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CHERNOBYL: THE FACTS

How Many Died?

The question in our headline is possibly the most disputed and most misrepresented statistic related to the deadly 1986 Chernobyl nuclear power plant disaster in Ukraine. The disparities over the death count are used to downplay and even dismiss the terrible and long-lasting after effects of Chernobyl. But focusing only on fatalities also serves to diminish the disaster's impact. Nuclear power plant accidents often do not kill people instantly and sometimes not at all. It can take years before fatal illnesses triggered by a nuclear accident take hold. This creates a challenge in calculating just who eventually died due to the accident and who suffered non-fatal consequences. Exposure to ionizing radiation released by a nuclear power plant (and not just from accidents but every day) can cause serious non-fatal illnesses as well. These should not be discounted. Arguably, neither should post-accident psychological trauma. Nuclear power plant accidents can and should be prevented. The only sure way to do so is to close them all down. Otherwise we risk another Chernobyl, or Three Mile Island, or Fukushima.

The stricken Unit 4 Chernobyl reactor after the explosion

Nuclear power is simply too dangerous and the price of failure too high. In these pages we examine precisely what those costs were in the wake of the Chernobyl disaster 32 years ago.

What Happened?

On April 26, 1986, Unit 4 at the Chernobyl nuclear power plant exploded. That explosion and the resultung fire, lofted huge amounts of radioactivity into the atmosphere. Unit 4 was relatively new, having only been in service for just over two years. The accident occurred during what should have been a routine test to see how the plant would operate if it lost power. The test involved shutting down safety systems but a series of human errors, compounded by design flaws, instead set in motion a catastrophic chain of events.

After shutting down the turbine system that provided the cooling water to the reactor, the water began boiling and workers desperately tried to re-insert control rods to slow down the nuclear reaction. But the rods jammed and control of Unit 4 was irrevocably lost. The explosion and fire — which took five months to put out — dispersed at least 200 times more radioactivity than that produced by the Hiroshima and Nagasaki bombs. The fallout contaminated several million square kilometers of land in the former Soviet Union and in Europe and was also detected in the US.

Soviet authorities were slow to react. The accident was first detected by monitors in Sweden. The nearby city of Pripyat was not evacuated immediately. By the time they did so, radioactivity levels were 60,000 times higher than "normal".

The financial cost of the accident, while difficult to calculate given the many unknowns, is estimated to be in the region of $700 billion and is expected to rise.

The Liquidators

The Chernobyl liquidators were dispatched to the stricken nuclear plant in the immediate aftermath, as well as for at least the subsequent two years, to manage and endeavor to "clean up" the disaster. They included military as well as civilian personnel such as firefighters, nuclear plant workers and other skilled professionals.

While estimates of the number of liquidators varies, the generally accepted figure is around 800,000. However, evaluating their fate has been difficult. Only a small portion of them were subject to medical examinations.

Yet by 1992 it was estimated that 70,000 liquidators were invalids and 13,000 had died. These estimates rose to 50,000 then to 100,000 deaths among liquidators in 2006. By 2010, Yablokov et al. estimated a death toll of 112,000 to 125,000 liquidators.

Even the Russian authorities admit findings of liquidators aging prematurely, with a higher than average number having developed various forms of cancer, leukemia, somatic and neurological problems, psychiatric illnesses and cataracts.

The UN Office for the Coordination of Humanitarian Affairs found a statistically significant increase of leukemia among Russian liquidators who were in service at Chernobyl in 1986 and 1987.

Monument to Chernobyl liquidators. Photo: Petr Pavlicek/IAEA

General Populations Inside And Outside The Former Soviet Union

Sheet music in an abandoned home. Photo: Jorge Franganillo

As with the liquidators, tracking the health of general populations exposed to the plume pathway of Chernobyl has been problematic. Within the Soviet Union, people moved away and neither they nor many living in other affected countries were tracked or monitored. While countless numbers may have died from their Chernobyl-related illnesses, equal or even greater numbers may have survived with debilitating or chronic physical as well as mental illnesses caused by the accident. Establishing exact numbers may never be possible. Media reports often rely on the 2003-2005 Chernobyl Forum report produced by the nuclear promoting International Atomic Energy Agency. The agency ignored its own data that indicated there would be 9,000 future fatal future cancers in Belarus, Russia and Ukraine, claiming there would be no more than 4,000. Both numbers are gross underestimations. The report focused only on the most heavily exposed areas in making its predictions. It ignored the much larger populations in the affected countries as a whole, and in the rest of the world, who have been exposed to lower but chronic levels of radiation from Chernobyl.

In contrast, a comprehensive analysis by the late Soviet scientist, Alexey Yablolov and colleagues, examined more than 5,000 Russian studies. They concluded that almost a million premature deaths would result from Chernobyl. Meanwhile, the TORCH report (The Other Report on Chernobyl), by Dr. Ian Fairlie, predicts between 30,000 and 60,000 excess cancer deaths worldwide due to the accident.

Unarguably, the Chernobyl disaster was not without major health consequences which continue to unfold including in generations born long after April 1986. At least five million people continue to live in highly contaminated areas in Belarus, Russia and Ukraine, while 400 million live in less contaminated — but not necessarily "safe" — areas.

The effect on large populations living in these areas of "low-level" radiation exposures, could be sizable. More than half the Chernobyl fallout landed outside of the Ukraine, Belarus and Russia — in Europe, Asia and North America. Fallout from Chernobyl contaminated about 40% of Europe's surface. Immediately after the accident, thyroid cancer was particularly rampant in Belarus, Ukraine and Russia, where no prophylactic remedy in the form of potassium iodide pills was offered.

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General Populations, cont.

Continued from previous page

Consequently, as Baverstock and Williams found in 2006, "by far, the most prominent health consequence of the accident is the increase in thyroid cancer among those exposed as children . . . particularly in children living close to the reactor."

In contrast, Poland, where potassium iodide was distributed, experienced relatively low rates of thyroid cancers. While thyroid cancer is considered one of the more treatable kinds of cancers, this does not mean it should be viewed as an acceptable consequence of a nuclear power plant accident. Such diseases — especially among children — impact emotional, social, and physical wellbeing. In the former Soviet Union, those operated on bear a scare referred to grimly as the "Chernobyl necklace."

Dr. Wladimir Wertelecki, a physician and geneticist, has conducted research, particularly focused on Polissia, Ukraine. There he found clear indications of altered child development patterns, or teratogenesis. Wertelecki noted birth defects and other health disturbances among not only those who were adults at the time of the Chernobyl disaster, but their children who were in utero at the time and, most disturbingly, their later offspring.

Important research has also been conducted on psychological effects. Pierre Flor-Henry and others examined some of the psychological disorders resulting from Chernobyl and found a clinical pathology related to radiation exposure. Flor-Henry found that schizophrenia and chronic fatigue syndrome among a high percentage of liquidators were

The iconic ferris wheel, Pripyat.

accompanied by organic changes in the brain. This suggested that various neurological and psychological illnesses could be caused by exposure to radiation levels between 0.15 and 0.5 sieverts.

There are of course many other non-cancerous diseases caused by major releases of radioactivity. A peak in Down Syndrome cases was observed in newborns born in 1987 in Belarus, one year after the Chernobyl nuclear accident. This phenomenon has been found around other nuclear sites. Abnormally high rates of Down Syndrome were recorded in the Dundalk, Ireland population possibly tied to the operation of the Sellafield nuclear waste reprocessing plant across the Irish Sea in Cumbria, England.

Why we can't trust the WHO

On May 28, 1959, the World Health Organization (WHO) made an agreement with the International Atomic Energy Agency (IAEA) that would effectively gag the agency on any nuclear issue from that day forth. The agreement gave the IAEA a veto on any actions by the WHO that relate in any way to nuclear power.

The IAEA's stated mission is to "accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world." In other words, to market and promote nuclear power across the globe. Any potential hindrance to such an endeavor — such as a nuclear accident that indicates serious health consequences, is therefore a highly inconvenient truth for the IAEA.

The WHO has capitulated to this pro-nuclear stranglehold, effectively forfeiting its mandate to properly assess and investigate the dangers of radiation exposure resulting from a nuclear disaster such as Chernobyl. This totally undermines the credibility of any statements by the WHO about such health consequences.

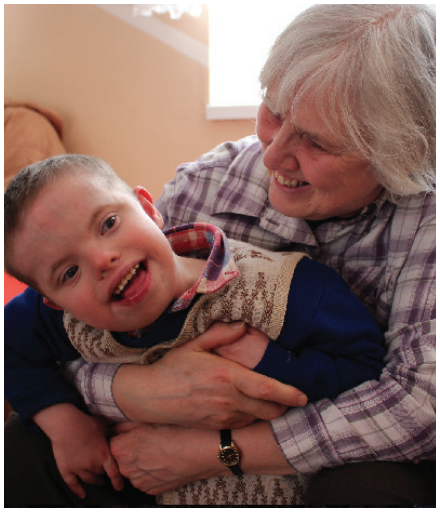
This is why the Chernobyl Forum report is generally viewed as a whitewash, dominated by the control of the IAEA and with the WHO effectively silenced. And yet because these bodies are considered credible and august, their unreliable figures continue to be quoted in press reports and elsewhere.

A movement was created in 2007, called Independent WHO, with the goal of freeing the WHO from the grasp of the IAEA. The group maintained a permanent vigil outside WHO headquarters in Geneva for 10 years. The group is now focused on different strategies but continues to demand that the truth be told about the short-term and long-term health damage suffered by all the victims of radioactivity, including those resulting from atmospheric military nuclear tests as well as the civil nuclear disasters of Chernobyl and now Fukushima. The WHO, however, remains shackled to the IAEA and its agenda.

The suffering of children

In the immediate aftermath of Chernobyl it became rapidly obvious just how many children, born or in utero at the time to of the accident, had been medically harmed. Organizations sprung up to help them. The best known is Chernobyl Children International, founded in 1986 by Adi Roche. As she writes on her website, Roche started CCI "to develop programmes that restore hope, alleviate suffering and protect current and future generations in the Chernobyl regions." She warns that while a perception lingers that the 1986 disaster is over, "and no longer poses a threat to the world," the reality is very different. Chernobyl's impact, she says, "can never be undone." Because the Chernobyl radiation exposures change DNA, children continue to be born with medical and mental challenges caused by the disaster. Roche's organization, and similar ones such as Linda Walker's Chernobyl Children's Project UK, offers humanitarian aid in the former Soviet countries but also brings children abroad for radiation respites where they experience the fun of a "normal" life.

Many children, born with debilitating physical problems or mental abnormalities as a result of Chernobyl, were sent to grim orphanages. These groups offer love, life, music and pleasure to these forgotten children. Please visit their websites to help.



Linda Walker hugs one of the children she is helping in Belarus through her Chernobyl Children's Project UK.

Epiphanies: Leaders

It is perhaps no coincidence that the two leaders of the countries that experienced the world's worst nuclear power plant accidents are today two of that industry's most ardent critics.

MIKHAIL GORBACHEV

Mikhail Gorbachev, now 87, was the leader of the former Soviet Union from 1985-1991 and was the last such before the USSR dissolved. Many, including Gorbachev himself, consider Chernobyl as the primary cause of the Soviet Union's collapse. The accident was also an eye-opener for Gorbachev about his country's continued lack of openness. Even he could not get access to vital information about the accident. He vowed to put an end to the broken system, and glasnost was born.

Thirty years after the disaster, Gorbachev recalled in a statement relayed to a British parliamentary briefing: "From the moment I was informed — by telephone, at five o'clock in the morning on that fateful April 26, 1986 — that fire had broken out in Block Four of the Chernobyl nuclear power plant, my life has never been the same."

Today, Gorbachev, who founded the global environmental organization, Green Cross International in 1992, calls for an end to the use of nuclear energy. He views Chernobyl as "one of the most tragic incidents of our time" and was saddened to see a similar failure in Japan, when the Fukushima nuclear disaster struck, of "scientists and engineers to foresee how seemingly small problems can snowball into disasters of almost unimaginable scale." As he says, "Nuclear power systems are not just a security issue, an environmental issue, or an energy issue. They are all of those at once."

NAOTO KAN

Naoto Kan was Japan's Prime Minister during the March 11, 2011 Fukushima-Daiichi nuclear disaster but resigned his position in August of that year. Kan's nightmare unfolded over the days and weeks immediately following the initial loss of power at Fukushima and the explosions that ensued. When Tepco announced it planned to withdraw its workforce at the stricken reactors, Kan insisted Tepco leave them in place. Evacuating them would have led to cascading meltdowns there and at neighboring reactors. Even still he, and the world, held its breath.

"I was shown this map with a 250km radius around Fukushima," he recalled. "An area home to 50 million people. One quarter of the country's population would have had to flee if all the fuel had escaped at Fukushima. We came that close. If 50 million people had had to evacuate Japan, as a state our very survival would have been questioned."

It was then, said Kan, who trained as a physicist, that his whole energy perspective was forever altered. "It was a moment when my view on nuclear power changed 180 degrees." Sticking with the nuclear energy path meant that "the country would go down in ruin." He could no longer in all conscience "make the decision to go with nuclear power and risk the survival of a nation."

Today, Kan's mantra is, "if you love your country, let nuclear go." It's a message he now travels the world to deliver.

Epiphanies: Countries

Austria

While Austria had already banned nuclear power plants in a 1978 referendum, opposition to nuclear power deepened as Austrians felt the direct effects of the Chernobyl fallout. Thirty percent of the land in Austria was contaminated by the accident. Radiation levels were found to be 740,000 becquerels per meter, the same as Belarus, the hardest hit of the former Soviet countries.

These effects continue. There are still significant levels of cesium-137 in mushrooms, wild boar, and roe deer in some regions of Austria, at levels up to 10 times higher than the limits for food. Despite Austria's distance from Chernobyl — roughly 1,000 kilometers — Austrians were shocked at how many precautions had to be taken. These included removing and replacing sand in playgrounds, restrictions on the consumption of vegetables, fruit, milk, mushrooms and game, and the canceling of outdoor activities at schools.

Today, Austria, like Germany, focuses on renewable energy development with a goal to be 100% renewable energy powered by 2030.

Germany

Germany is the best known example of a nuclear exit motivated by a nuclear disaster but it came only after the Fukushima nuclear catastrophe in 2011. However, it was a decision made politically possible by Chernobyl. The anti-nuclear movement in Germany, against both nuclear power and nuclear weapons, has been active for decades. It can trace its roots back to the rebellious '68ers, who, among other concerns, were enraged by the presence of former Nazis still in positions of power and vowed never to trust leadership no matter who was in government. This sense of skepticism and defiance colored the anti-nuclear movement.

Propaganda downplaying the harmful effects of Chernobyl in Germany was met with distrust. Even the measures that were taken to guard against the effects of Chernobyl fallout were viewed by the German public as likely inadequate and there to defend the vested interest of the nuclear sector. They were partly right as no decision was made then to phase out Germany's nuclear plants. By the time that decision was taken in 2011 it was politically suicidal to be pro-nuclear.

Italy

Italy made a simple decision after Chernobyl. In a 1987 national referendum, Italians voted by an 80% margin to shut down the three remaining nuclear plants still operating (out of four total) and outlaw the technology on their soil. In 2003, when the Italian government designated a site in the south for a high-level radioactive waste dump, there was an immediate rebellion. The site was instantly occupied, hundreds of thousands of people marched, interstates were blocked and the dump plan was defeated in two weeks. In 2011, then leader Silvio Berlusconi, tried to revive Italian nuclear power through another referendum. This time, Italians voted by an astounding 95% to keep the ban.

Actual fiction

In 2014, Irish writer, Darragh McKeon, published his first novel, *All That Is Solid Melts Into Air*. In searingly beautiful prose, McKeon sets his story during the unfolding Chernobyl disaster. It follows four primary characters. Yevgeni is a child piano prodigy living in Moscow; his aunt, Maria, a former dissident journalist, now works in a factory; Maria's ex-husband Grigory, a talented surgeon, leaves Moscow to treat Chernobyl victims; and another young boy, Artyom, is evacuated from his rural home close to the stricken reactor. McKeon was inspired to write the book when Chernobyl Children International began bringing children harmed by the aftermath of the nuclear disaster to his home town in Ireland for "radiation vacations."

The vivid descriptive powers of McKeon's prose are best summed up in a *New York Times* book review by Anthony Marra. Here is an excerpt:

"The flight from the towns and countryside surrounding Chernobyl is the most harrowing description of displacement I've read since the Dunkirk evacuation in Ian McEwan's "Atonement." Pages of the strange, surreal and horrific pass with the authenticity of raw news footage. Only one box of iodine pills is available for a city of 60,000, and so the elderly pass around contaminated milk, believing it will fortify them against radiation. The military responds to the humanitarian crisis by sending in fighter jets and robots designed for Mars exploration. Dogs are shot in front of their owners by soldiers who see themselves as war heroes. A woman fills a jar with dirt from her parents' grave, only to be told the earth beneath her feet has been polluted."

The book has been described in reviews as "powerful and moving" and "a supremely accomplished social novel." It can be ordered from Amazon.

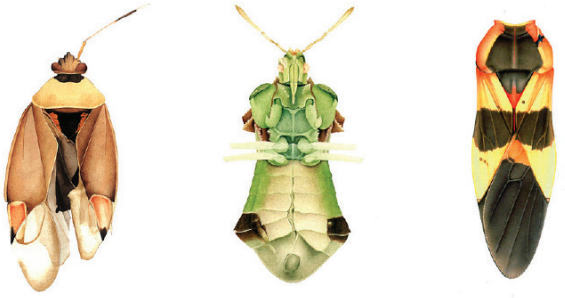
Blind Mice and Bird Brains: The Chernobyl Effect on Animals and Nature

It is logical to assume that the absence of humans from a natural environment would cause the wildlife there to flourish. But in the Chernobyl Zone, this turned out not to be the case. As evolutionary biologist, Dr. Timothy Mousseau and his research team suspected when they began their research around Chernobyl, the added component of high levels of radiation — to which these animals would be exposed on a long-term basis — changed everything.

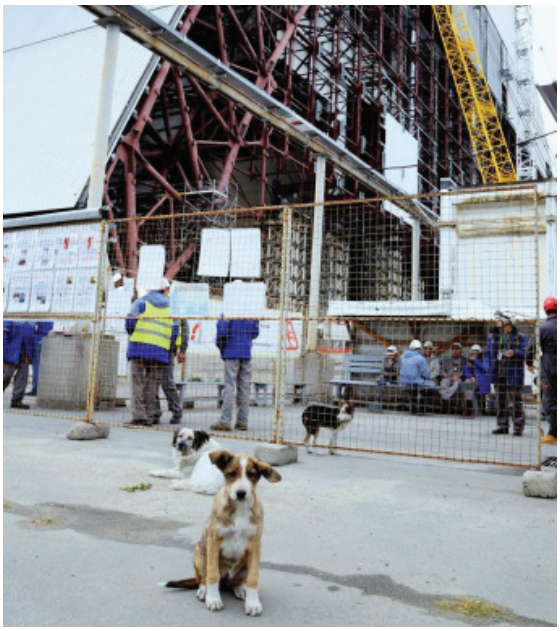
More than 90 peer reviewed articles and 17 years of research later, Mousseau found consistently that animals, and even trees and vegetation, were not doing well. The frequency of cancerous tumors was high in birds and mice. Birds and rodents also had cataracts, severely impeding their ability to catch food. There were low sperm counts and even sterility in male birds. The brains of birds were smaller than normal. And there were just fewer animals in general.

Mousseau also looked at trees and at micro-organisms and found equally startling results. Trees in the Chernobyl zone fall but do not rot, due to the disappearance of essential micro-organisms. Instead, leaf matter piles up without much decay, creating a tinder box for forest fires. These, in turn, loft radiation back into the atmosphere and disperse it further afield, actually expanding the exclusion zone. Mousseau noted that the areas surrounding forest fires in the Chernobyl zone show dramatic increases in ambient ground level radiation readings as a result of the radioactive ash dropping to the forest floor. This research was conducted in the infamous Red Forest surrounding Chernobyl where the trees turned an ominous reddish-brown color before dying.

Invertebrates are affected too. Mousseau found that the abundance of bumble bees, butterflies, grasshoppers, dragonflies and spider webs declined with increasing



Abundance is not the only stresser on insects. As Swiss artist, Cornelia Hesse-Honegger discovered, insects, like plants, are suffering strange mutations as a result of Chernobyl fallout. In 1990 she traveled to Chernobyl to collect leaf bugs and was shocked at what she found. Insects had



enlarged feelers, their larvae had divided wings and black growths protruding from their eyes. Hesse-Honegger painstakingly illustrated her findings — part art, part biological record. Her illustrations (pictured lower left) have been viewed around the world and are also contained in a coffee table book. In 2015 she received the Nuclear-Free Future Award for her work.

Domestic animals have also been affected. Unlike wildlife, these animals were entirely dependent on the presence of humans for survival. Evacuations meant many animals were left behind. Those who survived produced descendants still present today, in particular dogs. Approximately 250 stray dogs live around the Chernobyl nuclear site, tended to by the 3,500-strong workforce that is at the site daily. But it is a losing battle. Now, Dogs of Chernobyl, a project of the Clean Futures Fund started by Lucas Hixson (also a Beyond Nuclear board member) and Erik Cambrian, are seeking to alleviate the suffering of these dogs by providing medical attention including vaccinations, and a spay neuter program.

The Chernobyl dogs (as pictured above) are malnourished, and have been exposed to rabies by wild predators in the zone. And they don't seem to grow old. Hixson and Cambrian noticed that there are next to no mature animals (over 6-8 years old) at the plant, and most of the dogs appear to be under 4-5 years old. Whether this is due to predation and disease, or whether their lifespans are being shortened by exposure to radiation, as Mousseau found among wildlife, is yet to be determined.

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