Power Politics: Britain and Atomic Energy, 1945-62

by
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Abstract

This thesis concerns the role of atomic power in the development of British national identity and international relations between the end of the Second World War and the early nineteen-sixties. It deals with the changing nature of interaction with the United States, Europe and Commonwealth through the focus of new science as well as the impact of civil atomic power on British society and political decision-making structures. A new space for Britain in the context of Cold-War relations is identified in the field of atomic science, as Britain's development of independent nuclear weapons and subsequently civil electrical engineering ran counter to the otherwise prevalent trend of declining great power status. The thesis concludes that the atomic energy program in Britain was an important component in the definition of a new post-war identity, with increased scientific input into government policy ultimately resulting in Britain developing a potential for commercial uses which was a key factor in prompting American intervention in the European atomic arena during the nineteen-fifties. It also contends that the politics of European integration around the Treaty of Rome were substantially informed by British attitudes towards her atomic power legacy.

For Kurt Matheja and Gervase Theaker

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List of Abbreviations

AGR – Advanced Gas-Cooled Reactor
ALAS – Association of Los Alamos Scientists
BMC – British Motor Corporation
CEA - Central Electricity Authority
CEGB - Central Electricity Generating Board
CDA – Combined Development Agency
CDT - Combined Development Trust
CND – Campaign for Nuclear Disarmament
CPC – Combined Policy Committee
CSA – Chief Scientific Advisor
EFTA – European Free Trade Association
ENEA – European Nuclear Energy Association
EURATOM - European Atomic Energy Community
GATT – General Agreement on Tariffs and Trade
IAEA - International Atomic Energy Agency
MoD – Ministry of Defence (UK)
OECD - Organisation for Economic Co-operation and Development
OEEC - Organisation for European Economic Co-operation
PIPPA - Pressurised Pile for Producing Power and Plutonium
UKAEA – United Kingdom Atomic Energy Authority
UNAEC - United Nations Atomic Energy Commission
USAEC – United States Atomic Energy Commission

‘The discovery of this atomic energy science has placed us several laps ahead of the present phase of international political development, and unless we can catch up politically to the point we have reached in science, and thus command the power which at present threatens us, we are all going to be blown to smithereens!’

- Anthony Eden, House of Commons, 22nd November 1945

INTRODUCTION

Described as 'the work of men of genius' by the eminent scientist John Cockcroft, but 'a great and dangerous adventure' by President Truman, few issues during the twentieth century proved as controversial as the exploitation of nuclear fission[1]. In post-war Britain, the advent of a new technological era raised fundamental questions about the British attitude to science and its international implications while global relationships within the energy environment shifted rapidly as new military and domestic atomic issues forced their way into existing frameworks. It is the purpose of this analysis to detail the internal and external impact of atomic technology on British diplomacy and society, beginning with the scientists who developed the original knowledge and were thereafter invaluable to the post-war nuclear programme.

Enough has already been written to contextualise a weighty study; Margaret Gowing's *Independence and Deterrence* (1974) and R.F. Pocock's *Nuclear Power: Its Development in the United Kingdom* (1977) both launched the initial commentary on Britain's first-generation atomic plants. Gowing's analysis (often considered the field-grounding text) utilised the focus of individuals operating the first British nuclear experiments to divide nuclear power development into policy-making and policy-enactment phases, producing depth widely absent in the field[2]. However, the relatively brief period covered (from 1945-52) left gaps beyond the first nuclear planning phases. This space was partly filled by Pocock, who, in contrast to Gowing's highly-detailed account, charted the wider history of atomic power but still sought to break the Magnox era into two distinct periods: the 'years of military priority' from 1945-1953 and the era of commercial generation thereafter[3]. Where others had dismissed civil

[1] John Cockcroft, 'Future of Atomic Energy', *The Scientific Monthly*, Vol. 82, No. 3 (Mar., 1956), p. 136 and 'The Atomic Era', *The Manchester Guardian*, 16th April, 1946
[2] Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952, Vol. I.*, (London, 1974)
[3] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, (London, 1977), p. 19

power as a by-product of bomb-making, Pocock decreased the emphasis on military plutonium requirements, offering instead that nuclear power was a necessary response to global energy crises and increasingly costly coal[4].

The temporal divisions provided by these works agree that atomic history crossed a military phase before becoming a predominantly commercial concern roughly halfway in the period of study. This offers a reasonable framework to begin this analysis, as these shifting priorities can be tracked before the role of independent civil applications are investigated. Indeed, much existing scholarship surrounding the West's nuclear past has too often ignored the none-martial aspects of fission technology; this assessment will therefore follow the evolution of British policy through the early atomic age, starting with developments in Anglo-American diplomacy. British scientists had been crucial to the success of the Manhattan Project and were heavily involved in the fundamental stages of developing martial atomic power, yet were refused American resources and expertise almost immediately after the war. This assertion of a US atomic monopoly carried consequences for British atomic policy, making the impact of this development on wider Anglo-American relations a key issue for examination. Important arguments in this field already exist; Timothy Mitchell and David Painter framed a good general context for this analysis in their research into American interference in post-war European energy systems[5]. Additionally, John Baylis noted how America's refusal to co-operate for the first post-war years scuppered notions of *interdependence*, forcing a fundamental frame-shift in thinking, firstly at political, but later scientific levels, legitimising an *independent* British nuclear infrastructure[6]. This provides important background for study of another significant phenomenon: the impact of Britain's

[4] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, pp. 46-7
[5] For examples, see David Painter, 'Oil and the Marshall Plan', *The Business History Review*, Vol. 58, No. 3 (Autumn, 1984) and Timothy Mitchell, 'Carbon Democracy', *Economy and Society,* (Volume 38, Number 3, Aug. 2009)
[6] John Baylis, 'Exchanging Nuclear Secrets: Laying the Foundations of the Anglo-American Nuclear Relationship', *Diplomatic History*, Volume 25, Issue 1, (Winter 2001), p. 35

atomic power on relations with its former empire. Fission technology and nuclear fuels affected the redefinition of British influence in erstwhile dominions as the presence of uranium deposits in Commonwealth states generated diplomatic tension over the trade between technology and primary resources, articulating contrasting visions for the organisation.

Importantly, although the *theoretical* background of nuclear science took some account of energy-generating applications, the initial *implementation* of uranium fission technology was almost exclusively military. However, this thesis will restrict itself to examining nuclear power in a *civil* context, except when both applications become inextricably intertwined, notably during the initial post-war stages. The abrupt relationship changes with Britain's dominions (the traditional source of strength) and her core ally encouraged the development of an independent British nuclear programme; thus, the next step will be to analyse how Britain's post-war energy and military needs utilised scientific discoveries which could 'kill two birds with one stone' and provided electricity-generating potential through civil engineering schemes. A core debate in this field concerns whether this development represented a positive assertion of British independence or, as William Walker posited, a negatively-stimulated reaction to American frostiness[7]. In expanding the discussion, this analysis will identify the influence of atomic scientists within new organisational frameworks and in the context of the wider phenomenon prevalent in the nineteen-fifties described by Joseph Camilleri as the 'bureaucratisation of science'[8].

Evaluating the energy options competing with traditional coal power and the political events which decided their fates will open discussion on the extent to which science *can* be understood to have national identity, and the frontier between scientists working for national

[7] William Walker and Måns Lönnroth, *Nuclear Power Struggles: Industrial Competition and Proliferation Control,* (London, 1983), pp. 6-7
[8] Joseph A. Camilleri, *The State and Nuclear Power: Conflict and Control in the Western World,* (Brighton, 1984), pp. 13-16

benefit and those pursuing the global good will be carefully identified. Interpretations of the role of science within the contrasting political contexts of Labour and Conservative policy, the economics of fuel, and wider international trends have been developed in isolation, so elaborating and synthesising these multiple elements will facilitate analysis of atomic power's overall impact on Britain's domestic and global position.

This initial reaction brought about the next phase of atomic history, as the United States attempted to coerce and persuade its ally into assisting her nuclear defence programmes and visions for a united Europe. Finding a position for this study within the existing historiographical framework provides rich possibilities as current scholarship adopts a broadly US-centric approach, with attendant emphasis on martial atomic applications and American Cold War position. However, the influence of Britain's civil success has avoided significant attention, so whilst the work of, say, John Krige or Richard Hewlett provides solid fundamentals, they concurrently create space for an expansion of established arguments[9]. This analysis will therefore elaborate on how far the liberalisation of American atomic policy under Eisenhower reflected the nuclear accession of both the USSR (the currently-accepted argument) **and** Great Britain. The British position in pioneering atomic technology was unique among European states undergoing radical politico-economic alterations and movement towards integration deviated significantly from traditional power structures, raising questions about Britain's continental role, notably in the nuclear field. Therefore, this study will focus on the British reaction to European demands for nuclear technology and how these influenced the wider response to integration, ultimately producing a two-stream atomic politics with Western Europe forming a joined nuclear authority. Here the debate will centre on whether Britain's reluctance to join Euratom was based on the organisations weakness, as

[9] For examples, see Richard Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission*, (Berkeley, 1989) and John Krige, 'Atoms for Peace, Scientific Internationalism and Scientific Intelligence', *Osiris*, Vol. 21, No. 1, (2006)

Christian Deubner has asserted, or more cynical reasons of hegemony, as Henry Nau contended[10]. In either case, the atomic frontier, through which American desires for British agency in a united Europe were expressed, merits investigation into the role of civil atomic power in informing Britain's (in)activity in continental affairs. In this way it will be possible to shed new light on wider traditional debates.

Finally, the effect of atomic power on re-orientating social perceptions of Britain's position and the influence of this domestic reaction on development priorities will be examined. This will involve investigating local and national perceptions of civil power stations whilst evaluating whether Britain's pioneering position engendered public support for the new technopolitics that eventually underpinned Harold Wilson's 'white heat of revolution'. Thus, the analysis will use the lens of energy supply to scrutinise whether the 'New Britain' emerging from post-war austerity was credible or merely a mirage disguising relative decline. By drawing together the economic, political and scientific elements of civil atomic power, it will be possible to illustrate how the new technology affected Britain's world position and social identity as scientific influence grew and replaced traditional representations of power in the national consciousness. Assessing the role of scientists and technocratic elites will enable evaluation of how the demands of atomic power in the post-war world influenced the international scene, particularly in relation to the initial debate concerning military versus commercial priority highlighted by Gowing and Pocock.

Churchill's 'three circles' theory provides a good template to analyse Britain's position within this new power-political system; the United States, Europe and Commonwealth all experienced fluctuating responses from British policies designed to produce a 'swing power'

[10] Christian Deubner, 'The Expansion of West German Capital and the Founding of Euratom', *International Organization*, Vol. 33, No. 2 (Spring, 1979), p. 223 and Henry Nau, *National Politics and International Technology*, (London, 1974), pp. 186-9

at the centre of an often-ungainly three-spoked wheel[11]. Atomic energy demonstrated as well as any field how Britain alternated quickly between keen interaction and stubborn reluctance with her major partners as she sought a new international position. This analysis will thus place atomic power within the triple context of imperial decline, Cold War superpower struggle and European integration and investigate the manner in which it corresponded to or informed these processes. By navigating these core arguments and applying substantial original research it will be possible to contextualise this study correctly and further develop the scholarly field.

[11] John Dumbrell, *A Special Relationship: Anglo-American Relations in the Cold War and After*, (London, 2001), pp. 7-8

CHAPTER ONE: FROM HIROSHIMA TO THE *MODUS VIVENDI*

If the Second World War began with stuttering agreements failing to contain fascism, it ended with the cataclysmic atomic bombings of Japan. This result represented years of toil; early French work was furthered at the University of Birmingham by Otto Frisch and Rudolf Peierls, *émigrés* from Austria and Germany, who concluded that only a few pounds of difficult-to-extract uranium-235 were needed to take a bomb critical[12]. Once this scientific point was established, the British undertook feasibility studies under the 'Maud' Committee and organised the 'Tube Alloys' project to investigate practical military applications, but despite relocating their effort to Canada in the interest of safety and ease of research they soon realised that the engineering costs (approximately £95m) of such a plant would be prohibitive[13]. Thus, co-operation with the United States was inevitable and in August 1943, in the interests of 'wise division of war effort', the Quebec Agreement was signed, securing 'full and effective interchange of information' between American and British scientists in exchange for Britain disclaiming any post-war industrial atomic interests (enshrined in Clause IV). The treaty also required consent from all three signatories before using atomic weapons or exchanging information with additional parties[14]. The move prudently traded British knowledge that would soon be discovered by the Americans for details of nuclear processes that were unachievable in contemporary British facilities. Nonetheless, although the expedient wartime plan fairly acknowledged the British intellectual contribution, it tacitly accepted, for financial and engineering reasons, that the future of atomic power was American.

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[12] Atomic Archive, 'Frisch-Peierls Memorandum', March 1940. [online], (Date Accessed: 1st June 2011) Available from: http://www.atomicarchive.com/Docs/Begin/FrischPeierls.shtml

[13] Atomic Archive, 'Report by MAUD Committee on the Use of Uranium for a Bomb', 1941 [online], (Date Accessed: 1st June 2011), Available from: http://www.atomicarchive.com/Docs/Begin/MAUD.shtml

[14] Yale Law School, The Avalon Project: Documents in History, 'The 'Quebec Agreement', 'Articles of Agreement Governing Collaboration Between the Authorities of the U.S.A. and the U.K. in the Matter of Tube Alloys'', 19th August, 1943 [online], (Date Accessed: 1st June 2011), Available from: http://avalon.law.yale.edu/wwii/q002.asp

The agreement established a Combined Policy Committee (CPC) to decide mutual atomic policy, joined later by a Combined Development Trust (CDT) to corner global uranium supplies. However, in contrast to the 3:2:1 split between the USA, UK and Canada in the CPC Board, the CDT was joint-funded and an equal Anglo-American responsibility[15]. Thus, as long as the A-Bomb remained a concept for future consideration, Britain enjoyed an atomic relationship approaching equality with the United States, to the extent that Roosevelt and Churchill even agreed to continue full transatlantic collaboration on military **and** civil atomic energy beyond the (correctly) predicted first use of future weapons to compel Japanese surrender[16]. Therefore, although the wartime atomic relationship remained cordial, superior American engineering capabilities ensured that future British development of the new technology would require negotiation with her senior ally.

However, Roosevelt's death in April 1945 and the British general election the following July changed the leadership on both sides of the Atlantic. The close understanding faltered as Attlee and Truman stepped in to 'mop up' the war without any previous meeting, having inherited a tight working relationship between their predecessors. Into this uneasy political mix was thrown atomic power's transition from theory to reality, an important factor for international relations. Truman was conscious that fission processes were widely-known and believed that other powers would inevitably develop atomic bombs, making him eager to exploit America's position to instigate effective international control mechanisms while her

[15] NuclearFiles.Org: Project of the Nuclear Age Peace Foundation, 'Anglo-American Declaration of Trust', 13th June, 1944 [online], (Date Accessed: 1st June 2011), Available from: http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/history/pre-cold-war/manhattan-project/declaration-of-trust_1944-06-13.htm

[16] NuclearFiles.Org: Project of the Nuclear Age Peace Foundation, 'The Roosevelt-Churchill "Tube Alloys" Deal', 19th September, 1944, (Date Accessed: 1st June 2011), Available from: http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/history/pre-cold-war/manhattan-project/tube-alloys-deal_1944-09-19.htm

technological premiership remained[17]. Henry Stimson, Secretary of War, advocated swift tripartite consultation with Britain and Russia on the future of commercial atomic energy but this approach was rejected by Attlee, who was encouraged to share neither knowledge nor uranium with the Soviets until relations improved, saving the possibility of some 'substantial advantage'[18]. Instead, the Prime Minister proposed to use the period before Russia's inevitable proliferation to formulate control agencies, and in return for supporting Truman on this point Attlee arranged a meeting in Washington in November with the intention of retaining the Quebec Agreement as far as possible whilst freeing Britain to act on industrial atomic power without American intervention. His thesis contended that atomic energy, being too widespread a concept to contain, should be freely developed but leashed by the threat of massive retaliation from other nuclear states if strict codes of conduct were not followed[19].

Whilst much of this sentiment was included in the public Washington Declaration of the 15th November 1945, which called for a UN Commission to control international atomic energy, a more important development was the signing the following day of the secret 'Groves-Anderson memorandum'. The document downgraded the Quebec-mandated prerequisite for nuclear strikes to *consultation with* rather than *agreement between* the three Allies, specified that no atomic information be shared with additional parties and ordered the acquisition of all available uranium sources 'by purchase or otherwise' for stockpile under the CDT[20]. Crucially, this last point gave the United States equal rights (via the CPC) in the distribution of ores it had no previous claim over, allowing stockpiling to begin[21]. However, in exchange for releasing the vast majority of potential uranium resources, Britain found

[17] President Harry S Truman, 'Message to Congress on the Atomic Bomb' Washington D.C., 3rd October 1945
[18] Henry L. Stimson, 'Memorandum to President Truman on Control of Atomic Weapons, 11th September 1945', quoted in Richard D. Challener (ed.), *From Isolation to Containment, 1921-1952: Three Decades of American Foreign Policy from Harding to Truman,* (London, 1970), pp. 136-139 and NA CAB/129/4 'International Control of Atomic Energy, Prime Minister's Memorandum', 5th November 1945
[19] Ibid.
[20] 'Groves-Anderson Memorandum; 16th November 1945', quoted in Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952, Vol. I.,* p. 85
[21] Jonathan Helmreich, *Gathering Rare Ores: The Diplomacy of Uranium Acquisition,* (Princeton, 1986), p. 107

agreement on drafting a new document to supersede Quebec and finally rid herself of the much-hated Clause IV. Thus, Britain found itself (atomically) immeasurably poorer but significantly more independent.

Despite this rebalancing, the new accords soon proved troublesome. Attlee, already irked by the abrupt termination of Lend-Lease in September 1945, was keen to maintain strong Anglo-American relations whilst preserving respect for British intentions.
In his initial post-Washington House of Commons address, the Prime Minister described atomic energy as the collective property of **all three** Quebec signatories and proposed that technological information be negotiated on a reciprocal basis from interested parties through a future United Nations Organisation[22]. However the progress of the McMahon Bill, which proposed isolating atomic technology within America, worried Attlee considerably and he wrote to Truman in April 1946 requesting an explanation regarding the refusal of American CPC members to share information on constructing atomic plants in the UK[23]. Truman replied that, in his view, the Washington agreements were 'very general' and did not oblige the USA to offer practical post-war help[24]. Attlee protested this point lengthily to both Truman and Canadian Prime Minister Mackenzie King throughout the second quarter of 1946, but the President was reconciled to wait for the decision of Congress before responding meaningfully[25]. British trust was severely damaged; the loose wartime cordiality was demonstrably dead and the inability to formulate a strong post-war settlement preyed on the Labour government who became increasingly anxious for atomic information, not only for defence but increasingly as a cheap source of industrial power. Before the McMahon debate was truly underway, Attlee requested an organisation to control British fissile material and

[22] Clement Attlee, House of Commons Debate, 22nd November 1945, *Hansard* , HC Deb., Vol. 416. *cc601-714*
[23] Harry S. Truman, *Memoirs, Volume II: Years of Trial and Hope, 1946-52,* (New York, 1987), p. 12
[24] Ibid., p. 13
[25] Francis Williams, *A Prime Minister Remembers: The War and Post-war Memoirs of the Rt.Hon. Earl Attlee,* (London, 1961), pp. 112-119

although weapons were foremost on his mind, fuel shortages were fostering notions that atomic science held a potential solution. Therefore, Attlee proposed a programme to develop atomic technology 'as circumstances might require', keeping open possible future civil applications[26].

Truman, for his part, was under pressure from the Treasury Department to reorganise the American economy onto a peace footing and cut government spending, while hawks in Congress needed placating with measures to restrict the spread of atomic power beyond the US[27]. Some commentators have also noted that, despite his public applause for new scientific achievements, the president was wracked by 'nagging apprehension' that the scientists' blind pursuit of atomic technology would produce an almost-biblical apocalypse[28]. Furthermore, the establishment of the United States Atomic Energy Commission (USAEC) under civilian control, in the interest of 'established American tradition', had come at a price[29]. The McMahon Bill had received solid support in both American houses and, upon being signed in August 1946, provided for the complete cessation of international information exchange on *industrial* atomic power until Congress declared that *military* uses were appropriately internationally safeguarded[30]. Indeed, the military wing in Congress had negotiated a liaison committee within the USAEC which could refer any disagreeable decisions to the President via the Secretaries of War and Navy[31]. This was incredibly significant for the transatlantic atomic relationship; any future British access to American knowledge would be severely restricted as the US military guarded the gateway to atomic information and through it a

[26] NA CAB 128/5, 'Minutes of a Cabinet Meeting', 17th January 1946
[27] Harry S. Truman, *Memoirs, Volume II: Years of Trial and Hope, 1946-52*, pp. 4-5, p. 35
[28] Paul Boyer ''Some Sort of Peace': President Truman, the American People and the Atomic Bomb' in Michael J. Lacey (ed.), *The Truman Presidency*, (Cambridge, 1991), pp. 174-202
[29] Harry S. Truman, *Memoirs, Volume II: Years of Trial and Hope, 1946-52,* (New York, 1987), pp. 3-6
[30] United States Atomic Energy Act, 1946, Section 10a(2)
[31] Ibid., Section 2.4c

controlling interest in industrial applications. This continuing military context in American atomic policy left Britain essentially isolated.

The result of this was profound; British involvement in wartime atomic projects in Canada and Los Alamos produced a base of scientists returning to British universities with first-hand experience but lacking facilities to cultivate the new technology; a crucial factor in future developments. In January 1946, Attlee commissioned an atomic energy organisation under the Ministry of Supply to strengthen Britain's position at the United Nations Atomic Energy Commission (UNAEC) and more importantly create a unified voice and point of contact regarding the technology in Britain, thereby improving her negotiating position with the United States[32]. Despite this, relations worsened, as British protests received obfuscation and denial of precisely which agreements still represented what to whom[33]. This truculence left many in the British Cabinet concerned about recurring American isolationism, particularly in relation to defence commitments, increasing the importance of acquiring an independent atomic deterrent in the interests of security and, importantly, national respect[34]. Relations deteriorated further during 1947 as Britain continued to stockpile its Congolese ore allocation whilst American plants protested their short supply; hawks in the Senate were also unhappy at the proximity of British fissile material to Russia and that the fifty-fifty split of materials did not reflect the vastly different demands of America and the UK[35]. Britain, for its part was happy to accept its uranium entitlement under CDT contracts valid until 1956 (and which it paid in sterling, not rare dollars), demonstrating further her intention to press existing settlements to the maximum.

[32] NA CAB/128/5, 'Minutes of a Cabinet Meeting', 8th April 1946
[33] James L. Gormly, 'The Washington Declaration and the "Poor Relation": Anglo-American Atomic Diplomacy, 1945-46', *Diplomatic History*, Volume 8, Issue 2, (April 1984), pp. 141-143
[34] John Baylis, 'Exchanging Nuclear Secrets: Laying the Foundations of the Anglo-American Nuclear Relationship', p. 35
[35] Jonathan Helmreich, *Gathering Rare Ores: The Diplomacy of Uranium Acquisition*, pp. 122-123

Notably, although global uranium scarcity caused friction with Belgium, where the government realised the rising value of stocks it was contributing at very low prices for little return, Britain remained unwilling to engage extensively with Europe, her attention being consumed by the United States[36]. This point bears analysis; post-war Britain identified itself increasingly in relation to its primary alliance, and whilst atomic energy represented a dependence on America which was consistent with developments elsewhere, the response in this particular sector was different. Economically, material shortages were covered by loans and the Marshall Plan whilst Britain acknowledged military inferiority and conceded American hegemony in occupied Germany, Greece and the Middle East. However, in the atomic field, dependence was refused and Britain demanded equality, railing against American attempts to demote her importance. Thus, as Margaret Gowing noted, the atomic sector represented an important deviation from wider Anglo-American co-operation during the post-war forties[37]. It was certainly an important demonstration of the limits acceptable to Britain in the new world order.

Nonetheless, uranium shortages forced the Americans back to the negotiating table to claim some of Britain's hoarded stocks. The resulting agreement, the *Modus Vivendi*, attempted to break the effective stalemate in atomic relations by allocating all Congolese uranium for 1948 and 1949 to the United States and allowing her to tap unused British stockpiles to supplement any shortfall to the requirements of her 'minimum programme'[38]. This clause alone demonstrated the gulf between American and British needs, with the former requiring over ten-thousand tons of uranium ore for two years and the latter barely two-thousand[39]. In exchange, the United States offered to release limited scientific information

[36] Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952, Vol. I.*, pp. 152-159, 366-367
[37] Ibid., p. 10, pp. 241-242
[38] 'The *Modus Vivendi'*, 7th January, 1948, quoted in Ibid., pp. 266-272
[39] Ibid.

and technical knowledge, which, importantly, they insisted on categorising into suitable areas where sharing could be justified in the national interest. It thus fell to *scientists* to instigate an agreement where politicians had failed; John Cockcroft, Vannevar Bush and James Fisk negotiated information-sharing treaties on nine key topics, whittled down from Cockcroft's fourteen original proposals[40].

The *Modus Vivendi* also identified a new international atomic position for Britain as the controlling 'gateway' to new Commonwealth resources, a role of some importance as the negotiators envisaged rapidly increasing contributions to world uranium supplies after 1950 from South Africa (Figure I). The agreement detailed British commitments to her erstwhile colonies specifically, in order to 'secure information' held by Commonwealth scientists, effectively accepting that, as America remained inhospitable, they would invariably work at the Atomic Energy Research Establishment (AERE) at Harwell, join a British university or return home. This reassertion of post-imperial British power also had implications for Europe; the definition of what Ernest Bevin termed the 'Third Force' was soon readjusted to mean not merely an American-sponsored British-led Western European bloc but British leadership within a continental structure of equal strategic importance to the US[41]. Thus, Britain's influence was still accorded a position of some respect, allowing her to consider releasing rights on Belgian Congo uranium in the expectation that future Canadian, Australian and South African supplies could be more easily accumulated. Being within the traditional British sphere, these were jealously guarded; in late 1949 George Strauss, the Minister of Supply, was asked to 'make a real effort to see that our experience in relation to uranium from South Africa does not follow that of the Belgians in the Congo, where the Americans have taken the

[40] Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952, Vol. I,* pp. 245-6
[41] Ibid., p. 242

lot'[42]. Indeed, belief in Commonwealth uranium meant the British considered jettisoning their Congolese agreements in favour of new sources despite the prevalent assumption that uranium requirements would soon skyrocket[43]. These negotiations demonstrated that Britain was still internationally important and although her Atlantic status was diminished, the Commonwealth remained integral to her remaining prestige.

	1948	**1949**	**1950**	**1951**	**1952**	**Total U_3O_8 (short tons)**
Belgian Congo	2,200	1,200	1,200	1,200	1,200	7,000
United States	100	200	200	200	200	900
Canada	150	150	150	150	150	750
South Africa	-	-	125	320	825	1,270
Portugal	-	-	-	50	50	100
Total	2,450	1,550	1,675	1,920	2,425	10,020

Figure I: Predicted Sources of Uranium, 1948-52[44]

To summarise, although Commonwealth leadership shored-up her image somewhat, the post-war period severely altered the political perception of Britain in America. Empire and Churchill were replaced by a Labour government coping with fuel shortages and rebellious workers; Britain was economically crippled, susceptible to communism and possible Soviet attack[45]. Anthony Eden's exhortation to 'abate present ideas of sovereignty' and incorporate atomic energy into the international set-up was not widely appreciated; in Washington, General Groves was sceptical of any further atomic interchange, questioning why Britain, America's ally, even needed atomic bomb plants[46]. Even modest analysis highlights the relationship as fundamentally flawed; America had a strong lobby advocating isolationism on defence grounds but was *forced* to engage occasionally to secure uranium supplies whereas

[42] Question by Mr Platt-Mills, *Hansard,* HC Deb. 5th December 1949, Vol. 470, *cc1506-7*
[43] NA CAB/129/60 'Atomic Energy: Future Policy towards the Belgian Congo Uranium Agreement', 16th April 1953
[44] Adapted from Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952, Vol. I,* p. 269
[45] Jonathan Helmreich, *Gathering Rare Ores: The Diplomacy of Uranium Acquisition,* pp. 128-30
[46] Anthony Eden, House of Commons Debate, 22nd November 1945, *Hansard,* HC Deb. Vol. 416, *cc601*-714 and Ibid., p. 115

Britain was compelled to exert serious patience between these sporadic flashes of friendliness, often the only factor keeping the atomic relationship alive in the gloomy post-McMahon years. Thus, the *Modus Vivendi*, as Jonathan Helmreich noted, represented the international situation in microcosm; Britain clung to great-power notions of principle whilst the Americans pursued pragmatic defence concerns[47]. This complemented contemporary misgivings about the handover in international supremacy; Attlee criticised Truman's 'inconsistency' in demanding free trade whilst retaining protectionist devices and protested America's 'lack of tact' in exploiting its position as international creditor for profit[48].

Robin Edmonds has (rather generously) argued that the British accepted these constant humiliations because select 'atomically initiated' elites considered atomic science crucial to the Anglo-American relationship[49]. Had it not been for the realisation of Cabinet members like Bevin and Attlee that Britain's atomic future would still require tough negotiations with the United States, the opportunity to build a lasting special agreement might have been lost. However, an alternate view proposed by William Walker identified a more assertive British policy designed to maintain national greatness and remain independent of American military hegemony[50]. This point carries weight, especially when one considers the British willingness to spend millions pursuing an independent programme; it is therefore perhaps clearer to contend that Britain was merely squeezing existing agreements dry. Britain's politicians were operating from an unknown position; engineering dependence and formal political agreements ensured their actions depended first on anticipating American movements; Attlee and Truman enjoyed little of the trust visible between Churchill and Roosevelt and the atomic field reflected accurately the apprehension of the initial post-war years. Nonetheless, the

[47] Jonathan Helmreich, *Gathering Rare Ores: The Diplomacy of Uranium Acquisition*, pp. 129-131
[48] Clement Attlee, 'Britain and America: Common Aims, Different Opinions', *Foreign Affairs* Vol. 32, No. 2 (Jan., 1954), pp. 193-195
[49] Robin Edmonds, *Setting the Mould: The United States and Britain, 1945-1950*, (Oxford, 1986), p. 93
[50] William Walker and Måns Lönnroth, *Nuclear Power Struggles: Industrial Competition and Proliferation Control*, pp. 6-7

breakdown in Anglo-American relations must not be conveniently attributed to new leadership. Attlee himself blamed Senatorial greed and Congressional short-sightedness in passing the McMahon Act, after which Britain 'had to go it alone' in order to 'hold up <their> position *vis-a-vis* the Americans'[51]. Repeated attempts at compromise failed because British expectations always exceeded what the Americans were prepared to concede; 'the egg', as Margaret Gowing illustrated, was always 'addled'[52]. One certainty prevailed; the American superpower did not regard wartime agreements on atomic energy as an indefinite moral obligation, so Britain needed to catch up quickly, 'reinventing the wheel' if necessary, to achieve transatlantic parity[53]. As Christopher Hinton, later the Managing Director of the UKAEA's Industrial Group remarked, 'when we started in 1946 the Americans had a lead of four years on us and those were years in which they had an overriding priority'[54]. Thus, Britain proceeded, for better or worse, alone on its quest for atomic power.

[51] Francis Williams, *A Prime Minister Remembers: The War and Post-war Memoirs of the Rt.Hon.Earl Attlee,* (London, 1961), p. 118
[52] Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952, Vol. I,* pp. 254-6
[53] Jonathan Helmreich, *Gathering Rare Ores: The Diplomacy of Uranium Acquisition*, p. 132
[54] Margaret Gowing, 'Lord Hinton of Bankside', *Biographical Memoirs of Fellows of the Royal Society,* Vol. 36 (Dec., 1990), p. 11

CHAPTER TWO: BRITAIN; COAL, OIL AND NEW SCIENCE

In 1948, the physicist Philip Burton Moon argued that civilian nuclear power could proceed only once 'uranium, expert scientific and technical knowledge of the subject, and great engineering strength have been brought together and used on the job for a good many years'[55]. Moon continued, speculating that no single state, not even the USA, could yet command sufficient strength in all three domains to launch a successful civilian project[56]. Of the three, obtaining uranium supplies was arguably the simplest criterion and will thus be analysed last. The real challenge, certainly in a British context, was how scientific research was organised and suitable plant provided, particularly in reference to the interaction these factors had with successive political regimes and changing diplomatic environments.

The relationship between scientist and state had been tightened by Winston Churchill's inclusion of the physicist Frederick Lindemann (later Lord Cherwell) in his wartime advisory circle. The atomic bombings of Japan set the agenda for the future of weapons technology and international politics, increasing government interest in science regarding issues of national security and consequently, international position. However, scientific autonomy was a politically divisive issue rooted in disputes over whether nuclear power was a civilian or martial matter. The Labour Government of 1945-51 enjoyed military backing in maintaining centralised authority, keeping nuclear research closely bound to the Ministry of Supply via the 1946 Atomic Energy Act[57]. For their part, British scientists (with the notable exception of Cherwell) did not actively seek political power, often preferring to extend their influence indirectly, commonly to address their uneasiness at martial developments in nuclear physics. As early as 1941, the chemist Maurice Stacey, working on

[55] UBSC US16/E.32 Philip Moon Collection, 'Draft on Atomic Power annotated 'BBC-First draft, 1948', p. 6
[56] Ibid.
[57] United Kingdom Atomic Energy Act, 1946

'Tube Alloys', reported that 'the prospect was too much' for some scientists working on even fundamental bomb technology, causing resignations on ethical grounds[58]. Others, notably Joseph Rotblat, criticised the ''success' of the Manhattan Project' and quit in 1944 once Germany abandoned its nuclear bomb project. Many physicists in particular expressed their views through apolitical non-proliferation movements such as the Association of Los Alamos Scientists, established in 1945. In Britain, Rotblat himself established the Pugwash Conferences in 1957, which like CND (formed the same year), aimed to reduce the likelihood of nuclear war[59]. A detailed analysis of these movements is beyond the scope of this study but it can be reasonably asserted that, although they eschewed direct political power, scientists did seek representation on issues they believed important. In America, for example, scientists had been instrumental in preventing continued military control of atomic energy[60]. Although many scientists continued to support their states by researching contentious military projects, the increasing confidence felt by experts in their right of expression meant that relations with politicians were rarely one-way.

Nonetheless the first British atomic piles, built at Windscale in the early fifties to produce military plutonium, had demonstrated valuably that nuclear reactors could operate successfully, raising the possibility of civil plants for energy production. The political will to investigate commercial atomic power followed, as the 1951 election produced a Conservative government with a predilection for decentralised scientific control, as evidenced by Churchill's subsequent decision to order a thorough investigation into atomic research organisation. This greater openness was important, and the Waverly Committee, after studious consultation with both the political and scientific personnel directly engaged in

[58] UBSC US15 Section C.12 'Atomic Energy Research at Birmingham 1939-47', p. 2
[59] Joseph Rotblat, 'Taking Responsibility', *Science*, New Series, Vol. 289, No. 5480 (Aug. 4, 2000), p. 729
[60] J.A. Camilleri, *The State and Nuclear Power: Conflict and Control in the Western World*, (Brighton, 1984), pp. 13-14

atomic energy, recommended running the effort, in the interests of productivity, as an industrial organisation rather than a government department[61].

The new approach was further underpinned by the Prime Minister's decision to invite Lord Cherwell, a strong advocate of nuclear power, back into the Cabinet as Paymaster-General. As one of the only scientists directly involved in political processes, Cherwell pressed for a system similar to the United States, where government research was often transferred into the private field. This had notable advantages, such as increasing efficiency and reducing costs, but had been opposed by the Attlee government as unsuitable for what was still a purely military project[62]. However, as the economic and national prestige benefits of pursuing the new technology materialised, nuclear science claimed an increased role in state affairs and Cherwell's ideas gained support. Individual government departments were already appointing scientific advisers who thought in national contexts, as demonstrated in 1951 by the Chief Scientist of the Ministry of Fuel and Power, Harold Cox, who recommended developing atomic power if only to 'acquire a know-how which we could sell to others'[63]. This national thinking affected even Britain's greatest ally, with Cox stressing that Britain 'must not leave all export of these commodities to the US'[64]. Political awareness of the need for scientific advice elevated atomic experts from departmental to national level, as evidenced by the formation of the United Kingdom Atomic Energy Authority (UKAEA) in 1954, with several important scientists, including John Cockcroft and William Penney, on the Board[65]. This reflected a wider prevalent trend; the majority of politicians, with growing cross-party support (the motion to improve atomic organisation originated from a Labour MP), now appreciated the separate benefits of civil atomic power and supported the scientists'

[61] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, p. 26
[62] Ibid., pp. 25-6
[63] Margaret Gowing, *Independence and Deterrence, Britain and Atomic Energy 1945-1952, Vol. II,* (London, 1974), p. 288
[64] Ibid.
[65] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, p. 27

earlier request for autonomy[66]. Only the Minister of Supply complained that Cabinet 'had been influenced too much by the civilian and too little by the military aspects of atomic energy'[67].

The development of nuclear power was both a product and the catalyst of the changing philosophy of science and state as technological advances placed technical issues beyond politicians and into the hands of highly-educated men whose opinions were increasingly sought on important issues. The situation had developed so much by 1955 that Sir Frederick Brundrett, Chief Scientific Advisor to the Ministry of Defence, warned government that 'unless you incorporate the scientist as a full member of your team you are not turning out your First Eleven, and the mistakes that are made will be more numerous and have more serious consequences'[68]. As technology grew more complex, governments re-evaluated how they accessed information; scientists were sufficiently important to request control of their specific fields and the formation of talent-pools like the UKAEA allowed research to be run more effectively whilst enabling governments to obtain concentrated advice and co-ordinate strategy through a single organisation. The evidence for this argument within the existing research context is strong; Michael Posner has highlighted how British scientists gained power by successfully presenting their learning as an important national interest. Additionally, an important nuance has been developed by Joseph Camilleri, who identified the nineteen-fifties as a period during which advanced states institutionalised science and, with the co-operation of scientists, redirected research towards national goals[69]. Even so,

[66] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, pp. 25-6
[67] NA CAB/128/26, 'Conclusions of a Cabinet Meeting, 27th October, 1953, p. 60
[68] Sir Frederick Brundrett, 'Government and Science', *Public Administration*, Vol. 3, Issue 3, (Sep. 1956), p. 250
[69] J.A. Camilleri, *The State and Nuclear Power: Conflict and Control in the Western World*, pp. 13-20

Camilleri acknowledged that the 'bureaucratisation of science' was less severe in Britain, eventually giving the UKAEA a 'disproportionate influence' in energy planning[70].

Nonetheless, this autonomy had limits; while scientists were free to organise research, all Board members were appointed by the Lord President of the Council, a government position occupied in 1954 by Lord Salisbury, a long-established Conservative Cabinet member[71]. Furthermore, money had to be voted by the Treasury and unspent funds returned to state coffers[72]. Although financial control was eventually relaxed, serious governmental influence continued; after the 1957 Windscale fire the investigating committee requested organisational improvements in addition to the UKAEA remaining cost-effective. Nonetheless, these findings were presented as recommendations, not eventual government commands[73]. Therefore, it can reasonably be asserted that although scientists expanded their influence markedly, firstly through government departments and later autonomous organisations, there were important limits. The political acknowledgment that scientists presented a strong informational panel ultimately removed atomic power from ministerial control, placing it under the direction of experts with less influence from London. However, legal and financial frameworks ensured that although scientists were free to conduct research, their influence on top-level decisions would be as consultants. Nonetheless, the development of a scientific corps which could effectively *advise* governmental decisions was pivotal to the introduction of nuclear power and the experience in this sector illustrated wider trends wherein general scientific development attained increased prominence in government considerations throughout the nineteen-fifties. These broad-reaching changes eventually

[70] Michael Posner, *Fuel Policy: A Study in Applied Economics*, (London, 1973), pp. 89-90 and J.A. Camilleri, *The State and Nuclear Power: Conflict and Control in the Western World*, p. 40
[71] United Kingdom Atomic Energy Authority Act, 1954, Section 1
[72] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, pp. 26-7
[73] Ibid., p. 103

resulted in Labour formalising the role of Chief Scientific Advisor to HM Government in 1964 to encourage Harold Wilson's 'white heat of revolution'[74].

The third component of Burton Moon's triumvirate necessary for nuclear power, engineering, had already been advanced by the post-war demands of British defence infrastructure. Eric Hobsbawm argued that without World War Two the atom bomb would never have been developed and the subsequent huge expenditures to pursue nuclear electrical generation would not have been pursued[75]. Whether or not one agrees with this rather binary argument, it can certainly be accepted that the war accelerated the investigation into uranium fission for nuclear power; Maurice Stacey himself remarked that the Allied bomb project was accelerated 'by the fear that the enemy would get there first'[76]. Britain had played an important role in nuclear bomb research through the 'Maud Committee' but was forced to concede hegemony to the better-supplied American programme with the Quebec Agreement of 1943, after which many British minds transferred to the Manhattan Project that eventually provided the weapons which ended the war[77].

Possession of nuclear weapons was key for continued international prestige in the post-war environment, as demonstrated succinctly in autumn 1946 at a meeting of Attlee's 'GEN-75' group dedicated to investigating the possibility of a British nuclear deterrent. Sensing the committee opposed the idea, Ernest Bevin, the Secretary of State for Foreign Affairs, exclaimed 'we've got to have this thing over here whatever it costs! We've got to have the bloody Union Jack on top of it!'[78] This desire for an independent weapon was all the more

[74] David Edgerton, 'The 'White Heat' Revisited: The British Government and Technology in the 1960s', *Twentieth Century British History*, Vol. 7, No. 1, 1996, p. 56
[75] Eric Hobsbawm, *Age of Extremes: The Short Twentieth Century, 1914-1991*, (London, 1994), p. 47
[76] UBSC US15/C.12 Maurice Stacey Collection 'Atomic Energy Research at Birmingham 1939-47', p. 2
[77] Sheila Durie and Rob Edwards, *Fuelling the Nuclear Arms Race: The Links Between Nuclear Power and Nuclear Weapons*, (London, 1982), pp. 12-13
[78] Peter Hennessy, *Cabinets and the Bomb*, (Oxford, 2007), p. 7

pressing after the United States severed all technological and material support under the 1946 McMahon Act[79]. The result was the construction of the Windscale plutonium-producing nuclear plant, begun in September 1947 and completed three years later, during which time a second pile was commissioned. However, in the following years, the situation changed rapidly; the descent of Europe into Cold War and cooling relations with the USSR, including the outbreak of the Korean War in June 1950, showed that Britain's nuclear accession required acceleration. These political events dictated an upward revision in military plutonium requirements but ran counter to concerns about quantity and security of uranium supply. Thus, instead of a third Windscale pile, a uranium enrichment plant was commissioned at Capenhurst to increase plutonium yields from the same quantity of imported uranium. The need to obtain nuclear weapons was appreciated by scientists also, with Cherwell noting that 'in the military sphere atomic weapons will soon dwarf all other weapons and perhaps effect changes in international relations as great as those once wrought by gunpowder in the political structure of Europe'[80] The end product of this engineering development was the first British atomic bomb, detonated in October 1952 in north-western Australia[81]. Once again, the tightening working relationship between science and state was visible. As Margaret Gowing asserted, 'the scientists were concerned only that they had fulfilled the exacting and exhausting task the government had laid upon them' whilst retaining 'pride in their scientific and technological achievement'[82].

Nonetheless, the political drive to obtain British nuclear weapons had produced a large infrastructure dedicated to uranium fission for bomb-making. It was quickly understood that similar technology could be used for civilian purposes and a government report of late 1954

[79] United States Atomic Energy Act of 1946 (McMahon Act)
[80] NA CAB/129/55, 'Atomic Energy Organisation: Transfer from Ministry of Supply to a National Corporation', Memorandum by the Paymaster-General, 30th September 1952, p. 2
[81] Margaret Gowing, *Independence and Deterrence, Britain and Atomic Energy 1945-1952, Vol. II,* pp. 492-495
[82] Ibid., p. 494

concluded that atomic power had 'a good chance of proving, within the next 10 years to be competitive with electricity generated by conventional methods'[83]. R.F. Pocock has argued that commercial electricity generation became increasingly significant from 1953 onwards, but further examination quickly dispels the idea that weapons production therefore became a reduced consideration[84]. The continuing need for economic plutonium greatly informed the government's next step, to commission an atomic power station based on the PIPPA (Pressurised Pile for Producing Power and Plutonium) design at Calder Hall in Cumbria[85]. The new station would utilise technological advances to produce plutonium more efficiently, reducing uranium needs, but would also use the generated heat (previously released as waste) to produce electricity commercially, further reducing costs[86]. In short, plutonium plants were built which happened to produce electricity, rather than electrical generators with plutonium as a fortunate by-product[87]. The government were especially clear on the station's priorities, citing directly that 'Calder Hall was designed to produce fissile material for military purposes, as well as electricity for civil use' *in that order*[88]. To analyse briefly, it emerges that the push towards civil power was substantially consistent with Britain's wider post-war context; she had to produce atomic bombs to retain 'greatness' whilst enduring considerable financial constraints. Thus, although energy-generating technology originally emerged as an accomplice to military uses, the PIPPA reactors also successfully justified independent civil atomic power.

However, the government acknowledged the technological limitations of an expansive civilian nuclear programme, and the 1955 White Paper accepted that until

[83] NA CAB/129/72, 'The Production of Power from Nuclear Energy' Memorandum by the Lord President of the Council', 16th December 1954
[84] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom,* p. 19
[85] Ibid., p. 18
[86] Ibid., p. 19
[87] John, Krige 'The Peaceful Atom as Political Weapon, *Historical Studies in the Natural Science,* Vol. 38, No. 1 (Winter 2008), pp. 17-18
[88] NA CAB/128/28 'Conclusions of a Meeting of the Cabinet', Wednesday, 9th February, 1955

engineers had benefited from operational experience, all new plants would necessarily be of the 'Magnox' design[89]. The Magnox plants utilised gas instead of liquid coolants, owing to concerns for untested engineering techniques, material cost and safety, and consequently suffered low heat-emission and limited power generation[90]. Britain therefore committed itself to suffering the disadvantages of the pioneer and installed a generation of reactors which quickly became obsolete and more costly than the AGR systems which appeared from the mid-sixties. In total, eleven British Magnox stations were built, and although their military uses became progressively less significant, martial elements were fundamental to their original construction.

Regardless of military necessity or national prestige, the issue forcing nuclear power generation onto the agenda was Britain's increasingly unstable post-war fuel supply. On the surface, commercial nuclear power made little short-term financial sense, especially for a country struggling in the grip of austerity[91]. Even the initial tentative calculations made in 1950 by the Harwell engineer R.V. Moore accepted that a 90MW nuclear power station would cost £9m to build compared to a £5.4m conventional coal station and that the price per unit of electricity would be **at best** two-thirds higher from an atomic plant until significant engineering improvements could be achieved[92]. However, the study deliberately refused to factor-in any commercial benefit from the produced plutonium, the product which arguably inspired the British government to continue with the programme despite the costs. Nonetheless, offset against this was the 'time bomb' of coal supply. As Figure II demonstrates, British coal output rose after the war before plateauing in the early 1950s and declining at the decade's end. However, running counter to the trend of 'coming off coal' was

[89] NA CAB/129/73, 'A Programme of Nuclear Power', White Paper, February 1955
[90] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, pp. 23-4 and Peter Lloyd-Jones, *The Economics of Nuclear Power Programs in the United Kingdom*, (London, 1984), p. 9
[91] UK Public Spending, 'Statistics for British Public Debt, 1945-55' [online], (Date Accessed: 1st June 2011), Available from: http://www.ukpublicspending.co.uk
[92] Margaret Gowing, *Independence and Deterrence, Britain and Atomic Energy 1945-1952, Vol. II,* pp. 282-3, p. 303

the electricity sector, which enjoyed an increasing share of national coal consumption well into the 1960s. This state had been encouraged as early as November 1950 when the Ministry of Fuel and Power recommended prioritising coal for electricity generation to avoid repeating the disastrous energy cuts of 1947[93]. The tightness of coal was eased by other large consumers, notably British Rail, switching to diesel but it soon became clear that the collision of the upward trend in coal demand for electricity and the downward turn of supply could not be postponed forever[94].

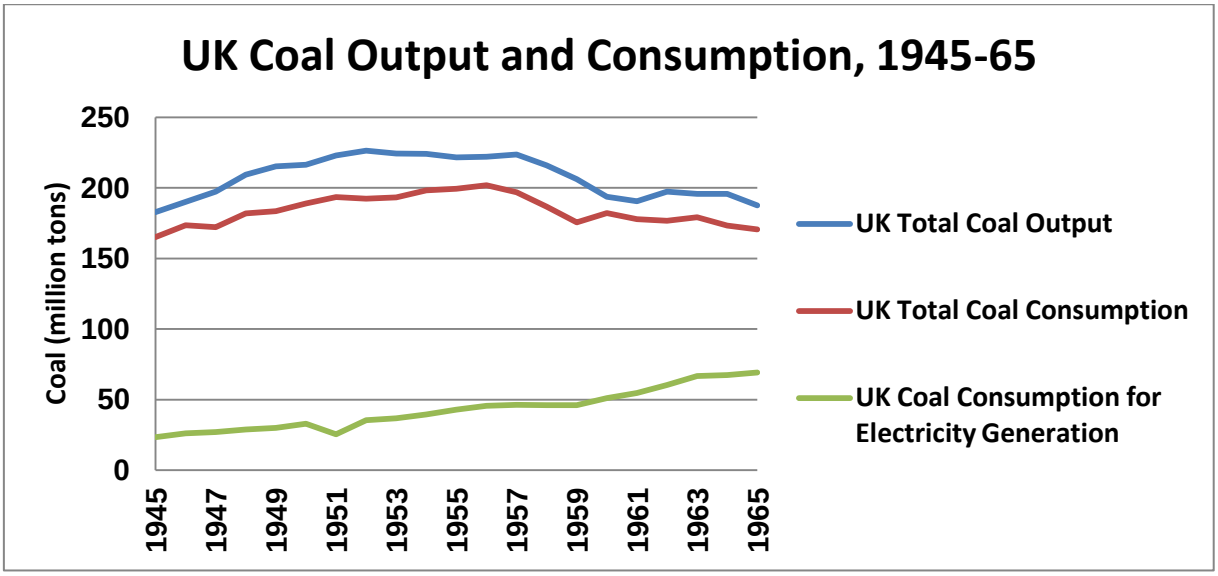

Figure II: UK Coal Statistics[95]

The immediate government solution was to increase oil imports, switching notably from the USA to Middle-Eastern states as the main provider. However, concerns over supply security resulting from the Suez Crisis of 1957 (visibly demonstrated in Figure III) forced the British to consider alternative, more politically-reliable energy sources, not least because events in Egypt had demonstrated British reliance on increased American imports to cover

[93] NA CAB/129/43, 'Coal: Priority for Power Stations' Memorandum by the Minister of Fuel and Power, 28th November 1950
[94] British Transport Commission, 'Modernisation and Re-equipment of British Railways', (London, 1955)
[95] B.R. Mitchell, *2nd Abstract of British Historical Statistics*, (Cambridge, 1971), pp. 66-8

gaps left by hostilities[96]. The search for an energy solution finally came to rest on the infant nuclear programme begun at Calder Hall in October 1956, less than a year earlier. The conditions present in Britain in the 1950s were certainly conducive to developing civil atomic energy; as John Cockcroft noted, Britain was 'a highly industrialised country with small hydro- electric resources, poor prospects of any substantial increase in coal production, and a rapidly increasing demand for electricity'[97]. In contrast to the US and its huge coal reserves, nuclear power was 'essential' for Britain to maintain economic growth.

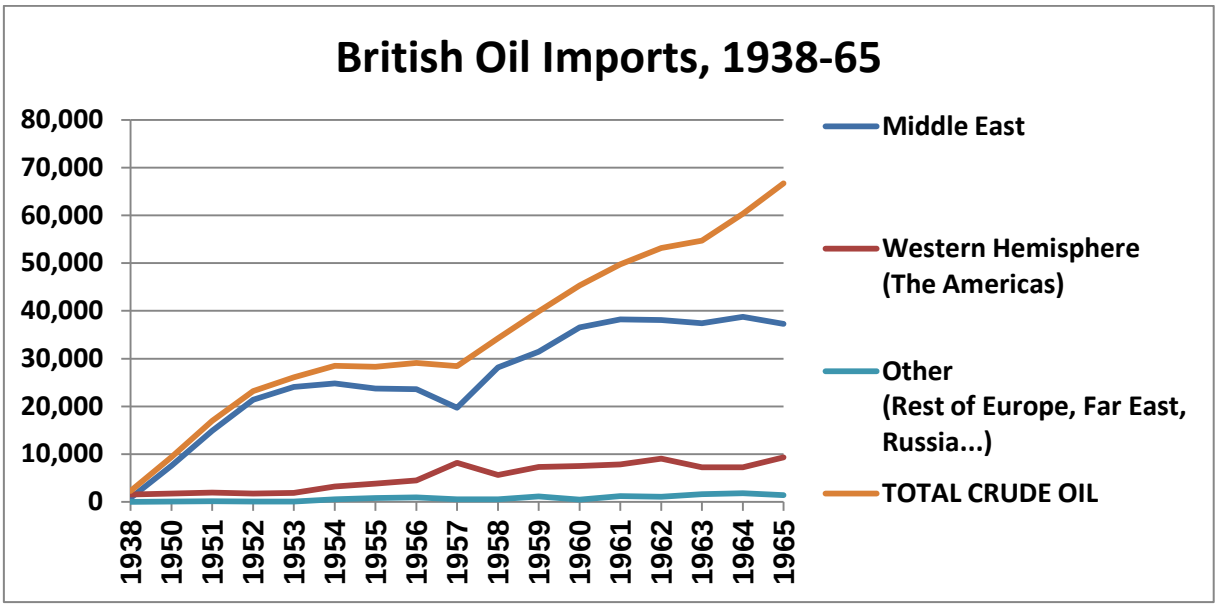

Figure III: British Sources of Oil, 1938-65[98]

Arguably the most attractive feature of uranium fuel was the security of its supply. The wartime projects had used Belgian and Canadian sources but even during the war politicians noted the potential for co-operation on atomic power within the British sphere of influence, a network John Curtin, the Australian Prime Minister, described in 1943 as the

[96] NA CAB/128/30, 'Minutes of a Cabinet Meeting' 20th November, 1956
[97] John Cockcroft, 'Future of Atomic Energy', *The Scientific Monthly*, (Mar., 1956), p. 137
[98] Kelly Adams and Kyle MacDonald-Wallis, 'UK Oil Imports since 1920', *Energy Trends*, (UK Department of Energy and Climate Change), June 2007, p. 27

'fourth empire'[99]. As demonstrated in Chapter I, one of Britain's few successes in the late forties had been to obtain more uranium than she strictly needed, much to the chagrin of the Americans. The CDA contracts continued into the post-war period, supplying Britain with Portuguese and Belgian ore sufficient to begin her domestic civil program[100]. Nonetheless, the presence of large reserves in politically secure, friendly Commonwealth states such as Canada, Australia and South Africa encouraged the British government to pursue close connections with erstwhile colonies in the expectation of a profitable exchange that would enable a large expansion of her atomic programme. The details of these negotiations will be examined in the next chapter.

The government White Paper of February 1955 acknowledged that coal was unlikely to cover Britain's rapidly expanding fuel needs, citing the lack of manpower as the main obstacle to increasing production. Instead, a tentative nuclear power programme was proposed, claiming that, if the Calder Hall experiment proved successful, electricity could be 'produced commercially in significant quantities within ten years'[101]. However, this slightly hesitant attitude had already been deemed inadequate by January 1956, when the Minister of Fuel and Power proposed accelerating the programme outlined in the White Paper in order to increase coal savings[102]. This desperation to transfer to a new fuel before the first commercial plant was even completed only deepened as the nineteen-fifties progressed. In 1957, directly referencing the problems caused by the Suez Crisis, the Minister of Power enthusiastically advocated uranium as a future energy source, citing that 'the tonnage that is needed of these raw materials is insignificant in volume and the generation of nuclear electricity could proceed without fear of such interference with shipping routes and pipelines as has caused the

[99] Christopher Staerck and Gillian Staerck, 'The Realities behind Britain's Global Defence Strategy' in Wolfram Kaiser (ed.), *British Foreign Policy, 1955-64: Contracting Options,* (London, 2000), pp. 37-9
[100] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom,* p. 117
[101] NA CAB/129/73, 'A Programme of Nuclear Power', White Paper, February 1955, p. 12
[102] NA CAB/129/79, 'Fuel and Power Prospects', Memorandum by the Minister of Fuel and Power', 26th January, 1956

present oil shortage'[103]. The conclusion was to recommend an eventual tripling (to 6,000MW) of nuclear energy capacity by 1965 with a further acceleration to 12,000MW in the five years thereafter[104]. Indeed, by the time one of the last Magnox stations, Dungeness A, was being planned in 1959, coal consumption had declined markedly and Macmillan was under pressure from mining unions to slow nuclear programmes to boost employment-generating coal production (Figure II). However, the Prime Minister heeded his Minister of Power and persevered, demonstrating the new importance of nuclear power in British energy politics by the end of the decade[105].

A consensus on atomic power economics is elusive. Margaret Gowing's initial analysis was unequivocal; Britain required atomic weapons at all costs, and although it was understood at both scientific and political levels that similar technology could produce power, military projects took absolute priority. Politicians were sceptical whether the huge capital outlay for civil nuclear power would ever be recouped, but acknowledged that contracting traditional fuel sources were making the previously uneconomical concept more attractive[106]. This view was reappraised relatively quickly by Roger Williams, who believed that nuclear programmes were hastened by a *premature* concern, prevalent across Europe in the early fifties, of a looming 'energy gap' in which oil could only provide temporary respite[107]. Indeed, Williams asserted that violently fluctuating fossil fuel supplies (moving from scarcity in the early fifties to abundance later in the decade) initially raised doubts about the economic viability of nuclear power and that civil programmes were only undertaken provisionally to be 'roughly competitive from the outset'[108]. However, by the time the plant had been sufficiently developed, costs were spiralling and Britain was forced to continue with nuclear power to

[103] NA CAB/129/85, 'Nuclear Power Programme', Memorandum by the Minister of Power, 25th February, 1957, p. 4
[104] Ibid.
[105] NA CAB/129/98, 'Nuclear Power Programme', Memorandum by the Minister of Power, 19th June, 1959
[106] Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-52. Vol. I*, pp. 236-240
[107] Roger Williams, *The Nuclear Power Decisions: British Policies 1953-78,* (London, 1980), pp. 60-63
[108] Ibid., p. 63

reduce the losses made on the technological investment. This debate was synthesised somewhat by Peter Lloyd-Jones, whose mathematical analysis demonstrated that the first Magnox reactors were inefficient even by contemporary standards and built with one eye on maintaining fuel supplies from safe, non-communist states, making fossil fuel security concerns fundamental to the decision to go nuclear[109]. However, he deemphasised the provisional nature of civil stations, arguing that atomic programmes were costly and would consequently be expected to play a long role in Britain's energy future. Thus, Jones supported Williams' conclusion that research and development of Britain's civil nuclear branch was underfunded and rushed, but simultaneously maintained that the cost of atomic power was not as concerning as he had implied. Instead, in agreement with Gowing, Jones contended that plant construction proceeded despite their inefficiency and cost precisely because *both* the military and the geopolitical fuel situation demanded it[110]. To summarise this debate, it is probably fairest to contend that economically, investing in new plant made little short-term sense in Britain and while civil power would eventually become an independent concern, its beginnings were almost exclusively bound to the redefinition of post-war British geopolitical strategy. Nonetheless, although politicians pursued atomic power with little initial interest in industrial applications, within five years it became apparent that the technology could solve other pressing issues.

Analysing these trends, the development of new technopolitical structures emerges as an important part of nineteen-fifties policy making. Labour's attempts to contain atomic science within centrally-controlled bounds for military purposes were countered by subsequent Conservative governments eager to find new approaches to severe pressures

[109] Peter Lloyd-Jones, *The Economics of Nuclear Power Programmes in the United Kingdom*, pp. 7-9, p. 39
[110] Ibid.

bearing down on Britain from multiple angles. While nuclear weapons were **the** vital asset for continuing political credibility, civil atomic power remained pertinent and quickly attained importance in the redefinition of British economic identity. In presenting a valuable escape from energy pressures, the technology simultaneously strengthened the government's hand in dealing with domestic coal flow and geopolitical energy crises resulting from the retreat from empire whilst fortifying the position of scientists as important to good economic policy decisions in the new energy environment. The 1955 White Paper predicted a saving of some six million tons of coal annually by 1965 and acknowledged that in an increasingly technological era, Britain's industrial future depended 'on the ability of her scientists to discover the secrets of nature'[111]. Nonetheless, while it was true that these experts experienced increasing influence, it is important to note that organisations like the UKAEA presented a unified atomic body which could offer stronger advice rather than impact decision-making directly. While new technopolitics required greater consultation, politicians were ultimately still free to override scientific opinion; after all, the civil atomic programme was a **government** initiative, within which the UKAEA was formed as a scientific coordinator. The scientific role in government policy will be evaluated further in the next chapters.

The contraction of the British vista produced questions about her identity; would she accept a reduced role and expose herself to foreign influence in energy or bullishly assert her independence? Atomic power offered the option that electricity supply could remain domestically safe through home-grown engineering at the price of removing energy from the eye-line of the working-class and placing it in the stratum of incredibly educated scientific elites. Although costly, this independence was important; atomic energy relied only on uranium supplies sourced from reliable cousins and provided a welcome counterpoint to the prevalent trend of British dependence on the United States exemplified by the Marshall Plan

[111] NA CAB/129/73, 'A Programme of Nuclear Power', White Paper, February 1955, p. 1, 12

and NATO. It also reasserted British willingness to participate at the highest level, despite outward decline, regardless of cost. The importance of atomic power was clear before the first station was even switched on, demonstrating that although the Magnox stations were built to produce power and plutonium, the importance of the former product was rapidly outstripping the latter within a few years of Calder Hall opening. Thus, by the mid nineteen-fifties civil atomic power was an independent element in the political understanding of Britain's changing international role and one which proved important in the upcoming years.

CHAPTER THREE: 'ATOMS FOR PEACE'; RECONCILIATION AND DEVELOPMENT

The next period of Britain's atomic history was arguably the most exciting in the technology's history. Every obstacle had been addressed; the economic rationale for civil atomic power had been hastened by energy tightness, the political will to achieve energy independence was established and the scientific body had been assembled to enact the work with suitable autonomy. The formation of the UKAEA combined scientists into a single strong lobby which could advise government effectively on maximising the potential of atomic energy. Whilst not an all-powerful interest group, the increased influence of science in good state policy ensured that the Authority was able to research improvements *and* provide the technical opinion on 'hard-core' government initiatives.

To proceed with industrial programmes, Britain needed to utilise the prestige of its new atomic autonomy to negotiate independent uranium agreements. The initial importance of South Africa evaporated as the anti-British Malan government ended the costly uranium prospecting commissioned by Jan Smuts[112]. South Africa would continue to supply uranium through the CDA only, albeit at a relatively low price, as the industry there was a cheap offshoot of gold mining[113]. The only other Commonwealth route, Australia, was problematic; the efforts of the Labour government to obtain uranium bilaterally in 1951 had been rebuffed and so production from Australia's two mines, Rum Jungle and Radium Hill, was guaranteed, *for defence purposes*, to the CDA until 1960 and 1963 respectively[114]. However, the opportunity to procure additional oxide for industrial purposes remained, and so the Conservative Cabinet decided in April 1953 to offer 'close technical co-operation' as

[112] David Fig, *Uranium Road: Questioning South Africa's Nuclear Direction,* (Johannesburg, 2006), pp. 38-9 and Margaret Gowing, *Independence and Deterrence, Britain and Atomic Energy 1945-1952, Vol. I,* pp. 381-383
[113] Peter Lloyd-Jones, *The Economics of Nuclear Power Programs in the United Kingdom*, pp. 28-9
[114] NAA A1209-1957/4196 PART 2 'Agreement between the Government of the State of South Australia and the Minister of Supply in the United Kingdom, 27th July, 1953' and NAA A4940 C2047 'Cabinet Committee of Uranium: Programme for Atomic Development, 18th September, 1953', p. 3

incentive for an independent agreement[115]. Churchill, encouraged by Cherwell and Chancellor Rab Butler, blamed the American agreements for Britain's lacklustre Commonwealth efforts and stressed to the Australians that Britain could no longer expect 'really useful collaboration' with America'[116]. Churchill now considered much of Britain's nuclear knowledge to be independently researched, enabling him to distribute industrial information freely, and without concern for America, among states offering worthy future partnerships, specifically Australia and Canada[117].

However, negotiations were rocky, as the Australians did not attach as much importance to British innovation as had been hoped; Cherwell's visit in October 1953 originally intended to swap British expertise for large options on local uranium, but succeeded only in guaranteeing Britain's 'preferred customer status'. The bargaining-chip of technical know-how was played down by the Australian Cabinet with Cherwell indignantly reporting that the local press and public had 'grossly inflated ideas about the value of their uranium deposits'[118]. Nonetheless, despite the tough attitude of the antipodean negotiators, the Paymaster-General argued that 'it would still on balance be worthwhile to make an offer of full technical assistance', demonstrating the degree to which Britain was reliant on its former dominion for a secure energy future[119].

Dealing with burgeoning Australian nationalism was chastening for the British, who rather expected to be greeted graciously by a nation grateful for scientific help. Indeed, the unsettling incident, alongside financial commitments, meant that Britain did not feel sufficiently confident to opt-out of renewing contracts with the Haut Katanga mine in the Belgian Congo the following spring, forcing them back into the American-controlled market

[115] NA CAB 128/26, 'Minutes of a Cabinet Meeting, 21st April 1953', p. 25
[116] NA CAB 129/60, 'Draft Telegram: Prime Minister to Mr. Menzies, 4th May 1953'
[117] Ibid.
[118] NA CAB CAB/129/64, 'Visits of the Paymaster General to Australia and the United States', Memorandum by the Paymaster General, 29th October, 1953, p. 2
[119] Ibid.

which they had sought to escape[120]. Thus, Britain fell back on its CDA stocks until an arrangement was finally reached in 1956 to supply uranium from Australia's Mary Kathleen mine, beginning in 1958 (Figure IV). Nonetheless, the price was relatively high; Britain would help Australia build a Harwell-type 'DIDO' reactor at Lucas Heights near Sydney in return for operating reports and concessions on future surplus uranium supplies[121]. The station opened in 1958 and represented the logical culmination of Commonwealth co-operation: Australian scientists trained at Harwell and British universities would operate a British-designed Australian-built plant using British-developed fuel rods made from Australian (CDA) uranium, with Britain processing the waste[122].

Mine	Proprietor	Period	Ore Milled (t)	U_2O_3 (%)	U_2O_3 Production (t)	Client
Radium Hill	South Australian Government	1954-62	970,000	0.11-0.15	850	CDA
Rum Jungle	Commonwealth Funded	1954-71	863,000	0.28-0.41	3,530	1953-1962 - CDA 1963-1971 - CS
Mary Kathleen	Mary Kathleen Uranium Ltd	1958-63	2,900,000	0.15	4,080	UKAEA
Moline (Mill Only)	United Uranium NL	1959-64	128,000	0.35-0.68	520	UKAEA
Rockhole	South Alligator Uranium NL	1959-62	13,500	1.12	138	UKAEA

Key:

CDA = Combined Development Agency
CS = Commonwealth Stockpile
UKAEA = United Kingdom Atomic Energy Authority

Figure IV: Australian Uranium Production, 1954-1971[123]

[120] NA CAB 128/27, 'Minutes of a Cabinet Meeting, 17th February 1954', p. 71
[121] NA DEFE 16/821, 'Letter to Winston Churchill from the British High Commissioner to Australia', 22nd January, 1954
[122] NA AB 22/1 'United Kingdom Atomic Energy Authority: First Annual Report (1954-55), pp. 31-32
[123] Adapted from: Parliament of Australia Senate, 'Parliament of Australia Senate Committee Report on Uranium Mining and Milling in Australia' 15th May, 1997, [online], (Date Accessed: 1st June 2011), Available from: http://www.aph.gov.au/Senate/committee/uranium_ctte/report/c01.htm

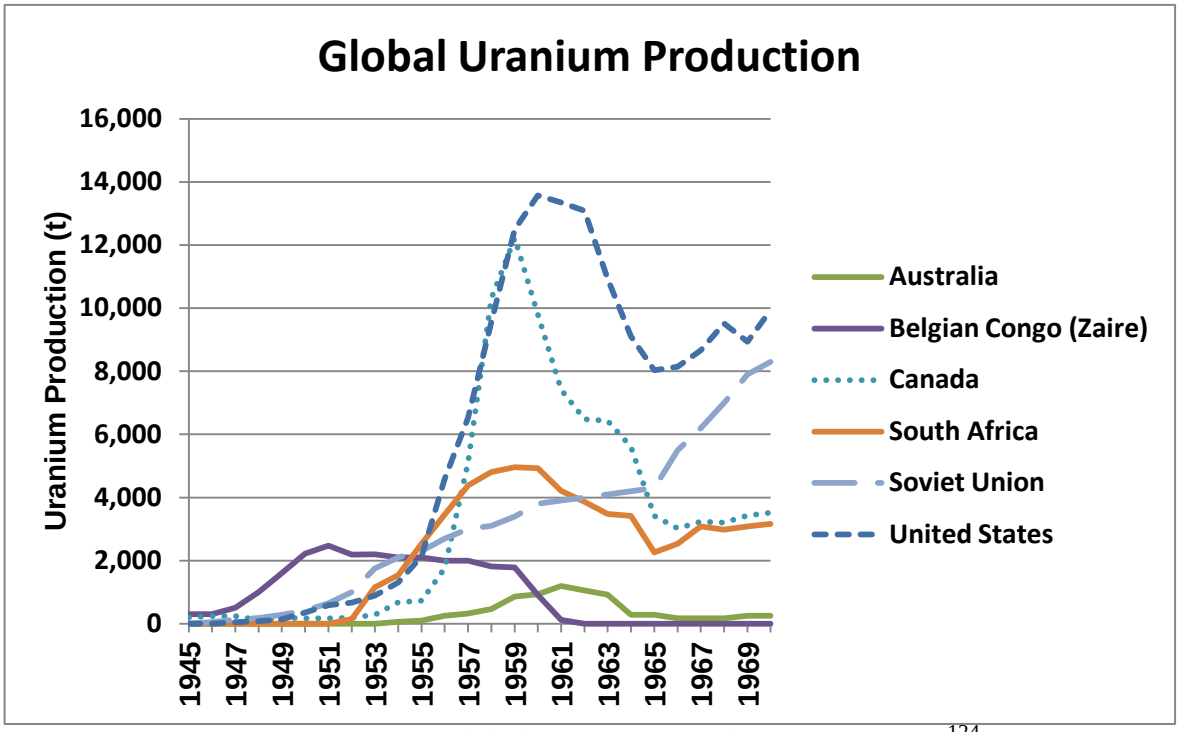

Figure V: Global Uranium Production, 1945-70[124]

A further contract was negotiated between the UKAEA and the Canadian El Dorado mining company in 1957[125]. However, the global uranium market was volatile; supply chains grew in strict connection with military (and a minority of commercial) contracts in a manner described by R.F. Pocock as resembling 'wildcat prospectors reminiscent of the nineteenth century gold rush'[126]. When these demands became saturated in the late 1950s, the market collapsed, causing serious problems for the British (Figure V). Huge overestimations of uranium requirements prompted cancellation of the Anglo-Canadian orders, with the UKAEA blaming the slow development of the nuclear programme, improved uranium usage efficiency, reduced military needs and disappointing exports[127]. The issue was politically sensitive; the Canadians were loath even to 'stretch out' orders and the Authority was warned

[124] OECD Nuclear Energy Agency, *Forty Years of Uranium Resources, Production and Demand in Perspective: "The Red Book Retrospective."* (Paris, 2006), pp. 255-258
[125] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, pp. 118-119
[126] Ibid., p. 117
[127] Marian Radetzki, *Uranium: A Strategic Source of Energy*, (London, 1981), pp. 37-39 and NA DO 182/2 'Atomic Energy Authority: Annex A:Uranium Stocks Report' 3rd November, 1960

against damaging Commonwealth relations[128]. Additional South African orders were more easily cancelled but the Canadian problems were serious and effectively ended any notion of a Commonwealth atomic organisation. Placing this study in its correct context is difficult, as little has been written about Britain's uranium supply; these negotiations have therefore been detailed because they demonstrate an important trend towards the re-definition of the Commonwealth. The atomic field highlighted Britain's reduced influence over former territories, a factor which would subsequently inform Britain's response in other quarters, notably Europe.

Nonetheless, despite a mixed Commonwealth reaction towards her atomic power, Britain secured the fuel and developed sufficient plant to proceed. The civilian element of peaceful atomic power generation, in which Britain was rapidly becoming world leader, has often been overshadowed by the perceived main objective of bomb testing. While the technical achievement of building atomic weapons during the American blackout was certainly 'undervalued', as Margaret Gowing asserted, the independent spirit it engendered also permeated far into the civil field[129]. The McMahon Act had been motivated primarily by concerns for sensitive scientific information and critics feared that British security particularly lacked the stringency of the US, where all federal scientists underwent loyalty checks[130]. Indeed, estimates of the time Klaus Fuchs' espionage had saved the Soviets varied from the reasonable (two years) to the over-reactionary (ten)[131]. The situation had not improved by the mid-fifties, with the USAEC Chairman Admiral Strauss protesting that Britain had failed to

[128] NA DO 182/2 'Commonwealth Relations Office Memorandum on UKAEA to Purchase 12,000 Tons of Uranium from Canada' Draft Revision, 16th August 1960
[129] Margaret Gowing, *Independence and Deterrence, Britain and Atomic Energy 1945-1952, Vol. II*, p. 349
[130] Harry S. Truman Library, 'Executive Order 9835 'Prescribing Procedures for the Administration of an Employees Loyalty Program in the Executive Branch of the Government', 21st March 1947 [online] (Date Accessed: 1st June 2011), Available from: http://www.trumanlibrary.org/executiveorders/index.php?pid=502&st=&st1=
[131] For the former calculation, see Hans Bethe (ed.), *The Road from Los Alamos*, (London, 1991), pp. 3-11 and for the longer estimate, see Edward Teller, quoted in John Krige, 'Atoms for Peace, Scientific Internationalism and Scientific Intelligence', p.178

improve security as promised[132]. British controls, although not lax, were certainly calmer relative to American paranoia during the McCarthy era, where politically-motivated censorship claimed its most high-profile scientific victim, Robert Oppenheimer, in 1954.

Lower security concerns allowed a large international scientific community to develop in Britain. Indeed, the futility of controlling foreign influence in the multi-national scientific sector was highlighted in an impassioned letter from Rudolf Peierls to Viscount Portal, in which he listed numerous ways he himself might be considered a security threat if otherwise meaningless personal details were wilfully misinterpreted[133]. The highest stratum of nuclear science involved scientists well-acquainted from years of communication and who consequently were often friendly (Peierls himself wrote frequently to 'Uncle Nick'- Niels Bohr)[134]. However, the ethics of top-level scientists often encouraged them to spread scientific information for the global good regardless of politics, causing domestic problems. Christopher Hinton, in a frank message to UKAEA Chairman Edwin Plowden, identified a fundamental split in the scientific body between scientists like John Cockcroft who wanted to 'disseminate information as widely as possible' in the interests of knowledge, and industrialists (like himself) who wished to pragmatically pursue British interests[135]. Cockcroft himself gave lectures in Poland and opened discussions on how Britain could assist atomic programmes behind the Iron Curtain, an approach supported by Peierls, who championed open science's potential for building communication with the Soviet bloc, subject to suitable safeguards[136]. Thus, in the sense of national identity, men like Cockcroft might more reasonably be described as 'scientific Britons' who enjoyed numerous close global

[132] 'Letter from the Chairman of the Atomic Energy Commission (Strauss) to the President', 3rd March, 1955, *FRUS* Vol. XX, Document 11
[133] 'Letter from Rudolf Peierls to Viscount Portal of Hungerford, 9th April 1951' in Sabine Lee (ed.), *Sir Rudolf Peierls: Selected Private and Scientific Correspondence, Vol. 2*, (London, 2009), pp. 271-4
[134] For one example see 'Letter from Rudolf Peierls to Niels Bohr', 6th February 1948 in Ibid., pp. 124-5
[135] NA AB 19/13 'Message from Christopher Hinton to Edwin Plowden', 28th March 1955
[136] NA AB 27/14 'Exchanges between Polish Minister for Atomic Energy and John Cockcroft' May-June 1957 and 'Lecture given to the Polish Academy of Science' 22nd March 1957 as well as 'Letter from Rudolf Peierls to William Penney, 6th March 1956' in Sabine Lee (ed.), *Sir Rudolf Peierls: Selected Private and Scientific Correspondence, Vol. 2*, pp. 538-542

contacts[137]. However, this was not always in the interest of those who wanted to develop civil atomic power to increase Britain's stock of secret information and thereby her power.

Nonetheless, wider events changed the scene. Prompted by the conclusion of the Korean War, in December 1953 President Eisenhower addressed the UN General Assembly with 'Atoms for Peace', a scheme designed to reduce tensions with post-Stalinist Russia and re-engage drifting allies[138]. The President acknowledged that America's atomic monopoly had been lost to Soviet proliferation for some time and decided on a policy of rapprochement whilst overseeing an unprecedented nuclear weapons build-up. Eisenhower increased US stocks twentyfold during his presidency and desperately needed to offset this warlike image in Europe; exploring this, John Krige identified an ulterior motivation in 'Atoms for Peace' as propaganda[139]. Britain, as the nation seemingly most seriously engaged with peaceful atomic energy, was enrolled by the United States to sanitise her martial image; as Admiral Strauss put it, 'America would no longer be the sole target of Communist propaganda and irrational protests from Nehru and others'[140]. Ironically, the technical advances achieved by Britain during the years of American atomic isolationism were eventually to prove critical to this re-evaluation of nuclear strategy; in 1954, Eisenhower oversaw the Atomic Energy Act which, as Simon Ball noted, 'enabled nuclear cooperation with countries which had made significant independent advances in the field of nuclear energy'[141]. This was tacitly an acceptance that Britain's nuclear programme had survived the American blackout and flowered regardless.

[137] This is well-documented, but for the specific case of John Cockcroft, see: NA AB 27/3. This file contains numerous warm congratulatory messages from various scientists and politicians upon Cockcroft winning the 1951 Nobel Physics Prize.
[138] Atoms for Peace Speech, UN General Assembly, President Eisenhower, 8th December, 1953
[139] John Krige, 'Atoms for Peace, Scientific Internationalism and Scientific Intelligence', p.162
[140] 'Letter from the Chairman of the Atomic Energy Commission (Strauss) to the President', 3rd March, 1955, *FRUS* Vol. XX, Document 11
[141] S. J. Ball, 'Military Relations between the United States and Great Britain under the Terms of the McMahon Act, 1946-1958', *The Historical Journal*, Vol. 38, No. 2, (June 1995), p. 449

Indeed, Eisenhower openly lamented the 'terrible attitudes' within the Truman regime towards Britain which stalled American atomic advances[142].

However, Britain's industrial atomic programme had strengthened her hand, as demonstrated by the response of some of its key scientists to the American overtures. Christopher Hinton argued forcefully that American information offered under the new agreement was of limited worth and that the knowledge of operating Calder Hall given in trade was far more valuable. The possibility of so unfair an exchange occurring caused Hinton to contact Plowden directly, requesting greater industrial representation on the UKAEA Committee in order to influence the government against dispensing information abroad too freely[143]. This was the new national identity in action; the emerging sense of international openness in the 1950s presented the opportunity for Britain to appreciate American overtures but also assert her own position as the atomic decade's leading commercial scientific power.

The American position in introducing potentially dangerous technology into the global scene was unenviable and 'Atoms for Peace' was hailed by contemporaries as a genuine attempt to defuse the nuclear world. However, further analysis suggests a parallel motivation; Britain's more liberal approach to atomic knowledge distribution was attracting increasing attention from nations wanting to invest in the new technology. Whilst it is implausible that 'Atoms for Peace' was born solely from fear that Britain might corner the market in atomic hardware development, the existence of Britain's independent reactor programmes, followed later by those in Canada and France, merited consideration. Atomic knowledge was clearly widespread and so America's policy shifted from preserving hegemony to supporting full atomic interchange, hoping that promoting civil power would divert foreign expertise and

[142] 'Memorandum of Discussion at the 236th Meeting of the National Security Council, Washington', 10th February, 1955, *FRUS* Vol. XX, Document 7
[143] NA AB 19/13 Message from Christopher Hinton to Edwin Plowden, 25th March 1955

resources from military science. The suggestion to produce an international fissionable uranium pool was driven by the knowledge that such material would be difficult to produce outside the USA, meaning that any contribution would slow foreign atomic projects considerably[144]. Whilst this was aimed firstly at retarding the Russian military programme, it was arguably later influenced by the British development of an independent atomic structure and the growing appreciation of potential future markets. Thus, Britain's atomic field exhibited strength in American eyes among weakness elsewhere.

The multiple facets of 'Atoms for Peace' have encouraged a lively debate; in addition to Krige's ideas on propaganda, Joseph Camilleri has offered that the potential foreign market for reactors (worth some $30bn.) was lucrative enough to encourage a policy change[145]. However, in the context of this study, the notion that Britain's atomic progress encouraged Eisenhower's policy has enjoyed significant support. William Walker contended that the American administration, their view clouded by layers of secrecy on both sides, identified that civil gains would provide Britain with *at least* a valuable tool for influencing neighbours while the technology potentially offered a second industrial revolution[146]. Whilst this may be overstating the case, it remains a reasonable contention that Britain, as the leader of nations making independent atomic gains, demonstrated convincingly that American technological premiership was threatened. Thus, foreign civil schemes were arguably a notable parallel consideration in Atoms for Peace, rather than merely a by-product of a policy designed to combat Soviet military proliferation.

Another aspect of Eisenhower's speech was its demand for a scientific conference to follow United Nations political meetings in 1955. The Geneva Summit, designed to relieve

[144] John Krige, 'Atoms for Peace, Scientific Internationalism and Scientific Intelligence', pp. 163-4
[145] J.A. Camilleri, *The State and Nuclear Power,* p. 28
[146] William Walker and Måns Lönnroth, *Nuclear Power Struggles: Industrial Competition and Proliferation Control,* pp. 9-10

tension with the Soviet bloc, preceded a scientific discussion marked as the first truly international event of its kind since the war. It also illustrated American acceptance of British civil leadership: Eisenhower allowed delegates to draft and expand the agenda after lengthy consultation with British scientists, notably Cockcroft[147]. Although there was 'no surprise in the Soviet Display', as the *Times* reported, the conference nevertheless built bridges with the Russians who were no longer seen, as one American general had previously claimed, as a 'retarded folk' dependent on Nazi scientists for trivial progress[148]. It also enabled the British to showcase their new technology to great aplomb; fifty UK companies received enquiries from dozens of nations about spreading atomic expertise globally[149]. Such was the demand for industrial information that the UKAEA chartered three flights from Geneva to show 100 foreign scientists (30 of whom came from the Soviet bloc) the Harwell laboratories[150]. It was the high summer of atomic optimism; Cockcroft himself enjoyed a little fanciful thinking, highlighting the potential of atomic power for such massive projects as draining the swamps of Bechuanaland or air-conditioning the Australian outback[151]. From a scientist's perspective, and particularly for men like Cockcroft, Geneva was a paradise. For politicians, it confirmed their suspicions: Russia was scientifically in the western slipstream, but nonetheless possessed the A-bomb and was *just* capable of embarking on civil atomic power using domestic uranium.

As a nation self-defining as an atomic pioneer, Britain moved quickly. In ten years she had accelerated from begging American help to attaining world premiership in commercial atomic power. The 1955 White Paper outlined how the new technology was perceived by politicians in relation to Britain's international role; it was confidently asserted that 'as a

[147] Richard Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission*, pp. 234-5
[148] 'New Atomic Projects', *The Times*, 8th August 1955, p. 6 and John Krige, 'Atoms for Peace', p. 178
[149] John Krige, 'Atoms for Peace', p. 175
[150] 'Iron Curtain Visit to Harwell' *The Times*, 12th August 1955, p. 8
[151] John Cockcroft, 'Future of Atomic Energy', *The Scientific Monthly*, Vol. 82, No. 3 (Mar., 1956), p. 138

leading industrial nation our duty, both to ourselves and other countries, is to establish this new industry of nuclear energy on a **firm** foundation and to develop it with all speed'[152]. The opening of Britain's first civil power station at Calder Hall in October 1956 was a huge event, glorified by the *Times* in a special supplement featuring interviews with all involved[153]. The good-feeling manifested itself widely, with Britain keen to demonstrate the benefits of her new technology globally. The government agreed to the requests of the UKAEA for greater openness and allowed visits from a team of Soviet electrical engineers in March 1956, with Khrushchev and Marshal Bulganin following in August[154]. In addition to thawing relations, the visits also demonstrated how atomic energy had risen seamlessly into the highest stratum of British industry. The engineers were shown the atomic sites of Harwell and Calder Hall alongside longstanding conventional power infrastructure; Khrushchev was offered tours of the same nuclear installations alongside traditional British powerhouses like Rolls Royce, BMC and Clyde shipbuilding[155].

It was certainly advantageous for Britain to generate foreign interest; the 1955 White Paper urged the rapid development of peaceful atomic power at home and through international agencies, hoping that Britain's pioneering status would help 'fulfil her traditional role as an exporter of skill'[156]. The increased flexibility of the 1954 Atomic Energy Act had produced 40 bilateral contracts between America and other states for research reactors, but crucially, Britain had also identified this market as ripe for development until full atomic programs were widely economical[157]. Despite being derided as 'somewhat primitive' by notable American physicists, the British Magnox stations were attractive enough to highly-

[152] NA CAB/129/73, 'A Programme of Nuclear Power', White Paper, February 1955, p. 11
[153] *The Times,* 17th October 1956
[154] NA AB 16/1737 'Central Electricity Authority: Visit of Soviet Engineers, Friday 16th March-Friday 6th April 1956, Working Itinerary' and 'Minutes of held in the Foreign Office on Tuesday, August 23rd, 1956, to discuss the Draft Programme for the Visit of Marshal Bulganin and Mr. Khrushchev to the United Kingdom'
[155] Ibid.
[156] NA CAB/129/73, 'A Programme of Nuclear Power', White Paper, February 1955, p. 9
[157] Henry DeWolf Smyth, 'Nuclear Power and Foreign Policy', *Foreign Affairs,* Vol. 35, No. 1, (October 1956), p.13 and J.A. Jukes, 'Nuclear Energy: A Survey of Britain's Position', *International Affairs,* Vol. 32, No. 3(Jul., 1956), pp. 280-1

industrialised, densely-populated countries suffering post-war energy shortages, most obviously in western Europe[158]. The true effect of British nuclear independence was the transatlantic reaction; abundant fossil fuel stocks made civil atomic reactor development in the USA uneconomical but American physicists nonetheless began to advocate developing an atomic programme 'beyond domestic needs' for export purposes[159]. Britain had led the demonstration that there was 'no such thing as a monopoly on the laws of nature' and was preparing to assist interested parties in launching their own atomic programmes[160]. Thus, 'Atoms for Peace', as an ideological shift-change in American thought, was not motivated solely by the need for international atomic security but the concern not to forfeit her potential commercial atomic advantage.

The development of civil atomic power in Britain proceeded well for the remainder of the nineteen-fifties and the second 'PIPPA' reactor was opened at Chapelcross in 1959, albeit it to less fanfare (a 40-word summary was all *The Times* deemed worthy)[161]. Two further plants were completed in 1962, although now the Central Electricity Authority (CEA, later the CEGB) offered commercial contracts to private companies under UKAEA supervision[162]. However, the saturation of military plutonium requirements described earlier ensured that these Magnox plants were intended primarily for civil power generation, making the future of atomic power in Britain a mainly commercial exercise[163]. One of the first tests of Britain's new scientific identity came around 1958, when it emerged that further research and development was required to improve atomic power's competitiveness. Britain's limited technical manpower was stretched too thin, forcing the UKAEA to streamline research into the most promising categories (Figure VI). Importantly, the private construction consortia also lacked skilled engineers and were occupied almost exclusively

[158] Henry DeWolf Smyth, 'Nuclear Power and Foreign Policy', p. 9
[159] Ibid., p. 16
[160] Ibid., p. 13
[161] 'First Nuclear Power in Scotland', *The Times*,26th February 1959, p. 5
[162] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom,* pp. 53-4
[163] Ibid., pp. 40-1

constructing the already-obsolete Magnox stations in Britain, meaning, as R.F. Pocock noted, that no reactor system was developed for its export potential alone[164]. Here, the British organisation stalled them; the UKAEA could not transfer government funds to private companies directly and had no remit to develop export potential. Its only contribution, therefore, was to provide intellectual assistance and lobby government to help industrial exports[165]. This hamstrung scientists working to promote international co-operation, with Cockcroft being forced to assist Norwegian reactor programmes to raise European financial assistance for his new helium-cooled research plant at Winfrith[166]. Thus, Britain's atomic development capacity reached its limits almost purely on domestic requirements, leaving little scope for extensive exporting and reducing the technology's potential as a foreign policy instrument.

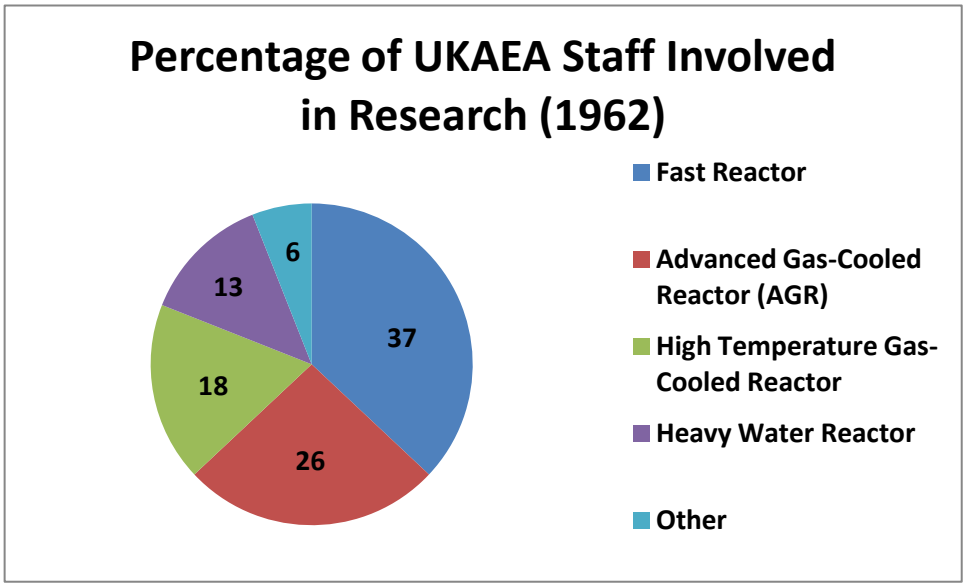

Figure VI: UKAEA Research, 1962[167]

An independent British nuclear programme to satisfy even domestic demand also did not fit into the wider American plan for post-war Europe. Timothy Mitchell has accused the American administration of deliberately undermining the traditionally strong coal lobbies in

[164] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, p. 88
[165] Ibid., pp. 86-88
[166] Ibid., p. 86, 107
[167] Ibid., p. 86

Europe by transferring the continents energy dependence to Middle-Eastern oil which had to be negotiated through dollars[168]. This assertion has been expanded by David Painter, who demonstrated how oil, with American backing, became the single greatest Marshall Plan purchase[169]. As a declining global power, Britain's dependence on oil from the Middle East, an area demonstrating increasingly nationalistic anti-imperial tendencies, was a less attractive proposition than most. The events of the Anglo-Iranian Oil controversy and Suez Crisis proved that oil in a great power context was undesirable, whilst the traditional support of 'King Coal' (described in Chapter II) was under severe pressure[170]. Atomic power was a logical escape to this conundrum, representing an opportunity for Britain to remain independent of wider energy commitments and sit more easily at the centre of her 'three circles'. Developing nuclear capacity, as a reaction to the confluence of European energy constraints and her self-envisaged global role, reclaimed much autonomy and influence in the energy field for the UK, giving her a new position based on scientific and technical expertise. As the UKAEA's economists concluded happily: 'the civil reactor programme has done its job by showing coal miners and sheikhs that there is strong competition not far above the present price range for coal and oil'[171].

Although Britain had successfully negotiated a more tolerable civil atomic understanding, it remained to settle the Anglo-American military relationship. Harold Macmillan, furthering as Prime Minister the beliefs he fostered as defence minister, pushed Britain's nuclear programme onwards to acquire the hydrogen bomb[172]. As one commentator put it, pursuing the H-Bomb amounted to a choice of whether Britain would return 'toward

[168] Timothy Mitchell, 'Carbon Democracy', p. 406
[169] David Painter, *Oil and the American Century: The Political Economy of U.S. Foreign Oil Policy, 1941-1954,* (London, 1986), pp. 153-165 See also: David Painter, 'Oil and the Marshall Plan', pp. 359-383
[170] David Painter, *Oil and the American Century*, pp. 172-207
[171] NA AB 16/2596 'P.E. Watts (Economics Branch) to Dr. Clarke, 1959'
[172] Leon D. Epstein, 'Britain and the H-Bomb, 1955-1958', *The Review of Politics,* Vol. 21, No. 3 (Jul., 1959), p. 517

the status of the superpowers, or toward that of Sweden and Switzerland'[173]. Continued pressure from British politicians and militarists to see Britain as integral to, rather than a forward base of, America's European nuclear defence wall eventually encouraged the resumption of Anglo-American information-sharing relations in the late 1950s, exemplified by the two bilateral agreements of 1958-9 resuming nuclear technology transfer [174]. Again, Britain's new assertiveness in the atomic energy sector was demonstrated; Macmillan co-operated happily on weapons matters in which America was obviously pre-eminent but insisted that the treaty omit any references to sharing civil atomic power, a preamble to which effect had been attempted by Congress in their repeal of the McMahon Act[175]. On a political level, Britain regarded civil atomic power as her area of hegemony, and was reasonably justified; the Americans acquiesced and the offending paragraph was removed[176]. The path, as John Baylis asserted, was now clear for 'an Anglo-American nuclear partnership that remained in force throughout the Cold War period' and finally buried the bad-feeling of the late nineteen-forties[177].

To summarise, the period described in this chapter was arguably the most fundamental to the evolving British outlook on atomic energy. Politically, Britain envisaged itself as the central hub of the Commonwealth; the most advanced nation seeking to promote civil atomic energy as a magnanimous gesture for global development[178]. She expected to export talent and in return receive raw materials necessary for her research programmes. However, the initial difficult negotiations produced a new definition of the Commonwealth as 'common'

[173] Leon D. Epstein, 'Britain and the H-Bomb, 1955-1958', p. 518
[174] S. J. Ball, 'Military Relations between the United States and Great Britain under the Terms of the McMahon Act, 1946-1958', p. 452
[175] NA CAB/128/32, 'Minutes of a Cabinet Meeting', 1st July, 1958, p. 3
[176] NA CAB/128/32, 'Minutes of a Cabinet Meeting', 3rd July, 1958, p. 4
[177] John Baylis, 'Exchanging Nuclear Secrets', p. 33
[178] NA CAB/129/88 - 'Commonwealth Economic Development: Note by the Secretary of State for Commonwealth Relations', 9th July, 1957, pp. 61-75

and not merely the old Empire wearing different clothes. Notions of Britain generously helping erstwhile colonies get on their atomic feet were soon disabused as the emphasis shifted to mutual assistance.

The years of American withdrawal produced political barriers increasingly at odds with the reality of growing atomic capability across the Iron Curtain, an action which in itself shaped a distinctly British national position. The scientific body which had accumulated in Britain was at the forefront of this, consisting of a pool of relatively international talent torn to varying degrees between atomic power as a matter of national prestige or its uses for international benefit. The offers to share scientific knowledge with interested parties went some way to identifying future European partners, thawing relations in Moscow and provoking an American response; 'Atoms for Peace' was forced by the dual realisation that the McMahon Act had contained neither the Soviet military nuclear programme nor Britain's potential commercial challenge. Encouraged by the progressive loosening of American legislation caused by independent acquisition of nuclear then hydrogen bombs, Britain grew increasingly confident, demanding a more equal relationship. Her commercial advances certainly provoked their own reaction; America promoted civil power as propaganda to cover military build-up and accelerate her civil research. Thus, this study has demonstrated how Britain's civil power was a more important factor in changing American attitudes than much current historiography allows. This effect was so strong that it finally achieved the previously most intractable 'fission', the separation of atomic energy into distinct military and civil categories.

Yet it was this latter application that slowed Britain's rise. There was no immediate appreciable Commonwealth market for atomic power; although India presented strong consumer potential, short-term interest was probable only in highly-industrialised areas which

were also under energy stress. However, the early stages of European atomic programmes were also viewed hungrily from across the Atlantic and so Britain entered the late nineteen-fifties with a prestigious position that it was not completely capable of sustaining. In any case, by the end of the decade much of the earlier hope for international cooperation had descended into a web of bilateral agreements; in 1959 the director of the IAEA labelled the USA the organisation's 'Achilles Heel' for repeatedly bypassing its authority in this manner. Britain and the USSR were also culpable, with a dozen such arrangements each[179]. The commercial flowering of civil atomic energy superseded the earlier military paranoia, with Britain developing the world's largest domestic atomic energy network and obtaining obvious economic advantages over its continental neighbours, which now offered a lucrative technological market. However, concerns over export capacity and political unwillingness to integrate, or even interfere with, a continent undergoing severe political fluctuations informed the role of atomic power in Britain's national position. The successes and failures of atomic Britain in post-war Europe shall be examined in the next chapter.

[179] Helen C. Allison, 'News Roundup', *Bulletin of the Atomic Scientists*, January, 1959, p. 47

CHAPTER FOUR: EUROPE

The next diplomatic challenge was presented by Britain's neighbours. In the broader context, the European political theatre, traditionally relegated behind imperial expansion, now presented an opportunity. As Tony Judt asserted; 'America might be the indispensable ally, but it could hardly furnish the British with a renewed sense of purpose, much less an updated national identity... where else but to Europe could Great Britain now look to recover its international standing?'[180]. The arrival of atomic technology coincided with the building of 'New Europe', and finding a place for such science on a continent undergoing severe political change proved challenging. Atomic weapons had already proved too much to act on internationally; Labour had lost Britain's veto on American nuclear bombs and the failure of the European Defence Community in 1954 demonstrated the limits of continental military integration. The acquisition of atomic arsenals was too vital an interest to contain; all great powers (real and perceived) coveted them, if only to ensure national security. Digesting the 1955 Geneva Conference, Harold Macmillan, Britain's Chancellor, described how nuclear weapons were now vital for preventing conflict and expressed confusion at disarmament lobbies encouraging a return to 'respectable war' with mass armies and huge casualties[181]. This paradox ensured that the future of atomic co-operation in Europe would, initially at least, involve only peaceful applications, although by the mid-fifties it was dubious that Europe could agree on even this issue. The young French nuclear programmes did not immediately consider a continental project, instead seeing independent Britain as the obvious benchmark for competition[182]. Indeed, the negotiations surrounding a unified European atomic energy

[180] Tony Judt, *Postwar: A History of Europe since 1945*, (London, 2007), p. 302
[181] Entry for 25th July 1955 in Peter Catterall (ed.), *The Macmillan Diaries: The Cabinet Years, 1950-1957*, (London, 2003), p. 459
[182] Gabrielle Hecht, *The Radiance of France*, (London, 1998), p. 87

community, and the attendant proposal to pool know-how were initially treated by some French sectors as dangerously assisting Germany, a 'Kollaboration' for the nineteen fifties, as George Beaulieu dubbed it[183].

The British position was more precarious; she was preoccupied with maintaining the independence that had consumed so much effort and would decline any European venture prejudicial to Commonwealth links. Indeed, atomic power was a policy area in which Commonwealth support was more important than most, given the previously-mentioned issues of uranium supplies and scientific exchanges. Later, concerns about retaining friendly military information-sharing relations with America also discouraged integration, as it was feared the USAEC would dislike British atomic co-operation with supranational European organisations[184]. Thus, the interests of the atomic energy lobby conformed to political euro-scepticism during the initial discussions on European integration during Anthony Eden's premiership. For these reasons, among others, British delegates did not engage seriously with strong European integration in the mid-fifties, sending only observers to the 1955 Messina Conference[185]. In British eyes, any action would have to come through the OEEC, a looser organisation formed in 1948 to promote individual European economies[186]. This lukewarm response caused consternation in Washington, where the British Ambassador was forced to defend the government position, criticising the 'air of unreality' regarding France's willingness to integrate and highlighting Britain's own commitment to Commonwealth association and reducing tariffs (conforming with GATT) as grounds for declining

[183] Gabrielle Hecht, *The Radiance of France*, p. 144
[184] NA CAB/128/34, 'Minutes of a Cabinet Meeting', 21st June 1960, p. 3
[185] Tony Judt, *Postwar*, pp. 302-4
[186] Jonathan Helmreich, 'The United States and the Formation of Euratom', *Diplomatic History*, Volume 15, Issue 3, (July, 1991), pp. 394-5

Messina[187]. British requests to keep-in-step regarding atomic policy antagonised the US State Department, where the view prevailed that the supranational approach to atomic energy and economic integration was superior to OEEC efforts. In a friendly letter of December 1955, Dulles tried to persuade Macmillan to engage more decisively with Europe, hoping that the Foreign Secretary would follow American lines and not cause a 'conflict of advice' with the Six[188]. In the atomic field, at least, this went unheeded; the European Communities sent three delegates, the 'Wise Men', to Britain in 1956 to see how the new technology could address their growing energy needs. However, Britain's willingness to co-operate was strictly defined as scientific, not political; the Foreign Office granted permission for the visit on the assumption that the Europeans were interested in 'technical substance' and did not arrive as 'evangelists for the Euratom approach'[189].

To an extent the reticence of Eden and Macmillan was prudent; the new European project had ambiguous aims and infighting regarding the atomic community began almost immediately. The famous 'Spaak Report' of April 1956 recommended establishing common research centres and supported Jean Monnet's earlier appeal to limit European atomic development to peaceful uses[190]. However, by January 1957, Spaak was in London complaining of West Germany's placation of the French Right by allowing France to maintain nuclear weapons within the previously exclusively-civil Euratom Treaty[191]. The resulting political uncertainty in Westminster was matched by scientists in British institutions.

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[187] 'Memorandum of a Conversation, Department of State, Washington', 22nd November 1955, *FRUS* Vol. IV, Document 131

[188] 'Letter from the Secretary of State to Foreign Secretary Macmillan', 10th December 1955, *FRUS* Vol. IV, Document 135

[189] NA FO 371/121969 'Foreign Office Memorandum from D.A.H. Wright to J.A.M. Majoribanks Regarding a Visit of the "Three Wise Men" to Britain', 29th November, 1956

[190] Henry R. Nau, *National Politics and International Technology: Nuclear Reactor Development in Western Europe*, (London, 1974), pp. 99-101

[191] NA PREM 11/2848 'Record of a Conversation Held at Downing Street between Spaak and Macmillan', January 15th, 1957

As the physicist George Thomson noted, there was little reason for Britain to join Euratom as there was no advantage in negotiating her uranium contracts through the organisation and little scope for industrial collaboration except a few specialist projects (such as a large-isotope separation plant) which even then might be obtained unilaterally[192].

Nonetheless, the European Atomic Energy Community **(**Euratom) came into being in March 1957, and Christian Deubner has made the valuable assertion that the Community, as an area within which the French could develop their nuclear program without American interference, was vital in overcoming the initial reluctance of Paris to integrate into a wider common market[193]. Regarding the British national position, the 'Wise Men Report' outlined roughly the state of atomic international relations at the founding of the European atomic community; Britain's concentration on commercial Magnox stations suggested a short-term benefit to Euratom of technical assistance in the manner offered by Macmillan, but as these reactor types were already obsolescent by the late nineteen-fifties, the most lucrative partnerships would clearly lie elsewhere. The United States, with no domestic civil atomic market, could use Europe as a breeding-ground to train scientists and investigate the long-term atomic projects which it itself might need in the medium term[194]. However, even in this relatively clear view the weakness of Euratom was visible. The 'divorce between institutions and programs', as Henry Nau labelled it, meant that this report was not submitted until *two months* after the Euratom treaty was signed, highlighting how the European atomic program was swept along by wider political concerns[195]. John Krige concurred, contending that the

[192] George Thomson, 'Britain's Drive for Atomic Power', *Foreign Affairs; an American Quarterly Review*, 35:1/4 (1956/1957), pp. 103-4
[193] Christian Deubner, 'The Expansion of West German Capital and the Founding of Euratom', p. 209
[194] 'A Target for Euratom', Report submitted by Mr. Louis Armand, Mr. Franz Etzel and Mr. Francesco Giordani at the Request of the Governments of Belgium, France, German Federal Republic, Italy, Luxembourg and the Netherlands, 4th May, 1957, pp. 13-40
[195] Henry R. Nau, *National Politics and International Technology: Nuclear Reactor Development in Western Europe*, p. 104

underwhelming impact of Euratom has been evidenced precisely by a shortage of analytical scholarship[196].

Despite the assertions of the 'Wise Men', British scientific institutions still regarded themselves as pioneers with everything to lose through integration. In a long memorandum to Macmillan on the 16th July 1957, Edwin Plowden railed against British entry into Euratom, claiming that as the organisation would not build reactors directly, the opportunity remained for Britain to access European markets. However, staff shortages at the UKAEA forced its chairman to demand a policy limited to basic information sharing, co-ordination of small joint projects and staff exchanges, allowing Britain to preserve its leadership and benefit from further co-operation despite her limited capacity[197]. However, political pressure on the Prime Minister was building; the Board of Trade sent a memorandum the following day complaining about the UKAEA's inaction regarding Europe and warned that Euratom could quickly become a commercial threat[198]. Macmillan responded to the 'great difficulties' of direct Euratom membership by pursuing a compromise of indirect participation, involving 'bilateral agreements, membership of the European Nuclear Energy Agency (ENEA), and the European Council for Nuclear Research'[199]. The ENEA, established in February 1958, was a looser organisation inside the OEEC with a narrow technical basis to develop atomic energy, unlike Euratom with its overtones of political union through economic integration[200]. The preferred business method for Britain was through projects like DRAGON, the high-temperature gas-cooled experimental reactor funded by contributions of 43.4% each from the UKAEA and Euratom, with the remainder paid by other European national atomic

[196] John Krige, 'The Peaceful Atom as Political Weapon, *Historical Studies in the Natural Science*, p. 9
[197] NA PREM 11/2848 'Letter from Sir Edwin Plowden to the Prime Minister' 16th July 1957
[198] NA PREM 11/2848 'Memorandum from the Board of Trade to the Prime Minister' 17th July 1957
[199] Debate on Euratom, *Hansard*, HC Deb. 4th March 1958, Vol. 583, cc968-9
[200] Henry Nau, 'Collective Responses to R&D Problems in Western Europe: 1955-1958 and 1968-1973', *International Organization*, Vol. 29, No. 3, (Summer, 1975), p. 625

institutes[201]. This stance was important as it demonstrated British position clearly; she would agree to technical co-operation designed to improve her research but would not yet risk losing her atomic prowess. Thus, the ENEA approach was not quite, as Henry Nau has contended, designed to rival and disadvantage Euratom but was significantly inspired by the practicalities of research and manpower to preserve British hegemony with limited resources[202].

However, the Foreign Office were nervous that too much reluctance in dealing seriously with Euratom would result in the Community becoming more accustomed to American methods and techniques, especially after the joint Euratom-US Agreement of November 1958 agreed to raise 1GW of European atomic capacity within seven years using American-designed reactors[203]. The UKAEA was encouraged to interact with Euratom members, if only to provide a forum for scientific and engineering exchange[204]. The result, a Euratom-UKAEA agreement in December, showed the limits that scientists at British national institutions were prepared to accept. The Authority agreed to the exchange of declassified scientific information, staff exchanges and to supply and reprocess nuclear fuel to operate *British-built* reactors with options to supply the same for other installations on a case-by-case basis[205]. As Jonathan Helmreich has demonstrated, by refusing to participate fully in the American scheme for European integration, Britain created the opportunity for more direct transatlantic involvement on the continent as Eisenhower sought to build a Soviet-resistant Europe atomic community containing markets for American reactors[206]. The irony was that, for much of the mid-fifties, atomic energy seemed possibly the only field ripe for further

[201] NA AB 32/96 'OEEC High Temperature Reactor Project DRAGON, First Annual Report: 1959-60', p. 190
[202] Henry Nau, *National Politics and International Technology,* pp. 186-9
[203] 'United States Euratom Agreement', *Nature*, 6th December, 1958, p. 1551
[204] NA FO 371/140574 'Memorandum from Geoffrey Kirk, British Embassy in the Netherlands to M.C. Hainworth, Foreign Office', 10th April, 1959
[205] NA PREM 11/2838 'Agreement between the Government of the UK and Euratom for Co-Operation in the Peaceful Uses of Atomic Energy' 17th December 1958
[206] Jonathan Helmreich, 'The United States and the Formation of EURATOM', pp. 389-90, 395-66

European integration and thus an opportunity for true leadership was spurned by the British[207]. Displaying customary foresight, John Cockcroft lamented the 'masterly inactivity' shown to Europe, demonstrating further the splits that remained between national institutions and elements in the highest echelons of British science[208].

Britain's lukewarm response was received as prevarication in Europe, with some elements of the German press reporting that Macmillan desired an anti-EEC counter-alliance[209]. This was partially true; Britain's favoured economic model was the European Free Trade Area (EFTA), an economic agreement signed in 1960 to reduce trade fees between members without establishing common external tariffs[210]. However, the issue was prejudiced further by Britain's stance on military nuclear power. Selwyn Lloyd, the Foreign Minister summarised it thus: 'the fact that we, alone of the Western European Powers, have made the hydrogen bomb, joined the American nuclear directorate and are now seeking to prevent any "fourth country" from possessing it, implies to many Europeans, especially the French, that we are seeking to establish and maintain a two-level Power system in the free world, with Britain and America in command and the rest in the ranks'[211]. The 'Six plus Seven' model, based on an integrated core of six EC members surrounded by 'free' EFTA participants was highly significant and the British role in dividing Western Europe into a Free Trade Area and a Community became the cornerstone of the debate on future European diplomacy.

Restoring relations with the 'Six' became important, not least because by the early sixties it emerged that Britain's Magnox construction had been too sluggish, once again raising the issue of external markets. The 'official' view was that Britain could export easily,

[207] Jonathan Helmreich, 'The United States and the Formation of EURATOM', pp. 391-2
[208] Robin Edmonds, *Setting the Mould,* p. 87
[209] Martin Schaad, *Bullying Bonn: Anglo-German Diplomacy on European Integration 1955-61,* (London, 2000), p. 140
[210] R.W. Bartlett, 'The European Common Market', *Illinois Agricultural Economics,* Vol. 2, No. 1 (Jan., 1962), pp. 11-12
[211] NA CAB/129/92, 'Anglo-American Relations: A Note by the Secretary of State for Foreign Affairs', 10th April, 1958, p. 7

but industrialists feared that heavy subsidies on American reactors would make any competition impossible[212]. The scientists at Harwell considered research to be Britain's strongest card; John Cockcroft highlighted that although Britain could not offer financial assistance to Euratom in the same manner as the United States, her research and development could be made available on a 'reasonable economic basis'[213]. The construction of the atomic power plant in Latina, Italy was suggested as the blueprint for future interaction; the installation would be designed in Britain but built by Italian industry under British supervision using special components and fuel cycles managed by the UKAEA[214].

However, the compromise was insufficient, and the proposals of the Hallstein Commission to accelerate the Treaty of Rome from June 1960 caused concern in London. In a letter to the *Times*, Conservative MP Peter Kirk argued that Britain had alternatives to the looming choice of economic war or accepting damaged trade. Arguing for a signal to reassure the Six, Kirk proposed that Britain join the ECSC and Euratom, in the case of the latter criticising the traditional rationale that membership would cost Britain more than she would gain. 'I doubt if that was ever true', Kirk claimed, 'and even if it is true now, it would certainly not be true in 10 or 15 years' time'[215]. Taking up this viewpoint Selwyn Lloyd urged Macmillan to utilise Euratom to negotiate with the Six, even at the expense of EFTA[216]. The move was still economically pertinent; 'Euratom needs the British knowledge and Britain needs the market for her nuclear energy industry' one journal claimed[217]. Macmillan concurred and instructed the Minister of State for Foreign Affairs, John Profumo, to announce Britain's intention to consider Euratom and ECSC membership at the Western European

[212] 'Fears of British Atomic Firms', *The Times*, 4th February, 1959
[213] NA AB 27/41 'John Cockcroft, Speech at Milan Fair Symposium', 13th April, 1959
[214] Ibid.
[215] Peter Kirk, 'Relations with Europe', *The Times*, 6th April 1960
[216] NA PREM 11/3774 'Memorandum on United Kingdom Relationship with the ECSC and Euratom from Foreign Office to the Prime Minister', 18th April, 1960
[217] Roy Herbert, 'Progress in Euratom', *The New Scientist*, 12th April 1962, p. 43

Union Assembly in Paris in June[218]. The gambit was well-balanced; Britain would apply if the Six would let her 'find her way through the technicalities to realities' and avoid full integration[219]. However it soon emerged that Euratom membership would rest on the larger objective of EEC participation. West Germany particularly would only contemplate further integration and would not accept British involvement in the two 'lesser' organisations when the Common Market was becoming increasingly influential[220].

Although unsuccessful, the attempt demonstrated the faith set by British politicians in their nation's atomic prowess; it was a card they believed sufficiently powerful that the 'Six' would tolerate an awkward arrangement with a semi-integrated Britain to accommodate it. Significantly, it also represented the changing attitude towards atomic politics in Westminster. The work of the Attlee and second Churchill governments, so desperate to attain nuclear independence for both military and commercial reasons, would now be offered as a sacrifice to wider political goals. As Miriam Camps highlighted, this phenomenon was representative of wider changes in British policy during the early sixties. Previously, commitment to Europe was viewed as binary; the common market was incompatible with Commonwealth ties, so Britain must 'choose' between Europe and the old Empire. However, once negotiation with the Six began, the tone shifted and it was asserted that engaging with Europe was now possible without damaging free trade ambitions[221]. The negotiations surrounding Euratom membership were at the forefront of these attempts to find a 'halfway house' but it was precisely this tightrope-walking which irritated the continentals, who, despite initial

[218] NA PREM 11/3774 'Note from Harold Macmillan to the Foreign Secretary' 22nd April, 1960
[219] NA PREM 11/3774 'Speech by the Minister of State for Foreign Affairs, John Profumo to the Assembly of the Western European Union' 2nd June, 1960
[220] Martin Schaad, *Bullying Bonn: Anglo-German Diplomacy on European Integration 1955-61,* p. 142
[221] Miriam Camps. *Britain and the European Community 1955-1963,* (London, 1964), pp. 368-9

friendliness, rapidly lost patience. Britain's atomic card was played too late, quickly losing value against wider continental political concerns.

Thus, Britain entered the nineteen-sixties in a peculiar situation, with her national confidence in its civil atomic sense arguably at its most vulnerable since the war. Atomic prowess was now a negotiable commodity to be utilised politically and to this end a UKAEA steering committee was established under William Penney to review monthly the prospect of joining Euratom '*as part of the process of joining the Common Market*'[222]. Penney was the senior scientist and pre-eminent national figure, being the only member of the group with a knighthood. His position as part of the weapons division was also instructive; Britain's most crucial atomic interest would be well-protected by his stewardship. Generally, the response was negative; supranational organisations like Euratom were still alien to the British, particularly those UKAEA scientists who were bewildered by the nature of research and development in the Community. France and Germany seemed not to gain much from their investments, whereas Italy was 'doing handsomely'[223]. The position of Britain in such an organisation was unclear and making a safe return on her research expenditure was not guaranteed. Another problem was demarcating what could safely be exchanged; weapons technology was off-limits and the British guarded their work on fast reactors extremely jealously[224]. Finally, one of Britain's strongest cards was its staff, who possessed far greater industrial experience than their European counterparts[225]. Nonetheless, this advantage had to be played carefully; Euratom offered better pay and conditions to almost all staff categories

[222] NA AB 41/349 'Minutes of a Meeting of the UKAEA Steering Committee on Euratom', 26th January, 1962, p. 1
[223] NA AB 41/349 'Minutes of the Sixth Meeting of the UKAEA Steering Committee on Euratom', 1st June, 1962, p. 2
[224] Ibid., pp. 2-3
[225] NA AB 16/4084 'Note from G.H. Greenhalgh, UK Delegation to the European Communities to D.E.H. Peirson, Secretary, UKAEA', 16th January 1962

and so the UKAEA recommended that, instead of handing over British sites, the two agencies proceed by 'contract of association' to avoid any significant brain-drain[226].

The scepticism of Britain's scientific institutions was often legitimate; Christian Deubner criticised Euratom as a 'stillborn' integration scheme which lacked mettle in allowing independent bilateral agreements and uranium contracts, hamstringing the cohesive 'European nuclear industry' that Cockcroft hoped Britain could assist[227]. This was partially true; many Euratom members, notably Italy and the Netherlands, negotiated directly with Britain to facilitate their civil atomic programs, infuriating the Community[228]. Nonetheless, contemporary commentators noted that Britain's atomic lead was valuable as a card best played in a measured fashion with the ultimate objective of integration. Kenneth Cohen, for example, criticised Britain's stand-offish compromise of lending technicians to Europe as this merely weakened Britain's domestic industry whilst doing nothing concrete to convince the Six of British methods[229]. In Cohen's view, American support made the rise of Europe inevitable; the only issue was when to climb in. The European scene changed quickly in the late fifties, and Britain was economically slow to react, leading Alan Milward to criticise the British system of import controls and free-trade area negotiations as a 'nineteenth-century solution to a twentieth-century problem'[230]. Ultimately, Britain did apply for EEC, and by extension, Euratom membership in July 1961, although the negotiating process became arduous. This was partly Macmillan's fault; his reactions to diplomatic and economic realities

[226] NA AB 16/4084 'Note from Mr. J. L. Croome, Head of the Overseas Relations Branch, UKAEA to the Office of the Minister for Science', 1st August, 1962
[227] Christian Deubner, 'The Expansion of West German Capital and the Founding of Euratom', p. 223 and NA AB 27/41 'John Cockcroft, Speech at Milan Fair Symposium', 13th April, 1959
[228] Jacob M. van Splunter, 'Nuclear Fission across the North Sea: Anglo-Dutch Co-Operation on the Peaceful Use of Atomic Energy, 1950-63', *Journal of Contemporary History*, Vol. 29, No. 4 (Oct., 1994), pp. 689-691
[229] Kenneth Cohen, 'Euratom', pp. 84-5
[230] Alan S. Milward and George Brennan (eds.), *Britain's Place in the World: A Historical Enquiry into Import Controls,* (London, 1996), p. 208

were slow to the extent that he was accused of 'backing into Europe'[231]. This attitude motivated neither the Germans nor the French, who, also suspicious of American influence in the UK, vetoed the British application in 1963.

In conclusion, Britain's atomic relationships with continental Europe were often conspicuous in the way they contradicted prevalent political trends. During the period of British political disinterest around Messina, nuclear energy was increasingly mooted as an area of possible interaction, whereas by the time Britain did attempt to integrate fully with Europe, the domestic atomic lobby protested it. This was symptomatic of the atomic community's relative stability throughout the period in comparison to the 'swing' witnessed in wider politics and economics; the UKAEA always recommended a safe distance from Europe using personnel exchanges and design discussions whilst remaining sovereign. Initially progressive, this policy soon became retrograde to Macmillan's vision for Britain in Europe as the Prime Minister slowly warmed to approaching the Six. However, Euratom was initially weak and far from a united front; even those committed to the Six hedged their bets and opened negotiations with Britain for information. Relative to Britain, the Community was of little initial interest, being essentially an expansion of the European Coal and Steel Community (ECSC) to cover new energy markets, none of which represented lifeline interests. France wanted German coal and peaceful atomic energy, Britain already had civil atomic power in development and sufficient, if plateauing, coal production. The independent atomic gains were a source of pride to many prominent British figures, both inside and outside scientific institutions; 'Britain had lifted itself by its own boot-straps into a peacetime atomic power at a great sacrifice of hospitals, schools, retooling of industry, etc.' wrote one

[231] Miriam Camps, *Britain and the European Community 1955-1963*, p. 513

commentator, 'and here were the Europeans trying to jump on the bandwagon'[232]. On a wider scale, this was acknowledged; British politicians eschewed supranational energy control bodies, preferring looser OEEC co-operation.

When Britain did engage with Euratom, it was merely to ensure that her trading agreements concerning uranium and technology sales would continue unchanged, preventing a monopolisation of the buyer's market by the Six and a consequent price slump[233]. Macmillan appreciated the value of a large market for British reactor technology and signed a second agreement with 'The Six' in February 1959, although it was anticipated that exports could not be greatly increased as the rapid acceleration proposed by the 1957 amendment of the 1955 White Paper would tie all British engineering and technical expertise to domestic construction[234]. Nonetheless, wider concerns overtook atomic considerations. The Commonwealth, although a sizeable factor in civil atomic spheres, was declining in economic and political importance and adherence to old colonies seemed increasingly outdated during the 'Winds of Change' era[235]. Factions with foreign policy experience within the Conservative government wondered whether Britain could still manoeuvre into a partially-integrated state, although this demand for a 'special place' for the UK was not appreciated by the Six, who went ahead with their fast-integration schemes. Anne Deighton and Piers Ludlow identified how the negotiation process was ludicrously overcomplicated from the outset; Macmillan presented the application as a commencement of negotiations, leading to endless rounds of discussion over each new development with EFTA, the Commonwealth and Parliament. Furthermore, the fragmented nature of the Six meant responses were sometimes equally

[232] Ritchie Calder, 'As the Hare Said to the Tortoise?', *Bulletin of the Atomic Scientists*, November 1960, p. 353
[233] Kenneth Cohen, 'Euratom', p. 84
[234] Etienne Hirsch, 'A Guide to Euratom', *The New Scientist*, 26th March 1959
[235] Harold Macmillan, 'Winds of Change', Speech made to the South African Parliament, 3rd February 1960

slow[236]. In a specifically atomic context, one must add to this inertia the reluctance of British scientists in the civil atomic authorities who were asked throughout 1962 what they thought about accession into Euratom, and replied repeatedly 'No'. The final straw was the issue of atomic weapons; Macmillan considered 'offering Britain's bomb to Europe in return for a sound economic tie-up' but French concerns for nuclear self-sufficiency scuppered the idea[237].

Slow progress in Europe called for concessions and civil atomic power was mooted as a field for potential compromise. Critics accused Macmillan of sacrificing Britain's atomic prowess on the altar of political integration, but wider concerns halted the plan. The French veto broke Macmillan's government and the Conservatives at large, bringing to the fore the first Labour government in thirteen years and Harold Wilson, who promised the return of the 'white heat of industry'. By the time Britain did join Euratom as a component of EC membership in 1973, the benefits of atomic union had dwindled significantly and nuclear integration became a by-product of, rather than the driving force behind, what was by then a much more important economic alliance[238].

[236] Anne Deighton and Piers Ludlow, '"A Conditional Application": British Management of the First Attempt to Seek Membership of the EEC, 1961-3' in Anne Deighton (ed.), *Building Postwar Europe: National Decision-Makers and European Institutions, 1948-63,* (London, 1995), pp. 107-9
[237] UBSC MS 191/1/1/7 Shuckburgh Papers, 'Minutes of a Conversation', 25th May, 1957
[238] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom,* p. 211

CHAPTER FIVE: SOCIETY

The final area of atomic power requiring analysis is the social perception of nuclear energy and how it responded to differing national and local agendas, in turn prompting investigation of how these changes influenced future priorities. The development of atomic weapons had placed Western leaders in a predicament concerning the image of new technology; Eisenhower was partly influenced by the awful public image of hydrogen bombs to promote his 'Atoms for Peace' program in Europe[239]. The British reception of atomic power was friendlier; she had never used bombs in anger and many agreed that atomic force was key for defence, never mind great power status. Her separate achievements in civil power also provided moral distance from aggressive weapons stockpiling in the United States. This independent attitude permeated into the public sphere, as demonstrated by a September 1955 survey, in which almost twice as many respondents asserted that they preferred budget cuts on military nuclear ventures (32%) than the nascent civilian programme (17%)[240]. This result was remarkable not only for the difference of opinion but also in demonstrating a public consciousness and understanding of the two distinct uses of nuclear fission. The impact on the news world was similar, with the *Times* identifying Calder Hall as a prestige project worthy of a twelve-page supplement. Private engineering firms certainly agreed, as identified by the clamour for advertising space surrounding the news of the plant and the glory of being associated with the pioneering work at the world's first 'commercial' power station[241].

The most important impact of atomic power was the interaction between layers of decision-making in British government. National government was certainly mainly pro-

[239] John Krige, 'Atoms for Peace', p. 163
[240] George H. Gallup (ed.), *The Gallup International Public Opinion Polls: Great Britain 1937-1975*, Vol. I, (New York, 1976), p. 355
[241] *The Times*, 17th October 1956

nuclear and the nineteen-fifties were a period when 'nuclear industry basked in the sunlight of public approval and political patronage'[242]. The White Papers of 1955 and 1957 assumed that it would be relatively simple to find space in Britain for atomic installations, a view that was later expanded. At a Cabinet meeting in 1957, the Minister of Power swept aside local concerns, arguing that 'it should be made clear, at the very outset of the new programme, that some loss of amenities was the unavoidable price which had to be paid if the needs of the economy over the next fifteen years were to be met'. The most the government could offer was a 'revised procedure' for obtaining planning permission which it hoped would be enough to allay rural fears[243].

At local authority level, atomic plants were often popular as councils vied to have their constituencies represented at the forefront of new science and industry. Construction of the experimental fast reactor at Dounreay was actively solicited by local MP Sir David Robertson in the hope of reducing chronic unemployment and providing skilled opportunities in northern Scotland[244]. As pieces of human geography, the new nuclear stations were often accepted into the local area as points of interest. For example, when Trawsfynydd station was under construction the local councils followed the industrialists' argument that atomic stations and nature could be complementary and that 'it was possible that people who came to see the power station might stay in the national park to enjoy the natural beauties'[245].

The impact on local identity in the Lake District was even more profound; 'West Cumberland Leads the World' was the view of the regional paper on the opening of Calder Hall[246]. The following year, the local development council released a brochure depicting the Marchon chemical works set against Cumberland countryside (Figure VII). This was the new scientific

[242] Timothy O'Riordan, 'The Prodigal Technology: Nuclear Power and Political Controversy', *The Political Quarterly*, 59, 1988, p. 164
[243] NA CAB 128/31 'Minutes of a Cabinet Meeting', 28th February, 1957, p. 5
[244] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom,* pp. 75-6
[245] 'Power Station's Life May be Less than 40 Years', *The Manchester Guardian,* 14th February, 1958
[246] 'West Cumberland Leads the World', *The West Cumberland News,* 20th October, 1956

identity in a nutshell; hyper-modern industry in a traditional Lakeland setting. Even after the 1957 Windscale fire the local authority stated that it trusted the UKAEA 'to do everything in the best interest of people and the nation'[247].

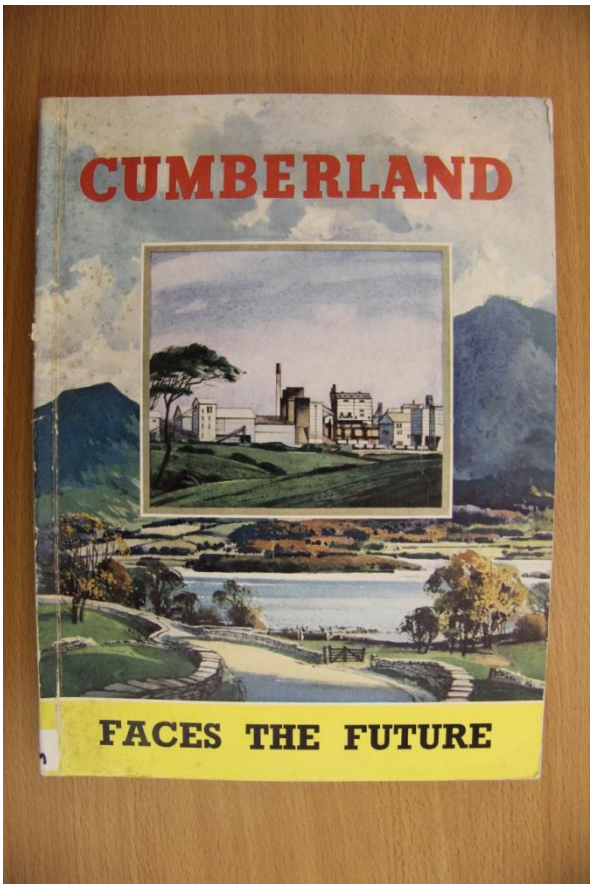

Figure VII: 'Cumberland Faces the Future', Local Development Brochure, 1957[248]
Used with Permission of Whitehaven Public Record Office and Local Studies Library

The large degree of state intervention in the early atomic program, according to Dave Elliott, gave Britain 'at least the appearance of preventing the worst excesses of uncontrolled competition'[249]. However his argument that, owing to remote coastal locations (an engineering necessity) for atomic stations, there were relatively few siting arguments has been

[247] 'Alarm over Disused Reactors: Perpetual Monument to the Atom?' *The Manchester Guardian*, 17th October, 1958
[248] Whitehaven Public Record Office, Cumberland Development Council Authority Brochure, 'Cumberland Faces the Future', 1957
[249] Dave Elliott, *The Politics of Nuclear Power*, (London,1978), p. 13

disputed. No nuclear power station was ever blocked by a local planning protest, but objections were often numerous and vociferous[250]. Between 1956 and 1961 the first seven proposed plants received over 500 individual objections, not counting thousands of petition signatures[251]. Analysing this data, Elizabeth Rough contended, importantly, that public opposition was not merely 'NIMBYism' as previously suggested, but rested instead on developed safety worries[252]. Rough's argument that 'public concern-whilst largely absent at the national level-was certainly present amongst the communities faced with hosting nuclear facilities' is logical, especially when one considers how unrealistic it would be for a public expected to understand atomic weapons as a tool of great destruction to not also fear the dangers of peaceful applications. Thus, despite the protestations of industrialists, it is untrue that most local opposition was confined to farmers concerned for cattle or ramblers complaining about views being spoilt by atomic chimneys,[253].

The first real tests of the new technology's credibility were its initial mishaps, notably the Windscale fire of 1957 which led to the first sizeable outcry against atomic power. Arguably influenced by his background as a nuclear engineer, Rowland Pocock described the Windscale 'disaster' as merely a 'non-event' which only served to highlight the safety of atomic stations simply by being Britain's worst contemporary nuclear mishap. In addition, he contended that much of the general social concern surrounding nuclear power was due to overzealous government secrecy and a lack of public relations skill in informing local citizens[254]. The top-level response was certainly confused; the national government insisted that the public should not fear civil stations because of detailed engineering differences

[250] Elizabeth Rough, 'Policy Learning through Public Inquiries? The Case of UK Nuclear Energy Policy 1955-61', *Environment and Planning C: Government and Policy*, Volume 29, 2011, p 32
[251] Ibid., p. 32
[252] Ibid., p. 34
[253] 'Alarm over Disused Reactors Perpetual Monument to the Atom?' *The Manchester Guardian*, 17th October, 1958
[254] R.F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, pp. 66-73

between Calder Hall and Windscale, the significance of which the public cannot be expected to have understood[255]. A session in the Lords six weeks after the accident illustrated the situation well; many peers felt that the event risked turning the public against atomic power despite its lack of casualties or damaging effects. Indeed, Lord Rea implored the Minister of Power to 'take the public a little more into his confidence' and release more information about the risks of civil stations and possible accidents. However, the reply was fractious; although he conceded that liaisons with the public were inadequate, the Minister retorted that Britain would not change its plans for atomic power, insisting that repetition was impossible[256].

The extent to which opposition to military atomic power spilled over into protest about peaceful uses is also debateable. Dominic Sandbrook has argued that, despite early successes, CND was never an effective political force in Britain because of her declining influence in relation to America. Any notable opposition to *military* nuclear power, therefore, was merely a concern of 'upper middle-class dissenters and student bohemians' and a matter of disinterest for the working-class bulk of Britain[257]. With anger at plutonium plants struggling even to register effectively, opposition to the more palatable uses of civil atomic power was rare. However, this view, while plausible, does not take account of the traditional criticism of nuclear power that its military origins in Britain led to layers of secrecy which public perception could not penetrate[258]. For this reason, and taking into account the evidence that civil nuclear power was a concerning issue at least for the *local* population, Sandbrook's view is possibly better placed as a general national statement. In any case, opposition to civil atomic power was initially too disparate to register effectively, consisting of communities in

[255] Atomic Power Stations, *Hansard*, HC Deb. 11th November 1957, Vol. 577 cc590-2
[256] 'Lessons From Windscale', *The Times*, 22nd November 1957
[257] Dominic Sandbrook, *Never Had It So Good: A History of Britain from Suez to the Beatles*, (London, 2005), pp. 274-5
[258] For one example, see Julia Bickerstaffe and David Pearce, 'Can There Be a Consensus on Nuclear Power?', *Social Studies of Science*, Vol. 10, No. 3 (Aug., 1980), p. 326

the immediate area and diffuse social elements at national level with whom they had little contact.

In addition to public perceptions, the attitude of the media is also worth noting. A notable statistical approach was undertaken by Martin Bauer, who argued that journalistic disposition towards science reporting, among which nuclear power was preponderant in the 1950s, began with (perhaps inevitable) negativity in the aftermath of Hiroshima before recovering a mainly positive light as Britain entered the nuclear age[259]. In agreement with Sandbrook, Bauer's study found that public mobilisation through the media began with an intense period during the 1950s, as British society was expected to appreciate new developments through 'celebratory propaganda'[260]. The perception of atomic power in the media was certainly initially positive during the early civil phases; in addition to support from local newspapers, the national press often backed the new technology. Indeed, *The Times*, having greeted atomic power with such fanfare, remained charitable even after the Windscale disaster, blaming the accident on the UKAEA's unfortunate mandate of developing an 'exciting field of technology' with a chronic shortage of manpower[261]. The left-wing media was also sympathetic, with the *Manchester Guardian* imploring the government to curtail other ambitious projects and support atomic power[262]. Although by no means a comprehensive overview, comparing these reactions shows how much of the media were initially friendly to civil atomic power and actively supported it on their pages. Indeed, a sign of how far the technology had permeated British national identity came from Sir Christopher Hinton, who rejected both the post-Windscale uproar and the political findings of the cause of

[259] Martin W. Bauer, 'Long-Term Trends in the Public Representation of Science across the 'Iron Curtain': 1946-1995', *Social Studies of Science*, Vol. 36, No. 1 (Feb., 2006), pp. 114-116
[260] Ibid., pp. 120-21
[261] 'Too Few at the Top', *The Times*, 20th December, 1957
[262] 'Setback for British Science: Painful Lessons from Geneva', *The Manchester Guardian*, 19th September 1958, p. 10

the accident. 'When any technological development becomes a totem of national prestige' he argued, 'common sense flies out of the window.'[263]

In conclusion, it is important not to judge the social popularity of atomic power in the fifties through sceptical lenses borne of later decades. As Joachim Radkau, a respected environmental historian, has shown, the original nuclear planners often sought solutions to the same problems that traditionally bothered environmentalists; i.e. producing renewable clean energy with minimal mining and drilling[264]. Radkau consequently warned against seeing atomic energy in the environmental sense of 'good against evil' and argued that civil nuclear power was not as socially unpopular as previously thought.

Socially, the most influential aspect of atomic power station construction was in demonstrating fault lines in British policy-making and the interaction between government and society. Westminster offered, via atomic stations, a chance for local regions to be associated with dynamic and exciting new technologies. This in turn would attract investment and create jobs, and thus many local authorities were keen to site atomic plants in their areas. Nonetheless, problems arose between the local government and public strata; the government's approach has been criticised for being heavy-handed, and Elizabeth Rough identified the method of commissioning atomic stations as following essentially a 'Decide-Announce-Defend' strategy[265]. This in itself is evidence that there were some objections by local populations, although within this, the level of opposition on scientific grounds was surprising.

The true level of public understanding of atomic power is debateable; it is probably most rational to assume that whilst laymen did not understand atomic science there were still

[263] Margaret Gowing, 'Lord Hinton of Bankside', p. 229
[264] Joachim Radkau, *Nature and Power: A Global History of the Environment*, (Cambridge, 2008), pp. 314-6
[265] Elizabeth Rough, 'Policy Learning through Public Inquiries? The Case of UK Nuclear Energy Policy 1955-61', p. 34

appreciable concerns for safety in the immediate vicinities of the new stations, almost certainly fuelled by worries about military uses. The lack of information released by government may indeed have let fears surrounding atomic power grow unchecked in a society which was initially largely supportive. The media also were far from critical and continued their broadly positive attitude for the remainder of the decade. For its part, government policy was often blunt and rested on public goodwill towards progress overriding concerns for local safety. High-level decision-making was not greatly influenced by social unease, a reflection of both the governmental will to modernise by force and the general lack of concerted public opposition. In any case, by 1959, despite declining coal consumption and the concurrent accumulation of stocks, Macmillan was keen to support nuclear power from 'the long-term point of view of our economy and our national prestige'[266]. Thus was demonstrated the momentum which civilian nuclear power had gained; it had become so fundamental to Britain's image that returning to previous methods was undesirable. For better or worse, civil atomic power was now well-established in the British social consciousness.

[266] NA CAB/128/33, 'Conclusions of a Meeting of the Cabinet', 23rd June 1959, p. 6

CONCLUSION

In conclusion, atomic energy occupied a significant role in post-war international history. Christopher Hinton summarised Britain's meteoric rise and subsequent stalling succinctly: 'we started four wartime years behind America; after only ten years we had a lead of at least two years' he claimed, before adding 'it took only another seven years to throw that lead away'[267]. Despite its relatively fleeting nature, the influence of civil atomic power was not restricted to being a feature of complementary contemporary changes; the technology in Britain often produced its own independent impact and the field deviated from important political trends on several significant occasions.

Nowhere was this more evident than the Anglo-American relationship, where greater co-operation and British financial dependence on the United States contrasted starkly with the awkward breakdowns of the relatively strong wartime atomic understanding. To an extent this reflected Britain's wider position; she was no longer an equal partner but a material burden on a technologically-superior American structure which was collecting abandoned economic and defence commitments. Fear of communism and weak alliances propagated American distrust for British security (exemplified by the McMahon Act), foreshadowing inadequate agreements that freed industrial atomic energy but confirmed American hegemony. Although Britain was still identified as the scientific leader of the Commonwealth, the breakdown of her key nuclear alliance stimulated a new, independent, atomic identity wherein the only productive strategy was the one adopted by Attlee and later Churchill, which John Baylis labelled 'consistent, patient, and determined', based fundamentally on attaining self-sufficiency[268]. This view has enjoyed some support; Robin Edmonds contended that the

[267] Margaret Gowing, 'Lord Hinton of Bankside', p. 227
[268] John Baylis, 'Exchanging Nuclear Secrets: Laying the Foundations of the Anglo-American Nuclear Relationship', p. 34

British endured American reluctance (bordering on national humiliation) precisely because select political and scientific elites understood that Britain's best hope of nuclear capability lay in salvaging what they could from wartime agreements whilst beginning independent projects and 'thinking for themselves'[269]. Acquiring nuclear weapons was non-negotiable; Britain's defence, if not her notions of great power status demanded them and thus some form of atomic infrastructure was unavoidable.

Atomic energy offered Britain a desperately longed-for symbol of continued independence amidst signs of imperial decline and achieved recognition in political consciousness as a field in which Britain would have to act totally independently on a continent which was experiencing greater American economic and military intervention. This self-reliance had a political price; scientists would have increased influence in the future of atomic energy as politicians were forced to grant greater autonomy to technological experts. British scientists first squeezed what they could from the inadequate post-war settlements, laboriously breaking information down into highly-specific 'exchangeable' categories, producing the capacity to proceed independently using theoretical knowledge developed during the war. This expertise was *just* enough to keep the atomic ball rolling during the breakdown of political initiatives in the late nineteen-forties.

Owing initially to the close personal relationships of Churchill, the role of science in state decision-making structures expanded as the atomic program grew, first by the inclusion of a CSA at the MoD and then through the UKAEA in 1954. This was part of a wider trend; as science and technology became increasingly complex and important to national interests governments eyed scientific processes with increasing awareness, a phenomenon articulated by Joseph Camilleri in his 'bureaucratisation of science' thesis[270]. The far-reaching

[269] Robin Edmonds, *Setting the Mould: The United States and Britain, 1945-50*, pp. 87-93
[270] Joseph A. Camilleri, *The State and Nuclear Power: Conflict and Control in the Western World*, pp. 13-16

momentum caused by this shift, within which atomic energy was a driving component, led directly to the creation of Harold Wilson's Ministry of Technology in 1964. Atomic power raised the question of who was best-placed to act on scientific matters; the international scientific community certainly had a reach beyond the political sphere, and the agreement on how far science should influence state was fundamental to the new British understanding of the role of government in the new technological age. However, there were limits; whilst the UKAEA did consolidate the body of scientific opinion into a more useful form for political digestion it was not a direct decision-making body, committees could be established, as they were to review Euratom entry, although their recommendations were not always adhered to.

However, although atomic scientists became a force for consultation, what ultimately kept nuclear energy relevant in political minds were the small contributions of various forces to the overall picture. The need to obtain nuclear weapons, reduce coal consumption, cut post-Suez oil dependence and remain free of Soviet influence all combined to produce a policy which arguably only the need for atomic bombs had made insistent. In terms of traditional identity sources, atomic power was simultaneously an acknowledgement that Britain could no longer successfully affect the Middle East or retain her position as 'King Coal'; new fuels would be sourced from politically secure former colonies which were eager to test *their* new national identities against the erstwhile patron. Atomic engineering also demanded greater, rarer expertise; Britain began to self-define as a technocratic state which bemoaned the shortage of scientists in the way the politicians of 1946 had criticised the lack of coal miners. The debate over the precise balance of these factors has been intense with some scholars, notably Margaret Gowing, strongly underlining military requirements[271]. However, as the discussion has developed, fuel security and domestic energy concerns have attained an increased importance and strong assertions to that effect have been made by Peter Lloyd-

[271] Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-52, Vol. I*, pp. 236-240

Jones[272]. This study has therefore found a position in this debate, articulating the interaction between various factors and demonstrating that although plutonium was the overriding immediate concern, fuel supplies and coal scarcity greatly informed the manner in which atomic power developed and subsequently influenced international relations. Britain's post-war position was strongly implied in her sources of energy; her strength would now rest on pioneering technology within a loose Commonwealth framework. However, this sphere also proved complex; Britain's relations with her old dominions were strained by uranium negotiations, lessening the potential value of close collaboration at a point when Europe was looming larger.

Nonetheless, the success in developing peaceful atomic power provoked a transatlantic reaction. Attlee had originally hoped that independence would encourage America to resume information sharing; by the mid-fifties British politicians and scientists alike feared American interference in European markets. Eisenhower's 'Atoms for Peace' scheme was born of the need for positive propaganda and American concern for Soviet military, and British commercial, applications of atomic power. While existing scholars, for example Richard Hewlett and John Krige, have stressed the former factors, this study has emphasised the impact of Britain's gains in producing policy change, expanding the debate[273]. In any case, the scheme re-engaged American interest in international action at the same time as she was trying to construct a strong Western European bloc, bringing Britain's role sharply into focus. The UK had a credible gravity for European states and partnerships with the UKAEA were attractive, but her political reticence prevailed during the period of genuine British atomic leadership in the nineteen-fifties. The fleeting nature of Britain's atomic prowess can be partly attributed to the decision to pursue depreciating Magnox plants, but also to the way politicians

[272] Peter Lloyd-Jones, *The Economics of Nuclear Power Programmes in the United Kingdom*, pp. 7-9, p. 39
[273] Richard Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission*, pp. 209-228

failed to ‘cash in’ her atomic lead for political and economic gain. The limits of scientific influence were demonstrated as scientists at the UKAEA argued against atomic integration. Indeed, they had good reason; Euratom membership offered little that could not be obtained independently and would compromise Britain’s ability to utilise her advanced position. Nonetheless, atomic power as a tool of integration was overrun by political initiatives in Europe and eventually also in Britain, where Macmillan attempted to offer the sector as a bargain to ameliorate the Six. In Europe this trend was insignificant; the Six had no notable atomic infrastructure and so combined development was logical, especially after the success of the ECSC. For Britain, atomic science was a card to be released carefully for an advantage, although this was confused by conflicting attitudes towards European integration, particularly the EC.

The debate over Britain’s atomic role in Europe has been complex; Henry Nau stressed that Britain, preferring a loose Europe, would only stretch to supporting the European Nuclear Energy Association, as this ‘reflected an existing organizational consensus’ and was ‘designed less to promote integration or development of common resources than to influence the debate over the future external posture of a united nuclear Europe’[274]. However, this was contested by Christian Deubner, who asserted that Euratom could not be considered a single entity in terms of treaty negotiation, as members were still free to enter the capitalistic uranium market and negotiate individual contracts with those offering the cheapest supply. However, although the UKAEA’s motivations in declining such an unreliable project, particularly from an advantageous position, are clear, Westminster often experienced difficulty reconciling this to wider objectives[275]. This developed a nuance in the new national identity; scientific prestige and engineering had been key to developing the new post-war

[274] Henry Nau, ‘Collective Responses to R&D Problems in Western Europe: 1955-1958 and 1968-1973’, pp. 624-5
[275] Christian Deubner, ‘The Expansion of West German Capital and the Founding of Euratom’, p. 223

Britain, but by the early sixties Macmillan was persuaded that atomic advances should no longer be regarded as ‘crown jewels’ and could be utilised as collateral for wider political goals. Science may have carved out a larger role in national life but it ultimately remained the servant of larger supranational objectives which politicians in the nineteen-fifties and sixties set themselves, particularly on the continent.

Nonetheless, although civil atomic power was a credible instrument of foreign policy it was also regularly at the forefront of debate on the role of science within the state and of the social context in which Britain began to self-define as it entered the nineteen-sixties. The decline of coal struck at one of Britain’s defining products, the source of both her metaphorical and physical power; in contrast, the new atomic stations were untested but dynamic and enticed ambitious local governments which actively sought to attract the new industry. Trust in atomic power was generally high, and although local opposition was more substantial than has often been accepted, civil generation separated itself from nuclear weapons in the public consciousness, undoubtedly a large factor in its development. On a national level, there was little concerted opposition and the media showed minimal visible antipathy in the early stages, contributing substantially to installing atomic power as a key component of Britain’s new technological identity. Even after worrying incidents like Windscale, faith in nuclear stations prevailed, although the government’s failure to communicate effectively with the public set a worrying precedent which arguably damaged long-term trust more than frank admission of facts would have done. Nonetheless, despite these wobbles, atomic power retained an important stake in the public consciousness throughout the period of study and solidified its position in the new scientific national identity.

Even when it was not at the cutting-edge, the debate over atomic power often influenced how parallel power relationships were negotiated. As an independent entity, the sector produced nuanced relationship dynamics as Britain's atomic experience in the nineteen-fifties often contradicted her otherwise comprehensive international step-down. Was this because of a genuinely new national identity taking time to emerge or was the entire venture merely representative of the excessive resource allocation now required by a nation desperate to retain its prestige? The question also remains of how far the Conservative success in new technology was obfuscated by the 'swinging sixties' narrative of Wilson's Labour and 'New Britain'. What can be ascertained is that civil atomic power informed contemporary debates to a considerable extent; Britain was not utterly dependent on the United States, she was not wholly integrated into Europe and she no longer commanded unquestioning respect from her old dominions. Atomic power proved that these relationships all contained potential for redefinition and adjustment as Britain moved from self-identifying through imperial-age trappings like coal production and colonies to a technologically-driven society striving to build Churchill's 'empires of the mind' as a replacement for fading geographical domination. Although born of military necessity, civil atomic science was contributing substantially to the 'White Heat' of industry and the national understanding of Britain's wider position long before 1964.

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