

Chapter Five: Conclusions and legacies of British wartime nuclear research

Hiroshima and Nagasaki shook the world. The moral questions raised by the bombings are still being debated and Britain's contribution to those events had an impact on world opinion towards her. Without Britain's timely research work and technical report, the bomb would not have been ready to drop in August 1945 and bring such a dramatic end to the Second World War. The MAUD Committee stuck to its task diligently, coping with only limited resources and little enthusiasm from Whitehall. It functioned under the extreme pressures of war, including the threat of bombing during the Blitz. Many complex technical problems were solved and this remarkable achievement paved the way for the United States to expand the programme abroad.

The rescue of the heavy water and the French scientists was an amazing feat by British Intelligence in the hurried and tense atmosphere of the German's Blitzkrieg. The logistics of getting personnel and 180 litres of heavy water across a choppy English Channel while under threat of mines and German U boat attack were formidable. It was an extremely risky operation and one which turned out to be of the greatest benefit to future heavy water research in Canada. As it transpired, the French Vichy Cabinet was not enamoured with British assistance, as is shown by an interesting piece of declassified information. Lt. Allier was summoned to meet the Vichy Cabinet in August 1940 and informed its members that the heavy water had left France. Pierre Laval¹ 'expressed regret that the Germans had not

¹ Pierre Laval had been French foreign minister in the early 1930's and was deputy Prime Minister in the Vichy Cabinet. He was second in command to Marshal Petain until December 1940.

succeeded in laying their hands on it before “ces salauds d’Anglais”.’ [those English bastards]² The Cabinet became divided at this point and descended into fierce argument, which was quite typical of the Vichy regime due to its fundamental political instability. Allier was then ‘treated to the spectacle of the Vichy Cabinet at play’³ with Petain ‘trying to drown the din by flapping his arms and bleating: “messieurs, messieurs, mais voyons donc messieurs!”.’[sirs, sirs, but come on sirs!]⁴ The dispute was revealing about where Laval’s loyalties really lay. He was known since the fall of France to have been seeking collaboration with Germany as he felt this was the best chance of creating a strong France. However, if Laval was willing to go so far as to provide Germany with the means to make an atomic bomb, as this evidence suggests, this showed he had an unshakable belief that Germany would come out of the war the strongest. Laval was also highly suspicious of anything he didn’t personally control which in part explains his apparent jealousy that England had the heavy water instead of Germany.

Subsequent British raids on the heavy water facility in Norway were done under intense pressure and with a great chance of the S.O.E operatives not coming back alive. In the successful raid of February 1943, the German guards ‘saw no one and heard nothing, until a cataclysmic explosion announced the destruction of the target.’⁵ The British successfully thwarted any German attempts to acquire heavy water by ordering the sinking of the *Hydro* ferry the following year. The Germans finally decided to keep the project on a laboratory scale. Unfortunately, because the heavy water work in Canada was used to research a method for

² CAB 126/171, Heavy Water (Deuterium Oxide) : General File, *Top Secret*, 6th March 1946, National Archives, p. 2

³ CAB 126/171, Heavy Water (Deuterium Oxide) : General File, *Top Secret*, 6th March 1946, National Archives, p. 2

⁴ CAB 126/171, Heavy Water (Deuterium Oxide) : General File, *Top Secret*, 6th March 1946, National Archives, p. 2

⁵ PREM 3/139/4, Tube Alloys, *S.O.E Activities in Scandinavia*, May 1945, National Archives, p. 3

nuclear power production, the work and the British part in it, was not given due credit in comparison to the explosives work at Los Alamos.

The scientists in Britain were especially good at using their initiative, sometimes disobeying rules, in order to get things done. An example was when the MAUD Committee was pondering techniques for diffusion. Peierls suggested the committee should talk to Francis Simon at Oxford. 'The Committee hesitated, even though Simon was a naturalised citizen. Oliphant then authorised Peierls out of hand to visit Simon at Oxford.'⁶ It was these spontaneous decisions that stopped the programme being bogged down in red tape. Leo Szilard later noted that Britain was quicker to realise the potential of atomic energy than America, probably because its scientists had not been compartmentalised like the Americans had. The Americans admitted that the early British research had been 'of the greatest importance in the final decision to go ahead.'⁷ In the early stages, Peierls' group of theoreticians and Chadwick's group studying fast neutron fission had played 'a leading part'⁸ in the field. The MAUD Report was issued in time to provide an opportunity to develop the bomb by the end of the war.

At Los Alamos, Britain gave significant help to the Americans in the theoretical groups. When the British were finally allowed to travel to America Rudolf Peierls toured the U.S.A. He was informed that there was a shortage of good young scientists so 'any competent men would probably be gladly accepted.'⁹ Without the British assistance in solving problems of bomb

⁶ Rhodes, R *The Making of the Atomic Bomb*, New York, Simon and Schuster, 1986, p. 339

⁷ Goldschmidt, B *The Atomic Complex*, Illinois, The American Nuclear Society, 1982, p. 39

⁸ CHAD 1 28/2, Relations between American and British S-1 Project, *Akers to Conant*, 15/12/42, Churchill Archives Centre, p. 3

⁹ AB 3/86, Notes on tour of U.S and Canada, *Notes on Dr. Tolman's visit*, 21st October 1943, National Archives, p. 2

design such as implosion, the bomb would not have been ready before the end of 1945. By the middle of 1944, the British had '50 good men working in the United States of America'¹⁰ who had 'undoubtedly made a significant contribution'¹¹ to the project, including work on hydrodynamics and mathematical problems. The British were also utilised in the diffusion project, which was running behind schedule. Peierls believed this was 'no doubt partly because the importance of purely theoretical work was not at first fully realised'¹² and the results needed more careful examination by the engineers at the diffusion plant. He was also quick to report the gaps in US experiments up to September 1943. For example, in Peierls' opinion the American blast wave calculation 'was crude'¹³ compared with the British work because it had been simplified. Peierls was a crucial part of the British team. His reports were accurate and detailed. He was organised and his suggestions were insightful. The work Peierls did for the group studying implosion was first class. Chadwick also deserves great credit for his part in organising the British team at Los Alamos and his efforts to get along with General Groves. The American military had not wanted the British experts to be working there and staying on good terms was a difficult job.

Upon examining British involvement at Los Alamos, one is bound to question the motive given by James Conant for stopping Britain accessing nuclear information in the run up to the Quebec Agreement. Conant had used the convenient pretext that giving Britain access to nuclear information would have endangered the security of the project. If that was so, how did so many members of the British Mission end up working at Los Alamos on the most secret

¹⁰ PREM 3/139/11B, *Notes on Tube Alloys (no date)*, National Archives, p. 1

¹¹ PREM 3/139/11B, *Notes on Tube Alloys (no date)*, National Archives, p. 1

¹² AB 3/86, Notes on tour of U.S and Canada, *Possible arrangements for collaboration on theoretical problems*, September 1943, National Archives, p. 3

¹³ AB 3/86, Notes on tour of U.S and Canada, *Meeting at the War Department 13th September 1943*, National Archives, p. 4

areas of technical theory? Egon Bretscher from Cambridge University even worked with Edward Teller on the fusion device which was infinitely more troublesome than the plutonium bomb. The hydrogen bomb ‘depended on hideously complex theoretical calculations.’¹⁴ It can be argued that American intransigence over sharing atomic research before the Quebec Agreement was purely an attempt by the Americans to acquire a nuclear monopoly. The years 1942-1943 were especially problematic for U.S-British relations and the U.S insistence on security of information dogged the diplomatic discussions for months, holding up collaboration that could have speeded up the bombs’ development further.

Another case in point was when General Groves had refused to share technical information after the Quebec Agreement was signed. He was highly reluctant to give anything away to the British. Groves therefore informed the Anglo-Canadian heavy water team in Montreal that they would receive no information about how to purify plutonium or about its chemical properties. They would however be able to use irradiated uranium slugs to replicate the time-consuming work already carried out by the Americans in Chicago so they could ‘work out independently the methods of plutonium separation and purification.’¹⁵ In this way, Groves had not violated the Quebec Agreement; he’d just made life unnecessarily difficult for the British. Groves later ‘boasted that he dragged his feet’¹⁶ concerning British requests for information. This in itself was not a surprise as Groves was thought to be xenophobic.

¹⁴ Goodchild, P *Edward Teller: The Real Dr. Strangelove*, London, Weidenfeld and Nicolson, 2004, p. 116

¹⁵ Hewlett, R.G and Anderson, O.E *The New World: A History of the United States Atomic Energy Commission Volume One 1939-1946*, Pennsylvania State University Press, 1962, p. 283

¹⁶ Hewlett, R.G and Anderson, O.E *The New World: A History of the United States Atomic Energy Commission Volume One 1939-1946*, Pennsylvania State University Press, 1962, p. 282

Churchill realised the extent to which nuclear energy would influence foreign affairs, especially considering the deterioration in diplomacy between the U.S and the Russians. Groves also felt the Soviet Union was the long term enemy after Germany had disappeared from the scene and the ideological clash of communism with western ideas would produce the arms race. Snow argues that the West should not have expected to keep a commanding lead over the Soviet Union in technology. ‘That expectation is a typical piece of gadgeteers thinking. It has done the West more harm than any other kind of thinking. History and science do not work that way.’¹⁷

First impressions would suggest that Britain was a haven for foreign born scientists. This is only partially true. Britain did let refugees from Nazi Germany work in its universities and saved important scientists from France. Nonetheless, Britain was overtly cynical in its use of foreign born scientists. To start with, they were only allowed to work on the uranium problem as they were ‘enemy aliens’ and not able to do other war research. Secondly, Frisch and Peierls were not allowed to sit on the original MAUD Committee, even though their ideas had sparked Britain’s nuclear programme. Then there was the problem of protected areas. Curfew regulations put the different teams of foreign scientists under an unnecessary burden of pressure, considering the extraordinarily complex nature of their research. Finally, encouraging the French team of Halban and Kowarski to escape the Germans and come to Britain was deceptive. Their work on the heavy water pile was not appreciated by General Groves who deeply mistrusted the French. As has been shown by the primary evidence, he wanted them to be interned on security grounds. The Anglo-Canadian heavy water pile, on which the French scientists from the British Mission were working, was low on the list for priority of materials as it was not working towards producing an explosive. There had been a series of ‘unending

¹⁷ Snow, C.P *Science and Government*, London, Oxford University Press, 1961, p. 70

delays'¹⁸ which had stretched the patience of the team to breaking point. The Americans had been slow to authorise the large scale work of heavy water piles for plutonium production. This was not unreasonable as the American graphite piles had been working with some success.

On the issue of espionage, it is undeniable that the British spies did incalculable harm to Anglo-American relations with the passing of information to the Soviet Union. The actions of Nunn May and Fuchs partly prevented the U.S from getting a sizable lead in the nuclear arms race and accelerated the start of the Cold War. Fuchs was especially harmful due to his extensive knowledge of the American atomic bomb and he also transmitted information while he was working at Harwell in Britain. The Intelligence Services did their best to excuse themselves from blame after Fuchs was exposed. M.I.5 in particular, tried to cover up the fact that the F.B.I had pinpointed Fuchs as the culprit. The actions of the spies alone could not have determined the end of an American nuclear monopoly, they merely accelerated the process. The basic principles of atomic weapons were in the open before espionage made any serious impact and 'in fact every nation that has attempted to build an atomic weapon in the half-century since the discovery of nuclear fission has succeeded on the first try.'¹⁹

Partly resulting from the Canadian spy cases, the Americans became wary of letting Britain have technical knowledge and stopped sharing information. On August 1st 1946 President Truman signed the Atomic Energy Act, which had been initiated by a bill proposed by Senator Brien McMahon. This Act nationalised all aspects of atomic energy including patent rights and

¹⁸ AB 3/110, Tube Alloys Correspondence: Simon/Akers in the UK and U.S, *Akers to Peierls*, 26th March 1944, National Archives, p. 9

¹⁹ Rhodes, R *Dark Sun: The Making of the Hydrogen Bomb*, New York, Simon and Schuster, 1995, p. 162

put atomic energy development under civilian rather than military control. In this period, Truman was swinging ‘from internationalist to cold-warrior’²⁰ and his patience with the Soviets was wearing dangerously thin. This was especially so given the Soviet encroachment into Eastern Europe after the war. The Red Army appeared to be mechanizing and gathering resources for biological warfare so Truman was eager to keep nuclear secrets locked away.

When Senator McMahon proposed the Bill, he was unaware of the preceding Quebec Agreement between America and Britain. The Act ‘forbade sharing information on the design and manufacture of nuclear weapons with foreign governments.’²¹ This obviously made the previous Quebec and Hyde Park arrangements contrary to U.S law. When the new British Prime Minister, Clement Attlee, heard about American intentions to stop information sharing he was furious. There was ‘an animated and forthright exchange of letters’²² between Attlee and Truman. America had jettisoned Britain, despite the provisions of the Quebec Agreement of 1943. This may have been a long time in the making, originating from Britain’s own rejection of American offers for joint nuclear collaboration in October 1941.

Both sides harboured a mutual suspicion of one another as is shown by the primary documents and especially Wallace Akers’ reservations about the chance of an effective programme continuing after the war. When British chemists and physicists had requested assistants to join them at Los Alamos, this often met with a frosty response from the American military. According to Akers, this suggested ‘the American Army, at any rate, is still remarkably

²⁰ Rhodes, R *Dark Sun: The Making of the Hydrogen Bomb*, New York, Simon and Schuster, 1995, p. 280

²¹ Rhodes, R *Dark Sun: The Making of the Hydrogen Bomb*, New York, Simon and Schuster, 1995, p. 294

²² Wheeler-Bennet, J *John Anderson*, London, Macmillan, 1962, p. 338

suspicious about our good faith and this does not make collaboration too easy.’²³ The Atomic Energy Act only served to confirm that the wartime atomic project had been a marriage of convenience between Britain and America. When Roosevelt died the secret agreements would no longer stack up and the need for international control of atomic energy would necessitate a different system. Truman wanted international control over atomic energy while the U.S still had the nuclear monopoly. He gave up this idea when it became apparent that the Soviet Union would not accept these terms. In that scenario, the U.S had no choice but to try to protect its lead against all nations capable of building atomic weapons. Britain happened to be one of these.

The Canadian espionage crisis was used by the Americans as justification for the Atomic Energy Act. Nunn May was the target of this anger and Senator McMahon blamed him primarily for the series of reports reaching the Soviets. McMahon said that ‘Russia’s success with the atom bomb was due to Canadian spying and to Dr. Nunn May’²⁴ after the confirmation of the first Russian atomic test in 1949. The following year Fuchs was exposed and the Americans stated his arrest vindicated ‘the position of those of us in congress who have opposed exchange of atomic information with other nations.’²⁵ However, Nunn May and Fuchs were dealt with swiftly by the British security services. They were arrested, convicted and jailed within several months. This meant their cases disappeared from the papers and their damage to international relations was not as bad as it could have been. The Burgess-Maclean defection to the Soviet Union, while not giving away so many technical secrets was just as

²³ AB 3/110, Tube Alloys Correspondence Simon/Akers in the U.K and U.S, *Akers to Peierls*, 26th March 1944, National Archives, p. 4

²⁴ KV 2/2226, Alan Nunn May, *Nunn May is blamed by senator*, Press Section, Daily Graphic, 24/9/49, National Archives, p. 1

²⁵ FO 371/82902, Arrest and Conviction of Dr. Fuchs on Charges of spying for Russia, *Telegram 404 from Washington to Foreign Office*, 4/2/50, National Archives, p. 2

damaging to Anglo-American relations as Fuchs had been. Burgess and Maclean had filched Foreign Office documents on Anglo-American strategy in dealing with the Soviet Union. This was highly embarrassing to the Foreign Office and 'wreaked havoc among the British authorities'²⁶ who had not moved quickly enough to arrest them. The worst part was that Burgess and Maclean were free men and rumours concerning their whereabouts kept popping up in the press at unfortunate moments, putting added strain on Anglo-American atomic discussions, only a short time after the Fuchs case. The spy scandals were especially unfortunate as they took the gloss off what had been a well organised and dedicated effort by the British teams in the U.S and Canada to give as much assistance as possible in order to facilitate the end of the war.

Clement Attlee was alert to security dangers of inadequate control of nuclear weapons. He wished for co-operation with America to continue to make the system stable. Attlee's letters to Truman were very articulate and to the point. In his letter of 25th September 1945, Attlee emphasised nuclear energy could be used either for peace or war. He told Truman if it was war 'I ought to direct all our people to live like troglodytes underground as being the only hope of survival...'²⁷ Attlee was not shy of warning the public either. In his speech to the House of Commons on 22nd November 1945, he expressed his fears over how nuclear weapons and science could progress to make even more terrifying devices, stating 'The atom bomb is the latest word in destructiveness but it may not be the last.'²⁸ This remark was especially prophetic as the concept of fusion weapons had already been investigated at Los Alamos and Edward Teller's fusion group had started on the early calculations. Britain helped start development of

²⁶ Modin, Y *My Five Cambridge Friends*, London, Headline, 1994, p. 210

²⁷ Williams, F A *Prime Minister Remembers*, London, Heinemann, 1960, p.100

²⁸ Jenkin, R *Purpose and Policy: Selected Speeches by the P.M the Rt Hon C.R Attlee*, London, Hutchison and Co, p.153

the atomic bomb and the super bomb was the next logical step. The hydrogen bomb turned out to be so massive, at several megatons of explosive, that it would naturally be wasted on a military target. This meant the weapon 'could have no other use than the mass destruction of civilian populations.'²⁹ Therefore, Britain helped to develop a weapon of genocide.

Attlee was determined Britain should make her own device as he could not accept the U.S being the sole power in possession of atomic weapons. His ambition was to have the bomb under United Nations control. However 'it was obviously going to take a long time. Meanwhile we had to face the world as it was. We had to look to our defence...'³⁰ The important issue to remember is that Britain was the very country that pushed for the bomb at the critical moment in the war. It was natural Britain would want her own nuclear weapons. As Gowing states 'The bombs were manufactured in the United States but the vast size and importance of the U.S project have concealed the fact that the bomb was 'invented' in Britain.'³¹ It must also be remembered that the British team had gained a valuable amount of technical knowledge from their time at Los Alamos and this was a great step forward in building an independent weapon. This came from Churchill's determination to get a good deal for Britain at Quebec. First impressions would suggest that Churchill had signed away rights to future economic benefits of nuclear technology for little reward. However, once the British arrived in the States, their expertise was attractive to the Americans and they gained extensive access to the project, certainly more than the Quebec Agreement had implied, and much more than Bush and Conant had wanted.

²⁹ Thorpe, Charles (2004) 'Violence and the Scientific Vocation', *Theory Culture and Society*, 21;3, 59-84, p. 71

³⁰ Williams, F A *Prime Minister Remembers*, London, Heinemann, 1960 p. 119

³¹ Gowing, M and Arnold, L *The Atomic Bomb*, London, Butterworth, 1979, p. 13

Britain now had to make an atomic bomb by herself, feeling that one was needed to protect her Great Power status and to attempt to keep pace with the United States. Britain would not be bullied out of owning the technology for herself, even though making Britain's own device would be much more difficult due to the break in collaboration with the U.S, not least because of the expense involved in replicating American research. The task would be especially difficult given that Britain was financially crippled at the end of the Second World War. However possession of the weapon was crucial because no system of international control had been devised that could work adequately to stop nuclear proliferation. The most drastic suggestion had been to stop all nuclear weapons research and destroy existing nuclear installations. However, 'the kind of inspection that would be necessary to ensure compliance with this would meet with prohibitive difficulties'³² and would depend on whether nation states trusted each other enough to dismantle their weapons. The Soviet Union was certainly likely to be 'extremely resentful and suspicious'³³ after being left out of atomic weapons development. Nation states which had plentiful stores of uranium could easily produce large amounts of plutonium and argue this was for power production. There would be no guarantee that these states were not making nuclear weapons as well. As Clark points out, any state 'which generated nuclear power would contain within its national apparatus the potential for producing nuclear weapons.'³⁴

As an overall assessment of Britain's role in the development of nuclear weapons, it is clear to see that Britain played a crucial part, but her actions did not always have positive results. Frisch reminisced that he wrote his memorandum with Peierls to awaken the world to the dangers of

³² CAB 126/209, Atomic Scientists Association Provisional Committee, *Summary of Recommendations*, 1946, National Archives, p. 3

³³ CAB 126/183, *Top Secret, Telegram from Ronald Campbell (no date)*, National Archives, p. 1

³⁴ Clark, R.W *The Greatest Power on Earth*, London, Sidgwick and Jackson, 1980, p. 116

German possession of the bomb. This was not the only reason. Once you have thought of a possible use for science, can you really pretend the knowledge is not there? The legacy of Hiroshima has not reflected kindly on the nations that developed the atomic bomb, including Britain. However, on balance the atomic bomb was a necessary evil. It ended World War Two, kept Britain in the discussion on nuclear power with the United States and when Britain embarked on making its own weapon, the bomb was an effective and essential deterrent to have available in the uncertain era of the Cold War. Britain's encouragement, effort and technical skill was put to excellent use in the U.S. Without it the U.S would not have had an atomic bomb to drop on Hiroshima. Britain's help definitely hastened the end of the Second World War, certainly by several months, arguably as much as half a year, considering the unique technical challenges the Americans had needed assistance with.

Edward Teller was meanwhile working out the theory for his fusion or 'super' weapon. Teller was a staunch anti-Communist and his views became more pronounced after the success of the fission weapon. He fell out with Oppenheimer due to Oppenheimer's moral qualms about the hydrogen bomb and felt Oppenheimer's stubbornness was delaying the thermonuclear programme. In the same way that Frisch and Peierls had fretted about the Germans acquiring nuclear fission, Teller then became fixated about the Russians acquiring fusion. For Teller, the hydrogen bomb 'was both a strategic and scientific goal and the focus of his own personal ambition.'³⁵ The development of such a weapon had apocalyptic possibilities. Fusion weapons were known to have no theoretical limit to their size.³⁶ Defence against fission weapons was

³⁵ Goodchild, P *Edward Teller: The Real Dr. Strangelove*, London, Weidenfeld and Nicolson, 2004, p. 110

³⁶ Fission weapons are limited by the size of the critical mass, their limit is around 50 kilotons of explosive, unless they have been 'boosted' with fusion material. In contrast, fusion weapons are just a smaller version of the stars in the sky, using hydrogen for fuel. If a bigger fusion weapon is desired, just add more hydrogen isotopes and this will produce a bigger yield. Fusion weapons were normally around 10 megatons in yield.

unlikely. Defence against fusion weapons would be impossible due to the immense area that they could destroy. As soon as the Trinity device proved for certain that fission could work, the Cold War, and the race for the super bomb, were on.