Face to Face Media

NUCLEAR DYNAMITE

NUCLEAR DYNAMITE

VHS

I GAVE MY TOOTH TO SCIENCE

"if your mountain is not in the right place, just drop us a card"
Edward Teller 1959

Produced by Face to Face Media and the National Film Board

NUCLEAR DYNAMITE

UNTOLD HISTORY

This is the first ever documentary about the "peaceful nuclear explosions" programs of the US and USSR. Drawing on extensive stock footage from the once secret Soviet archives, newly discovered footage from the American program, promotional and propaganda films of the era, and interviews with participants and witnesses, the program explores one of the most ambitious "big science" projects ever imagined.

Nuclear Dynamite principal interviews in order of appearance

Edward Teller, Director Emeritus at the Lawrence Livermore National Laboratories, co-inventor of the hydrogen bomb. He was the first director of Project Plowshare.

Victor N. Mikhailov, Academician and former participant in the Soviet program of "Peaceful Nuclear Explosions for the National Economy". He is now the Deputy Minister of Atomic Energy, MinAtom.

Barry Commoner, a founder of the environmental movement in North America and a member of the Committee for Nuclear Information in St. Louis in the 1950s. He was an organizer of the baby teeth campaign.

Freeman Dyson, Professor Emeritus at the Institute for Advanced Study in Princeton. He joined physicist and weapons designer Ted Taylor in the early research on the Orion nuclear pulse powered rocket project.

Keith Lawton, Episcopalian minister at Point Hope Alaska at the time of the proposed nuclear experiment in 1960 and **Earl Kingik**, wildlife officer for the Native Village of Point Hope.

Nikolay P. Voloshin, witness to the Russian use of nuclear explosives to extinguish a gas well fire. He is currently Head of Weapons Design, Ministry of Atomic Energy.

John Gofman, former director of the Biomedical Division at Lawrence Livermore National Laboratories. He became an outspoken critic of Project Plowshare and has written extensively on radiation hazards.

Ursula Franklin, Physicist, Professor Emeritus at Massey College, University of Toronto. She is a founding member of the Voice of Women, and an organizer of the baby teeth campaign in Canada.

Also in the program: Russian scientists Evgeniy Avrorin and Vadim Simonenko; American scientists Milo Nordyke, Paul Kruger, Joe Knox and Fred Holzer; Canadian activist Phyllis Margolick; Point Hope residents Elijah Attungana, Rex Tuzroyluk and Joe Frankson.

Directed and written by
Gary Marcuse

Producers
Betsy Carson
Gary Marcuse

Producer for the NFB
Selwyn Jacob

Director of Photography
Kirk Tougas

Editor
Stuart de Jong

Original Music by
Henry Heillig
The Heillig Manoeuvre

Narrator
David Suzuki

Consultant
Dan O'Neill
author of
The Firecracker Boys

Educational Use in Science, Technology and Society

For younger audiences Nuclear Dynamite locates the origins of the environmental movement in the nuclear protests of the 1950s. For older audiences this strange tale revives a forgotten story. For all viewers this program raises difficult questions about the consequences of new technologies in applied science. Many discoveries — including nuclear technology, antibiotics, and biological engineering — offer great promises and bring great risks. How will society evaluate and regulate new technologies that have the potential to alter or damage the biosphere? A teaching aid is being developed for this program. For more information please contact Face to Face Media.

Distribution
Available in NTSC or PAL
Lengths: Feature 71:53
Broadcast Hour: 52:00
Audio Stereo, Close Captioned

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Inside Cover:
LLNL, Kirk Tougas, Gary Marcuse,

Gary Marcuse Fonds Attachment A

DESCRIPTION OF MATERIALS

The Gary Marcuse papers consist of materials related to the documentary film *Nuclear Dynamite* (2000) *and Waking the Green Tiger: A Green Movement Rises in China (2011)* along with the short film *Searching for Sacred Mountain* (2013)

Nuclear Dynamite (2000)

Historical relevance of donated materials

> "The materials Gary Marcuse used to produce *Nuclear Dynamite* would be a valuable addition to any archive. Initially, one might assume that this documentary and the supporting evidence Mr. Marcuse used would focus strictly on the histories of science, technology, and nuclear testing. While that is in itself of great import, the papers, interviews, and videos he wishes to donate also tell a lot about the histories of superpower relations and the environmental movement in the United States. Indeed, while one might assume the modern American environmental movement began with Rachel Carson's book *Silent Spring* in 1962, *Nuclear Dynamite* and its supporting materials demonstrate that the foundation of that movement was established years earlier. Simply put, what Mr. Marcuse has to offer will draw researchers, both domestic and international, from a wide variety of fields of study."
>
> Scott Kaufman, Professor of History, Francis Marion University.
> Author of *Project Plowshare: The Peaceful Use of Nuclear Explosives in Cold War America*, Cornell University Press, 2013

Synopsis (110 words)

In the 1950s Edward Teller, the co-inventor of the H-bomb proposed using "the great and violent power" of the atom bomb for peaceful purposes. *Nuclear Dynamite* explores the Soviet-American race to develop nuclear explosives for gigantic megaprojects.

Scientists planned to harness the power of the bomb to launch huge spaceships, dig an instant harbor in Alaska, blast out oil and gas deposits, cut through mountain ranges, and dig a new Panama canal with 300 explosions. More than 150 nuclear blasts were carried out between 1958 and 1988 before this bizarre and extraordinary atomic dream was abandoned, undermined by the emergence of the an environmental movements and the growing awareness of the dangers of radioactive fallout.

Produced by Face to Face Media Ltd. in co-production with the National Film Board of Canada in association with the Canadian Broadcasting Corporation, with the participation of the Canadian Television Fund created by the Government of Canada and the Canadian cable industry.

This donation consists of eleven banker boxes of interviews, footage, research and production notes, promotional materials, archival footage and photographs pertaining to the creation of the 2000 documentary film *Nuclear Dynamite*. The film explores the history of Operation Ploughshare, a U.S. government effort to develop and utilize "peaceful nuclear explosions" for use in large-scale "Atoms for Peace" projects. The film explores the debate between scientists and environmental activists concerning the potential health risks from low level radiation that would be released by "geographical engineering " projects proposed by Dr. Edward Teller including Project Chariot, a proposed excavation deep water port near an Inupiat village in Point Hope, Alaska and a proposed full- scale excavation of a new Panama canal. A sidebar with physicist Freeman Dyson explores the intriguing prospect of a nuclear powered rocket ship that could explore the solar system.

The film illustrates the popular debate in the 1950s which included government films extolling the benefits of the "peaceful atom". 80+ hours of contemporary interviews and an equal amount of archival films are blended together in this award-winning broadcast documentary about the origins of the peace movement and the environmental movement which occurred nearly a decade before Rachel Carson's publication of *Silent Spring*(1962*)*, an alarming account of the impact of chemical pesticides in food chains.

Nuclear Dynamite also brings together Russian and American physicists who were also pursuing similar projects during the height of the Cold War. Meeting in Nevada, 50 years later, they visit the Nevada test site and reflect on the promise and the problems posed by the new technology. Rising public anxiety about the dangers of "atom bombs" and a growing resistance to atmospheric testing led to an atmospheric test ban treaty in 1963 that put an end to Project Plowshare.

Key Participants in *Nuclear Dynamite*

U.S. scientists
Edward Teller, Director Emeritus, Lawrence Livermore Laboratory (LLNL)
Milo D. Nordyke, Physicist, Plowshare program, consultant for international IAEA
Freeman Dyson, Professor Emeritus, Institute for Advanced Study, Princeton
Paul Kruger, Professor of Civil Engineering, Stanford University
Joeseph B. Knox, Meteorologist, Lawrence Livermore Laboratory, Plowshare program
Fred Holzer, LLNL Plowshare energy and resources programs
John Gofman , former director of Biomedical Division, LLNL

Russian scientists
Academician Victor N. Mikhailov, Deputy Minister of Atomic Energy (MinAtom)
Nikolay P. Voloshin, Head of Weapons Design, Ministry of Atomic Energy (MinAtom)
Evgeniy Avrorin, Physicist, Soviet nuclear weapons designer
Vadim A. Simonenko, Deputy Scientific Director, Russian Federal Nuclear Center

Residents of Point Hope, Alaska
Elijah Attungana, Point Hope Elder
Joe Frankson Point Hope Elder, Councilor
Rex Tuzroyluk, Elder and leader, Point Hope
Earl Kingik, Wildlife Officer, Native Village of Point Hope

Activists
Barry Commoner, Professor of Plant Physiology, an organizer of the St. Louis Baby Tooth Survey
Keith Lawton, Episcopalian Minister, Point Hope
Ursula Franklin, Physicist, University of Toronto, founding member, National Organization of Women
Phyllis Margolick, participant in the "BabyTeeth" campaign, opponent of nuclear testing

Nuclear Dynamite Awards and broadcasts (2000)

Gemini Award, Best Scientific or Environmental Program
Canada

Golden Dragon, Best Environmental Film
Beijing International Scientific Film Festival

Chris Award, Humanities Category
Columbus International Film and Video Festival

Gold Award
Houston International Film and Television Festival

Silver Certificate
Prix Leonardo Medical and Scientific Film Festival, Parma, Italy

Silver Plaque, Science Documentary
Chicago International Television Competition

Jury's Honorable Mention
Millennium Scientific Film Festival, Szolnok, Hungary

Broadcasts
Canada: CBC *The Nature of Things* Canada, DRS Switzerland, NHK Japan, SBS Australia

NUCLEAR DYNAMITE

Production Data

Title: Nuclear Dynamite
Length: 71:53 or 52:00
Original language: English
Production format: Beta SP (1.33:1) NTSC
Release format: Digital Betacam / Beta SP
Audio: Stereo (international version available with split tracks: Dialogue and M&E)
Close captioned: Yes
Completion date: May 1 2000
Broadcast premiere: CBC *The Nature of Things*
First Broadcast: Canada : October 2000
International release: following Canadian premiere
Genre: Science, Technology and Society, History, Environment

Credits

Director/Writer: Gary Marcuse
Producers: Gary Marcuse and Betsy Carson
Producer for the National Film Board: Selwyn Jacob
Editor: Stuart de Jong
DOP: Kirk Tougas
Music: Henry Heillig and the Heillig Manoeuvre
Narration: David Suzuki
Sound Recordists: Jeff Henschel, Gary Marcuse, Betsy Carson
Consultant Dan O'Neill, author of *The Firecracker Boys*
Sound Supervisor: Gael MacLean
Sound Editors : Gina Mueller, Rusty Dunn
Re-Recording Mixer: Ewan Deane
Original Graphics Carl Chaplin
Animation: Mark Rasmussen , Enigma Animation
Executive producer for the NFB: Graydon McCrea
Executive producer for the CBC: Michael Allder
Produced by Face to Face Media in coproduction with the National Film Board, and in association with the Canadian Broadcasting Corporation
Produced with the participation of the
Canadian Television Fund
Licence Fee Program
Telefilm Canada: Equity Investment Program
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Produced with the assistance of
The Canadian Film or Video Production Tax Credit

Short summaries

Russian and American scientists planned to re-shape the surface of the planet with nuclear explosives. *Nuclear Dynamite* explores the archives and interviews scientists and environmentalists in this first-ever documentary about this strange atomic mega-dream. (35 words)

Nuclear Dynamite cracks open Russian and American archives and traces the roots of the environmental movement back to the 1950s as it presents the untold story of superpower plans to harness the power of the atomic bomb for planetary engineering projects. (41 words)

Nuclear Dynamite reveals the untold story of American and Soviet plans to use nuclear explosives to launch spaceships and carry out gigantic "geographical engineering" projects including digging a new sea-level Panama Canal with atomic bombs. More than 150 nuclear blasts were carried out between 1958 and 1988 before this bizarre and extraordinary atomic dream was destroyed by the emergence of the environmental movements in both countries.(66 words)

In the 1950s Edward Teller, the co-inventor of the H-Bomb proposed using "the great and violent power" of the atom bomb for peaceful purposes. *Nuclear Dynamite* explores the Soviet- American race to develop nuclear explosives for gigantic megaprojects. Scientists planned to harness the power of the bomb to launch huge spaceships, dig an instant harbour in Alaska, blast out oil and gas deposits, cut through mountain ranges, and dig a new Panama canal with 300 explosions. More than 150 nuclear blasts were carried out between 1958 and 1988 before this bizarre and extraordinary atomic dream was destroyed by the emergence of the environmental movements in both countries. (107 words)

Archives

The archival material was gleaned from many sources, including the National Archives and Records Administration in Washington, the Lawrence Livermore National Laboratories, the Oral History Department and Film Archives at the Elmer E. Rasmuson Library, University of Alaska, Fairbanks, and the Moscow archives of the Ministry of Atomic Energy

Untold history

This is the first ever documentary on this extraordinary subject. Our crew combed the archives of the US and Soviet nuclear programs and turned up hundreds of reels of film documenting nuclear experiments in geographical engineering, and the development of a nuclear powered rocket ship. The program utilizes extensive stock footage from the once secret Soviet archives, newly discovered footage from the American program, promotional and propaganda films of the era, and interviews with participants and witnesses to explore one of the most ambitious "big science" projects ever imagined.

Audiences

Science, Technology and Society.

For younger audiences *Nuclear Dynamite* locates the origins of the environmental movement in the nuclear protests of the 1950s. For older audiences this strange tale revives a forgotten story about one of the most ambitious “big science” projects ever conceived. For all viewers this program raises difficult questions about the consequences of new technologies in applied science. Many discoveries -- including nuclear technology, antibiotics, and biological engineering -- offer great promises and bring great risks. How will society evaluate and regulate new technologies that have the potential to alter or damage the biosphere?

On Location

This documentary was prepared during the spring and fall of 1999, and was shot on location at the Inupiat village of Point Hope Alaska and at the Nevada Test Site. The Russian participants were interviewed in Las Vegas during a joint US-Russian nuclear test ban testing verification conference. Edward Teller was interviewed at Livermore where he is director emeritus, in the fall of 1997.

Diverse perspectives

The story of Nuclear Dynamite is told by witnesses and participants. Scientists in the US and Soviet program recall the excitement of trying to capture the power of the sun and put it to work on earth. Inupiat hunters in Point Hope recall their fight to prevent a huge blast near their village in the western Arctic. Other scientists and activists recall the dawning awareness of the dangers of fallout that helped to give birth to the early environmental movement in the 1950s, and put an end to plans for atomic megaprojects.

Distribution

US and Canadian Broadcast, US video

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NUCLEAR DYNAMITE The Interviews

American Scientists

- **Dr. Edward Teller**, first worked on the Manhattan project and later was the co-inventor of the hydrogen or fusion bomb which was the more powerful successor to the first fission bombs created by the Manhattan project. In 1958 he was the director of the Lawrence Livermore National Laboratory and the head of the Plowshare program. He retired in 1975 and remains Director Emeritus at Livermore where he was interviewed for this program in the fall of 1997, shortly before his 90th birthday.
- **Barry Commoner**, Originally a plant pathologist, Commoner and other scientists formed the Committee for Nuclear Information in St. Louis in the 1950s to promote public debate about radiation hazards from nuclear testing. The baby teeth campaign originated with CNI in 1957 and continued until the test ban treaty of 1963. He currently manages the Center for the Biology of Natural Systems, a research organization attached to Queens College in New York. The collection of baby teeth has been revived recently by researchers studying the impact of nuclear power plants.
- **Freeman Dyson**, Born in England, Dyson attended university in England and the US, and was a professor of physics at Cornell University in 1951. In 1953 he joined the Institute for Advanced Study in Princeton where he is currently Professor Emeritus. Dyson joined physicist and weapons designer Ted Taylor in the early research on the Orion nuclear-pulse-powered rocket, and was planning to travel to Mars and Saturn in the rocket.
- **John Gofman**, former director of the Biomedical Division at Lawrence Livermore National Laboratories became an outspoken critic of Project Plowshare and has written extensively on radiation hazards.
- **Fred Holzer**, Engineer. Holzer helped to develop methods for measuring the yield of underground atomic explosions . His work helped to lay the foundation for verification methods for current arms control treaties.
- **Joe Knox**, Plowshare, developed computer models to predict distribution of fallout from Plowshare excavations. His work has been elaborated and extended by the Atmospheric Release Advisory Center at the Lawrence Livermore National Laboratories which supplied the graphic simulations of radioactive dispersion from a hypothetical Panama excavation and from Chernobyl.
- **Paul Kruger**, consultant and engineer. Kruger developed a civil engineering course on the use of nuclear explosives at Stanford University. By 1968, 22 universities were offering related courses.
- **Milo Nordyke** originally a cratering expert for Project Plowshare, Nordyke was a member of the US delegations that negotiated a draft PNE treaty in 1976 and the Comprehensive Test Ban Treaty in 1977-80. He has written a book about the Soviet peaceful nuclear explosions program.

Russian Scientists

- **Academician Evgeniy Avrorin**: Head of the Scientific Division, Russian Federal Nuclear Centre , Avrorin developed the special explosives used at the Kama Pechora canal excavation experiment. He and his colleagues are also part of the US-Russian Joint Verification Experiment in monitoring international test ban treaties.
- **Academician Victor N. Mikhailov**, former participant in the Soviet program of "Peaceful Nuclear Explosions for the National Economy", later Minister of Atomic Energy and current Deputy Minister, Russian Ministry of Atomic Energy (MinAtom).
- **Vadim Simonenko**, Deputy Scientific Director, Russian Federal Nuclear Centre. He is currently participating in international symposia on the potential use of nuclear explosives to divert asteroids.
- **Nikolay P. Voloshin**, witness to the Russian use of nuclear explosives to extinguish a gas well fire. He participated in experiments using nuclear explosives to strip away overburden and uncover ore bodies. He is currently Head of Weapons Design, MinAtom.

Canadian Narrator, Interviews

- **David Suzuki**, the narrator of Nuclear Dynamite, is an award-winning scientist, environmentalist and broadcaster. Trained as a geneticist, he is a professor at the University of British Columbia's Sustainable Development Research Institute. He is also the Chair of the David Suzuki Foundation, and the well known host of the Canadian Broadcasting Corporation's popular science television series, *The Nature of Things.*
- **Dr. Ursula Franklin**, physicist, professor emeritus at Massey College, University of Toronto. She is a founding member of the Voice of Women, and an organizer of the baby teeth campaign in Canada
- **Phyllis Margolick**, local organizer for the "baby teeth" campaign in Montreal, and a founding member of the Committee on Radiation Hazards in the late 1950s which included Rene Levesque and Pierre Trudeau.

Alaskan Interviews

- **Elijah Attungana, Joe Frankson, Earl Kingik, George Kingik, Rex Tuzroyluk**. Inupiat residents of the village of Point Hope, in Alaska. Earl Kingik is the wildlife officer for the Native Village of Point Hope.
- **Keith Lawton**, former Episcopalian Minister at Point Hope at the time of the proposed nuclear experiment in 1960, and an active opponent of the nuclear excavation. .

NUCLEAR DYNAMITE Quotes

Atomic visions

One can straighten out the beds of large rivers to construct gigantic dams, cut canals literally in minutes... the cold current that washes our transpolar region can be made warmer than the Gulf Stream. The tundra will disappear, the subtropics will reach up to Moscow, and in Kolyama, there will be the climate of France

> Prof. G. Poskrovsky in 1954. But the Soviet Union didn't start their program until ten years later.

"The great and violent power of nuclear explosions can be used for peaceful purposes"

> Edward Teller "Project Plowshare" promotional film, 1957

"Nuclear explosions can be used to blast harbours in otherwise inaccessible coasts, to break up the rocks and make them yield up their riches, to reshape the land to your pleasure."

> Edward Teller, commencement address, University of Alaska, 1959. From a tape in the University of Alaska, Fairbanks archives.

"He used to have a hundred ideas a day. 99.9 were terrible, but that tenth one was a good one, and so compared to other people, you know, one good idea per day is pretty remarkable, even though the 99 others were awful."

> Project Plowshare team member Fred Holzer recalling working with Edward Teller.
> From an interview for *Nuclear Dynamite*, 1999.

"If your mountain is in the wrong place, just drop us a card"

> Edward Teller quoted in the Anchorage (Alaska) Daily Times, 26 June 1959 p 11.

"He tells the people it's not dangerous. When this happens, nuclear tests or the bombing, I can take my family over there and live there. He said, 'It won't affect anything.' I didn't really believe it, myself. "

> Point Hope Inupiat resident Elijah Attungana recalls reassurances by atomic scientists that an experimental 240 kiloton explosion to excavate a harbour 50 kilometres from the village would be harmless. 1999 interview for *Nuclear Dynamite*.

"What interested me about it was the degree to which ordinarily intelligent people would distort their minds in order to find something supposedly useful in an inherently very dangerous force."

"It was the Atomic Energy Commission that converted me into an ecologist. "

> Barry Commoner, 1999

" I think the Panama Canal idea is biological insanity"
"Just who the hell has the right to decide that you shall take a dose of radiation for this Plowshare project? "

> Dr. John Gofman, former director, Biomedical division, Lawrence Livermore National Laboratories recalling his statements to Teller and others at meetings at Livermore in the 1960s. Interview for *Nuclear Dynamite* , 1999

Nuclear-pulse-powered rocket ships

"I think it was a kind of intoxication with the power and scale of things you could do with your mind, and it gave you a feeling of playing God, in a way."

> Physicist Freeman Dyson discussing the invention of a huge rocket ship powered by nuclear explosions. 1999 Interview

"In the early '60s, Sakharov, I remember, once invited us into his office and told us about this idea for an interstellar space ship that would be propelled through space by micro nuclear explosions. "

> Former USSR Minister and current Russian Deputy Minister of Atomic Energy (MinAtom) Victor Mikhailov recalling discussing nuclear powered rockets with Andrei Sakharov ca. 1961.
> From an interview for *Nuclear Dynamite*, 1998.

"We were talking about ships that weighed 5,000 tons, and carried 1000 bombs, and so it was built more like a submarine than like an airplane."
"We were thinking in terms of huge manned expeditions. We planned to have 50 people on board this ship and live on Mars for five years, or something like that."

> Freeman Dyson, recalling plans for the Orion Project in 1960. 1999 interview.

Peaceful Explosions?

"Any explosion, peaceful or weapon, will kill people. The difference, basically, is that peaceful nuclear explosions are designed physically and chemically so that they are optimized for the peaceful nuclear explosion use. They are either bigger or smaller or heavier than a weapon, and so they generally are not optimum for weapons use. But there's nothing to keep them from being used as weapons. "

Plowshare cratering expert, and later arms control negotiator physicist Milo Nordyke, 1998 interview. After Plowshare ended in 1974, Nordyke helped to negotiate the 1976 PNE draft treaty between the US and USSR.

Fallout, Baby Teeth, the Environment

"How can you avoid getting the public concerned when fallout is dust coming down from the sky, and people begin to think, 'Well, what's that on my lawn?' It gets very personal. "

Barry Commoner, 1999, recalling public protests against atmospheric testing.

"Every kid that gave a tooth got a little button that said, 'I gave my tooth to science' and I still meet people who say, 'You know, I walked around Grade One with a button like that'. "

Physicist, and founding member of the Voice of Women, Ursula Franklin recalls the baby teeth campaign of the early 60s. Children's teeth were tested for the presence of radioactive strontium which had infiltrated the food chain from atmospheric testing of nuclear weapons.

"In the end, the thing got so much publicity that we were getting teeth from all over the world. "

Barry Commoner,recalls the baby teeth campaign organized by Citizens for Nuclear Information, in St. Louis, Missouri. 1999 interview

"That was a recruitment for the peace movement as well as an immense education in what living in a common environment means. You don't muck around with that, because you can't clean it up. "

Ursula Franklin recalls the baby teeth campaign. Interview for *Nuclear Dynamite*

"I'm biased, but I think that what stopped the American program was the clear public position that really has been unshakeable that radiation is bad stuff."

Barry Commoner commenting on the end of the Plowshare program in 1974. 1999 Interview

"People started worrying about radioactivity, radioactivity.. moving mountains just didn't seem to appeal to too many people any more "

engineer Paul Kruger, 1999.

"Chernobyl elicited a very strong wave of fear of how terrible radioactivity was. This affected all the nuclear programs. That was the main reason. "

Evgeniy Avrorin, commenting on the end of the Soviet program in 1988. 1998 interview.

The Future of Peaceful Explosions

"I look at Plowshare as something that will be re-established if and only if the present anti-scientific trend, the present trend to be afraid of anything that is new, if that can be brought to an end. "

Edward Teller Interview for *Nuclear Dynamite*, 1997.

"All that we did in those decades will belong to the future of mankind... like the invention of the wheel, it just keeps rolling along in all kinds of ways."

Vadim Simonenko, 1998 interview

"I just feel that weight of the human conceit of thinking that human beings are entitled to create elements that have not been in the ecosystem before, like plutonium, and then say, 'It's business as usual. I just did it because it was Tuesday and it was very convenient.' The enormous moral and ethical burden of this seem to be so unrecognized. "

Ursula Franklin, 1999 interview

"The test ban treaty said that in 10 years, we could discuss resuming peaceful explosions. This is a good idea. We should consider it. "

Nikolay Voloshin, former participant in the Soviet program, current head of weapons design, MinAtom, commenting on the test ban treaty that provides for a review of the ban on explosions in 2006.

"There's nothing that nuclear explosions can do in the way of digging holes that you can't do without nuclear explosions. It only takes a little longer and costs a little more, but there's nothing indispensable about bombs. I think that the only thing bombs can do that nothing else can do is something like Orion. "

Freeman Dyson , 1999 interview

NUCLEAR DYNAMITE Chronology

Key dates in the Peaceful Nuclear Explosions (PNE) race

1945	First atomic bombs
1949	First Soviet bomb
1954-55	Hydrogen (fusion) bombs developed by US and USSR
1957	First US contained underground nuclear tests
	Teller and three other scientists meet in San Francisco to create Project Plowshare
1958	US-USSR Testing moratorium, High explosives tests for Plowshares begin
	Nuclear-pulse-powered rocket conceived for space exploration
1961	End of moratorium. Soviets explode 30 bombs in atmosphere in the Arctic, up to 54MT
	First Plowshare explosion in New Mexico salt deposit
	Canadian PM Diefenbaker intervenes to prevent 9 KT nuclear test in Athabasca tar sands in Alberta
1962	Project Sedan, first US nuclear cratering experiment uses 104 KT modified warhead, digs crater.
1963	Partial test ban treaty signed by US, USSR, UK ends explosions underwater, in atmosphere, or in space
	Peaceful nuclear explosions including cratering explosions still allowed but "debris" or "fallout" should not cross international boundaries. US nuclear rocket program abandoned. Plowshare focuses on Panama Canal project
1965	USSR launches PNE program with 140KT explosion
1966	USSR puts out first of five gas-well fires using nuclear explosives
1968	US Buggy row charge successful, USSR develops row craters for canal construction
1970+	International PNE projects promoted at Geneva
	German-Egyptian-US project in Egypt to dig nuclear canal, flood the Qattara depression
	US-Soviet scientists exchange visits, information
1974	Threshold test ban treaty signed , limits underground explosions to 150 kt.
	Final underground explosion in Plowshares series
	First atomic explosion in India, claimed as a PNE
	US abandons Plowshare
1976	US / USSR negotiate draft treaty on Peaceful Nuclear Explosions to allow larger row charge explosions
1980-88	USSR: 49 more nuclear explosions for oil, gas, seismic sounding, waste disposal, program ends 1988
1986	Chernobyl nuclear reactor fire
1990	USSR dissolves, Soviet engineers in Ottawa offer nuclear explosives for waste disposal
1996	Comprehensive test ban treaty (CTBT). China gives up demands for PNE program and signs, along with 150 other nations.
2000	Russia ratifies CTBT
2006	Ten year review date for CTBT makes allowance for possible resumption of PNEs.

Global Nuclear Explosions 1945-1998

source: Brookings Institution**:** http://www.brook.edu/FP/PROJECTS/NUCWCOST/TESTS.HTM

United States	1032	(815 underground	217 atmospheric)	(Includes PNEs)
Soviet Union	715	(496 underground	219 atmospheric)	(Includes PNEs)
Britain	45	(24 underground	21 atmospheric)	
France	210	(160 underground	50 atmospheric)	
China	24	(22 underground	23 atmospheric)	
India	3	(3 underground)		
Pakistan	2	(2 underground)		

NUCLEAR DYNAMITE Peaceful Nuclear Explosions

How large is it?

The bomb dropped on Hiroshima released the energy equivalent of 40,000,000 pounds = 20 kilotons of conventional TNT explosives. Peaceful nuclear explosion (PNE) experiments varied from a fraction of a ton to 140 kilotons used by the Soviet union to excavate the Chagan crater in Kazakhstan. Much larger individual explosions or groups of explosions were planned but were not carried out. The smallest practical size for cratering explosions is in the 100 kiloton (KT) range, similar to the 104 kiloton explosion used by the US to excavate the Sedan crater in Nevada. Below that it may be equally efficient to excavate by conventional means. Rows of explosions totalling up to 18 million tons (megatons abbreviated MT) were considered for the excavation of the Panama Canal. The largest single military explosion was a 54 megaton bomb exploded over Novaya Semlya by the Soviet Union.

In the USSR

Dates	Number	Size (KT)	Purpose
1965-1970	5	1.1 to 140	Water reservoir development
1968-1971	3	.24 to 15	Canal construction (incl two row shots x 3 explosives)
1974	2	75 and 98	Dam construction
1965-1987	21	2.3 to 15	Oil stimulation, underground
1966-1971	3	1.1 to 64	Salt cavity development (experimental industrial application)
1966-1981	5	3.8 to 47	Putting out runaway gas well fires
1967-1984	25	0.3 to 15	Underground cavity construction
1971-1988	39	2.3 to 22	Deep seismic sounding
1972,1984	2	1.8 to 2.1	Breaking up ore bodies
1973,1974	2	10	Underground cavities for burying toxic wastes
1975-1979	13	.35 to 58	Creation of transplutonic elements
1976	1	10	Decoupling experiment
1979	3	1	Coal mining application to control coal dust, methane blow outs
1964-1984	40	.001 to 150	Development of explosive devices

In the US

Dates	Number	Size (KT)	Purpose
1961	1	3	Salt cavity and neutron experiments
1964- 1967	2	2.2 and 12	Neutron flow in one metre pipe
1962- 1968	5	up to 104	Cratering experiments
1968	1x 5	1.1x 5	Row charge of five explosives for canal experiment
1967-1969	2	29 and 40	Nuclear gas stimulation
1973	1x3	3 x 33	Vertical set of three simultaneous explosions for gas stimulation
not given	9	not given	Development of ultra low fission thermonuclear explosives
not given	1	not given	Low tritium thermonuclear device
not given	1	not given	Special emplacement device
not given	5	not given	Transplutonic elements experiments

Notes on tallying PNE explosions

The final tally of PNE explosions depends on which explosions are counted. Some counts include testing new devices and triggers, some only include applied explosions. In some cases PNE explosions were “add ons” during military tests. Interview subjects commonly referred to 15 for the US and 135 for the USSR. The total, in any case, is in the 150-180 range, compared to more than 2000 nuclear explosions of all kinds by all nuclear powers to date. Source: Nordyke, Milo *The Soviet Program For Peaceful Uses of Nuclear Explosions* , Center for Global Security Research, Lawrence Livermore National Laboratories 1996.

NUCLEAR DYNAMITE Background

Peaceful Nuclear Explosions (PNE)

The idea of applying nuclear explosives to massive engineering projects is as old as the bomb itself, and it promised to fulfil many of the ambitious projects proposed by an earlier generation of engineers who had harnessed the power of steam to dig the first Panama Canal. The Russians, like the Americans were entranced by the possibilities from the beginning.

One can straighten out the beds of large rivers to construct gigantic dams, cut canals literally in minutes... the cold current that washes our transpolar region can be made warmer than the Gulf Stream. The tundra will disappear, the subtropics will reach up to Moscow, and in Kolyama, there will be the climate of France Professor. G. Poskrovsky, 1954

Neither the US or the USSR took steps toward such "peaceful applications" until the mid 1950s when President Eisenhower's "Atoms for Peace" initiative promoted non-military applications, especially in the areas of medicine and electrical power generation. Experiments in "geographical engineering", as Edward Teller called them, began after 1957 when the US created Project Plowshare at the Lawrence Livermore National Laboratories in California.

Fallout from military testing

At the same time, high levels of radioactive fallout from military testing provoked international protests and increased demands for an end to atmospheric testing. The efforts of the Citizens for Nuclear Information, and the publicity surrounding their campaign to collect and analyze baby teeth for evidence of radioactive fallout in the form of Strontium-90 contributed to the pressure on the Eisenhower and Kennedy administrations to negotiate limits on testing.

Fallout in the form of strontium 90 was detected in children's milk in the mid 1950s, and was traced back to plants eaten by cows. Strontium 90, a radionuclide with a half life of 27 years, is created during nuclear explosions and disseminated in the form of dust over large areas. Travelling through the food chain, it mimics calcium and is bound up with calcium during the formation of bones and teeth. While the consequences were debatable, the evidence of an increase of strontium 90 in children because of atmospheric testing was not. As one activist remarks during the program, concern about children's health recruited many young parents into anti-nuclear protests and the peace movement

A moratorium

A voluntary moratorium was initiated by the USSR and joined by the US between 1958 and 1961. The moratorium slowed the progress of Project Plowshare, but at the same time the military began to explore the possibilities of underground testing, in order to continue weapons testing while limiting fallout. Some of the early tests, notably the Ranier and Blanca explosions at the Nevada Test Site erupted unexpectedly and created small craters. The potential for moving huge amounts of earth quickly was evident. Plowshare's nuclear cratering experiments began in earnest after the moratorium was abandoned in 1961. The first Soviet tests began in 1965 with the Chagan Reservoir excavation.

Radiation and the environment

Plowshare's plans for experimental blasts in the Alberta tar sands and on the Alaskan coast near Point Hope collided with rising public concern about radiation. This concern was fuelled by further scientific discoveries about the concentration and transmission of radiation through food chains. By 1959 another food chain was documented in the arctic where strontium 90 is taken up by lichens, eaten by caribou, and passed on to Aboriginal peoples in the North. Evidence was also accumulating from studies of the use of x-rays in hospitals that increased exposure was associated with increased risk of cancers. Inside Plowshare some scientists had increased reservations about the dangers of fallout. However, throughout the 1960s, many Plowshare scientists remained largely convinced that radiation levels could be safely managed, and work continued on the planned excavation of a new 1000' wide sea-level Panama Canal and other large scale projects.

Friendly rivalry, cancelled programs

The American program relied on Congressional support, and Teller chose the high profile Panama project in order to rally the influential Joint Committee on Atomic Energy behind Plowshare. Publicity about Plowshare was not lost on scientists in the Soviet Union who happily used Cold War rivalries

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to stimulate internal support for their own program. The resulting experiments were remarkably similar. Both programs were designed to use the compact energy of nuclear explosives for purposes of blasting, excavation, seismic sounding, fracturing gas-bearing rock formations, creating new elements, digging canals, diverting rivers, and a number of other imaginative applications including lifting large and heavy spaceships into orbit. But nuclear blasting was increasingly out of step with pubic concern about radiation which continued to escalate during the 1960s.

Test Ban Treaties

The Partial Test Ban Treaty (PTBT) was signed in 1963. It eliminated explosions in the atmosphere, under water, and in space. This led to the cancellation of the Orion project, but underground explosions, and cratering shots were still permitted provided the fallout did not cross international boundaries. PNE advocates held out hope that the treaty would be modified in favour of peaceful excavations. The 1976 draft PNE treaty was a step in this direction, but by this time the US had abandoned Plowshare.

Plowshare continued to develop the tools and techniques of geographical engineering during the 1960s. Explosives that released far less radiation were also developed, but public resistance to nuclear technology was rising faster than radiation levels were falling. The Panama project was abandoned as "unproven technology" in 1970, and Plowshare continued, much diminished, until funding was cancelled in 1974. The much larger Soviet program continued until 1988 when the first "green" movement emerged in Russia, following Chernobyl.

The Comprehensive Test Ban Treaty of 1996 eliminates all nuclear explosions by the signatories, which do not include Pakistan and India. While the US Senate has not ratified the treaty, it is honored by the US administration. A clause in the treaty allows for a review in 2006, and leaves open the possibility, if all parties agree, that peaceful explosions could resume. While some geographical engineers retain hope that nuclear excavation might one day dig canals and harbours, a more likely use of nuclear explosives would be small scale high energy experiments.

A footnote: the future of PNEs

The energy released in nuclear explosions is so much more powerful than chemical explosions that they may yet be considered for use in space where weight is a critical factor. One theoretical use, based in part on the cratering experiments of the 1960s, is the diversion of asteroids. Another, being considered by NASA, is the use of small atomic explosions to propel rockets in deep space, to explore regions beyond the reach of chemical rockets.

NUCLEAR DYNAMITE Images and captions

People

(see also biographies of principal interviews)

Edward Teller b. 1908, seated, autographed photo., 1958, co-inventor of the hydrogen bomb, first director of Project Plowshare, and a staunch advocate of the use of nuclear explosives for planetary engineering. Dr. Teller is interviewed in the documentary, at age 89. Photo credit LLNL/ Jon Brenneis. See also his close up portrait ca. 1980, age 72. Photo: LLNL/ DOE.

Barry Commoner, a founder of the environmental movement in North America, a member of the Committee for Nuclear Information in St. Louis in the 1950s, and and an organizer of the baby teeth campaign. Photo: Gary Marcuse

Freeman Dyson Professor Emeritus at the Institute for Advanced Study in Princeton. He joined physicist and weapons designer Ted Taylor in the early research on the Orion rocket project. Photo: K. Tougas

Ursula Franklin, physicist, professor emeritus at Massey College, University of Toronto. She is a founding member of the Voice of Women, and an organizer of the baby teeth campaign in Canada.. Photo: Gary Marcuse

Projects

Sedan explosion, clouds rising. AProject Sedan@ a few seconds after detonation, July 12 1962, at the Nevada Test Site. This was the first time a nuclear explosion was used to dig a hole. This 104 KT explosion excavated 6 million cubic yards of dirt, leaving a crater 1280 feet (390 m.) across and 320 feet (97m.) deep. The cloud rose to 14,000 feet (above 4000 m.) and drifted north into Canada. Photo credit: US DOE (See also the digital color images of the explosion and crater on disk.)

Sedan post explosion When the dust settles. Atomic Energy workers survey the Sedan Crater in Nevada, 1280 feet (390 m.) across and 320 feet (97m.) deep Created in July 1962 by Project Plowshare with a 104 Kiloton Thermonuclear explosion, which moved six million cubic yards of earth. This is the largest man made crater on the planet, and is the smallest nuclear crater that would have been made in the nuclear excavation programs of the US and Soviet Union. Photo credit: US DOE or US Department of Energy.

Nuclear Excavated Canal graphic. A new sea level Panama Canal was the goal of Project Plowshare Photo: US DOE

Project Schooner (1968) A tilting cloud of debris rises from a 30KT experimental explosion in wet rock at the Nevada Test Site Part of a series of cratering shots in preparation for the Panama Canal project. Photo: US Dept of Energy or US DOE

Project Buggy A man stands beside a specially designed low radiation 1.1 KT nuclear explosive. Five were used for the Buggy row charge explosion, Nevada Test Site 1968 Photo: US DOE

Project Gasbuggy (1967) A 29 KT nuclear explosive designed to stimulate gas wells. Special explosives could be as little as 8" (20cm) in diameter Photo: US DOE

Orion Rocket Graphic (additional images available on disk.)**The Orion Rocket**, artists rendering of the Orion prototype, as conceived by the Orion project in 1962. This 5000 ton behemoth could be 130 feet (40 m.) across at the base and 18 stories tall. The US Air Force funded research by General Atomics, under the leadership of physicist Ted Taylor. Freeman Dyson made calculations on the effects of the plasma cloud. Windows on the ship would be closed during launch, and the crew would be confined to an interiour radiation shelter. Shock absorbers in the base and legs dampen the impact of the Asmall@ atomic blasts that accelerate the ship.

Insignia of the US Atomic Energy Commission, promoters of Project Plowshare.

Russian Logo. Logo: Soviet Scientific Films , made documentaries on the the Soviet program of peaceful nuclear explosions which continued until 1988.

Child without a tooth. Insignia of the baby teeth Campaign initiated by Barry Commoner and Citizens for Nuclear Information in St. Louis, Missouri in 1957. Traced the movement of Strontium 90 from fallout, through the food chain into children=s bones. Photo credit: CNI Bulletin

Orion Rocket and the Statue of Liberty The original design for Orion had a base 100 feet (31 m) across and nearly twice as tall. The statue is 151' (46 m.) tall. Image: Face to Face Media

Additional digital images: Sedan blast, crater, rocket, portraits. Please contact Face to Face Media

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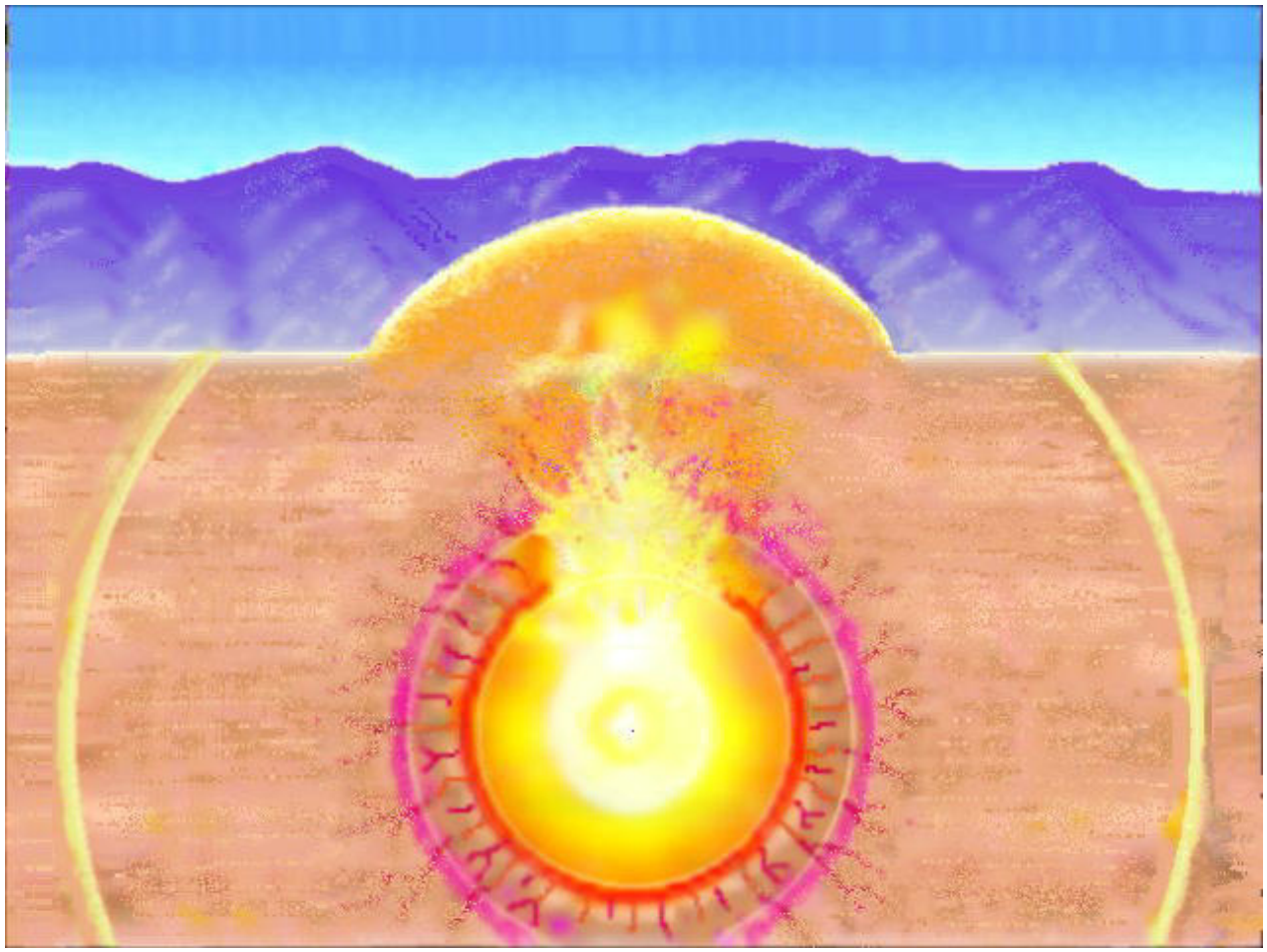


PROJECT SEDAN
CRATER STATISTICS