FEATURE

Britain's bomb

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On the 60th anniversary of Britain's first nuclear test, **Richard Corfield** explores how Operation Hurricane – the British effort to develop the atomic bomb in the 1940s and 1950s – compares with states such as Iran that today wish to have such devices

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Just off the north-west coast of Australia is a small, low-lying group of islands. It has only three things of interest: spinofex grass, the rare black-and-white fairy wren and a high background of patchily distributed ionizing radiation.

It was here, in the Monte Bello Islands, that 60 years ago this month Britain became the third member of the atomic club when it exploded a plutonium-based atomic-fission bomb. The US and Russia had already exploded their devices and Clement Attlee, the British prime minister at the time the project was initiated, regarded it as essential that Britain have the bomb so that it could talk at the nuclear table as an equal.

The situation was especially sensitive, not to say fraught, because Britain – whose scientists had helped to develop the US atomic bomb at Los Alamos during the war years – had been suddenly and summarily dumped by its former ally. In 1946 US senator Brien McMahon sponsored legislation that prohibited sharing of nuclear secrets outside the US even with those Allied scientists who had been involved with the development of the bomb. It was signed into law by President Harry Truman on 1 August 1946.

This was humiliating for Britain. William Penney, for example, who later would be placed by Marshal of the Royal Air Force Charles Portal in charge of the British bomb project, had been an observer at the nuclear bombing of Nagasaki when the first plutonium implosion device had been used militarily. In the days that followed, Penney – an expert on damage assessment – had toured the ruined city gathering data on blast effects for the Americans. Now he – and his country – had been kicked out of the club.

By any standards it was a slap in the face for Britain but the Dunkirk spirit kicked in again and Attlee's government decreed that Britain would develop its own bomb using whatever memories the British veterans of Los Alamos had, and whatever information any sympathetic US scientists – many of whom disagreed with the McMahon Act – could be persuaded to impart on their journeys through London.

And so, in the shadow of the Second World War and at a time when Britain's economy was on its knees, the UK embarked upon a project to recreate the Los Alamos effort within its own shores.

In the space of merely half a decade Britain went from having zero nuclear-weapon capability and only a handful of specialists, to being the third nuclear nation in the world. This short turnaround time illustrates just what is possible when a country has the means and the motive – a worrying prospect today. So exactly how do Britain's efforts to develop the bomb in the 1950s compare with states such as Iran that today wish to have the bomb?

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Setting the scheme in motion

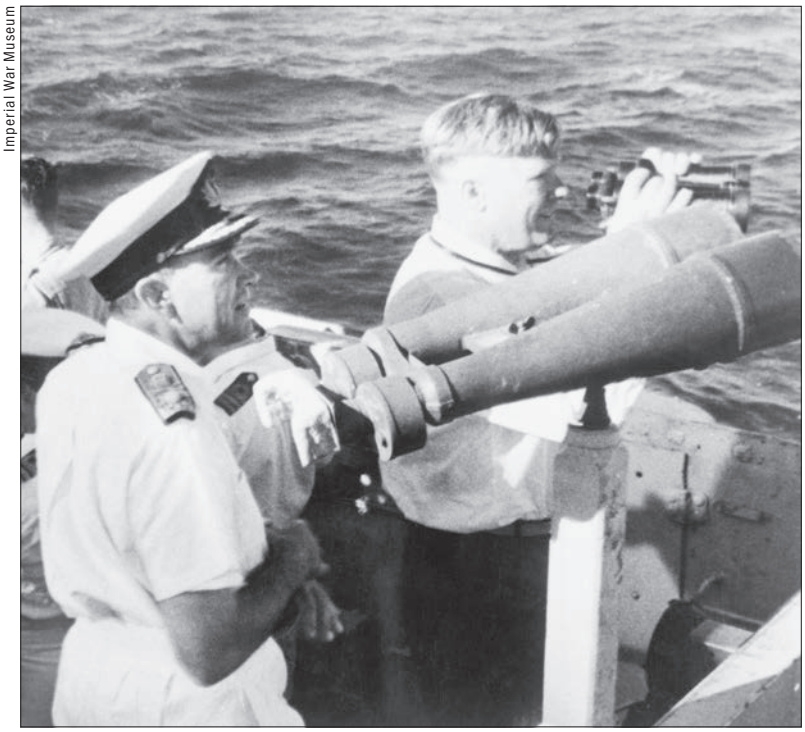
Penney had been the most senior British scientist at Los Alamos and so was the obvious choice to lead the UK project. He brought on board several of his compatriots who had been with him on the Manhattan Project, including the physicists James Chadwick and Rudolf Peierls.

When Robert Oppenheimer was recruited for the Manhattan Project, he stated that the way to build the bomb successfully was to have a group of scientists all in the same place and freely sharing information in a secure environment. In short, a critical mass to design a critical mass.

Today, existing members of the nuclear club eye prospective "applicants" with deep suspicion. It can be no coincidence that the most controversial atomic wannabe, Iran, is currently suffering an epidemic of sudden death among its most senior nuclear scientists. Mostafa Ahmadi Roshan, who was a professor of chemistry and deputy director of Iran's foremost uranium-enrichment facility, became the fifth such casualty since 2010 after a magnetic bomb was attached to his car by a motorcyclist in January this year. Families of Iran's murdered scientists filed a lawsuit against Israel, the US and the UK in August, with Iran blaming Mossad, the CIA and MI6 for the assassinations. The US and the UK have denied involvement in the killings, while Israel has not commented.

The British began work on their bomb in 1947. From an early stage Penney knew that he wanted to build a plutonium weapon. After the US's first nuclear test at the Trinity Site on 16 July 1945 and the destruction of Nagasaki on 9 August that year it was known that a plutonium-based bomb was both more efficient and required less material to detonate

Mat Ward


Imperial War Museum

Witnessing history William Penney watches the first British nuclear test through binoculars. With him on the deck of HMS *Campania* is Rear Admiral A D Torlesse, commander of the naval forces for the operation.

than a uranium-based bomb. For example, the Little Boy device dropped on Hiroshima on 6 August used 65 kg of uranium-235 and produced a blast equivalent to about 15 kilotonnes of TNT (67 TJ); the Fat Man used on Nagasaki, in contrast, used only 6 kg of plutonium to produce a 19 kilotonne TNT-equivalent (88 TJ).

So for the British bomb, a uranium-enrichment facility capable of manufacturing plutonium was constructed at Windscale (now Sellafield), while the non-nuclear components of Britain's bomb were made in various locations including Fort Halstead, Foulness and Woolwich. A new facility at Aldermaston in Berkshire eventually became the hub of the whole enterprise.

Bomb building

To assemble a device that could be relied upon to detonate on demand and not "fizzle", as Penney's team put it, or, even worse, detonate prematurely, was a nightmare of complexity. Even the nuclear core of the bomb was more complex than the name alone suggests. Two hemispheres of plutonium had to be synthesized from uranium-235, then cast (no easy task because plutonium contracts as it cools and the size of the plutonium mass is, quite literally, critical). The plutonium was then alloyed with gallium, machined to two perfect hemispheres and gold plated. Each hemisphere then had a dimple machined into the precise centre of the flat surface to contain the initiator.

The initiator was perhaps the most dangerous part of the bomb. It was made up of a fingernail-sized sphere of polonium – a material so radioactive that it spontaneously ionizes the air around it, glowing blue – which was in turn covered in a layer of beryllium. The device was triggered by igniting an outer layer of conventional explosives, causing an implosion to compress the plutonium core and hence the initiator. The compressed initiator would then release a burst of gamma rays and a stream of neutrons, causing the plutonium to fission.

In other words, the dreaded but necessary chain reaction that unlocks the nuclear Gorgon would be under way.

Although this technology sounds – and is – very intricate and complicated to build, today the largest barrier for countries wanting to develop nuclear weapons is a much earlier stage of the enrichment process: gas centrifugation, in which the fissile uranium-235 is separated from the more common uranium-238. This method of centrifugation – known as the Zippe process after the Nazi scientist Gernot Zippe – had been developed in the immediate aftermath of the Second World War. Indeed Zippe himself had been taken from Germany to Russia because Stalin decided that he must have the bomb, which by August 1949 he did.

The Zippe centrifuge, when used in sequence with many others – a so-called centrifuge-cascade – can concentrate uranium-235 to the 5% purity necessary to fuel a reactor or, if left to run for much longer, the 90% purity required to make a uranium bomb. There is no doubt that Iran already possesses at least one such Zippe centrifuge cascade, but how did it get this technology?

In the 1970s a Pakistani scientist named Abdul Qadeer Khan travelled to Europe to study and found himself working in a branch of Urenco, which manufactured centrifuges for the enrichment of uranium. At about the same time, on 18 May 1974, India announced that it had detonated its first atomic weapon.

Khan set about stealing the designs for the centrifuges and taking them to Pakistan, where the prime minister, Zulfikar Ali Bhutto, put him in charge of part of the Pakistani nuclear-weapons development programme. So successful was Khan's programme that Pakistan detonated its own atomic bomb on 28 May 1998.

As a fringe benefit, and in recognition that it was Khan who had brought them the technology, the Pakistani military allowed Khan to sell nuclear equipment and know-how, including the crucial Zippe centrifuge technology, to other regimes that wanted the bomb. One of these was Iran.

Although Iran is now allowed by the UN to enrich uranium, its use must be solely for the peaceful generation of nuclear power. But when International Atomic Energy Agency (IAEA) weapons inspectors have visited Iran, they have been concerned about the number of centrifuges in the plants they visit and how enriched the uranium is, because the same set-up can also be used to produce weapons-grade fuel. Uranium in all its forms must be accounted for to the nearest gram and plutonium production is forbidden in Iran. And with good cause: inspectors last year found a "discrepancy" in the country's inventory, which is still being investigated.


Mohsen Shandiz/Corbis

A watchful eye Inspectors from UN watchdog the International Atomic Energy Agency set up surveillance equipment at the Uranium Conversion Facility of Iran, just outside Isfahan.

Britain's first test

As the 1940s gave way to the 1950s and the Cold War, Penney announced that he expected that the British bomb would be tested in 1952. It was at about this time that the Monte Bellos were selected as the test site. The Australian premier, Robert Menzies, was an ardent Anglophile and when he received the top-secret request from Attlee to use the Monte Bello Islands he acquiesced immediately.

The criteria for the selection of the islands were simple: secrecy and isolation. Secrecy was wanted because at that time the British government still preserved the fantasy that its intentions were not already in the public domain. As for isolation, Britain wanted to make sure that no citizen of the British Empire – human or animal – should suddenly start glowing in the dark. The Monte Bellos fit the bill perfectly. If they had a drawback, it was that they were almost too isolated, and in later years the British nuclear effort would be relocated to Maralinga in south-west Australia.

So it was that in the spring of 1952 a small flotilla of ships sailed from Portsmouth for the north-west coast of Australia. Nestled deep within the hold of HMS *Plym* was a 5 tonne sphere of aluminium. Inside, an array of felt-lined pressure pads in turn cradled the intricate blocks that held the plutonium core. Britain's bomb was on its way for its appointment with destiny.

When the flotilla arrived at Trimouille Island in the Monte Bellos, so leaky had the security become that an enterprising team of journalists had even parked themselves on the island as unofficial observers. They were summarily evicted but set up a new camp on the mainland near Mount Potter, 90 miles from the town of Onslow, from which they could overlook the Monte Bellos some 60 miles distant.

By the time the bomb team arrived, a team of sappers had already spent several months on the islands setting up the equipment. All was ready and the test was scheduled for October. The detonation occurred at almost exactly 00:00 on 3 October 1952. It occurred 2.7 m below the water line, vaporizing HMS *Plym* and leaving a crater on the seabed 6 m deep and a third of a kilometre across.

Thinking the unthinkable

Penney told the BBC four weeks later, "Mr Churchill has said that the results of our atomic-weapons programme should be beneficial to public safety. I should like most strongly to agree with this view. The energy and enthusiasm which have gone into the making of this new weapon stemmed essentially from the sober hope that it would bring us nearer the day when world war is universally seen to be unthinkable."

And since then he has been right. World war of the kind that Penney knew from the early 20th century is almost unthinkable now.

The world is, or should be, a safer place. The Cold War has come and gone. The nuclear arsenal of the US and the Soviet Union that was enough to destroy

The nuclear arsenal of the US and the Soviet Union that was enough to destroy the world at least seven times over has been mostly decommissioned

Nuclear morality

No article about the bomb would be complete without at least a cursory glance at the moral need for it. Put baldly, why should just a handful of countries such as Britain, the US and Russia have the bomb and other countries not?

Britain built its own bomb for protection from its enemies. Modern states – particularly those that feel that they are under threat – would argue that they have the same rights.

However, the global geopolitical landscape has changed beyond recognition since the 1950s. Britain wanted the bomb principally as a means of earning a seat at the high table of international diplomacy. Its international credibility meant that it had to get onto the same playing field as the US and the Soviet Union, which came perilously close to nuclear conflict 50 years ago this month in the Cuban Missile Crisis.

Today, there is no conceivable set of circumstances under which the democratically elected government of the UK would unilaterally use the bomb – it would always be working as part of a team with its NATO allies. Put simply, Britain's bomb is now part of a supra-national deterrent. This loss of control over its use has, politicians will argue, made the nation a safer place.

In contrast, many states – particularly in the Middle East – are only interested in having the bomb for national defence against perceived enemies. Opponents would say that those nations cannot be allowed to have the bomb on the grounds that they are too likely to use it.

Patrick Landmann/Science Photo Library

Nuclear baking A barrel full of yellowcake – a uranium oxide mixture obtained from uranium ores, containing high concentrations of uranium.

the world at least seven times over has been mostly decommissioned. And yet we still cannot rest easy. Four powers who are not signatories to the Treaty on the Non-Proliferation of Nuclear Weapons nurse grievances and nuclear weapons with equal fervour. They are India, Pakistan, Israel and North Korea. In short, the four nations that are least suitable to have nuclear weapons are the ones most likely to use them.

And of course, this is a club that other nations are keen to join, with, as mentioned previously, Iran being the most notable aspiring applicant. Last year the IAEA published a report that suggested strongly that Iran still has the desire to build its own nuclear weapon despite repeated denials and assertions that its only interest is the peaceful generation of atomic energy.

But a hostile state (or terrorist organization) does not necessarily need to make a high-yield bomb because it probably does not have a "clean kill" in mind. For such situations, it would be enough to explode a dirty weapon that contaminates the surrounding area with unused fissile material and fission products.

For the British test in 1952, Penney had decided that the detonation would be aboard a ship because, since his days in the Pacific with the Americans, he had been deeply worried by the phenomenon of "base-surge" and he wanted to investigate its effects. Put simply, a nuclear weapon detonated in a ship is much "dirtier" than one detonated on land because it creates a column of contaminated water and sediment that then falls on the surrounding area. Penney calculated that such a weapon would kill many more people than a conventional air burst. The fear was that an unfriendly nuclear power (i.e. the Soviet Union) would sail a bomb-equipped ship into a British harbour and detonate it, causing incalculable damage to Britain's international trade and infrastructure.

And 60 years on, can we be sure that a terrorist organization will not target another nation's port with a dirty nuclear weapon hidden in a cargo container?

It would seem that 60 years after Britain joined the nuclear club, the old fears and the old technologies still stalk our nuclear nightmares.