

Being a radical scientist: lessons from the 1980s

SGR patron Keith Barnham reflects on his work with Scientists Against Nuclear Arms investigating the military diversion of civilian nuclear materials – and considers the relevance for academics and activists today.

With Trump's election, the recent spiral of fiery nuclear rhetoric, and the continuing Western and Russian involvement in Middle East conflicts, the Doomsday Clock – that measure of how close human civilisation is to global catastrophe¹ – is moving closer to midnight. Those of us who can remember the early 1980s see parallels with the rise in Cold War intensity following President Reagan's election and Soviet Russia's invasion of Afghanistan. We also recall the remarkable rise in the global peace movement that followed. This included the founding of Scientists Against Nuclear Arms (SANA), one of the forerunners of SGR.

During and following the SGR annual conference in 2016 there was discussion about the problems of organising SGR working groups² given the current pressures on academics/scientists. This prompted me to set down the following recollections on an early SANA working group that I joined. I hope the similarities and contrasts with the current university situation will encourage younger SGR members as they try to balance involvement in SGR activities with the demands of an academic career – as well as informing the current and future development of working groups within SGR.

The founding of SANA

The inaugural meeting of SANA in 1981 at the Open University was a memorable experience. The hall was full of young, old, senior and student scientists from universities and industry. The epithet 'scientist' was broadly interpreted – ranging from theoretical physics to engineering and the social sciences. Equally impressive were the pages of flip-charts with suggestions for working groups. These were updated while the opening presentations were being made. The groups got underway in parallel afternoon sessions, enthused by Prof Mike Pentz – SANA's first chair – whose unforgettable exhortation was that we should provide the tools that the peace movement needed to fulfil its aims.

My choices from this cornucopia of options were easy. As my research in particle physics at Imperial College involved experiments at CERN in Switzerland, I joined the group planning to develop international links with other scientists in the peace movement. Secondly, I had recently decided that, being fortunate

to have a permanent academic contract, I wanted to change my research field to solar energy (for reasons described in my book *The Burning Answer*³). The working group most closely related to my new field was the one on the links between nuclear power and nuclear weapons.

SANA's contribution to the CND Sizewell Working Party

The SANA 'Nuclear Links' working group started by studying the Non-Proliferation Treaty and its application worldwide. It soon focussed on the question whether the UK was setting a poor example to other signatories of the treaty through links between its civilian and military nuclear activities. We decided to challenge the UK government's insistence that there were no such links by calculating from first principles the total amount of plutonium produced in the first generation of UK civilian Magnox reactors. We would then subtract from this total the amount the government admitted had been produced since 1969 to determine the amount generated in the early years of operation. The aim was to test if one could believe government assurances that all this early-years plutonium, which would have had an isotopic purity of interest to the military, had been sent to civilian locations in the USA.

To do this we needed accurate data on reactor operation. Fortunately, the ideal mechanism for prising such sensitive information from the government was imminent: the public inquiry into the proposed Sizewell B nuclear power station (1983-1985). Under the old public inquiry system, the government was obliged to provide information requested by objectors that was pertinent to the inspector's remit.

Though the efforts of the Campaign for Nuclear Disarmament's Sizewell Working Party, informed by the scientific input from SANA, did not stop the Sizewell plant, there were a number of significant achievements. Firstly, the Inspector's final report devoted the whole of one of his thirteen recommendations to actions to enhance the separation of civilian and military nuclear activities. This included ending the practice of co-processing civilian and weapons grade plutonium, which CND uncovered during questioning of the Sellafield experts. Secondly, Prime Minister Margaret Thatcher subsequently made a rare U-turn. She amended the categorical assurances that civilian plutonium had never been weaponised by adding the caveat that it hadn't happened during her

administration (i.e. only since 1979). Further details of these achievements can be found in *The Burning Answer*.³

Finally, and more negatively for the environmental movement, I think it likely that the CND working party's achievements were a significant factor in the government's later decision to amend infrastructure planning law so that such public inquiries were no longer required for new nuclear build.

Confirmation of the accuracy of the SANA calculations

In 1996, the authorities in the USA published a figure of 5.4 tonnes for the total plutonium they had received from the UK that was in remarkable agreement⁴ with a revised figure of 5.4 tonnes we had published four years earlier. The figure for missing plutonium in our 1985 paper had to be reduced in 1992 when David Lowry, a founder member of the SANA working group, uncovered new data on plutonium in waste much higher than the official figure quoted at the time of our original paper. It was still significantly more plutonium than could be contained in the civilian locations the UK government had listed as destinations for the exchanged plutonium.

Following this lead from President Clinton's Administration, the new Labour government published an inventory of UK military plutonium as part of the Strategic Defence Review in 2000.⁵ This came up with a remarkable admission. The UK had more weapons grade plutonium than it thought it had! In the words of the Ministry of Defence report, "the weapon cycle stockpile is in fact some 0.3 tonnes larger than the amount of plutonium the records indicate as available." The report admits that 0.37 tonnes of weapons grade plutonium came from 'unidentified sites'. It does not attempt to identify the origins of this 70 bombs' worth of weapons grade plutonium despite there being only one possible source. The origin must have been the low-irradiated fuel from the civilian programme that was co-processed together with the military fuel at Sellafield.

This was the final confirmation of the accuracy of the SANA calculations.⁵ Our 1985 paper shows that 0.36 tonnes of weapons-grade plutonium were produced in the early years of operation of the civil reactors, again remarkably close to the 0.37 tonnes the Ministry of Defence describe as coming from 'unidentified sites'.

Relevance to current day SGR activities

I appreciate today's university environment, with research funding and permanent positions harder to obtain and increased pressure on research associates to generate their own funding, makes similar working groups difficult to establish. Some of the funding sources that supported this SANA working group, like the Greater London Council, no longer exist. But CND and our American colleagues in the Union of Concerned Scientists are still very active.

I have no quantitative evidence, but it seems to me that nowadays there are more academics with permanent contracts doing socially responsible research than in the 1980s. Hence there are more options for collaboration between these and SGR working groups. At the 2016 SGR annual conference we heard from some impressive researchers bravely persisting with their work despite the pressures from commercial interests or their surrogates.⁶ However university studies in the anti-nuclear area appears to have become more acceptable nowadays. This can be seen, for example, from the impressive list of academics supporting the Nuclear Consulting Group.⁷

One formative experience of the SANA Nuclear Links group provides further evidence for a change in the attitude of the political establishment nowadays. Following the publication of our first *Nature* paper, a government scientific advisor telephoned my Head of Department to warn him that some 'chaps' in his Department had 'got it all wrong'. Fortunately, whoever had briefed the advisor hadn't done their homework properly. The Head of Department happened to be Professor Tom Kibble, then vice-chair of SANA, and one of our 'chaps' was Jenny Nelson (now an award-winning professor of physics and patron of SGR). Tom arranged for us to meet the advisor and it became very clear he had not been briefed on the contents of our paper. Following the confirmation⁵ in 2000 that we had 'got it all right', I had the satisfaction of a telephone conversation with the advisor, now retired, in which he admitted what he had been unable to say while in post: that his experience of the Sellafield operation suggested it was highly likely that such events could well have happened.

By contrast, the recent and important work of researchers at Sussex University that has established links between the UK's new nuclear power programme and its military submarine programme⁸ has already been publicly presented at a hearing of the House of Commons Public Accounts Committee.

One other related issue. Following publication of the 2000 *Nature* letter, I managed to arrange a meeting

with those in the UK government responsible for nuclear safeguards. This was due to the relevance of our calculations to international discussions on the Fissile Material Cut-off Treaty as a demonstration that one could monitor the amount of weapons grade plutonium produced in a reactor. Sadly, but not unexpectedly, they did not follow up on my proposal that, were they to compare our results with their own figures, it could provide confidence that this treaty could be reliably policed by independent bodies given reactor operation information that is supplied to the International Atomic Energy Agency. If anyone in SGR is currently interested in fissile material cut-off issues, please get in contact.

Modern developments aiding SGR working groups

The research funding schemes that supported my transition from particle physics to solar photovoltaics research still exist. I was very fortunate to obtain a Royal Society Industrial Fellowship that supported a year at Philips Research Laboratory in Surrey to learn about the latest developments in semi-conductors. On my return to Imperial College, Jenny Nelson and I founded the Quantum Photovoltaic group using funding obtained from the Greenpeace Environmental Trust (a registered charity) with the help of SANA member (now leading solar energy advocate), Jeremy Leggett.

Also on the positive side, the internet and social media have made working groups far easier to organise than in the 1980s. In particular, it greatly facilitates the multinational collaboration and access to international funding that the SANA Nuclear Links working group pioneered. The other SANA working group that I joined, which developed contacts with scientists aboard, would have been able to achieve far more with modern communications. The early history of that SANA working group is relevant to an initiative that is proposed in Part III of *The Burning Answer: an international solar laboratory*. This could be organised entirely over the internet by co-ordinating the work in national hubs. But that is for another article in the *SGR Newsletter*...

Keith Barnham is Emeritus Professor of Physics at Imperial College, London, a founder member of SANA and a patron of SGR.

References

1. The Doomsday Clock was founded in 1947 by the Bulletin of the Atomic Scientists. For more information, see: <https://thebulletin.org/timeline>
2. Under SGR's constitution, such groups are classified as 'local', 'regional' or 'study/ research' groups.
3. Barnham K (2015). *The Burning Answer: a User's Guide to the Solar Revolution*. Weidenfeld and Nicolson. <http://burninganswers.com>

4. Barnham K, Nelson J, Stevens R (1998). Where has Britain's plutonium gone? *Nature*, vol.395, p.739.
5. Barnham K, Nelson J, Stevens R (2000). Did civil reactors supply plutonium for weapons? *Nature*, vol.407, p.833.
6. SGR (2016). Universities for sale? The influence of the arms, fossil fuels and other industries. SGR conference papers. <http://www.sgr.org.uk/events/universities-sale>
7. Nuclear Consulting Group. <http://www.nuclearconsult.com/about/>
8. Cox E, Johnstone P, Stirling A (2016). Understanding the Intensity of UK Policy Commitments to Nuclear Power. Science Policy Research Group, SWPS 2016-16. <http://www.sussex.ac.uk/spru/documents/2016-16-swps-cox-et-al.pdf>