Nuclear Reactions

Presentation by Walt Patterson

I didn't notice Hiroshima. In August 1945 I was eight years old, with other things on my mind, such as model airplanes and comic books. But I noticed the Bikini atom bomb tests in July 1946, as reported by *Popular Science* magazine. I read every issue of *Popular Science* from cover to cover. Their story about the Bikini tests, with stunning photographs of ships standing on end against the giant waterspout of the underwater explosion, was riveting. The story said nothing about how the tests were actually a trial of strength between the US navy and airforce, with the navy bidding for a role with nuclear weapons. Nor did the story mention the US government's brutal abuse of the Marshall Islanders, whose homeland they devastated with nuclear explosions. All this nine-year-old noticed was that nuclear physics was the most exciting scientific pursuit imaginable. From then on I told everyone I was going to study nuclear physics.

In due course I did. At one stage I knew almost everything there was to know about the beta-ray spectrum of iridium-192. I also constructed and briefly operated an automated detector for airborne radioactivity. In its very first run it detected the fallout from the last US atmospheric nuclear explosion, in 1958, in Nevada, some 2000 miles away from my university in Manitoba, Canada. But we didn't draw any conclusions from that, except that the equipment worked.

When I left Winnipeg for New York and then London, my cover story was that I was going to do a PhD in nuclear physics at Edinburgh. But mainly I wanted to get out and see the world, and find out what I could do. In nuclear physics I found that I was learning more and more about less and less. I quickly realized that another three years in the cloisters at Edinburgh would be closing doors, not opening them. I thanked the Edinburgh professor and his colleagues and dropped nuclear physics. I had no idea then that I would later dedicate my best-known book 'To my parents, who didn't worry when I dropped nuclear physics; and to Cleone, who didn't worry when I picked it up again.'

I didn't pick it up again for a decade. In the interim I met and married Cleone, with whom I was to spend 40 wonderful years. None of my subsequent adventures would have happened without the devoted support of my beloved Cleone. In 1968, with the help of our friend Bob Hunter, later the founder-president of Greenpeace, Cleone and I discovered something called 'the environment', and our life together changed from then on.

Almost immediately my long-dormant nuclear know-how came into play. I happened upon a new small magazine called *Your Environment*, founded by three British poets, one of them Ted Hughes, who later became poet laureate. They wanted an article on nuclear waste. I offered to write it. It appeared in the issue for June 1970, entitled 'Odourless, Tasteless and Dangerous'. If you're interested you can now find it on my website archive Walt Patterson On Energy, www.waltpatterson.org . When I reread it recently I was startled to find myself saying, in 1970,

'Fossil-fuel power plants create their own hazards' including 'disturbance of the carbon dioxide balance in the biosphere'. We knew about that problem long before politicians took it seriously.

In June 1972 I attended the United Nations Conference on the Human Environment in Stockholm, the first UN mega-conference, and helped the newly-established international environmental organization Friends of the Earth, known as FOE, to produce the first independent conference newspaper. Back in London, FOE invited me to join their small staff, for a minute salary. I discussed the idea with Cleone, a hardworking dentist. She said 'It needs to be done, and you can do it. If you want to, I'll back you.' And she did.

I soon became FOE's first 'energy campaigner', and nuclear issues filled my agenda. FOE invited me to Washington, to contribute to another newspaper, about the hearings held by the US Atomic Energy Commission into the safety of water-cooled reactors. My first article for *New Scientist* magazine, in September 1972, was called 'US ponders possible runaway reactors'. You can find it on my website. It makes uncomfortable reading, especially after recent events in Japan.

The following year, the UK's then Central Electricity Generating Board revealed that it proposed to order some 32 American water-cooled reactors in the ensuing decade. A furore erupted, with FOE in the thick of it. As the controversy raged, nuclear advocates, including the then UK secretary of state for energy Tony Benn, habitually referred to us opponents as 'emotional' about nuclear issues, by which they meant 'ill-informed, irrational, hysterical'. I found the label infuriating, not least because as far as I was concerned the more I learned about nuclear power the more uneasy I grew. Only much later did I realize that those who were most emotional about nuclear power were its promoters. Nuclear power was supposed to be the boon to humanity that justified their careers, to compensate for the bomb, the terrifying threat they had created. When we opposed and rejected their proffered boon they were baffled and hurt.

At any rate, when the furore subsided, the new Labour government had turned down the CEGB proposal - a long story for some other occasion. But one corollary had become clear. The purported economics of nuclear power was, to say the least, suspect.

Penguin Books had commissioned me to write a book that became my most successful. *Nuclear Power* eventually sold some 130 000 copies in English, and also appeared in five other languages. The last edition, published the week before they blew up Chernobyl 4, is on my website as a free download. It's 25 years old, but it still gets downloaded more than 2000 times a month.

I mention the book because when writing it I called the chapter on nuclear economics 'Nuclenomics', to indicate that it was not quite economics as we otherwise understand it. Although nuclear safety had initially caught my attention, and that of many others, nuclear economics soon became the dominant consideration. In the US, for example, electricity companies, alarmed by escalating costs and overruns, ordered their last nuclear unit in 1978. Thereafter, every plant in the US ordered after 1974 was subsequently cancelled, some even when 97 per cent complete.

In the meantime FOE and I were preoccupied with reprocessing and the fast breeder reactor. Do you remember the fast breeder reactor? You should. For nearly four decades, from the 1950s through the 1980s, it was the centrepiece of the anticipated global nuclear future. Governments around the world - the US, UK, USSR, France, Germany, Italy, the Netherlands, Japan, India - poured many billions of taxpayers' dollars and equivalents into fast breeder reactor research and development, far outspending every other form of energy research. Reprocessing, separating plutonium for use in fast breeders, was a parallel pursuit. My colleagues and I thought it was at best misguided, and likely to

be desperately dangerous. Trying to turn nuclear weapons material into commercial fuel, and shipping plutonium around the world by the hundreds of tonnes, seemed to us verging on insane.

After years of campaigning we and our colleagues forced the UK government to hold a major inquiry into the plans of British Nuclear Fuels to build a new thermal oxide reprocessing plant for commercial oxide fuel - THORP - at what was then called Windscale. The 'Windscale Inquiry' sat for 100 days in 1977, with FOE as key participants and me as lead witness. We thought we had put forward an unanswerable technical and economic case against THORP. We failed to understand that the inquiry inspector, Mr Justice Roger Parker, clearly understood which verdict the government expected from him. When his report was published he accepted every argument that BNFL put forward, and simply ignored FOE's counter-arguments. At the time I felt as though I'd been kicked in the stomach. Never again would I take the word of any government on anything nuclear. In due course our evidence against THORP proved to be comprehensively vindicated, but too late to prevent the creation of a vast radioactive white elephant in Cumbria.

After Windscale I was burned out. I left the staff of FOE; but nuclear issues pursued me. In March 1979 I was in Hannover, Germany, as a member of an international panel recruited to review the proposed reprocessing and plutonium facility at Gorleben, just across the Elbe from what was then East Germany. On 28 March 1979, at 0900 Central European Time, the eminent German physicist Carl von Weizacker opened the Gorleben hearings, in front of an elite invited audience of hundreds of German politicians and luminaries and national German television. None of us knew that 0900 in Europe was 0400 in Pennsylvania - the exact moment when the feedwater pumps failed at Three Mile Island 2.

As lead speaker for the international panel, I told the hearing that my colleagues on the safety subcommittee had identified possible accident sequences that might entail immediate evacuation out to 1000 kilometers from the site, and long-term evacuation of up to 400 000 square kilometers. I could see the politicians twiddling their thumbs - 'Here we go again, these Kaoten' - 'chaos-ists', a popular German put-down of the time.

The following morning in my hotel room I tuned in American forces radio and heard an announcer refer to a 'spill of radioactivity' in Pennsylvania. At the inquiry I telephoned a friend on the Reuters desk in London; my friend was not there, but the duty man said he had nothing significant. In the inquiry coffee room with an American panel colleague, Jan Beyea, an expert on evacuation plans, we lamented that the media always made such a big deal out of any little incident with radioactivity.

A few hours later, we were watching the hearings in the TV room when another American panel colleague, Gene Rochlin, burst into the room. 'Jesus Christ you guys - it's happened!' The ensuing hours and days were manic. All my American panel colleagues were trying to phone anyone they knew in the US Department of Energy, Nuclear Regulatory Commission and other bodies, to find out what was happening. Jan Beyea, from Princeton, was debating flying back to the US in case they needed to evacuate New York city. By the Friday evening German national television news had a map of the eastern US with huge yellow letters - 'EVACUIERUNG'.

The Gorleben controversy had already stirred intense local opposition. A march had set out from Gorleben days earlier, headed for the hearings in Hannover. Three Mile Island turned it into a torrent. On the Saturday an estimated quarter of a million people converged in central Hannover. Six weeks after the hearings, the Landespresident - state governor - Ernst Albrecht announced that he was turning down the Gorleben proposal. More than thirty years later Germany still has no plan for final disposal of spent fuel.

Many commentators have since declared that Three Mile Island put an end to US nuclear power. They are wrong. US electricity companies had given up on nuclear power for economic reasons almost a year before Three Mile Island.

In the UK, however, only eight months after Three Mile Island, the new Conservative government of Margaret Thatcher announced a proposed programme of ten new American-designed pressurized-water reactors. Yet again controversy raged. Yet another official inquiry convened, into the first new unit at Sizewell B. I kept my involvement to a mininum. I was more concerned with the continuing battle over reprocessing, plutonium and the fast breeder, writing my book *The Plutonium Business*. That proved such a dark book that I then wrote *Going Critical: An Unofficial History of British Nuclear Power*, a true and very black comedy, juxtaposing lofty official pronouncements by government and the nuclear establishment with what then actually happened, a catalogue of what would have been acute embarrassments to anyone less brazen than the nuclear promoters.

Then, on Monday 28 April 1986, a friend at the BBC phoned to ask 'Have you heard the news from Sweden? Can you come in right away?' Knowing almost nothing about Soviet nuclear power I grabbed a reference book from the US Library of Congress and headed for TV Centre. The reference book said - erroneously - that the reactors at the Soviet site called Chernobyl were VVERs - the Soviet version of PWRs. We broadcast accordingly, alluding to the long-established concern about the safety of water-cooled reactors. However, at midday Tuesday, in yet another TV studio, we learned that the Soviet authorities were requesting western help with a graphite fire. Soon the name Chernobyl was on front pages all over the world; and I was talking about it in Rome, Greece, Hong Kong, Canada and elsewhere.

In late August 1986 I was in Vienna, at the International Atomic Energy Agency, when the Soviet authorities, including Academician Valery Legasov, dumfounded the world with the brutal vividness of their description of what happened at Chernobyl 4. I still get a shiver recalling my first view of the helicopter film of the blazing interior of the shattered reactor. The Vienna hearings were the first hint of the coming of *glasnost* and *perestroika*, and the eventual breakup of the Soviet Union. Western nuclear advocates declared, with some justice, that the Chernobyl accident was the result of a combination of a poor Soviet reactor design and wildly risky operator error. But the impact, as radioactivity from Chernobyl circled the globe, was profound. A number of governments shelved plans for new nuclear plants; some shut down existing plants. For nuclear promoters the future looked unpromising.

Two years later, at the Toronto conference on the global atmosphere, the threat of so-called 'global warming', climate change, leapt up the political agenda. Nuclear promoters seized it as a drowning man seizes the last floating plank. Vociferously they proclaimed that nuclear power was the answer to climate change, the only proven low-carbon energy technology.

For many years, however, very few listened. In the UK, the Thatcher government abruptiy announced plans to sell the state-owned electricity system to private investors, to break it up and introduce competition - so-called 'privatization' and 'liberalization'. Investment analysts in the City of London forthwith declared that if the UK nuclear plants were included in the sale package no one would buy it.

In July 1989 the government announced that it would withdraw the old Magnox plants from the sale. City analysts shrugged, unimpressed. On 9 November 1989 the government finally caved in,

and withdrew all the nuclear plants from the sale. I spent the day in television and radio studios, pointing out that the City analysts were simply confirming what my colleagues and I had been saying for fifteen years, that the economics of nuclear power just did not add up.

At 2230 that evening I was crossing the studio floor at BBC TV Centre, on the way to a live discussion on 'Newsnight', when my eye caught a monitor and my jaw dropped. 'Have they opened the Berlin Wall?' Indeed they had. 'Why are we talking about British nuclear power on a night like this?' I asked. But we did anyway. Only later did I notice the metaphorical parallel between the fall of the Wall and the breach of the barricade that had so long concealed the truth about UK nuclear economics.

The government reluctantly set up another state-owned company called Nuclear Electric. When the nuclear plants proved unable to compete in the new electricity market, the government decreed a 10 per cent levy on fossil-fuel electricity, to provide a subsidy to Nuclear Electric of over a billion pounds a year. They did not want to call it what it was, a nuclear levy, so they called it a ' Non-fossil Fuel Obligation'. Off in the corner a small voice said 'We're non-fossil too - can we have some?' The fledgling UK renewables industry was thereupon granted a princely two per cent of the NFFO subsidy, as a welcome figleaf for the nuclear embarrassment. Successor mechanisms of the original nuclear levy still support UK renewables.

After nearly two decades in the thick of nuclear controversy I had grown tired of the sound of my own voice, reiterating the same arguments over and over. I was delighted to seize the opportunity to move on, to more rewarding and satisfying work, and I did. With some difficulty I extricated myself from the continuing wrangles about Sellafield, about Sizewell B and about the appalling radioactive shambles at Dounreay. Since then I have been immersed in the exciting field of innovative electricity, which grows more exhilarating almost by the day. But that too is another story.

In 2005, to my astonishment and that of many others, nuclear power somehow managed to bulldoze its way back onto the global agenda. One commentator after another, one politician after another, at last succumbed to the message that the nuclear faithful had been crying in the wilderness for more than fifteen years. Nuclear power was the answer to climate change. A nuclear renaissance was at hand. I told Cleone 'I just can't face getting back into this nuclear morass all over again'. She said 'You don't have to. You've already done it. Just make it available.' Cleone had been saying for years that I should put up a website. This time she convinced me, and set to work to make it happen. It went live in January 2006. It now contains nearly 200 files, including five complete books. Until March this year it was averaging some 500 hits a day, from - thus far - more than 110 countries. The numbers have since increased.

But otherwise I managed to stay out of the latest nuclear upheavals. When I was asked - and I was, repeatedly - I had a succinct answer. 'If you're really concerned about climate change - and you should be - why pick the slowest, the most expensive, the narrowest, the most inflexible and the riskiest of all the available options?' By 'riskiest' I meant in purely financial terms. Then came 11 March 2011, the Miyagi earthquake and tsunami, and the Fukushima nuclear plant.

That Friday evening I got a call from an old friend, a BBC World Service reporter called Nik Gowing - incidentally the son of the splendid and much-missed official historian of the UK Atomic Energy Authority, Margaret Gowing. Without really thinking about it I agreed to do a TV interview with Nik. That did it. From then on the phone did not stop ringing, and the email and text messages poured in. At length I had to put a statement on my website to call a halt. I had said what I had to say about Fukushima.

With the ugly mess of Fukushima still suppurating, I can draw only one conclusion. My overriding concern about nuclear power for decades has been its opportunity cost. Nuclear people appear to think that any nuclear question is a Yes-No question: 'Do we do this nuclear thing or not?' In fact, of course, the question is actually Either-Or: 'Do we do this nuclear thing, or use our resources, skills and time to do something else instead?' Questions about nuclear safety, even in the looming shadow of Fukushima, will not put an end to nuclear power. But such questions will henceforth make the public even less willing to let elected politicians and democratic governments give nuclear power the financial support on which it has always depended. What may at length put an end to nuclear power is the weakness it has suffered from its inception - the crippling weakness of nuclear economics.