Physics, physicists and the bomb

Scientists involved in nuclear research before and after the end of the Second World War continue to be the subjects of historical and cultural fascination.

Almost 70 years since Hiroshima and Nagasaki, the military, historical and moral implications of the nuclear bomb remain firmly lodged in the public's consciousness. Images of mushroom clouds serve as powerful reminders of the destructive capability that countries armed with nuclear weapons have access to — a capability that continues to play a primary role in shaping the present geopolitical landscape of the world.

For physicists, the development of the nuclear bomb generally brings up conflicting feelings. On the one hand, physicists played a central role in helping to create it; on the other, they were also among the first to realize its terrifying power. This contradiction is most famously epitomized by Robert Oppenheimer, the scientific director of the Manhattan Project, who, on witnessing the first test of the atomic bomb, the Trinity test, in July 1945, was reminded of a quote from the Hindu scripture *Bhagavad Gita*: "Now, I am become Death, the destroyer of worlds."

Although Oppenheimer and the Manhattan Project have certainly become part of the popular narrative of the events leading to the end of the Second World War and the beginning of the nuclear age, many other figures and events are, to the general public at least, much less well known. However, as popular sitcoms such as *The Big Bang Theory* attest, there currently seems to be an appetite for accurate portrayals of scientists on television and cinema screens. Given the upcoming anniversaries associated with the war, now is a good time for cultural events that seek to shed light and bring attention to the fascinating history of nuclear research in the 1940s.

Tom Morton-Smith's *Oppenheimer*, a new play performed by the Royal Shakespeare Company in Stratford-upon-Avon, England, is a case in point. As Iulia Georgescu describes in her review on page 208 of this issue, the play not only provides an engrossing account of the first ever 'big science' project — a template that continues to influence the way science is carried out today — it also provides a realistic description of the excitement, pressure and worries that scientists working on the Manhattan Project would have experienced at the time, and indeed the serendipity, teamwork and managerial brilliance that helped to ensure the project was, ultimately, successful in delivering the bomb. It is by placing things in this context that the public can truly come to feel the growing sense of disillusionment of those scientists as they realized their goal; a sense of lost innocence, that knowledge that has been unleashed cannot be 'unknown'.

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Manhattan Project physicists at Los Alamos. From left to right: Kenneth Bainbridge, Joseph Hoffman, Robert Oppenheimer, Louis Hempelmann, Robert Bacher, Victor Weisskopf and Richard Dodson.

Although driven by the US government and associated with Los Alamos, it is also interesting to consider the genesis of industrial-scale nuclear research programmes more broadly. Britain had the lead for a short while in the early 1940s, mostly because of two scientists based there, Rudolf Peierls and Otto Frisch, who first realized that the amount of uranium required to sustain a nuclear chain reaction was roughly five kilograms — far less than previously thought. But after May 1940, they also had a prime minister who had an interest in nuclear technology, in the shape of Winston Churchill. His largely under-appreciated scientific legacy is the topic of *Churchill's Scientists,* an exhibition at London's Science Museum — reviewed on page 209 by Luke Fleet.

The history of Britain's role in the race to develop the atomic bomb, although little known, has recently been examined in Graham Farmelo's book, *Churchill's Bomb.* Although it paints a picture of diplomatic misunderstandings and missed opportunities on both sides of the Atlantic, in the end it was inevitable that the British atomic bomb project, known as Tube Alloys, would be subsumed into the far larger and more focused Manhattan Project. And although he eventually became intensely preoccupied with easing tensions in the Cold War arms race following the Second World War, there is no question that Churchill was an early and influential champion for government-sponsored science and technology in Britain.

Although allies during the war, rising political and military tensions between the United States and the Soviet Union stoked by nuclear weapons soon gave rise to the Cold War. In *Half-Life* — reviewed on page 207 by Andrea Taroni — Frank Close tells the story of Bruno Pontecorvo, the only Western scientist involved in wartime nuclear projects to have defected to the Soviet Union. What emerges from this biography is a brilliant physicist and a complex man, with a multitude of possible reasons for choosing to defect. Like many of his colleagues in the 1940s, his early aversion to fascism and his international outlook made him sympathetic to communist ideals. But as outdated and misplaced as these ideals may appear today, any moral judgement of Pontecorvo is almost beside the point, at least compared with the ethical quandary posed by the invention of the bomb itself.

The 'original sin' of modern physics is therefore something all physicists have to live with, one way or another. However, although by no means the only template for carrying out fundamental research, big science projects such as CERN are now synonymous with international collaboration and achieving a fundamental understanding of nature's inner workings. Perhaps it is a search for atonement, as much as pure curiosity, that now drives these incredible endeavours. ❐