruckelshaus, an active member of the Environmental Defense Fund, banned DDT in 1972, in what he later admitted was a decision based on political reasons.

lieve that Ruckelshaus was influenced by the ecological organization Environmental Defense Fund, of which he was an active member.⁴³

In developed countries, where the farmers have access to a variety of insecticides, the ban of DDT was without many disturbing effects. The situation was very different in poor countries infected with malaria where the removal of DDT had devastating consequences,⁴⁴ as it resulted in unnecessary death of millions of people from malaria. It is true that with his single signature Ruckelshaus committed the crime of genocide on an unimaginable scale. His willing accomplices were ecological organizations with their relentless propaganda against DDT.

Environmentalists plead not guilty and say that removal of DDT was due to increasing insect resistance, but by doing so they only commit one more lie. The best evidence against the claims of the environmentalists is the continued "illegal" use of DDT in third world countries.

The Population Question

The potential to save human life was used as an argument by both the supporters and opponents of DDT. The supporters argued that DDT must not be banned because it prevents millions of death cases from malaria, while the opponents said that there are too many people on this planet and DDT ban would lessen the problem of overpopulation. J.G. Edwards, a distinguished participant in the DDT discussion, quotes the following statement made by Alexander King, the chairman of the Rome Club:

"I am against DDT because eradication of malaria increases the overpopulation."⁴⁵

Similar but much more direct is the statement by C.F. Wurster, the scientific advisor of the Environmental Defense Fund:

"There are too many people and banning DDT is as good a way to get rid of them as any."⁴⁶

These quotations tell us that for a proper judgment of environmentalist intentions, it is useful to remember what dark ideas lurk behind the scene of public discussions on DDT.

The astounding effectiveness of DDT against malaria is illustrated by the following statistics of malaria cases before and after introduction of DDT in some countries (after H. Hug, *Der tägliche ökohorror*, München, 1997). Such statistics are never referred to in publications authored by writers who are convinced that DDT is an extremely haz-

ardous substance.

Country	Number of Malaria Cases	
	Before DDT	After DDT
Turkey	1,185,969	2,173
Italy	144,631	10
Romania	333,198	4
Bulgaria	144,631	10
India	over 1,000,000	287,000

The DDT Family

It is necessary to define DDT, PCBs, and dioxins prior to the discussion of the effects they have in the environment. Unfortunately, nothing is easy or simple concerning these three most important POPs, and even their definitions are complicated.

The structure of DDT shown in the figure does not give a full picture of what is now understood as DDT in the environment. In addition to the

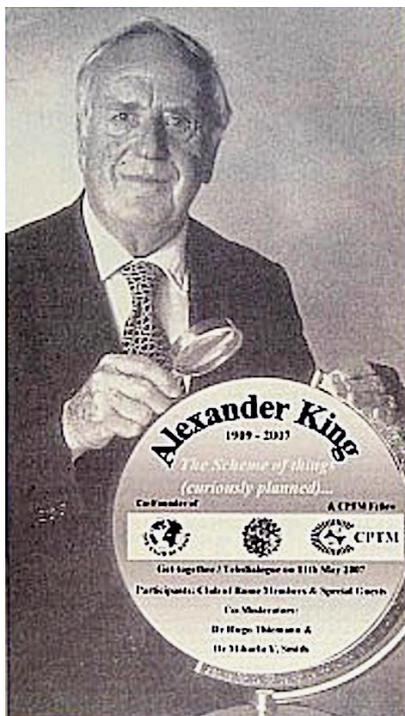
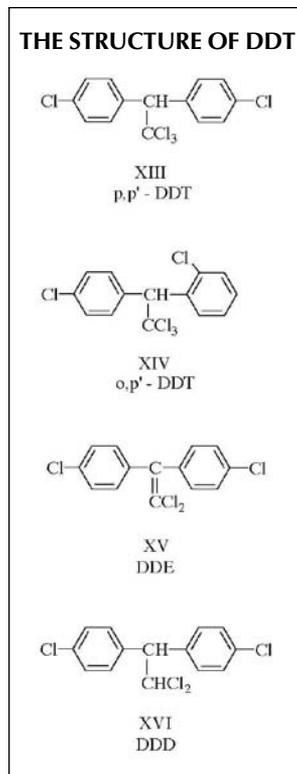
compound defined by the chemical schematic (the correct abbreviation of its name is p,p'-DDT), the technical DDT used to eradicate insects contains also about 20 percent of the isomer with a different position of one of chlorine atoms (XIII). This isomer, known as o,p'-DDT,

was introduced into the environment along with p,p'-DDT. That is not the whole story yet, because in the environment, p,p'-DDT very easily splits off a molecule of HCl and is transformed to the unsaturated compound DDE (XIV).⁴⁷ Another reaction, involving the substitution of one chlorine atom with hydrogen produces DDD (XV).⁴⁸

Unchanged p,p-DDT occurs in the environment together with o,p'-DDT, DDE, and DDD. There are present also small amounts of o,p'-DDT derivatives similar to DDE and DDD. The DDT and related compounds found in the environment are represented summarily by the formula Σ DDT or simply as DDTs...

Human Experiments with DDT

Symptoms indicating that something is terribly wrong in environmental sciences are severe and numerous, but perhaps none is as striking and ominous



Club of Rome Alexander King, co-founder of the Malthusian Club of Rome, acknowledged that although he had supported DDT use during the war, he later regretted his decision, because malaria eradication by DDT increased population.

as the fact that an article was published in 2004 in which DDT is accused of having been the cause of the poliomyelitis (child paralysis) epidemic of 1942-1962.⁴⁹ The article appeared on the Internet and will probably have more impact than the publications in refereed scientific journals because more readers browse in the Internet than among library shelves. There is the hazard that the most stupid lie about DDT which was ever told will be repeated until it becomes another generally accepted fact. The article⁵⁰ mentions the paper by Biskind, who as far back as 1949 demonstrated quite exceptional ignorance.⁵¹

We have already quoted Biskind in Chapter 4. The reappearance of Biskind in the scientific literature 55 years later indicates that among the environmentalists there are scientists who understand nothing and are probably unable to learn anything.

The ubiquity in human tissues and the frequently encountered high or very high concentrations of DDT were of considerable concern in the early days of DDT

and were used by ecological organizations to bring public concerns to the level of hysteria. Let's see, then, what scientific literature has to say in the matter of DDT and human health.

The effects of DDT and its metabolites on human organism have been carefully watched since the first applications of that insecticide in fields and forests. Because of the enormous volume of information collected so far, an exhaustive review would fill a rather sizable volume. Despite restrictions imposed by the small size of this book, all care was taken to include the papers which claim that DDT is harmless as well as those which describe harmful effects.

Let's begin with cases of death after ingesting solutions of DDT:

1945: A one-and-one-half-year-old child drank ca. 30 ml of DDT in naphtha and died after a few hours.⁵²

1946: Suicide by drinking an unknown amount of DDT solution in naphtha.⁵³

 Suicide by drinking ca. 50 ml of DDT solution in methylcyclohexanone.⁵⁴

 Death upon drinking a 6 percent solution of DDT in naphtha.⁵⁵

 Deadly poisoning by inhalation of DDT vapors.⁵⁶

 Death after staying in a room sprayed with a 6 percent DDT solution in naphtha.⁵⁶ This death was probably caused by a strong allergic reaction. Protection from mosquitoes by spraying walls with DDT is safe for humans.

1947: Death upon drinking 120 ml of a 5 percent solution of DDT, solvent unknown.⁵⁷

No cases were reported after 1947 except for a mention on the Internet of the death in 1994 of a child after ingestion of DDT solution in kerosene.⁵⁸

The deaths in all of the above listed cases was probably due



Prints and Photographs Division, Library of Congress.

A special tractor developed in wartime for DDT spraying of food crops to control insects and increase yields. There was no reported damage to human health from the proper use of DDT.

to the solvent rather than to DDT. Cases of death after ingestion of DDT without solvent are not known.

During the first years of DDT history, there were many cases of poisoning without death. The descriptions of non-controlled poisoning episodes are of rather little scientific value but make a quite interesting reading and are quoted here to bring back the characteristic for those times' carelessness in handling chemicals:

1945: A technician stirred a mixture of DDT and acetone with his bare hands. The technician became ill with symptoms of insomnia and weakness. The symptoms disappeared after one year.⁵⁹

1946: A cook at a British army unit baked a cake using flour accidentally contaminated with DDT. Twenty-five soldiers who ate the cake suffered from vomiting and dizziness.⁶⁰

1946: A group of prisoners of war was poisoned upon eating cakes contaminated with DDT. The poisoning was serious and required hospitalization.⁶¹

1946: A worker employed in the preparation of solutions for use against mosquitoes stirred DDT in diesel oil with bare hands. After several weeks the worker suffered headache, weakness, vomiting, and a high temperature.⁶³

1947: In Göttingen, Germany, a Dr. H. Velbinger investigated the toxicity of DDT on himself and two other persons, who let themselves be persuaded to participate in the investigation. The experiments involved swallowing increasing doses of DDT. After the first dose of 250 milligrams and the second one of 500 mg taken four weeks later, there were no visible effects. The dose of 750 mg produced nausea. Three weeks later, the participants received a dose of 1,000 mg and the nausea increased. The last and largest dose of 1,500 mg was given under medical control in a hospital. The 1.500-mg dose produced tremors,

vomiting, and vertigo.

There is no need to continue the description of that heroic experiment, probably one of the last human experiments in the history of medicine.⁶⁴

Other Human Experiments

Demonstrating on oneself the lack of toxicity of DDT was not uncommon during the heated discussion which preceded the DDT ban. Thus, Professor K. Mellanby, a well-known participant and director of several programs of research on insecticides, used to swallow sizable doses of DDT during his popular lectures to demonstrate its benign nature. Professor Mellanby says that he never noted any harmful effects.⁶⁵

A similar example was provided by Professor Gordon Edwards, who, during his many lectures, used to swallow a tablespoon of DDT and who enjoyed a good health even at the age of 80.⁶⁶

Such heroic experiments are of little scientific value, but making them widely known might perhaps help to convince the public that DDT is not a dangerous substance.

The biggest ever experiments with DDT on human subjects were described by Hayes in 1956 and 1971. The experiments were carried out on several dozen prisoners from



Courtesy of Gordon Edwards

Entomologist J. Gordon Edwards for years demonstrated the non-toxicity of DDT by ingesting a spoonful of DDT at his university lectures.

American jails who agreed to take part in that experiment. It is not even possible to imagine the fury of the media if somebody proposed to conduct such experiments at present!

In the experiments conducted by Hayes, the human subjects received daily doses of 35 mg of DDT for almost two years, and some were observed for several years after the last dose. Hayes states that no harmful effects were found by medical examination.^{67, 68}

A human experiment was conducted also by Morgan and Roan in 1971. In their experiment, the volunteers received 10 or 20 mg of DDT daily for a period of 183 days. Hematological and biochemical examination did not reveal any irregularities.⁶⁹

Long-term Experimental Evidence

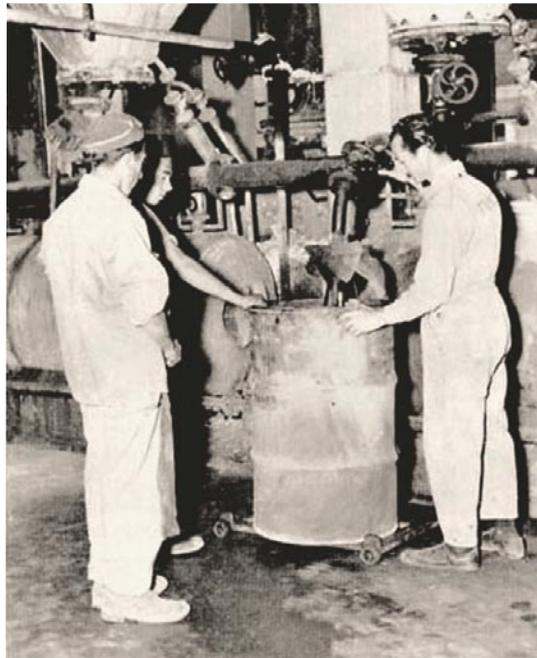
In the discussions of the dangerous nature of DDT it is always stressed that diseases may appear many years after exposure. The environmentalists are not satisfied with the five-years observation

by Hayes, but should find satisfactory the results obtained by Cocco et al., who in 1997 examined the health of persons who 50 years earlier participated in mosquito eradication programs in Sardinia, and had prolonged contact with sprayed DDT.⁷⁰



U.S. Army

The Army used repeated aerial spraying of DDT in Italy to control mosquitoes and prevent malaria. One 1997 study examined the health of 5,193 residents of Sardinia who had prolonged contact with DDT spraying during the war, including some 2,908 persons with high exposure. Fifty years later, there was no difference between the health of these people and other Sardinia residents.



U.S. Army

Drums of a 5 percent solution of DDT being mixed with kerosene or diesel oil for use by the Army in Italy.



IIISD

An ugly United Nations Environment Program poster, which proclaims in six languages, "Persistent Organic Pollutants: A serious threat to human health and the environment."

Cocco et al. examined 5,193 participants of the anti-mosquito campaign including 2,908 persons with high exposure. There was no difference between the expected and the officially registered number of deaths. This result shows that the general health of persons highly exposed to DDT is not different from the health of other people living in Sardinia.

Cocco et al. state that the persons exposed to DDT displayed an increased frequency of liver cancers. It is difficult to understand why they included such statement, because in the next sentence they say that the increased number of cancers is meaningless because similar numbers were found in control group. The authors apparently did not understand, and did not care at all, that just one slight mention of cancer is enough for the environmentalists to register a paper as evidence that DDT is carcinogenic.

The strongest evidence that DDT is a benign substance is provided by the gigantic experiment in which all humanity has participated

since DDT appeared in the environment. The experiment started 60 years ago and the number of participants at present is over 6 billion. Every human being takes part in this experiment, because everybody contains DDT in his or her tissues. For more than one-half century, the scientists scrupulously looked for evidence of harmful effects and failed to find even one disease caused by DDT. What's more, human life span increased very significantly during the presence of DDT. If DDT were as dangerous as some claim it to be, one should not expect people to live longer.

All arguments for the benign nature of DDT extend automatically to its metabolite DDE, because from the beginning the environment contains more DDE than DDT.

Some Alleged Non-lethal Effects of DDT

The facts described in here should convince everybody that DDT is not harmful to humans. The environmentalists are not convinced, however, because they never do agree with facts which prove that something is harmless.

Due to their efforts, and contrary to the facts, the literature is overflowing with papers claiming that DDT is a dangerous substance. Some of such papers have to be discussed here despite their low scientific value, because their omission would be met with accusation of non-objectivity in the selection of the presented material.

The most proper place to discuss the DDT hazards to human health are the chapters on cancer. Here we shall be concerned only with examples of papers dealing with some alleged effects of DDT other than cancer.

In 1970, there appeared a paper on the association of DDD and DDE with abortions. The title suggests that there is an association, but a table included in that paper shows that there is none. In the last sentence the authors say:

"Exposure to DDT during pregnancy does not belong to the essential abortion-stimulating factors."⁷¹

Unfortunately, those scientists who read only the titles of



© P. Virot/WHO

While the environmentalists continue the war against DDT, hundreds of thousands of people become ill and disabled from malaria each year. Here a malaria patient in Ethiopia.

the papers they quote will think that publication⁷² brings a proof that DDT induces abortion.

The authors of a paper entitled "Pesticide Levels in the Blood of Mothers and Newborn Infants" say that they are unable to rule out a causative link between DDT levels in umbilical cord blood and premature births.⁷³ But they were also unable to demonstrate the existence of such a link.

Very radical conclusions are found in a 1981 paper on "Chloroorganic Pesticides in Blood Samples Taken in Cases of Abortions and Premature As Well As Normal Births." The authors state simply that DDT is an antagonist of pregnancy.⁷⁴ That conclusion is negated by the fact that from the beginning of DDT use, several billion healthy children were born, and an increased frequency of abortions was not noticed.

The authors of a very recent paper on DDT and abortion claim that DDE increases the frequency of premature births and decreases the size of newborns.⁷⁵ That paper was criticized because of errors in the interpretation of results.⁷⁶

... The litany of similar papers could be continued ad infinitum. Without discussing such publications in detail, I want to assure the reader that papers on non-lethal effects of DDT are generally of very little ecological relevance, and none of them demonstrates that DDT is dangerous...

DDT and Human Cancer

The first signal that DDT should be considered a human carcinogen appeared in 1969⁷⁷ and the official proclamation that DDT is "possibly carcinogenic" to humans was issued in 1991 by the International Agency for Research on Cancer.⁷⁸ During the next decade numerous papers were published with the purpose of finding out whether DDT is or is not a human carcinogen. Traditionally, most of these papers refer to the carcinogenicity of DDT but what is being studied is the carcinogenicity of DDE because DDE is the only member of the DDT family still present in tissues at relevant concentrations. Some papers on carcinogenicity refer only to DDE without even mentioning DDT.

The question of cancer induction can be answered only by means of epidemiological studies which are based on comparisons of tumor frequency in exposed persons and in the general population. The degree of exposure is inferred from tissue con-



ARS/USDA

A U.S. Department of Agriculture poster issued in 1947 promoting the use of DDT to control household pests. Despite the environmentalist belief that DDT has harmed human beings, after 60 or more years and much epidemiological research, there is no scientific evidence to show human harm.

centrations of the presumed carcinogenic agent. Up to now, the epidemiology has failed to provide evidence that DDT or its metabolites are carcinogenic in humans. This is illustrated by the following examples of recent results:

1. No association was found between DDE concentration in adipose tissue and cancers of the testicles and prostate.⁷⁹

2. No link was found between non-Hodgkin's lymphoma and DDT,⁸⁰ although such association was claimed in earlier papers.

3. Examination of 3,579 workers with long-term exposure to DDT at a chemical plant failed to find an increased number of cancers.⁸¹

4. Serum concentrations of DDE are not associated with endometrial cancer risk in the United States.⁸²

There are also papers claiming a positive association of DDT with cancer, but the number of such papers is not large and many of them were criticized. In one of such papers, Garabrant et al. report that exposure to DDT increases the risk of cancer of the pancreas.⁸³ The authors arrived at that conclusion by observation of workers at a chemical plant for about a dozen years. The authors admit that their study is not conclusive, because of the small number of detected cancers and because the workers were employed in the production of several different chemicals, not only DDT.

The Garabrant paper was criticized by other scientists⁸³ and is a quite typical example of the poor quality of many studies on the carcinogenicity of environmental contaminants. Other examples of poor quality will follow.

Very strong evidence against the carcinogenicity of DDE is presented in a recent paper where cancer mortality in the Uni-



© P. Viroit/WHO

A baby with advanced malaria at Garki General Hospital in Abuja, Nigeria. Environmentalists argue that the "risks" of DDT use outweigh the benefits. Meanwhile 90 percent of malaria deaths in Africa are children under five and malaria kills one child in Africa every 30 seconds.



IISD

Participants in the December 2000 meeting of the Stockholm Convention in Johannesburg joining the Greenpeace demonstration against POPs.

ed States was examined in relation to prolonged exposure to DDE.⁸⁵ The authors examined the association of the DDE levels in adipose tissue with mortality rates for multiple myeloma, non-Hodgkin's lymphoma, and cancers of the breast, corpus uteri, liver, and pancreas, and they observed no association. Thus, the results of this study exclude DDE as the causative agent of most cancers. . . .

Should We Be Concerned about Industrial Estrogens?

. . . The present discussion of the harmful effects of endocrine disrupters will be limited to a few topics only. The subject is so huge and includes so many different topics that an exhaustive coverage would require a large book.

Some very simple considerations suffice to dispel the notion that synthetic estrogens may be harmful to humans. First of all there is the matter of plant estrogens (phytoestrogens). Many plants and plant products in our daily diet contain significant concentrations of phytoestrogens which are perfectly able to do as much harm as the synthetic ones, but the ecologists do not warn us against eating bread, cabbage, potatoes, or apples. They argue that phytoestrogens must not be compared with synthetic estrogens because they are rapidly destroyed in animal and human bodies while estrogens like DDTs, PCBs, and dioxins are persistent and accumulate in tissues.

That argument is useless, however, because phytoestrogens are consumed with every meal and their amounts in tissues are constantly replenished. The distinct biological effects of soybean estrogen indicate that phytoestrogens can and should be compared with synthetic organochlorine estrogens. After all, organochlorine disrupters of the human endocrine system were never shown to disrupt the human menstrual cycle, as do phytoestrogens from soybeans.

We are eating much larger amounts of phytoestrogens than of synthetic endocrine disrupters because our diet contains vanishingly small concentrations of industrial contaminants, while the concentrations of phytoestrogens are quite large.

Some plants contain estrogens at levels of several dozen to several hundred ppm.⁸⁶ Despite their large consumption, the harmful effects of phytoestrogens are observed only on very rare occasions. It is known, for example, that excessive consumption of soybeans may disturb the menstruation cycle but nobody issues warnings against consumption of soybean products. The lack of harm due to phytoestrogens indicates that we should not be afraid of the minute amounts of industrial estrogens in our food.

Any disruptive activity of DDTs, PCBs, and dioxins is precluded by the fact that their concentrations in human and animal tissues are below levels necessary for biological action to appear. For example, *o,p'*-DDT, the most potent estrogen of the DDT family, is estrogenic at

concentrations of at least 1 ppm which is very much above *o,p'*-DDT level in human tissues.⁸⁷ The affinity of organochlorines to cellular estrogen receptors is at least a thousand times lower than the affinity of mammalian estrogens. Low affinities and low tissue levels of organochlorine disrupters make it impossible for them to compete successfully with natural estrogens. . . .

It is evident that concerns about the carcinogenicity of organochlorine pesticides, and other environmental estrogens are unfounded; and similarly unfounded are concerns about human fertility. One should be aware, however, that environmentalist organizations think differently and continue to spread the scare of environmental estrogens.

The sensitivity of the general public to threats of cancer is ruthlessly exploited by environmentalist organizations to gain popularity and financial support. It is difficult to defend the public against such threats, because the media usually refuse to publish opinions which contradict the false environmental beliefs. Truth is to be found in scientific journals, but these are read only by selected few.

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by Dr. J. Gordon Edwards

Summer 1992, pp. 41-52

A well-known entomologist documents some of the falsehoods in Carson's *Silent Spring*, the 1962 book that poisoned public opinion against DDT and other pesticides (Includes a report on a May 21, 1992 press conference in Washington, D.C., where a panel of scientists described the effect of the U.S. 1972 ban on DDT in one word—genocide.)

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Downwinders Deluded And Waiting to Die

by Daniel Miles

These are excerpts from Daniel Miles's book, The Phantom Fallout-Induced Cancer Epidemic in Southwestern Utah: Downwinders Deluded and Waiting to Die. The 130-page book is available through amazon.com or booksurge.com for \$15.00.

Dr. Miles is Professor Emeritus at Dixie State College in Utah. He taught physics there and at Westminster College in Salt Lake City, and he is the author or co-author of 42 scientific papers. In the interest of calming the radiophobia of his neighbors, he took out an ad for his book in a local magazine that was mailed to every home in southwestern Utah.

* * *

The testing of nuclear weapons at the Nevada Test Site began on Jan. 27, 1951. Almost three decades later, news articles about excess rates of cancer in atomic veterans triggered the arrival of a team of lawyers at St. George, Utah.

The residents, who became known as "downwinders" because they were subjected to fallout carried by the wind from atomic testing in Nevada, were told that their cancer rates were more than double nationwide rates and even Utah rates. Activists said that more and more of them would soon be falling victims to incurable cancers and other diseases; that they would die younger than the average American; and that their children would suffer from strange congenital diseases or be born deformed as a result of radioactive fallout exposure.

The tort lawyers, with the aid of activists, politicians, and the print and electronic media succeeded in creating an atmosphere of fear, of panic, of emotional hysteria, and of political expediency that still lives in southwestern Utah, over the dimly understood dangers of radioactive fallout.

Utah politicians quickly became involved. In the Oct. 27, 1978 issue of

the *Color Country Spectrum*, a southwestern Utah daily, we read: "U.S. Representative Dan Marriott, speaking at a press conference in St. George, said he wanted an explanation from the Federal Government on why southern Utah cancer rates were twice that of the rest of Utah."

No reporter challenged Marriott to document his statement about southern Utah cancer rates.

Unchallenged Lies

The alleged fallout-induced cancer epidemic in southwestern Utah has been called the Utah nuclear tragedy. The people of St. George, Utah, and surrounding areas in Washington County, Utah, and beyond came to believe that they may be doomed because a radiation-induced cancer epidemic was sweeping through the countryside, causing thousands of deaths.

One downwinder expressed the concerns of many: "When a Geiger counter is run across my body, it clicks. In the back of my mind is the unspoken dread. When will the bomb inside me go off?"

Beginning in the Fall of 1978, Downwinders, encouraged by trial lawyers, began to tell their heart-wrenching stories about schoolmates, neighbors, and family members afflicted with cancer, or any other nasty affliction, or birthing a defective child, or having a miscarriage, and so on. Their stories have been published in transcripts of court records and town meetings, in newspapers and magazines, and in books and told to nationwide TV audiences.

However, prior to at least 1977 no anecdote or testimonial about radiation sickness or about a cancer epidemic or about any other fallout related health problems in Utah appeared in any news-



National Nuclear Security Administration/Nevada Site Office

One of the bomb tests at the Nevada Test Site.

paper article or other media publications.

After 1978, many statements like the following have appeared in print: "Cancer had never been a noticeable problem before [in southwestern Utah]. But, as the 1950s wore on, and for decades afterward, the ravaging effects came like a pestilence in serial form: the leukemias, usually the quickest to result from radiation exposure, came first; numerous types of cancer ... tended to arrive later."

One magazine account has dozens of young folks in St. George, Utah, dying of leukemia by 1955, four years after testing began at the Nevada Test Site. (Not true, see page 51.)

Another account has young boys and girls dropping like flies in the 1950s from fallout-induced leukemia in Cedar City, Utah. The death rate was so high according to one account that they were holding three or four funerals a week. (Only one young Cedar City girl would die of leukemia during the 1950s.)

Heart-wrenching But False

Another anecdote that has appeared in two books and several magazine articles features the small town of Enterprise, Utah, in northern Washington, County.

This story is about the death of nearly all the boys in the Enterprise High School Class of 1970 from leukemia or other cancers by 1980. (Totally false, see page 50.)

A recent newspaper op-ed article by a Utah politician claimed that little Parowan, Utah, in Iron County with a 1960 population of 1,545 has suffered 85 to 90 fallout-induced cancer deaths a year since the fallout era. (Totally false, see page 45.)

The Utah media continues to give much weight to anecdotal accounts—three pages' worth a few years ago in the *Deseret News* and nearly seven pages' worth in *The Spectrum*, a southwestern Utah daily.

A recent editorial proudly stated that, "Over the past 10 years, downwinders have appeared 265 times in articles published in the *Deseret Morning News*." In all of these articles, downwinders' stories imply that radioactive fallout from bomb testing in Nevada had produced severe adverse health consequences in southwestern Utah.

For example, a *Deseret News* article quotes a St. George lady as follows:

"Every time I go out, I see someone else my age that's dying." The article states that her class reunions are now held at the local cemetery.

Another story that persists is that many young people in southwestern Utah had their thyroid glands surgically removed because of possible malignant neoplasm caused by fallout. The truth is that only surgical exploration of the gland—not surgical removal—was carried out on 24 of the 5,179 children surveyed—no malignant neoplasm had been found by 1975 in southwestern Utah people who were exposed to fallout as children.

Supporting the downwinders anecdotally based "evidence" of a cancer epidemic linked to fallout is a row of books taking up space on a shelf in the Washington County Library, located at the center of St. George. These books, discussed in later chapters, are about the "clouds of death" over southwestern



LLNL

An aboveground diagnostic setup for an underground experiment at the Nevada Test Site. The data signals from a test explosion moved from the device, 300 meters underground via cables, up to the surface and along the surface to the instruments for reading the signals, housed in trailers on the site.

Utah—clouds of death containing radioactive debris released by the detonation of over 100 nuclear weapons at the Nevada Test Site periodically dusting the downwinders with "deadly dust."

There are no books and few news stories about the series of expensive and time-consuming dose reconstruction studies that have found that the exposure in southern Utah may have been too small to produce a detectable increase in solid cancer rates. There are no books about a number of well-controlled studies that have failed to uncover any increase in overall cancer rates that might be attributable to fallout. There are no books on fallout effects making use of the broad knowledge which we now have of the relationship between radiation doses and their effects.

The Linear No-Threshold Model

The antinuclear lobby has used the linear no-threshold model to predict that millions are yet to die from fallout cancers. One such set of frightening figures is found in the book *Radioactive Heaven and Earth*, sponsored by the interna-

tional arm of the Physicians for Social Responsibility. Completely trivial doses are assigned frighteningly high figures by this group, by a series of fraudulent multiplications.

Radioactive Heaven and Earth's predictions are based in part on a United Nations Scientific Committee on the Effects of Atmospheric Radiation (UNSCEAR) estimate that earthlings' annual exposure from fallout over the last 50 years amounts to about 0.002 rads. The book multiplied 5 billion earthlings by 0.002 rads to get 10 million person-rads, and then divided by 1,250 person-rads per cancer death to get 8,000 deaths annually from nuclear weapons testing, and then multiplied 8,000 by the number of years since onset of testing to predict that about 350,000 earthlings will have died from fallout-induced cancers by the year 2000.

The Carbon-14 Hoax

But this frightening number of deaths to global fallout does not include the effects of what the book states is the greatest killer of all—the deadly radioactive



The "Small Boy" nuclear test, July 14, 1962, part of Operation Sunbeam at the Nevada Test Site.

DOE

matter produced by detonation of nuclear weapons, radioactive carbon-14. So far, carbon-14 is accused of causing about 80,000 fatal cancers, but it's just getting a good start according to the Physicians for Social Responsibility. Carbon-14 is still killing humans, they say, and will continue to kill humans for the next 50,000 years.

Natural carbon-14 is produced in the upper atmosphere when neutrons from outer space collide with air nitrogen knocking out a proton in the process. Man-made carbon-14 is produced when neutrons from nuclear detonations collide with air nitrogen. Before the nuclear age, the upper atmosphere process was the only source of carbon-14, and it was present in the atmosphere (as carbon dioxide) at a constant, steady-state concentration determined by the relative values of the rate of production, and the total rate of removal by consumption of the carbon dioxide by plants, by dissolving in the oceans, and by radioactive decay.

Carbon-14 is the longest lived of the major radioactive products from nuclear detonations (half-life is 5,730 years). However, according to nuclear scientists Glasstone and Dolan:¹ The whole-body

dose from carbon-14 in nature before 1952 was somewhat less than 1 millirem per year. By 1964, this dose had been roughly doubled by the additional car-

bon-14 arising from nuclear tests in the atmosphere. If there are no further substantial additions, the dose will decrease gradually and approach pre-test levels in another 100 years or so.

Blatantly ignoring the fact that most of the man-made carbon-14 will decrease gradually and approach normal in another 100 years or so by natural processes, the Physicians for Social Responsibility has calculated that the man-made carbon-14 will eventually cause nearly 2 million fatal cancers worldwide. For this calculation, they assumed a world population of 10 billion and extended the effects of man-made carbon-14 to forever (infinity).

Human yearly exposure from man-made carbon-14 peaked at a measly 1 millirem in 1964, and the yearly dose has dwindled away every since. Yet no correction was

made for yearly removal of man-made carbon-14 by natural processes. In a few decades, our exposure to radioactive carbon-14 will be back to that of



Courtesy of www.dostgeorge.com

St. George, Utah, is uniquely positioned in an area where three major zones come together: the Great Basin Desert, the Mojave Desert, and the Colorado Plateau. Much of St. George is at an elevation of 2,800 feet, and mountains surround the city, some as high as 10,000 feet. The city is ringed by red sandstone (stained by oxidizing iron) and black lava from ancient volcanoes.

the pre-nuclear age.

The Radon Ruse

Antinuclear activists also draw attention to the fact that uranium ore processing exposes millions of Americans to some 0.001 millirem per year from radon emitted by the residues of the processed uranium ore, and that these processed ores will continue to release radon for thousands of years. Using the collective dose concept, they foresee some thousands of supplementary cancers from this extremely small dose (about one-thousandth of the dose you get annually from your TV set) added to the billions normally expected.

However, it can easily be shown that breathing out of the window 30 seconds longer once every year (to avoid breathing the higher radioactive radon levels inside the house), cancels out this effect.

Alternatively, moving to a house 1 inch lower in elevation to reduce your exposure from cosmic rays would also cancel out this effect.

Real Information

This book makes use of wealth of information that now exists about the health consequences of human expo-

sure to ionizing radiation. For example, the author has relied extensively on information found in the 2005 report from the National Research Council of the National Academies titled *Health Risks From Exposure to Low-Levels of Ionizing Radiation, BEIR VII Phase 2*.

The National Research Council Report is based on over 1,400 studies of the health effects of ionizing radiation. It is interesting to note that Table 9-2B of this Report, titled "Populations Exposed from Atmospheric Testing, Fallout, or Other Environmental Releases of Radiation," does not include any studies on Utah downwinders, implying a lack of a detectable increase in downwinders' cancer rates. Only the study of thyroid disease incidence in Utah schoolchildren exposed to fallout is cited, but Committee members found this study "not statistically significant."

No one questions the existence of human tragedies in Utah or anywhere else. A family that has a child with leukemia has suffered real tragedy, whatever caused it. The appearance of essentially any cancer in a person exposed to fallout might understandably

appear as causal sequences to the people concerned.

A balanced perception of the health risks of ionizing radiation is of great societal importance in relation to issues as varied as the future of nuclear power, nuclear waste storage, the cleanup of nuclear waste sites, occupational radiation exposure, medical X-rays, atmospheric and underground testing of nuclear weapons, manned space exploration, frequent-flyer risks, and radiological terrorism. It is also relevant to the current effort by activist groups and The Spectrum newspaper to extend the Radiation Exposure Compensation Act (RECA) nationwide.

It is the author's belief that it is time to revisit the so-called Utah nuclear tragedy and to re-examine the effects of the clouds of death over Utah. He also believes that exaggerating fallout effects is just as dishonest as to minimize them. Hopefully the author will not be guilty of either.

Footnote

1. S. Glasstone and P.J. Dolan, 1977. *The Effects of Nuclear Weapons*, Revised Edition, Department of the Army Pamphlet.

21st CENTURY SCIENCE & TECHNOLOGY

- Jerry M. Cuttler, "The Significant Health Benefits of Nuclear Radiation," Fall 2001
- James Muckerheide, "It's Time to Tell the Truth about the Health Benefits of Low-Dose Radiation," Summer 2000
- Dr. Theodore Rockwell, "Radiation Protection Policy: A Primer," Summer 1999
- Zbigniew Jaworowski, "A Realistic Assessment of Chernobyl's Health Effects," Spring 1998
- Jim Muckerheide and Ted Rockwell, "The Hazards of U.S. Policy on

Low-level Radiation," Fall 1997
Radiation experts argue that current U.S. policy of a "linear no-threshold" approach to radiation damage has no science behind it and is wasting billions of government dollars in clean-up that could be spent on real health benefits.

- Sadao Hattori (interview), "Using Low-dose Radiation for Cancer Suppression and Revitalization," Summer 1997

A discussion of Japan's wide-ranging program of research into the health effects of low-dose radiation.

- T.D. Luckey, "The Evidence for

ARTICLES ON RADIATION and HORMESIS

Radiation Hormesis," Fall 1996

A comprehensive review of the evidence of the beneficial effects on health of low-dose radiation.

- Zbigniew Jaworowski, "Hormesis: The Beneficial Effects of Radiation," Fall 1994

In 1994, the United Nations Scientific Committee on the Effects of Atomic Radiation, after 12 years of deliberation, published a report on radiation hormesis, dispelling the notion that even the smallest dose of radiation is harmful.

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A Grand Vision of Man's Role In Colonizing the Universe

by Oyang Teng, LaRouche Youth Movement

Krafft Ehricke's *Extraterrestrial Imperative*

by Marsha Freeman

Burlington, Ontario: Apogee Books, 2009

Paperback, 302 pp., \$27.95

There are two reasons to read Marsha Freeman's book, *Krafft Ehricke's Extraterrestrial Imperative*. The first is that it adds a crucial dimension to the historiography of 20th Century space-flight, through a loving portrait of one its most important and interesting founders, Krafft Ehricke. More important, it evokes in the reader a childlike optimism about the possibilities for the future of humanity, with the inescapable truth—at the same time obvious and fantastic—that mankind belongs among the stars.

This latter feat is accomplished largely through the writings of Ehricke himself, a sampling of which comprises the bulk of the book, following Freeman's enlightening biographical sketch of Ehricke and his place among the pioneers of human space exploration. The selection of his writings ranges from a fictional account of a trip to Mars, written in 1948, to an excerpt from his titular manuscript *The Extraterrestrial Imperative: From Closed to Open World*, a book-length work that was never published because of what Ehricke described as the "then rising emotional anti-technology and anti-space moods" of the early 1970's.

In one article Ehricke outlines the possibilities for space tourism, with such features as a Space Zoo for animals reared in low-gravity conditions; in another, he provides a detailed technical and economic analysis of the industrialization of the Moon. In one of his most penetrating essays, his 1957 "The An-

thropology of Astronautics"—written at the dawn of the Space Age—Ehricke establishes three "fundamental laws of astronautics":

1. Nobody and nothing under the natural laws of this universe impose any limitations on man except man himself.

2. Not only the Earth, but the entire Solar System, and as much of the universe as he can reach under the laws of nature, are man's rightful field of activity.

3. By expanding throughout the uni-



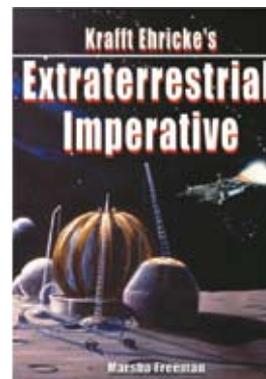
Photos courtesy of Krafft Ehricke

Krafft Ehricke (1917-1984)

verse, man fulfills his destiny as an element of life, endowed with the power of reason and the wisdom of the moral law within himself.

An Early Love of the Extraterrestrial

As a young boy in Germany, Ehricke was enthralled by Fritz Lang's famous 1929 silent movie *The Woman in the Moon*, and subsequently spent the rest of his life developing, and then elaborating, his three laws as the drivers for the next phase of conscious, human evolution. He poetically envisioned the coming transition from our current "Two-Dimensional" civilization, in which the human population is limited to the surface of the



Earth, to a "Three-Dimensional," and, eventually, "Four-Dimensional" civilization, capable of moving across interstellar stretches of space-time.

Ehricke brings to bear his extensive technical credentials in describing the actual means of accomplishing this, credentials which he initially earned during Germany's wartime rocket research at Peenemünde, and later, with both the U.S. Army rocket team under Wernher von Braun, and the civilian aerospace firms involved in America's space program.

Ehricke was an apostle for all aspects of space research and exploration. To the practical benefits of such activity for life on Earth, he devoted many pages of detailed proposals for industrial mining on the Moon and other planets, the use of orbiting microwave transmitters to relay electrical power across the globe, and even the employment of giant solar reflectors to increase crop yields and provide safer night-time lighting in poorer areas of the world.

He argued that, more than a pragmatic approach to the human use of space, these activities ought to be viewed as relatively modest steps on the pathway to fulfilling mankind's Extraterrestrial Imperative—that is, the moral, spiritual, and physical-economic requirement for the human species' expansion into the Cosmos.

Ehricke writes in "The Anthropology of Astronautics":

"The concept of space travel carries



“Selenopolis,” the major city on the Moon, as envisioned in a painting by Ehricke. At left is the Hall of Astronauts museum. Note the indoor monorail for getting around in the city. Ehricke’s concept of the Moon was as Earth’s “Seventh Continent.”

with it enormous impact, because it challenges man on practically all fronts of his physical and spiritual existence. The idea of traveling to other celestial bodies reflects to the highest degree the independence and agility of the human mind. It lends ultimate dignity to man’s technical and scientific endeavors. Above all, it touches on the philosophy of his very existence. As a result, the concept of space travel disregards national borders, refuses to recognize differences of historical or ethnological origin, and penetrates the fiber of one sociological or political creed as fast as that of the next.”

Biospheric Evolution

For Ehricke, the Extraterrestrial Imperative is a natural extension of the evolutionary process of the biosphere itself, characterized by a continual supersession of existing physical limits, such as the movement of life from the oceans to mammalian life on land, and now mankind’s technological capability to leave Earth’s biosphere altogether. Far from being an “unnatural” development, Ehricke writes in “The Heritage of Apollo,” that technology has been “life’s principal weapon since its inception. Photosynthesis was life’s first large-scale industrial process to achieve control over an adequate energy source, to enlarge its raw material base and to control the produc-

tion of its essential needs. It was the first time life reached out for an extraterrestrial resource.”

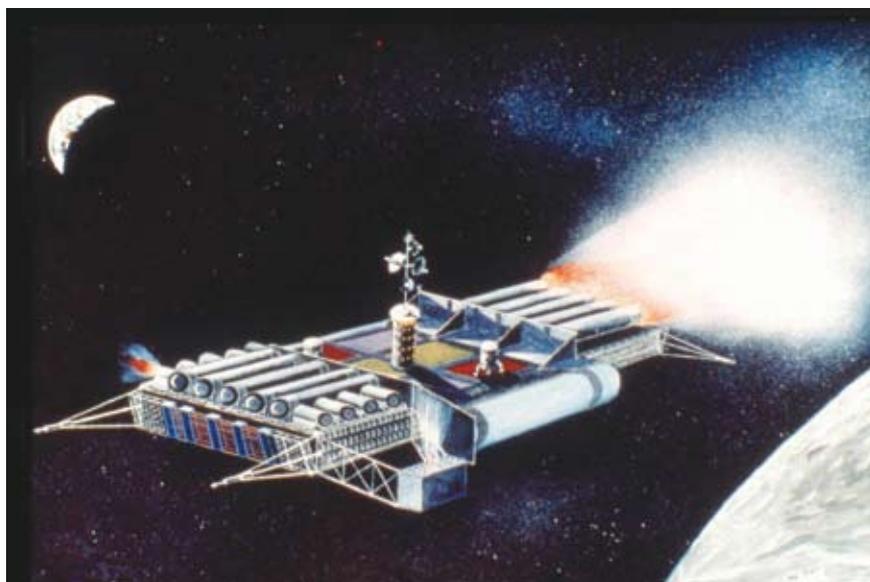
This kind of striking insight demonstrates Ehricke’s intellectual kinship with the great biogeochemist Vladimir Vernadsky, who characterized the qualitative superiority of man’s creative activity as the advent of the Noösphere over the

Biosphere, itself a cosmic phenomenon. A similar kinship with Lyndon LaRouche, with whom Ehricke collaborated in the 1980s around their shared perspective for a “great projects” policy of colonizing space, was based on taking a simple epistemological principle—that man’s Reason has no limits to growth—and applying imagination and expertise to working out the practical expression of that principle in its full scope.

This depth of thought comes across through the broad range of Ehricke’s writings and spoken words included in the book, which show him to be a consummate organizer, inviting the reader or listener to share in the celebration of mankind’s most exciting endeavor. As both a profound philosophical truth, as much as a practical assessment of the reality of human nature, Ehricke’s message is clear: The whole Universe is our rightful domain.

As Freeman adeptly elaborates the background with her own intimate historical knowledge of the period, Ehricke’s brand of militant optimism took on new significance amidst the cultural degeneration beginning in the late 1960s, in which existentialism and environmentalism led, among other things, to the extinction of the once great ambitions of our national space program.

Ehricke’s Classical education in the humanist tradition of the science of Kepler and Leibniz, to which he was consciously

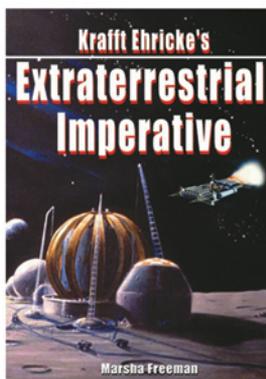


A nuclear-powered lunar freighter, which uses materials on the Moon for fuel, is one of the vehicles Ehricke designed as part of the transportation infrastructure that would open the Solar System for mankind.

Krafft Ehricke's Extraterrestrial Imperative

by Marsha Freeman

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Apogee Books, 2009,
302pp, \$27.95



From this new book the reader will gain an insight into one of the most creative minds in the history of space exploration.

Krafft Ehricke's contribution to space exploration encompasses details of new, innovative ideas, but also how to think about the importance and value of space exploration for society.

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At this time, when there are questions about the path of the space program for the next decades, Krafft Ehricke has laid out the philosophical framework for why space exploration must be pursued, through his concept of the "Extraterrestrial Imperative," and the fight that he waged, over many years, for a long-range vision for the program.

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A huge sweeper vehicle designed by Ehricke to clear away boulders to create a landing strip to accommodate his Slide Lander spacecraft.

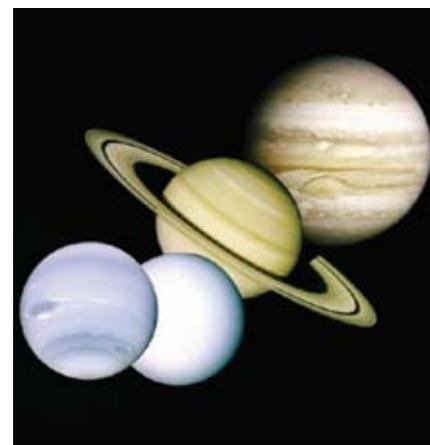
committed, gave him an instinctual aversion to the pseudo-science of the ecological "Limits to Growth" pessimism that became pervasive in Western Europe and the United States. Here it becomes most clear that Ehricke's signal contribution, as he himself saw it, was toward the philosophical underpinnings of a new social-scientific paradigm, embodied in the *Extraterrestrial Imperative*, of which he was a tireless advocate until his death in 1984.

Industrializing the Solar System

It is important to point out, that Ehricke did not simply advocate grabbing real estate on other planets as a scheme to relieve overpopulation and overpollution on Earth. Rather, he argued that it would be more effective to initially focus on shifting large-scale industrial processes to other planets, in order to better maintain the Earth as a garden spot, capable of supporting a growing population at an increasing standard of living. With the "industrialization" of the Solar System, we would be in a position to create entirely self-sufficient colonies, or "planetallas," not attached to any planetary body, eventually moving out beyond our own neighborhood, beyond the Solar System itself.

The horizons of today's national space program are pitifully shrunken compared to Ehricke's grand vision, with the Space

Shuttle scheduled to cease operations for good next year without a replacement vehicle for at least several years after that. As such, Ehricke's writings should be required reading for national policy makers, NASA managers, and aspiring scientists, but also for anyone who takes joy in the understanding that imagination is necessary for human knowledge. Marsha Freeman's book is an excellent place to start.



A composite of the outer planets, taken by the Voyager 2 spacecraft, which was launched with a Centaur upper stage. Ehricke's work on liquid hydrogen in rocketry propulsion led to the world's first upper stage rocket, still used today. Ehricke called it the Centaur, after the mythic Greek figure.

Teller. Teller's chief crime is what Seife terms as his "manic optimism"; the author's belief is apparently that any kind of optimism is a mistake. But Teller's crime doesn't end there. In Seife's view: "Teller became obsessed with wielding the power of the sun. It was an obsession that molded him into one of the darkest and most twisted figures of American science."

To build his case, Seife digs up a collection of comments of fellow scientists disparaging Teller. But despite such assiduous attention to the details of who said what about Teller, Seife reports, wrongly, that Teller limped because "At the age of twenty, he jumped off a tram and nearly lost his right foot." In reality, Teller did lose his right foot and wore a prosthesis. When he was in his 80s, Teller, in fact, joked that he had enough mechanical parts in him to be a bionic man.

Seife puts Teller at the center of his fusion fiasco, from his backing of the hydrogen bomb, to his "monomaniacal" anti-communism, his support for Project Plowshare (which proposed the use of nuclear and fusion bombs to excavate for infrastructure projects), and even his support for "cold fusion" funding, at a time when Seife and co-thinkers had already written off cold fusion as fraud.

Using Teller's military research as a starting point, Seife goes on to claim that inertial confinement fusion research is just an excuse to sell the public on getting a military program funded.

There is no mention by Seife of some of the nearer-term uses for fusion power, short of having a full-scale fusion reactor: for example, fusion propulsion for space travel (using deuterium/helium-3 and pulsed power); the fusion torch, to reduce garbage or rock to its constituent elements, or eliminate nuclear waste; or the fusion/fission hybrid, an intermediate-stage reactor that would use fusion neutrons to breed more fission fuel, or to destroy high-level fission products.

The 'Biggest Scientific Scandal'

As for "cold fusion," Seife devotes a nasty chapter with the theme "the biggest scientific scandal of the twentieth century." He follows the same format as with hot fusion, very selective reporting and outright lies: Martin Fleischmann, a respected and innovative electrochemist who had been president of the International Society of Electrochemists,



NASA

Fusion propulsion is crucial if man is to explore the Solar System, for it would shorten years-long journeys into manageable travel times. Here a NASA engineer inspects the solenoid magnets of a magnetic mirror-based fusion propulsion system under devel-

and who had received the Royal Society medal for electrochemistry and thermodynamics in 1979, and who became a fellow of the Royal Society in 1986, Seife tells us, became a liar in 1989—because no one accredited in the eyes of Seife could replicate the initial Pons-Fleischmann cold fusion experiment.

(Researchers at MIT did get excess heat when they replicated the experiment, but they hid this fact. Many other experimenters also replicated the Pons-Fleischmann results, but these were apparently not researchers approved by Seife.)

Seife ignores the scores of scientists worldwide, with eminent credentials, who are still working and achieving results with what is now called low energy nuclear reactions (LENR) in the United States and around the world. He dismisses the few he does mention as "true believers." And he toes the establishment physics line dismissing bubble fusion and Rusi Taleyarkhan as a fraud, an affair in which he played a role as a *Science* reporter.

Why a Review?

Why review such a book, written by someone who knows so little about the real history of fusion and its pioneers, or about classical science, for that matter? Unfortunately there is an adulatory audi-

ence for such a book, composed of people (and publications) who share the author's implicit view that we cannot provide for a growing world population at a decent living standard. According to this group, we simply must shrink the world's population and keep our scientists away from costly projects that provide hope of a more human future.

In addition to these Malthusian co-thinkers, there is a segment of the nuclear community which firmly believes that we don't need fusion; we can simply develop advanced forms of fission. Some of them even blame the hot fusion physicists for gobbling up government funds so that there aren't enough for nuclear, a view echoed by many in the "cold fusion" community.

All of the above anti-fusion adherents need to study some American history, specifically the American System of *physical economy*, which viewed man's mind as a national resource and understood that without national backing for great infrastructure projects, there was no road to a prosperous future. The works of Alexander Hamilton, Henry Carey, Friedrich List, and others are instructive and accessible on how a physical economy works, and why one plans 50 to 100 years ahead, for the betterment of future generations.

None of these American System writers would have Charles Seife's problem of thinking that money on fusion has been wasted.

So, where are we left at the end of this book? The author states that "the true power of science comes from its ability to withstand the wishful thinking of the humans who craft its stories." Knowing firsthand much of the history of fusion and cold fusion, and having known many of the pioneers personally, I can state flat-

ly that it is Seife, and his friends, like the Malthusian sniper Robert Park, who are doing the wishful thinking, and that they have no idea of what real science is, or what a real mission is, one that is measured in what one leaves for the advancement of posterity, not how many points one scores against rival teams.

In reality, the "biggest scientific scandal" of modern times is that scientists and commentators with views similar to those of Seife, have helped destroy science

with their pessimism and Aristotelian empiricism. Seife ventures to say at the end of his book that fusion "might be the energy source of the future." Yet, on his website, Seife predicts: "In the year 2050, there will not be an operating fusion power plant—a device that generates net energy via a nuclear fusion reaction and transmits it to the electrical grid—anywhere in the world," and he offers \$1,000 to those who disagree and are proven right.

A Comprehensive Review of Ancient Underwater Cities

by Charles Hughes

Sunken Realms: A Survey of Underwater Ruins from Around the World and a Complete Catalog of Underwater Ruins

by Karen Mutton

Kempton, Ill.: Adventures Unlimited Press, 2009

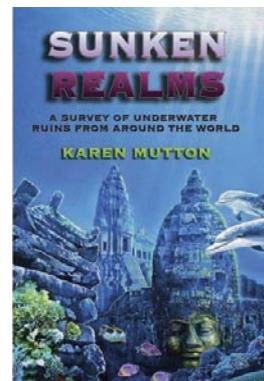
Paperback, 282 pp., \$20.00

This is a book that truly lives to its claims! Its 282 pages feature descriptions of virtually every major construction discovered on the submerged continental shelves of the Americas, Europe, Africa, and Asia, as well as sunken cities under seas, and even rivers. The author, an Australian researcher with an interest in ancient history, has accurately de-

scribed her work in the book's subtitle.

Each item, such as the controversial underwater constructions in the Bahamas, is complete with Internet references, so that the reader can obtain more material and even photos of the ruins.

My particular interest has been the constructions consisting of large walls and docks, made of gigantic stone blocks, and found in the Bahamas on the islands of Andros and Bimini, which were first reported in 1968. It is almost certain that a construction as large as a football field in 20 feet of water on the bottom of Nicholstown harbor, was a quay for loading cargo ships when the area was above sea, in about 8000 B.C.

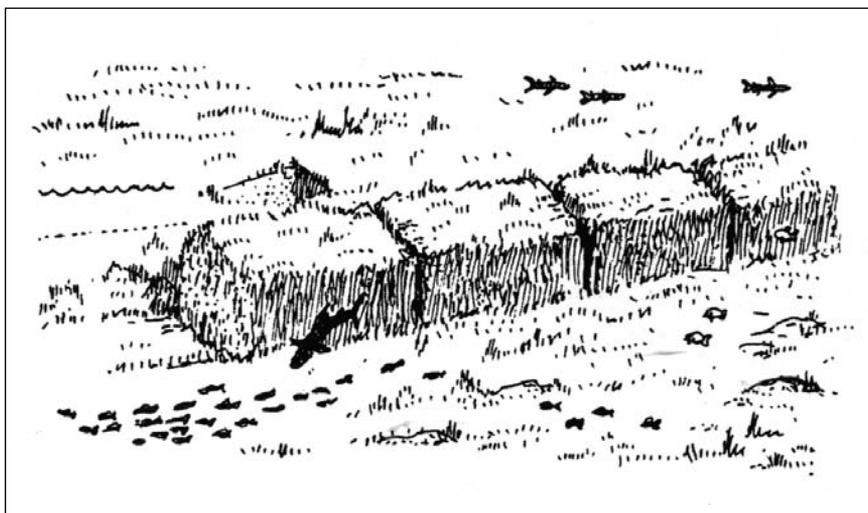


This is proof that an unknown civilization of sea people was located in the Caribbean, before a time that mainstream establishment science acknowledges that such a civilization existed anywhere in the world. So the science establishment refuses to examine such sites, or reports that they are unusual natural rock formations!

Another singularity is the coast of Spain, on the continental shelf between Morocco and Cadiz, Spain. Numerous sunken ruins have been reported in this area, such as a large stone wall off the coast of Morocco that is said to be nine miles long.

It is believed that ocean levels were about 400 feet lower during the Ice Age, which lasted for about 100,000 years and began its long melt back about 18,000 years ago. And so, if a city were built on the then-dry continental shelf, which is now under water, that construction or ruin is much older than established science dares admit, in order to hold onto its mistaken axioms concerning human civilization.

I recommend this book for anyone interested in a field of archaeology that is now demolishing the old worn-out and uncreative ideas concerning civilization's great age.



Sunken Realms

Sketch of an underwater wall off the coast of Morocco, which is reported to be 9 miles long. (From William Corliss, *the Sourcebook Project*.)

The Rock That Changed the World

by Glenn Mesaros

Uranium: War, Energy, and the Rock that Shaped the World

by Tom Zoellner

New York: Viking Press, 2009

Hardcover, 337 pp., \$26.95

Shortly after President Harry S. Truman dropped two atomic bombs on Japan in August, 1945, he invited Manhattan Project scientist Robert Oppenheimer to the Oval Office.

"When will the Russians be able to build the bomb?" Truman asked.

"I don't know," said Oppenheimer.

"I know," insisted Truman.

"When?" asked Oppenheimer.

"Never." claimed Harry S Truman.

Oppenheimer then remarked that some of his scientists felt they had blood on their hands as a result of the atomic bombs. An infuriated Truman pulled out his handkerchief and handed it to Oppenheimer.

"Here," Truman said, "Would you like to wipe the blood off your hands?"

After Oppenheimer left, Truman instructed an aide, "I don't want to see that son of a bitch in here ever again." The Russians exploded their first atomic bomb on August 29, 1949, four years before the newly created CIA forecast.

* * *

Uranium traces the modern history of this heavy metal in the 20th Century as the critical component of nuclear energy. Author Tom Zoellner especially goes into the U.S. development of African sources of uranium in the Manhattan Project, and then develops the postwar story of the international race to create nuclear bombs and peaceful nuclear energy. In his conclusion, Zoellner documents the current "renaissance" of nuclear energy development in third world countries as the only energy source that can satisfy growing demand of electricity.

Zoellner is a layman who is very familiar with the science of nuclear energy, but less so with the geopolitics surrounding it. His anecdotal approach to the subject is interesting and useful.

However, Zoellner relates the fascinating story above, without realizing the stunning and insulting arrogance of Truman against America's leading scientists; Truman dropped their bomb on Japan as a geopolitical attack on Russia.

That little person, Harry S Truman, believed the fairy tale when his "experts" told him that uranium was so scarce that the Russians could never get enough of it to build an atomic bomb.

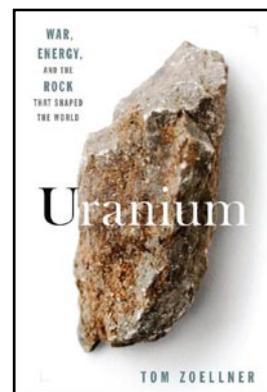
Contrary to the little Truman, President Franklin Delano Roosevelt had thrived on conflicting advice, and played different factions of the Federal government against each other to determine what was really going on. At the beginning of his Presidency in 1933, Roosevelt developed a system of "chits," which are like today's "e-mails." He filled out little slips of paper asking questions such as "Please find out about Finland's financial position," or, "Did the Silver Purchase Act of 1890 raise prices?" and he directed them to the various departments, accumulating the responses in his a great repository of knowledge (*The Roosevelt Omnibus*, 1934).

Deep in the Geopolitical Wells

Zoellner situates the "nuclear age" within the constructs of H.G. Wells, who when he learned about the potential of atomic energy from British scientists, wrote a science fiction novel about it in 1914. Titled *The World Set Free*, Wells's book perpetrated the classic British Empire geopolitics of "the Free Nations Vs. Central Powers," before World War I had even started. Wells's novel has both sides using "atomic bombs" to destroy Europe. A heroic King Egbert rallies a council of nations to safeguard the rare atomic element, calling it "Carolinum," and saves civilization from further destruction.

Apparently, Zoellner is not aware that the British Empire deployed a stable of such geopolitical "authors," whose job entailed "shaping" public opinion along desired geopolitical ends.

What were the geopolitical ends of the British Empire? The "free nations"



must safeguard dangerous technologies from "unstable" powers.

Although Zoellner does not quite realize the shaped charges of these geopolitics, he remarks later in the book that the George W. Bush war on Iraq stemmed from deliberately contrived false intelligence that Saddam Hussein had procured the dangerous uranium material from Niger: President Bush told us on January 28, 2003 that the "British government has learned that Saddam Hussein recently sought significant quantities of uranium from Africa."

Why did those "unreliable" French allies oppose the Bush War? Because, the author says, they have controlled the Niger uranium shipments for over 40 years, and knew that such a deal with Iraq was impossible. The CIA sent a now-famous agent named Wilson to Niger to confirm this.

The Uranium Club

The author also tells us the important story of Rio Tinto Zinc in forming a Uranium Club, or cartel, in 1972, when various uranium suppliers, sans the United States, met in Paris. They included Canada (33.5 percent), South Africa (23.75 percent), Australia (17 percent), France (21.75 percent), and Rio Tinto Zinc (4 percent). The astute observer will note that all these club members, except France, were members of the British Commonwealth.

Zoellner writes, "The presence of the Rio Tinto company among this breadline of sovereign nations was a reminder of ... the matchless reach of Rio Tinto, which tended to behave as though it was a wholly owned subsidiary of the British throne ... [and shareholder] Queen Elizabeth II herself, via a secret account

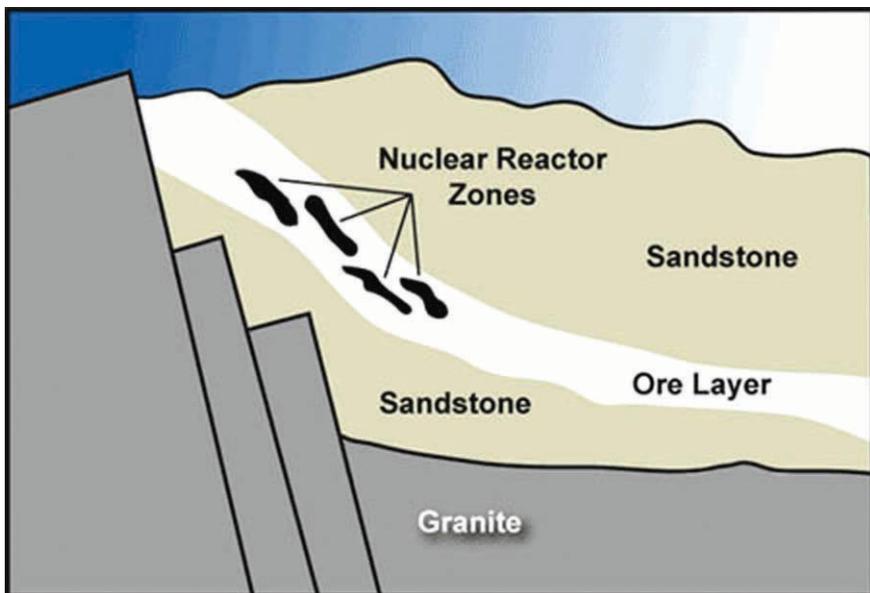


Diagram of one of the natural nuclear reactors found in Oklo, Gabon.

at the Bank of England.”

This sheds some needed light on the role of Her Majesty in international skullduggery. Rio Tinto chairman Sir Val Duncan built up a network of railways, ports, and mills to extract minerals from Britain’s former colonial possessions. Its web of affiliate companies was a closely guarded secret, its ownership records kept inside a four-inch thick book known within the company as “the Bible.”

Sir Duncan’s employees included Anthony Eden, who became Defense Secretary, and Lord Peter Carrington, who became Secretary of State for Energy during the Wilson administration. When political chaos engulfed Wilson in 1974, Sir Val Duncan remarked at a dinner party: “When anarchy comes, we are going to provide a lot of essential generators to keep electricity going. Then the army will play its proper role.”

As Zoellner elucidates, a result of this uranium cartel arrangement, its members established a floor price of \$5.40 a pound, which translated into \$8 for actual end-use buyers, such as Westinghouse, which were nearly bankrupted by the arrangement, and sued the Uranium Club members for price fixing. However, uranium prices then climbed to as high as \$23 a pound, and the group disbanded, its work accomplished.

Zoellner’s story is a small but useful example of how the British Empire

controls raw materials through interlocking directorates in Rio Tinto, Anglo-American, De Beers, and various other entities.

Nuclear Renaissance, Yes!

The book end with a chapter on the current Nuclear Renaissance, where various nations are ramping up nuclear energy after a 25-year hiatus engineered by the carefully generated anti-nuclear hysteria of the 1970s. Zoellner interviewed the Minister of Electricity in Yemen, a desert country appended to Saudi Arabia, which has no oil. The minister told him that there is not a single city in the developing world that is not trying for a huge increase in nuclear power. “There is no doubt, my friend, that the nuclear industry is now living in a renaissance.”

Zoellner notes that World Nuclear Association, located in London, claims that the world will build as many as 8,000 reactors in the 21st Century, up from the current total of 440. There are many new technologies now available, he says, including Thorium and Pebble Bed Reactors, which cannot be used for destructive purposes.

Zoellner even quotes Nancy Pelosi as now willing to include nuclear power in any energy mix. He also names James Lovelock, the famous British Gaia scientist, who is a founder of the Environmentalists for Nuclear Energy, and who says that opposition to nuclear energy

is based on irrational fear fed by Hollywood style fiction, the Green Lobbies, and the media.

Zoellner concludes by relating Manhattan Project scientist George Cowan’s discussion of the startling discovery of a natural nuclear reactor in the French colony uranium mines of Gabon, Africa. French chemists had noticed back in 1972 that the fissionable U-235 component of this uranium was less than the 0.7202 percent (the rest being the isotope U-238), which had been constant in all known uranium rocks. Sandwiched between sandstone and granite, and sloping at enough angle to allow water to drain through it, this rock formation at Oklo, Gabon, had formed a natural nuclear reaction 2 billion years ago, which had reduced the fissionable U-235 content to 0.7171 percent, a significant difference.

Cowan thus states, “In the design of fission reactors, man was not an innovator, but an unwitting imitator of nature.”

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- **The Coming (or Present) Ice Age** by Laurence Hecht
- **An Oceanographer Looks at the Non-Science of Global Warming** by Robert E. Stevenson, Ph.D.
- **Ice Core Data Show No Carbon Dioxide Increase** by Zbigniew Jaworowski, Ph.D.
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GLOBAL WARMING UPDATE

Compiled by Gregory Murphy

EU Ministers Bare It All

The atmosphere was pure hedonism at the July 23-25 meeting of the European Union energy and environmental ministers in Aare, Sweden. You'd almost never know the purpose of the meeting was to negotiate policies for a new fascist climate agreement to be signed in Copenhagen in December 2009.

Events included bringing all the guests to a tourist waterfall, where a fully naked man sat in the cold water playing the violin. His carbon footprint was scarcely noticeable.

The meeting's chief brainwasher, Lord Nicholas Stern, gave his usual genocidal presentation of the dangers of global warming and the need to cut carbon emissions—a policy which will kill 4.5 billion of the world's 6.7 billion people. Maybe Lord Stern spent too much time listening to the naked violinist to notice that the Earth has entered a prolonged phase of global cooling—sort of like the violinist.

Lord Stern attacked the notion of developing nuclear power in an interview with the Swedish daily *Svenska Dagbladet*, saying "We need all the CO₂-free energy we can get. But new nuclear power cannot deliver any electricity until after 2020, and I hope renewable energy sources will have developed strongly until then."



The quiet Sun gave New York a cooler summer.



Gunnar Seibold/ Swedish Government Offices.

Swedish environment minister Andreas Carlgren at the closing of the hedonistic EU environment ministers meeting in Aare, Sweden.

If the Sun remains in its current phase of inactivity, and the Earth experiences similar conditions to those of the Dalton Minimum (1796-1824), which caused widespread food shortages and crop failures, even Lord Stern and the EU ministers may have wished they had called for massive development of nuclear power, instead of foolishly demanding cutting of carbon emissions to solve the non-problem of global warming.

The Cooling Continues

Even New York City's huge urban heat island can't counter the ongoing global cooling, because of the current inactivity of the Sun.

This year is the first since 1926 that New York City has seen a Summer like this. For both the months of June and July, New York City did not break 90 degrees, as measured at the temperature station in Central Park.

For those who argue that this station is located in the shade, we note that similar temperatures were recorded at the temperature station at LaGuardia airport, which is sited near the runway. The *New York Times* reported on Aug. 1 that the cooling the city experienced was due to natural variation, but the same *New York Times* said during the very hot Summer of year 2000 that the high temperature was due to man-made global warm-

ing.

You can bet that global warming nut-case James Hansen will be burning the midnight oil cooking the books on these stations over the next couple of months. Hansen has adopted the George Orwell 1984 model of rewriting history to fit the fascist argument that post-World War II industrial development is the cause of dangerous man-made global warming.

A Summer of Mice And Sweaters

The abnormally cold July this year hit Hubbard County, Minnesota, residents with a sudden influx of mice indoors. Residents noted that mice invasions are supposed to be a Fall sport, but the unusual cold had driven the mice indoors early this year. National Weather Service meteorologist Dan Riddle said the unusually cold pattern may stick around until August.

Eva Fritz, manager of the Park Rapids Farmers Market joked, "Next week I'm wearing my Christmas sweater." She said that on Saturday July 18, that only "three vendors braved the cold and they were huddled under warm blankets and clothing." Fritz quipped, "I was gone over the Fourth of July. Did I miss that one day of Summer?"



theringbear.ca

Fashion conscious greens are flipping over this eco-friendly style.

Eco-Friendly Bridal Footwear

In this era of Al Gore's global warming fraud, green brides are looking for a new fashion that says, "I am eco-

friendly.” Such brides need not look any further than the latest global warming footwear, “High Tide Heels,” a fashionable high heel combined with a scuba flipper.

Warming Will Squeeze Bigfoot

A recently published paper in the *Journal of Biogeography*, by biologist Jeff Lozier of the University of Illinois at Urbana-Champaign, found that Bigfoot or Sasquatch or whatever you want to call the legendary North American biped, is in trouble (<http://www3.interscience.wiley.com/journal/122476732/abstract?CRETRY=1&SRETRY=0>). It is likely that the elusive beast will lose a portion of its existing habitat in the coastal and lowland regions of the northwestern United States as the climate warms.

In all seriousness, the subject of the study by Lozier was not Bigfoot but the use of ecological niche computer models. The study showed that these niche models are seriously flawed and rely on questionable data. These same niche models are used to say that polar bears or other wildlife will be endangered by global warming.

To make the point of how flawed these models are, Lozier used the database of sightings of Bigfoot as the basis of his ecological niche model, and, yes, he determined that a mythical beast could be endangered by mythical man-made global warming.

Those Incredible Shrinking Sheep . . .

Among the latest lame attempts to keep Prince Philip and Al Gore’s genocidal global warming hoax alive, *Science* magazine published a paper from Dr. Tim Coulson of Imperial College in the United Kingdom claiming that global warming is to blame for shrinking the wild sheep on St. Kilda Island in northern Scotland (*Science*, July 2, 2009).

The sheep have been studied since 1985, during which time the average temperature has risen by 1.2 degrees Celsius, the paper states. Coulson notes that the sheep have been getting smaller by about 81 grams or 0.178574432



Shrinking? Soay sheep are enjoying the benefits of a slightly warmer climate in northern Scotland.



Not shrinking.

pounds, and blames the rise in temperature for this scientifically meaningless shrinkage.

Coulson’s study was conducted only over a very short period, and does not take into account the fact that during the 1930s, temperatures in the Arctic region and the area surrounding St. Kilda Island were between 2 to 5 degrees warmer than today.

In reality, the recent warming that Coulson calls “alarming” has been a benefit to the sheep. It has made more land available for the sheep to graze, and now more first-year lambs are maturing and reproducing. So what Coulson calls a threat to the sheep, in reality is a benefit.

. . . and Trees

On July 29, the U.S. Geological Survey and University of Washington scientists released a report claiming that global warming was responsible for the shrinkage in the number of large-diameter trees in Yosemite National Park during the 20th Century. This report is yet another example of faulty statistical methods that can be worked to show any result, and is a classic case of the recent trend of science by press release.

A climate skeptic and forestry expert called the report “pure rubbish,” and noted that the USGS and Department of Interior would be better served by adopting an effective policy of forest management, than wasting time studying the effects of the non-problem of man-made global warming.

Gore Roasted at Aussie Breakfast

On an extremely cold July 13 morning in Melbourne, Australia, Leon Ashby, one of the founding members of a new political party called the Climate Sceptics, led a 40-person street protest in front of the convention center which was hosting Al Gore’s Climate Project breakfast. The crowd outside of 1,000 devotees of the global warming prophet were entertained with humorous limericks and songs attacking Al Gore and his lunatic notion of man-made global warming.

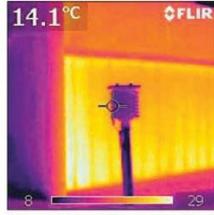
After the speeches and limericks, Ashby and the merry band of protesters had several TV and radio interviews.

Climate Sceptics plan further protests as the countdown proceeds on two Australian Senate votes on the emissions trading scheme. The first Senate vote will be in August.

Climate Fears Are A ‘Pseudo Religion’

More than 60 German scientists and 189 German business leaders sent an open letter to German Chancellor Angela Merkel July 26, asking her to reconsider her stance on man-made climate change. The letter describes the belief in genocidal man-made climate change as a “pseudo religion,” and also attacks Merkel for making the issue a high priority, noting that as a physicist she should know better.

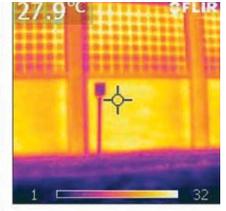
The letter states: “Humans have had no measurable effect on global warming through CO₂ emissions. Instead, temper-



Figures 7 and 8. Parry, Oklahoma—near downtown fire department; infrared view.

wattsupwiththat.com

The heat island effect, which maintains an artificially higher temperature than surrounding areas, is visible in these infrared photos of two U.S. temperature stations.



Figures 11 and 12. Independence, Kansas—near water treatment plant; infrared view.

wattsupwiththat.com

ature fluctuations have been within normal ranges and are due to natural cycles. Indeed the atmosphere has not warmed since 1998—more than 10 years—and the global temperature has even dropped significantly since 2003.”

“More importantly, there’s a growing body of evidence showing anthropogenic CO₂ plays no measurable role,” the letter continues. “Indeed CO₂’s capability to absorb radiation is almost exhausted by today’s atmospheric concentrations. If CO₂ did indeed have an effect and all fossil fuels were burned, then additional warming over the long term would in fact remain limited to only a few tenths of a degree.”

Despite its debunking of the climate change hoax and the demand that Merkel change her stance, the letter is rendered impotent by its recommendation to set up a review panel of the climate research conducted at the Potsdam Institute for Climate Impact Research. Why? Because the Potsdam Institute is the German center for Prince Philip’s genocidal policies. Its director, Hans Joachim Schellnhuber, is currently Chancellor Merkel’s climate change and environment advisor, and comes out of Britain’s leading center of climate disinformation, the University of East Anglia in the United Kingdom.

Queen Elizabeth II honored Schellnhuber in 2004, awarding him the CBE (Commander of the Order of the British Empire) for his work promoting the global warming hoax.

Himalayan Glaciers Melt Gore Scare

In the science fiction comedy-horror flick “An Inconvenient Truth,” Al Gore claimed that man-made global warm-

ing was causing the rapid melting of the Himalayan glaciers, and said that people in the region would be subject to massive floods and loss of available drinking water. Now, Gore’s campfire scare story has been debunked by a new study of the Himalayan glaciers conducted by Geologists R.K. Ganjoo and M.N. Koul of Jammu University’s Regional Center for Field Operations and Research of Himalayan Glaciology.

According to the study, published in the Aug. 10 journal *Current Science*, the Himalayan glaciers, including the world’s highest battlefield, Siachen, are melting due to variations in weather, and not because of global warming.

Ganjoo and Koul found overwhelming field geomorphological evidence to suggest the poor response of the Siachen glacier to warming. The snout of the Siachen glacier of 2008 has retreated by about 8-10 meters since 1995, making an average retreat of 0.6 meter per year.

The eastern part of the Siachen glacier

showed faster withdrawal of the snout, which is essentially caused by ice-calving, a phenomenon that holds true for almost all major glaciers in the Himalayas, and occurs irrespective of global warming. Ganjoo and Koul contended the Siachen glacier shows hardly any retreat in its middle part and thus defies the “hype” of rapid melting.

Global ‘Warming’ Freezes Wildflowers ...

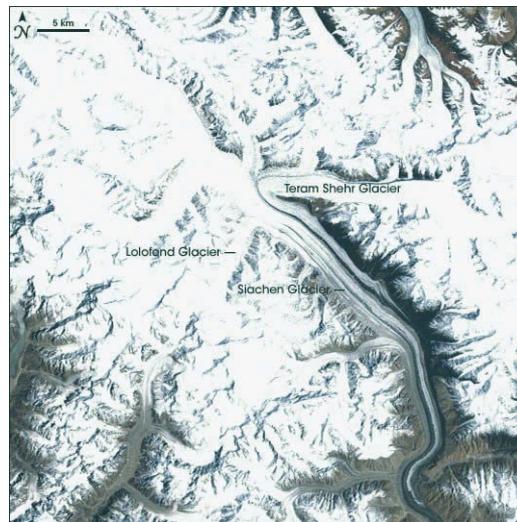
The National Science Foundation has recently given a grant of \$449,000 to University of Maryland professor David Inouye to support his now 36-year study of wildflowers in Colorado. Dr. Inouye is certain that global warming is to blame for the increasing pattern of wildflowers budding early and then becoming damaged by late Spring frost. The same scenario was promoted by Al Gore in “An Inconvenient Truth.”

This “global warming is really cooling” story sounds about as confused as the global warming alarmists are at the moment, given that the Earth is entering into a prolonged period of global cooling.

... And Makes Polar Bears Obese

The cooler-than-usual Summer produced thicker ice on Hudson Bay, giving the area’s polar bear population several extra days to feed on tasty ringed seals. Daryll Hedman, the northeast regional wildlife manager for Manitoba Conservation said, “Polar bears stay on the Hudson Bay ice for as long as possible so they can feed.” This year, he said, “the ice was so thick that the bears stayed out for an extra two weeks.” Hedman commented that has led to fatter, healthier bears this Summer.

That explains the growing waist lines of the polar bears. What’s Al Gore’s excuse?



NASA

Siachen Glacier, Kashmir, in an image obtained by the Landsat 7 Enhanced Thematic Mapper Plus Instrument.