Britain and the World

Britain, Europe and Civil Nuclear Energy, 1945–62

Power Politics

MARTIN THEAKER

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Dedicated to my Mum, in loving memory.

Preface

On 23 June 2016, voters in the United Kingdom (UK) elected by referendum to end their country's 43-year membership of the European Union (EU) and its predecessor institutions. Among the varied reasons given by analysts and commentators for this watershed decision were a list of social, economic and legal concerns; a preoccupation with unrestricted immigration, anger over Britain's perceived net financial contributions to the EU, and dissatisfaction with the ability of European courts to overrule national legal organs were all in turn identified as the spark that had ignited the tinderbox. The outcome of the vote in turn soon cast a shadow of uncertainty over a number of facets of British national life. The prospect of a 'hard border' between the Republic of Ireland and Northern Ireland was quickly raised by diplomats and the status of Britain's overseas territory of Gibraltar (including London's willingness to defend it) was brought into question, while the legal rights of European citizens residing in the UK were also publically scrutinised. By the time Article 50 (the legislation beginning the two years mandated by the 2009 Lisbon Treaty for a state to negotiate its departure from the EU) was eventually triggered by the new Prime Minister Theresa May on 29 March 2017, the list of issues to be discussed had become considerable.

In response to the challenge posed by agreeing Britain's divorce terms, diplomats, journalists and ministers posited several options, including three existing relationship models which they asserted Britain would be able to select *à la carte* should it so desire. The first of these was the 'Norway option' which would preserve Britain's access to the European single market via membership of the European Economic Area, albeit at the cost of implementing the EU's rules relating to the internal market including the thorny necessity of continued free movement of people across borders. Britain would also lose the ability to influence the rules it would have to adhere to as an external partner. The second off-the-shelf model suggested by public figures was the 'Switzerland option', a network of bilateral treaties that would enable Britain to select the specific sectors of the single market it wished to retain access to while also giving Whitehall the power to cap EU immigration under surge conditions. Britain's financial contributions to the common coffer would also be substantially reduced. The downside to this arrangement, however, was its infamous complexity: Switzerland had taken six years to agree its first package of bilaterals with the EU and another five to expand these in 2004. Finally, commentators pondered the possibility of a 'Canada-plus' option, named for its similarities to the Comprehensive Economic and Trade Agreement (CETA) signed by the EU and Canada at the end of 2016. Such an arrangement would remove tariffs on the vast majority of Anglo-EU trade and exclude any need for Britain to accept EU immigrants or to make financial contributions to the EU's funds. However, it would not preserve the ability of Britain's extensive financial services industry to 'passport' the licences of international banks within the EU and, like the Swiss option, was also criticised by sceptics for the seven years it had taken to negotiate.

Yet despite the hours of television coverage and miles of column inches devoted to the economic and political implications of the inevitably-titled 'Brexit', there was little discussion of how the separation would affect Britain's cooperation with the EU on science and technology projects organised at EU level. These activities were certainly numerous and significant enough to warrant serious attention: the EU's Horizon 2020 scheme, the eighth funding round dedicated to supporting EU scientific and industrial research, is worth some £67bn in total, while EU expenditure on research, development and innovation in the UK between 2007 and 2013 totalled some €6.9bn (£5.86bn in contemporary values). Of particular interest too was the absence of extended discussion (at least at the public level) of Britain's participation in Euratom, the combined European civil atomic community established in 1957. Although no longer regarded with the same excitement as it had been at the time of the creation of the European communities in the mid-1950s, civil nuclear energy technology remained a multi-billion pound investment with Euratom's Joint European Torus (JET) project at Culham alone supporting

350 scientific jobs. Assuredly, then, Britain's exit from Euratom would seem to merit more than a few brief articles in the popular press.

This book will trace the origins of Anglo-European cooperation in civil nuclear energy from its roots in the wartime atomic projects undertaken by the United States and Britain, and will highlight how the technology's perceived importance during a period of severe energy shortages lent it a unique weight as a diplomatic tool. The enormous commercial prospects and security risks posed by civil nuclear collaboration set it apart as a scientific field which no modern government dared ignore, and it is this urgency which lends the technology such value as a microscope capable of uncovering the fundamental dynamics which controlled Britain's diplomacy towards Europe during the 1950s. In studying this relationship, this book will therefore highlight how Britain's early acquisition of civil nuclear capabilities imbued London with numerous opportunities to connect its atomic prowess with its grander aims by using technological collaboration to influence the political and economic shape of Europe. The intention is to contribute simultaneously to our understanding not only of international technological cooperation but also of Britain's place in Europe, a dynamic currently under perhaps the most intense scrutiny it has ever faced. With the much-discussed Brexit now due to be completed in spring 2018, the time has thus never been more appropriate to launch a fresh reappraisal of how Britain engaged with its European neighbours during the early post-war period during which notions of continental cooperation and integration were at their most malleable.

Acknowledgements

This book has already undergone several iterations during its short life. Beginning as a Master's dissertation completed at the University of Birmingham in 2011, it was eventually expanded into a doctoral thesis submitted to the University of Cambridge in 2016 before finally being reworked into the book you see before you. As such, there is now an innumerable list of people who have supported this work and helped to see it through to its conclusion. Nonetheless, there are a few friends to whom I am especially grateful and who are worthy of special mention.

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Contents

List of Abbreviations

Technical and Organisational Abbreviations

AAEC	Australian Atomic Energy Commission
ACAE	Advisory Committee on Atomic Energy
AEA	Atomic Energy Authority
AERE	Atomic Energy Research Establishment
AEC	Atomic Energy Commission
AGR	Advanced Gas Cooled Reactor
AWRE	Atomic Weapons Research Establishment
BWR	Boiling Water Reactor
CDA	Combined Development Agency
CDT	Combined Development Trust
CEA	Commissariat à l'Énergie Atomique
CERN	Conseil Européen pour la Recherche Nucléaire
CNRN	Comitato Nazionale per le Ricerche Nucleari
COSR	Committee for Overseas Scientific Relations
CPC	Combined Policy Committee
CRNR	Comitáto Nazionále Energia Nucleáre
CRO	Commonwealth Relations Office
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFR	Dounreay Fast Reactor
DSIR	Department for Scientific and Industrial Research
EAES	European Atomic Energy Society
EC	European Community

ECSC	European Coal and Steel Community
EDC	European Defence Community
EEC	European Economic Community
EFTA	European Free Trade Association
ELDO	European Launcher Development Organisation
EMA	European Monetary Agreement
ENEA	European Nuclear Energy Agency
EPU	European Payments Union
ESRO	European Space Research Organisation
EU	European Union
Euratom	European Atomic Energy Community
FTA	Free Trade Area
GATT	General Agreement on Tariffs and Trade
GLEEP	Graphite Low Energy Experimental Pile
HAR	Homogenous Aqueous Reactor
HTGC	High Temperature Gas Cooled Reactor
HTR	High Temperature Reactor
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
IMF	International Monetary Fund
ITER	International Thermonuclear Experimental Reactor
JENER	Joint Establishment for Nuclear Energy Research
NATO	North Atlantic Treaty Organisation
NPC	Nuclear Physics Committee
OCAE	Official Committee on Atomic Energy
OEEC	Organisation for European Economic Cooperation
ORGEL	Organique Eau Lourde Reactor
PFR	Prototype Fast Reactor
PIPPA	Pressurised Pile for Producing Power and Plutonium
PWR	Pressurised Water Reactor
SGHWR	Steam Generating Heavy Water Reactor
UKAEA	United Kingdom Atomic Energy Authority
UN	United Nations
UNAEC	United Nations Atomic Energy Commission
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USAEC	United States Atomic Energy Commission
WEU	Western European Union

Archival Abbreviations

AA	Auswärtiges Amt—Politisches Archiv, Berlin
CC	Churchill College Archives, Cambridge
DDE	Dwight D. Eisenhower Presidential Library, Abilene, Kansas
HAEU	Historical Archives of the European Union, Florence
LAC	Library and Archives Canada, Ottawa
MAP	Seeley G. Mudd Manuscript Library, Princeton University
NAA	National Archives of Australia, Canberra
RS	Library and Archives of the Royal Society, London
TNA	National Archives, Kew Gardens

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CHAPTER 1

Introduction

Writing in *The Bulletin of Atomic Scientists* in 1950, the British physicist John Cockcroft lauded the 'increasing command over the forces of nature' won by scientists since the discovery of nuclear energy during 'the Renaissance of Physics' which had occurred during the early twentieth century. With cheap electricity produced by atomic power stations slowly becoming a realistic prospect, the possibility now existed for nuclear technology to shed its military legacy and instead power global economic growth. Exploited properly, Cockcroft wrote, one ton of uranium could release the same energy as burning three million tons of coal, creating excellent initial prospects for this vast new supply of power. And yet for all their optimism, these thoughts were also tempered by an awareness of several significant obstacles looming on the path ahead. For the scientist, Cockcroft warned, a demanding new field had opened up; for the engineer, the challenge now was to harness nuclear forces safely and profitably, while for the politician, the important task remained of organising the international cooperation necessary to provide a world in which this new technology could be developed securely.[1]

Such concerns were certainly credible. The twentieth century witnessed an expansion of research effort that brought with it, to borrow historian Jon Agar's phrase, a 'bewildering array of new phenomena' with which to confound physicists.[2] Among these, few discoveries prompted as much excitement and controversy as that of atomic fission, the control of which would afford a colossal military and industrial advantage to whichever

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nations could harness it successfully. The atomic bombings of Japan in August 1945 had underlined the power of nuclear weapons, and acquiring the new hardware rapidly became as important for would-be global powers as controlling its proliferation was for states already established in the nuclear domain. Debarred by Congressional edict in 1946 from continuing the wartime partnership with Washington that had successfully produced the atomic bomb, London consequently increased its military spending and built independent national nuclear establishments manned by a large state research corps.[3] Determined to restore technical exchanges across the Atlantic and to fight for every possible concession of information and materials from its erstwhile partner, Whitehall thus ensured that its domestic atomic effort would be fraught from the outset by continual diplomatic wrangling.

Against this backdrop of technological advance, a second great change was underway. In Europe, the political situation had become dangerously unstable as a result both of internal forces and of external pressures wrought by tensions between the two post-war superpowers. An artificial schism divided democratic West from authoritarian East, while the need to reconstruct key industries and housing weighed heavily on bankrupt war-torn economies. The ascendancy of the United States to the rank of sole nuclear power and the ever-present danger of espionage were also of primary significance, providing a volatile and challenging environment in which to develop sensitive atomic technology. And yet despite these obstacles, the modernistic appeal of civil nuclear energy was soon seized upon by numerous actors who identified the technology as a tool capable of fostering European unity by both promoting economic growth and encouraging transnational cooperation in a research field whose demands would stretch the resources of any one state. Appreciating these positive aspects of civil nuclear energy and tying them to their vision for a united continent, these influential lobbyists therefore quickly succeeded in binding the question of nuclear development inextricably to that surrounding Europe's future. Here, then, was the duality of atomic technology laid bare: atomic bombs could fuel a third world war as easily as nuclear plants could power the recovery necessary to help Europe resist communism.

This book will examine the travails of British scientists, diplomats and politicians as they sought to develop civil nuclear energy in the UK during the difficult early post-war years. In particular, it will analyse how the new technology was deployed as a diplomatic tool during a period of intense debate about the future shape of Europe, an argument characterised by division between those states favouring traditional intergovernmental cooperation and those demanding that national governments subject first specific industrial sectors and later their entire markets to supranational regulatory bodies. Beginning with the formation of the European Coal and Steel Community (ECSC) in 1950, the drive towards European integration was consistently opposed in London, where policy makers sought instead to use Britain's best assets as collateral to promote intergovernmental cooperation. Among the most attractive resources in Britain's armoury was its impressive array of technological competences, in particular its civil nuclear capabilities which by 1953 had grown to the point that Britain had surpassed even the United States to become the world's leading power in the sector. This in turn presented British scientists and diplomats with the challenge of maintaining Britain's technological lead while simultaneously exploring those opportunities where international cooperation could reap financial, political or scientific benefits for their nation. Accordingly, this book will examine closely the impact made by Anglo-European nuclear diplomacy on the political decisions taken during the period 1945–1962, and will analyse the reasons for Britain's failure to use its leadership of a crucial new technology to negotiate a future more in tune with its own desires.

Existing works on Anglo-European civil atomic relations habitually follow three main axes; assessing either Britain's stance towards European integration, the role of science and technology in promoting continental cooperation or, lastly, the part played by civil nuclear power specifically in fostering such collaboration. Beginning with the first of these, Britain's refusal to join the Netherlands, Belgium, Luxembourg, West Germany, Italy and France (the so-called 'Six') in integrating their coal and steel markets under the European Coal and Steel Community (ECSC) in 1950, along with its non-participation in the 1955 Messina Conference and the 1957 Treaty of Rome (the cornerstone events in the formation of the European Economic Community (EEC) and Euratom, the combined atomic agency of the Six) have formed the nexus of a historiographical debate over whether British recalcitrance represented a 'missed opportunity' to steer the integration process at an early stage. This discussion has been divided by historian Oliver Daddow into three eras; a period of orthodox criticism of British ministers during the 1960s, a revisionist surge in the 1980s and, finally, an emerging body of 'post-revisionism'.[4] Typical of the first approach is the work of Miriam Camps, who derided London's 'misjudgement' in ignoring Messina, blaming it partly on national pride.[5] Similarly, Elisabeth Barker has criticised British 'egotism' in spurning the

Six, although she has generously allowed that Whitehall was distracted at the time with animating the North Atlantic Treaty Organisation (NATO) and tackling its other Cold War commitments.[6] Finally, Max Beloff has condemned Britain's self-exclusion from Euratom, arguing that it left UK exports exposed to a competitor whose progress became unexpectedly rapid.[7] Literature of this school, then, derides Whitehall's ministers as short-sighted and conservative.

Among revisionists, the economic rationale determining London's refusal to integrate is well-established: post-war Britain, as Alan Milward has stated, needed to liquidate its diminishing advantages to secure an international arrangement which would guarantee its security and prosperity. Within this 'national strategy', Whitehall pursued a 'one-world' policy which would maintain Britain's influence in Europe, Washington and the Commonwealth simultaneously by establishing a trading system conducive to these aims.[8] Supranationalism under such circumstances remained inconceivable, however, placing British ministers increasingly in conflict with American officials who nurtured the integrationist impulse planted by French ministers in 1950. Pursued with cross-party consensus throughout the 1940s and 1950s, the strategy was lauded by Milward as a rational response to Britain's relative decline, even if the gambit eventually failed due to ministerial unwillingness to reconsider the role of the Commonwealth.[9] These notions have been developed by Wolfram Kaiser, who has highlighted how London attempted initially to construct an intergovernmental 'British Europe' which prioritised trade liberalisation. Within this framework, Whitehall would undertake economic and military cooperation through the Organisation for European Economic Cooperation (OEEC) and the North Atlantic Treaty Organisation (NATO), eschewing the integration demanded by the ECSC and the unsuccessful European Defence Community (EDC). At most, Kaiser notes, London could accept a loose customs union binding Commonwealth producers to continental manufacturers, a notion explored by Foreign Secretary Ernest Bevin in 1947 before its rejection by the Treasury.[10]

Additionally, John Young has railed against notions espoused by Camps that Whitehall's indifference represented a 'lost opportunity' to assume leadership of a continent desperate to accommodate Britain. Instead, Young charges that ministers underestimated the commitment of men like Belgian Foreign Minister Paul-Henri Spaak and West German Chancellor Konrad Adenauer to integration: without embracing the supranational concept itself, Young argues, there *was in fact no such opportunity* and

Whitehall could *never* have taken control on its own terms.[11] Even after the traumatic Suez Crisis, the Conservatives preferred to strengthen their Atlantic rather than their European ties, leaving the humiliated French to scornfully embrace the common market. With this being the case, Young criticises Britain's torpor in devising an alternative trading bloc which could have neutralised the European Economic Community by amalgamating it into an OEEC-led Free Trade Area (FTA).[12]

'Plan G', as this latter proposal was known, has been condemned by revisionists as an attempt by London to retard the progress towards integration made by the Six, but has recently been rehabilitated by post-revisionist scholars. James Ellison, for instance, has contended that the plan was 'not devised to sabotage the Common Market but to come to terms with it', and in fact represented an intelligent accommodation of 'Europe's rise within the geometry of Churchill's "three circles"'.[13] Driven by a post-Suez acceptance that the need to preserve American goodwill prevented outright hostility to the Six, and a domestic dynamic in which the Foreign Office's traditional dominance over European policy was progressively usurped by the rising influence of the Treasury, Britain thus attempted instead to neutralise the Six.[14] Importantly, however, Ellison nevertheless identifies a 'dormant negativity' towards Europe within key players at Whitehall, reflecting some continuity with his revisionist predecessors.[15] This then, as Daddow allows, is a 'messier' narrative which defines Whitehall not as a monolith but as a 'variety of different individuals and agencies, infiltrated by a plurality of outside interests'.[16] With current literature thus encouraging more nuanced analyses of policy-making, an opportunity emerges for a study of how Britain's atomic interests influenced its European diplomacy during the 1950s.

It is a field ripe for exploration: across all three schools, historians grudgingly acknowledge Euratom as a waypoint between the ECSC and EEC without examining atomic collaboration in detail. Miriam Camps' seminal study, for example, addresses Euratom only fleetingly, commenting that Britain eschewed participation because of its technological lead, its dependence on Canadian uranium and its intertwined military-civil atomic programme.[17] This trend continues in the revisionist literature: John Young has largely ignored Euratom in his work on *Britain and European Unity*, while Piers Ludlow has allowed that atomic integration may at most have decided the *timing* but not the *success* of Britain's eventual 1961 application to join the European Communities (EC).[18] Such oversight is peculiar, however, considering that Ludlow himself has shown how French antipathy to proposals made by the Dutch for a European customs union was overcome only by an offer to collaborate on civil nuclear energy too.[19] Indeed, the inextricable link between atomic energy and the rebirth of the European project after the failure of the EDC represents a popular theme in the few articles addressing Euratom's origins: to forget the community's place in rekindling the integrationist impulse, as Mervyn O'Driscoll has opined, therefore remains 'tantamount to historical amnesia'.[20] Addressing this space directly therefore, this book will establish what chances existed for Britain to utilise its nuclear prowess to shape the continent and what became of these openings. In this way, it will re-energise the 'missed opportunities' debate by applying it to a new technology of paramount importance.

Moving to the second strand of literature of interest to this book, the tendency of political historians to treat 1945 as a 'zero hour' has long concerned analysts of European science and technology who oppose the conceptualisation of continental institution-building as a dichotomy between supranationalism and intergovernmentalism. Instead, such commentators highlight the role of technicians in fostering cooperation over a far longer period, analysing how technical experts developed collaborative networks on merit of function over politics. For example, Wolfram Kaiser and Johan Schot have recently criticised the whiggish notion of integration as a tale of post-war 'European saints', proposing instead a story of 'hidden integration' originating in the 1800s and featuring technocrats and cartels who adopted 'internationalist working patterns'. Drawing on examples including railways and the steel industry, Kaiser and Schot demonstrate how expert interaction shaped the integration process and argue that the supranationalist ideals fostered by influential lobbyist Jean Monnet (chairman of the Action Committee for the United States of Europe, a forum formed in 1955 to unify political parties and trade unions in promoting continental economic integration) were not truly revolutionary, stemming as they did from Monnet's knowledge of Allied cooperation during the Great War and of American experience with experts operating semi-autonomously in the Tennessee Valley Authority.[21] Furthermore, Vincent Lagendijk has illustrated how the interwar period witnessed the progressive promotion by transnational politicians and engineers of a European electrical grid which they believed would secure peace by fostering infrastructural interdependence.[22] Disrupted by war, these notions resurfaced after 1945 to animate Europeanists and engineers alike.

As an ideal priding itself on its modernistic visions of prosperity, European integration soon established a logical marriage with new science and technology. As John Krige has noted, American technological superiority forced post-war European nations to answer the increasing demands of modern science by pooling their resources into collaborative projects. Driven by 'a huge infrastructure of industrial, scientific, technological and managerial collaboration', European science, Krige argues, thus became a driver of integration 'far more durable and important, in a way, than the comings-and-goings of political parties'.[23] Indeed, the role of scientists in propelling collaboration has proved a popular theme in case studies such as CERN, the particle physics accelerator project begun at Geneva in 1954. As Dominque Pestre and John Krige have argued, CERN should not be viewed, teleologically, as an inevitability given the contemporary drive towards political collaboration. Instead, they note that the absence of national science policies left individual scientists free to act as 'product champions' who often shielded governments from real decision making. Under such circumstances, Pestre and Krige conclude, it was not the 'European spirit' or expert unanimity which built CERN, but rather fortune and the benefit of being the first such collaboration, uninhibited by historical baggage.[24]

Notions of US-European competition have also been addressed in case studies of aeronautical collaboration. As Keith Hayward has demonstrated, the 1967 Airbus agreement represented a natural confluence of interests between French airframe manufacturers, British engine firms, and German aeronautical industries. As such, the project's success has been attributed by Hayward to four factors; namely the existing base of European aerospace excellence, an acceptance that collaboration offered the only way to challenge American firms, an unwavering political commitment by Paris to break Washington's dominance, and a process of progressive harmonisation which allowed Airbus to function as one company. Thus, as Hayward concludes, Airbus has become one of Europe's most successful collaborations and, 'just as an individual project has a "learning curve", where costs per unit are high at the start of production and steadily diminish [...] so collaboration should be seen in a similar light'. As a result, despite taking a hiatus from 1969–1978 to focus on domestic alternatives, the 'British government has learned, if not to love Airbus, at least to accept it as the only way that Britain can stay in the large civil airliner business'.[25]

Another key historiographical theme has been the use by governments of technological collaboration to incentivise political objectives. Krige, along with Michelangelo de Maria, has also analysed space projects including the European Launcher Development Organisation (ELDO) which arose from *Blue Streak*, the British ballistic rocket system cancelled in 1960. Supported by aerospace firms, British politicians 'Europeanised' the project in order to release the commercial benefits of communications satellites, to incentivise Britain's application to join the EC and to preserve its engineering capabilities. The move was popular with industry: as Krige explains, conventions like ELDO '"locked" governments into costly, long-range programmes from which it was difficult, if not impossible for them to withdraw'.[26] Yet the diplomatic and commercial imperatives spurring the project also left it susceptible to political whim, and Prime Minister Harold Macmillan's Labour successors withdrew from ELDO in favour of a national rocket programme after the rejection of Britain's second EC application in 1968. Despite the presence of these political overtones, however, de Maria and Krige have argued that ELDO was not merely a diplomatic expedient, being based on tested technology with considerable capital already invested.[27] Instead, the authors propose that the pressure to answer superpower advances in rocketry may have stimulated ELDO prematurely, a crucial argument when considering the similar imperatives in the nuclear field.

Political motives were also apparent in aerospace collaboration, a field in which European states collaborated to overcome their comparatively small domestic markets. Works on Concorde, for example, describe how Britain's struggles with its famous Comet jets led it instead to attack the burgeoning market in supersonic airliners, a choice which encouraged symbiotic cooperation with French aeronautical firms hampered by their small size and inability to build engines. Older analyses such as Annabelle May's polemic have berated Concorde for its economic failure, but Lewis Johnman and Frances Lynch have recently emphasised the scheme's vital political relevance after 1961.[28] With Britain's preference for Anglo-American cooperation terminated by the Kennedy administration's decision to pursue a Mach 3 airliner (unlike the Mach 2 option desired in London), and with Whitehall now requesting EC membership, France's initially junior position in any potential partnership was immeasurably strengthened. Based initially on a mutual technical interest in staying in the civil aviation game, Anglo-French cooperation thus assumed a diplomatic relevance: faced with the alternative of isolation while France cooperated with German airframe companies using American engines, Britain was therefore 'bounced' into joining forces.[29]

Although sketched briefly here, existing works on technological cooperation assert that European states built up their technical capability communally after 1945 in order to help them both compete against and collaborate with American industry. Within this environment, three key groups emerge within the proponents of collaboration, namely internationalist experts, ministers seeking to generate political goodwill, and firms who foster teamwork to stay competitive. Cooperation also entailed a complex relationship between political attractions (notably EC accession) and technical goals, with the negotiation of influence between scientists and ministers often determining the scheme's success. ELDO, for instance, demonstrated how troubled national technologies could be Europeanised for political benefit, while CERN's success owed much to its distance from national egotism. This book, then, will expand these themes by analysing Anglo-European interaction in civil atomic energy, a technology unique in its perceived urgency, thirst for resources and comparatively early beginnings. In so doing, it will reassess existing notions of technological collaboration as a tool capable of incentivising political objectives or preserving scientific contact despite official classification. Adopting a longer view, it will examine Anglo-European atomic engagement after 1945 rather than beginning with the integration debates of 1955, and discuss whether Britain offered a realistic potential partnership for European powers unable to cooperate with the United States. Additionally, it will assess the interplay between Britain's political and technical motivations in cooperating overseas and determine the freedom afforded to experts over technical foreign policy. In this way, it will decipher what lessons the nuclear example holds for our understanding of international technological collaboration.

Turning lastly to the literature on the foreign policy aspects of Britain's atomic project, European issues have long been relegated below Anglo-American and, less markedly, Anglo-Commonwealth nuclear relations. The core author in this respect is Margaret Gowing, whose *Britain and Atomic Energy* and two-volume *Independence and Deterrence* represent the keystone texts of the nuclear genre. The former study details how an American offer of nuclear collaboration in 1941 was declined by British officials worried about plant location, a delay Gowing believes to be fatal: 'if the two projects had at that time become closely intertwined […] not even the United States Army could easily have pulled them apart again'.[30] Instead, when cooperation was eventually agreed at Quebec in 1943, American advances meant that Britain was accepted only as a junior partner on terms far worse than those initially offered. This situation, Gowing identifies, was exacerbated by Whitehall's disastrous misreading of its position: assuming that post-war collaboration would continue *alongside* an independent domestic programme, British officials overlooked Washington's distrust of any such undertaking, leaving London at the mercy of 'the generosity and sense of fairness of an unknown future President'. With Quebec rendering Britain's post-war atomic activities dependent on American permission, the incident would thus 'affect profoundly' its diplomacy for at least the next decade.[31]

Continuing the story, Gowing's *Independence and Deterrence* details Britain's post-war path to becoming a nuclear weapons power on the brink of realising an independent civil atomic project. In between, the analysis examines exhaustively Britain's nuclear development from the termination of Anglo-American atomic relations under the 1946 McMahon Act to the eventual procurement of the titular deterrent. Reflecting the diplomatic trends prevalent during her period of study, Gowing again focuses overwhelmingly on the Anglo-American nuclear relationship that dominated contemporary policy, with only cursory references to continental or Commonwealth relations. Indeed, across the entire two-volume work, barely a dozen pages are devoted to Anglo-European atomic exchanges, and even this minimal analysis is geographically constrained, dealing primarily with Belgian uranium contracts and the French scientists who fled to Britain in 1940.[32] There are other weaknesses: Gowing's work offers little insight into Britain's civil atomic achievements after 1953, while contemporary security restrictions also prevented any thorough referencing. By re-examining the material with the lapse of the thirty-year rule governing archival releases, this book will therefore reconnect primary and secondary literature.

Gowing's Anglo-American perspective is replicated elsewhere. Existing literature identifies Britain's bomb as a prop for its prestige *vis-à-vis* Washington, a competitive dynamic elaborated by Septimus Paul, whose characterisation of Washington and London as 'nuclear rivals' provides a valuable framework for this study's early chapters, and by Martin Sherwin, who has developed the notion of 'two policemen' struggling to guarantee international atomic security.[33] In this vein, Peter Hennessy has highlighted how Whitehall could not ignore atomic energy's 'revolutionary' potential, while Britain's subsequent pursuit of thermonuclear weapons has been attributed by Lorna Arnold to a need to maintain Britain's influence at the highest level of Atlantic defence planning.[34] Analyses of

Washington's decision to pursue nuclear and thermonuclear weapons by Gar Alperowitz and Richard Rhodes have also been contextualised by Shane Maddock, who noted how Washington's unipolar 'nuclear apartheid' was undone by Britain's acquisition of atomic weapons.[35]

So dominant is this Anglo-American focus that very little has been written about Britain's *bilateral* atomic engagement with continental nations beyond that offered in national studies. For example, Gabrielle Hecht has identified how Anglo-French rivalry caused French technicians and politicians alike to attempt to outperform British designs.[36] Britain's acquisition of nuclear weapons is also held by Lawrence Scheinman to have been decisive in persuading Paris that obtaining the bomb could bridge France's 'real and theoretical status' in the Atlantic alliance.[37] Michael Eckert, meanwhile, has also discussed how Britain's atomic establishments provided an organisational model for West Germany's nuclear project, while Astrid Forland has highlighted how Atlantic politics prevented London from aiding Norway's nuclear activities.[38] Furthermore, Jacob van Splunter has revealed how Whitehall countenanced low-level exchanges of uranium metal for uranium ore from the Dutch, who themselves pursued bilateral cooperation both to maintain their access to multiple reactor types and to affirm their sovereignty from supranational authorities. In this way, van Splunter distils succinctly the basic problem confronting European atomic cooperation by identifying how smaller nations were obliged to collaborate on projects that exceeded their individual financial and technological means.[39] The disequilibrium between advanced nuclear states like Britain and smaller nations with more modest aims consequently mirrored the contemporary struggle to find continental politico-economic harmony.[40]

In the main, existing literature addresses Anglo-European nuclear cooperation primarily within the context of supranational integration. Aiming, in historian John Gillingham's words, to 'surmount historic antagonisms that were fast becoming irrelevant', French and German ministers agreed in 1950 to pool their coal resources under the ECSC to help Europe resist Soviet aggression.[41] With this achieved, the Six soon sought fresh fields in which to collaborate, and Alan Milward has identified how Europeanists quickly recognised atomic energy as a 'a new and more potent symbol of modernization', and moreover as a field which complemented French interests by providing access to German finance and engineering that could facilitate the isotope-separation plant long desired by Paris.[42] British ministers, however, remained uninterested in the scheme, a decision Milward has attributed to Whitehall's belief that it had more to gain from an independent atomic project than from European cooperation, an attitude seemingly justified by an Anglo-American civil nuclear agreement signed in March 1956.[43]

Nevertheless, although Britain's Atomic Energy Authority (AEA) considered itself significantly more advanced than Euratom, it still needed to help British industry sell reactors to the Six. To this end, Milward argues, the Authority manipulated ministerial prejudices against the military and material supply connotations of cooperation to dissuade Whitehall from signing any bilateral agreement with Euratom as an inducement to countenance London's FTA proposals, suggesting instead that Britain engage through a *general* OEEC free trade area designed to neutralise the new community. This proposal was however rejected by the economic ministries who, spurred by the US-Euratom Agreement in summer 1958, demanded a formal link with Euratom to encourage exports while Britain retained its technological advantage. Importantly, then, Milward's work showed how the fear of losing reactor sales forced Britain to correct its aloofness and to accept that it must accommodate the Six to remain relevant.[44]

Developing this view, Mauro Elli too has identified that the AEA's jealous defence of its technological lead seriously impeded Whitehall's ponderous attempts at joining the Six. By imagining nuclear power as a totem of national virility, Elli argues, the AEA encouraged an unhealthy situation in which 'rationality was politically-tinted by the idea of technology as a substitute for power'. Under such circumstances, Britain's atomic mandarins refused to pool attractive technologies, leaving government negotiators to table 'comprehensively inadequate' proposals to Euratom.[45] These notions of an administrative divide have proved popular, and Stuart Butler has noted how the 'pitched bureaucratic battle' between the Board of Trade and the AEA was settled only by Macmillan's 1961 EEC application. Like Elli, Butler scrutinises what the AEA proposed to offer to Euratom within this remit, and details how the Authority and Foreign Office struggled for supremacy over the negotiation process. In this way, he has liberated the Euratom negotiations from their traditional subservience to the EEC discussions, highlighting that while British ministries became more enamoured of the common market in the run-up to 1961, the same cannot be said of the Authority's persistent negativity towards Euratom.[46]

The crux of these studies, then, is atomic sovereignty, and existing literature portrays the AEA as an obstinate anti-integrationist voice in the interdepartmental deliberations that determined Whitehall's response to the common market. Motivated by a need to protect Britain's military activities, a fear that participation in Euratom would jeopardise its privileged relations with Washington and, finally, a fundamental hostility to pooling its researches, the Authority successfully prevented the Foreign Office and Treasury from using atomic cooperation to secure a broader arrangement. Across all three analyses, the AEA is therefore depicted as parochialist, intent on disrupting the reconciliation with Europe desired by senior departments: described as 'indefensibly unrealistic' by Milward, 'consistently negative' by Butler and 'a matter of dogma' by Elli, the advice and behaviour of the Authority have thus been castigated as deleterious to progress.[47]

In turn, the diplomatic aspects of Britain's relations with Euratom have been readily developed by Gunnar Skogmar, who has redefined Euratom as an instrument designed to improve American security by granting Washington control over French and German nuclear ambitions.[48] Aiming to locate atomic energy as a pillar of the 1955 *relance européenne* (the 'relaunch' of the integration project), Skogmar identifies how Washington supported supranational integration over London's intergovernmental approach in order to 'prevent, retard or minimize' the development of national nuclear weapons projects or of a neutralist European force outside NATO.[49] Needing therefore to control the ability of European states to enrich uranium, Eisenhower instead opted to supply continental states directly with American supplies, embedding Washington as a permanent stakeholder in Europe's nuclear fuel cycle. Regarding Britain's role in this process, Skogmar makes the important assertion that Washington restored Whitehall's privileged atomic relations in 1958 in order to dissuade London from abetting the Franco-German military atomic complex then under discussion. Furthermore, he demonstrates how American opprobrium prevented Whitehall from incentivising the OEEC approach with collaboration on an enrichment plant, reducing its ability to compete with Euratom directly.[50]

Analysing Washington's longer-term foreign policy, John Krige has shown how the traditional anti-authoritarianism of scientific culture was coopted after 1945 to oppose European totalitarianism.[51] Examining examples including the Marshall Plan, Rockefeller Foundation and NATO operational research, Krige demonstrated how Washington *coproduced* a 'consensual hegemony' with continental elites who shared its 'economic, political and ideological ambitions', in turn allowing European science to be 'Americanised' and modernised to meet the communist threat.[52] These machinations also encompassed Euratom, an organisation which advanced

Washington's diplomatic objectives while also allowing European states to accelerate their scientific development.[53] Confronted however by suspicions that Eisenhower's offer of cheap enriched uranium was merely a ploy to render Europe permanently dependent on Washington's benevolence, Secretary of State John Dulles authorised an agreement under which Washington would help Euratom to build nuclear reactors, a policy which allowed the United States to supplant an outraged Britain as Europe's atomic hegemon.[54] As Henry Nau has highlighted, then, Euratom's birth reflected a blend of strategic dimensions interpreted differently by key actors. The United States emphasised the 'specific' nature of technological research and development (R&D) whereas Europeanists admired the 'structural' allure of supranational nuclear integration. Britain, finally, disdained the 'symbolic' aspect of the project, preferring to affirm its atomic *independence*.[55] Taking this conflict as a starting point, this analysis will thus argue that Britain in fact posited a stronger alternative to integration than existing analyses have allowed.

The final sub-strand within the literature on Britain's overseas nuclear engagement tackles the economic aspects of Britain's civil atomic project, and here scholars have characterised the era surrounding Britain's first Magnox reactors (1956–1971) as one of low competitiveness and poor export performance. This field is now quite dated, with many principal works addressing the transition from Magnox to AGR reactors in the late 1970s and focusing accordingly on the cost of nuclear electricity compared to fossil fuels. Roger Williams, for example, has illustrated the 'economic confusion' caused by Britain's rush to install nuclear generating capacity after 1955 and its hasty scaling-back in the light of an improving fossil fuel economy just three years later.[56] Detailing several 'blows to nuclear economics', namely the declining credit allocated by the government for plutonium production, rising interest rates which hampered nuclear stations with high capital costs more than they did conventional plants, and renewed competition from cheap coal and oil, Williams thus highlighted Magnox's 'unhappy' early life, a scenario mitigated only partly by the eventual improvement of the plant's lifespans.[57]

Expanding these notions, C.M. Buckley and R. Day have noted that Magnox technology forced Britain into a 'narrow front' of research, whereas their American competitors maintained interest in a far broader range of options.[58] In a scathing polemic, Duncan Burn too has criticised the notion that possessing the world's first nuclear power station amounted to true leadership for Britain, highlighting that American plants had attained more credible efficiency goals sooner. British atomic 'leadership', Burn argues, was illusory under such circumstances, and UK industry was in fact engaged in the 'last development stages of a system with no future'.[59] Thus, although temporary Anglo-US technological parity may have been reached in 1956, Burn concludes that Magnox remained 'unexportable', and that Britain's pioneering position was a myth perpetuated by deluded ministers.[60] In the main, then, Britain's nuclear exports have been judged a failure, with its two successes (sales to Italy and Japan) amounting, in William Walker and Måns Lönnroth's estimation, to little more than an affectation by foreign governments to associate with new technology 'for prestige and demonstration purposes'.[61] Indeed, as Robert Boardman and Malcolm Grieve have noted, 'the bigger prizes of turnkey contracts […] eluded Britain's grasp', leaving UK firms to settle for what was admittedly 'a flourishing export trade' in fuel reprocessing, enrichment and radioisotopes.[62] This failure of 'national champions' to win 'international contests' in this manner eventually culminated, as David Edgerton has stressed, in a 'loss of faith in national science as a source of national power'. In turn, these shortcomings precipitated a decline in government funding *relative* to private investment, a fact accelerated by the Six's internal trade liberalisation after 1958.[63] Importantly, then, Edgerton identifies implicitly the interaction between ailing national science and European integration.

Taken in sum, the separate historiographies on Britain's nuclear project and European integration provide a valuable but incomplete basis from which to analyse the Anglo-European atomic relationships which gained relevance throughout the 1950s. First among the key trends, however, is a scholarly preoccupation with Anglo-US relations over European issues. Focusing primarily on the strategic importance of the 'Special Relationship', historians have paid little attention to Britain's atomic engagement with Europe, save for a few commentaries on its response to Euratom. As such, there remains considerable scope for an investigation into the Anglo-European exchanges which survived despite Britain's immediate post-war mollification of Washington, in turn paving the way for a study of Anglo-Six nuclear relations that is more substantial than the temporally-restricted analyses presently available. Secondly, current historiography has asserted that the AEA adopted a consistently negative perspective towards Euratom, a view which requires refinement in several respects. In particular, the Authority is often portrayed as a monolith, with little mention of the longer-term evolution of Britain's atomic interests which caused its jealous defence of its prowess. For example, despite compressing several complex issues into an effective summary in *National Strategy*, Alan Milward's analysis remains brief, and a greater appreciation of the technical debates would illuminate the debate considerably. This book will thus elaborate expert motivations by looking beyond the final advice transmitted by the Authority to ministers, and discerning instead how this opinion was first constructed by the AEA's officials.

Furthermore, while the AEA's hesitance regarding supranationalism has been well-defined by scholars, there is insufficient appreciation of the alternative mode of cooperation proposed by British ministers and technical experts. Aside from cursory commentary that Whitehall preferred the OEEC approach, there is little analysis of the UK's counterproposal to integration, and there is no mention of Britain's long-standing attempts to construct a bespoke commercial network using bilateral treaties.[64] As a result, this study will illuminate the so-called 'middle course' pursued by the Authority as it sought to advance Britain's atomic influence while preserving its sovereignty, in turn facilitating a new discussion of the Authority's attitude towards the integration negotiations eventually forced upon it by political mandate. Thus, by analysing the Authority's diplomatic activities more thoroughly over a longer timeframe, this book will adopt a more consistent approach than the reviews of key flashpoints offered by current studies. Finally, existing scholarship has analysed the AEA primarily as a domestic actor, with historians preferring to assess Britain's overseas atomic influence largely in terms of its lacklustre Magnox exports. As such, there is little analysis of the Authority's diplomatic role, and still less of the international activities of its technicians. Consequently, there remains great scope for an analysis of Britain's material intervention overseas beyond its power reactor exports, including the role of unclassified assistance (particularly in the early post-war years), research reactor sales and personal engagement by eminent scientists.

This book will set itself the task of tackling a neglected aspect of international nuclear history by joining the separate historiographies on European integration and nuclear diplomacy, and by addressing the abovementioned gaps in scholarship. Accordingly, its overarching contention is that Britain's atomic foreign policy between 1946 and 1963 was characterised by an inability to utilise fully Britain's civil atomic prowess as a diplomatic tool. Importantly, this study will portray British atomic diplomacy with Europe not as a 'missed opportunity' in the sense of the orthodox literature, but rather as a possibility that went unexploited because of numerous factors, not all of which were under the control of the political and technical actors involved. The reasons for this shortcoming were manifold and often interwoven, but nonetheless follow four basic paths, namely failures of politics, organisation, diplomacy or capacity. Whereas present studies have highlighted individual aspects of Britain's failure to engage with Europe such as poor export performance or simple political disdain, this study will thus undertake a more thorough assessment linking existing assertions with numerous new sources.

This book will develop existing historiography in several respects, the first of which will be to assert that Britain in fact undertook deeper atomic cooperation with Europe, and from an earlier point, than has previously been appreciated. Moreover, it will contend that much of this engagement was driven by scientists who utilised declassified information to keep cooperation alive during the first post-war decade. Although the importance of such activities has been briefly highlighted by Gowing, their implications have escaped notice in the longer context, and so this study will revise the frequently-repeated assertion that Anglo-US imperatives terminated third-party interaction by showing how unclassified exchanges in fact established Britain as Europe's informal nuclear leader. Furthermore, this study will show how Whitehall remained willing to engage *all* potential partners and created new mechanisms for processing atomic foreign policy which relieved scientists from scrutiny over 'routine matters', even if these initially harboured a pro-Commonwealth bias consistent with the 'one world' policy identified by Milward. Building on these assertions, this book will demonstrate next that Washington's persistent interventions, although well-known for their effect in restricting Britain's nuclear agency overseas, could also function *in reverse*. Making an important new argument, it will highlight how Britain was hampered by Washington's *positive* attempts to construct a new international security regime under Atoms for Peace. By involving himself personally in the scheme, Churchill committed Britain to make contributions of men and resources to an international agency which reduced its ability to intervene abroad independently. In this way, Anglo-American wartime relations presented a phenomenon more complex than a simple ban on British activity abroad.

The second argument of this book is that British scientists and politicians alike remained more amenable to European cooperation than has previously been allowed. Existing literature has addressed Britain's nuclear engagement with Europe preponderantly from the perspective of its post-1955 stance towards integration, and has determined, correctly, that the atomic lobby's refusal to integrate ultimately prevented Euratom accession from incentivising Britain's EEC negotiations. Importantly, however, such assertions do not appreciate the early work of scientific internationalists in fostering cooperation, and overlook the fact that Britain's atomic specialists proposed an alternative model of European cooperation which protected their sovereignty while satisfying the political demand for activity. This study, therefore, will examine the AEA's objectives beyond its pursuit of a nuclear-free trade area of the kind highlighted by Milward, and will contend that the Authority consistently pursued a 'middle course' which aimed to scotch accusations of political recalcitrance by undertaking some carefully calibrated cooperation with continental partners.[65] Within this strategy, Britain would participate in continental nuclear organisations in a bid to control them until such time as these relationships could be exploited commercially, and would also tailor bilateral treaties to maximise its atomic influence. Importantly, however, this study will also show how such cooperation did not satisfy the political need for action to justify intergovernmental cooperation and will demonstrate how, like ELDO, atomic projects with uncertain futures too were Europeanised to release political capital. Furthermore, it will contest the prevalent assertion that the Authority petulantly scuppered Britain's Euratom accession negotiations, arguing instead that Britain's atomic gurus were in fact well-advanced in their plans to control the organisation from the inside once it became clear that integration was inevitable. In this way, this book will connect existing studies of the AEA's opposition to integration with a backstory of steady continental cooperation, revising notions of the Authority as an anti-European voice.

Next, this book will charge that Britain's problems in delivering hardware to qualify its influence was caused by a far broader series of problems than the three factors habitually identified in existing literature. Among critics, Robert Boardman and Malcolm Grieve have attacked the 'limited growth potential' of Magnox reactors, while Richard Hewlett and Jack Holl have highlighted how Washington crushed British competition through extensive reactor subsidies.[66] Finally, Rowland Pocock has highlighted how British nuclear exports were left to those industrial consortia already overstretched by exhausting domestic construction targets.[67] Expanding these arguments, this book will highlight the different categories of restriction that beset Britain's nuclear diplomacy, including shortages of manpower, finance, fuel or construction capacity, but will also detail the technical and organisational problems that damaged London's credibility abroad. In particular, it will highlight how design issues with research reactors hampered Britain's attempts to propagate new markets, and detail London's travails in helping European states to construct vital infrastructural nodes. Furthermore, it will consider the reluctance of British industry to export its wares to competing nations, and discuss Britain's difficulty in donating scientific manpower and valuable fissile materials to Eisenhower's International Atomic Energy Agency. Thus, by appending new evidence from the nuclear case to existing historiography addressing Britain's scarce resources, it will show how London was limited to *quid pro quo* exchanges which dampened its ability to intercede abroad.

Finally, this book will demonstrate how Britain's political stance hampered its atomic engagement with Europe. Existing literature has readily identified that British politicians eschewed supranational atomic integration, and it is clear that Whitehall's belief in its technological superiority continued to inform its policy beyond a rhetorical level.[68] Importantly, however, scholars have hitherto failed to appreciate fully how Whitehall utilised nuclear energy cooperation to incentivise its FTA and OEEC preferences. Such oversight is also common in the earlier stages of Britain's nuclear relationships with Europe, during which Whitehall was compelled to recognise the waning value of the Commonwealth and actively countenanced participation in continental nuclear organisations in order to control them. In response, this study will charge that Britain's pursuit of intergovernmental atomic interaction was weakened at key junctures by diplomatic mismanagement borne of a fundamental difference of perspective. Rather than courting Euratom's politically-minded delegates, the AEA's economically-driven mandarins often angered the community's representatives with their disdain, while Macmillan demonstrated considerable naivety in allowing the OEEC's activities to be formulated by a lethargic working group. As a result, Britain failed during 1956–1957 to exploit a position in which almost all European nations (including the Six themselves) looked to London to vivify the intergovernmental method of nuclear cooperation. Augmenting existing criticisms of Britain's *ideological* opposition to integration, this book will thus highlight how untimely diplomatic failings contributed to Britain's failure to formulate an effective alternative around which sympathetic European states could rally.

In summary, this book will demonstrate that atomic energy provided a viable and powerful tool with which to shape the post-war European settlement, but will show too that Britain was unable to capitalise on this opportunity effectively. While historians have labelled political events such as the Suez Crisis crucial in determining which vision of Europe would be realised, they have ignored the chances that existed for Britain to incentivise its intergovernmental preferences, addressing Britain's atomic diplomacy preponderantly in terms of its response to supranationalism. As such, this study will define Britain's stance towards Europe not just in terms of what it *opposed* but in terms of what it *promoted*, and discuss why its objectives were not reached. In so doing, it will charge that Britain's politicians and technicians were more willing to cooperate with Europe than has previously been allowed, but that they were hampered in their effort to build the relationships they desired by a continual lack of resources. By punctuating these long-standing issues with a new analysis of key events, this study will thus define more clearly whether or not these failings amounted to a 'missed opportunity'.

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68. Elli, "A Politically-Tinted Rationality," 123–124.

CHAPTER 2

Britain and the Limits of Atomic Independence, 1945–1953

During the twentieth century, the intricate relationships between science, state and industry were fundamentally altered as the quickening pace of scientific development began to demand greater specialisation from its practitioners. In the laboratory, the workbench was progressively exchanged for more complex apparatus, while professors increasingly assumed responsibilities peripheral to their research.[1] By the 1940s, this 'scaling-up', to use historian Jon Agar's terminology, was producing larger, costlier machines that enabled experiments on an entirely new level of intricacy or scale.[2] This trend was further catalysed by two world wars as the need to gain the technological upper hand encouraged the belligerent powers to expand and better organise their scientific endeavours in a bid to maximise their war-making potential.[3] Nowhere was this evolution more pronounced than in the field of nuclear physics, where new national laboratories organised physicists into dynamic research clusters with funding and government support scaled to match the seriousness of their task.[4] Inevitably, then, with post-war governments eager to utilise 'more and better science' to guarantee successful policies, as Sheila Jasanoff has highlighted, technical specialists were asked after 1945 to continue the consultancy roles they had performed during wartime.[5] Elevated in importance, British scientists were thus removed from their laboratories and asked to sit on advisory committees alongside ministers, catalysing the phenomenon that Joseph Camilleri has labelled the 'bureaucratisation of science'.[6]

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Alongside this trend, the early development of nuclear energy in Britain was also shaped by the nation's contemporary geopolitical and economic context. Drained by war, Britain still possessed considerable international responsibilities that fed notions of continued 'Great Power' status. Furthermore, the atomic bomb now provided the nation's enemies with the potential means to annihilate its cities, and so the acquisition of such armaments became not only a military necessity but also a reaffirmation of London's scientific prestige and political status. With Washington unwilling to continue developing atomic energy in partnership with Britain after 1946, post-war ministers were thus confronted with the daunting task of organising a sovereign nuclear project to achieve their goals independently while simultaneously attempting to encourage Washington into restoring collaboration by foreswearing serious collaboration with third parties. Across the Channel, meanwhile, war-torn Europe was rent further by political schisms that divided communist East from American-sponsored West, making physical and political reconstruction imperative if the continent was to resist Soviet influence. As Europe's most advanced nuclear power, Britain consequently came under increasing pressure to take the lead in fostering collaboration in a new technology which carried with it great expectations of providing cheap and reliable energy to resurgent European industry. With nuclear energy therefore as capable of starting a third world war as powering a new industrial revolution, Britain's scientists and politicians confronted the task of developing sensitive new technology during a period of diplomatic instability within which concepts of 'Europe' were decidedly malleable.

This dilemma will form the crux of this chapter as it traces the genesis of Anglo-European civil nuclear collaboration during the earliest years of the technology's life. Reassessing the prevailing historiographical line that London's need to mollify American senators all but prevented third party nuclear cooperation, it will argue that while Britain undoubtedly remained restrained by American edict from undertaking *large-scale* atomic exchanges overseas, ministers were nonetheless acutely aware of the growing demand for nuclear assistance emanating from neighbouring states and sanctioned limited engagement in a bid to maintain London's nuclear influence abroad. Crucially, this chapter will also show that it was Britain's *scientists* who were often key in keeping such collaboration alive, pushing official limits to foster considerable unclassified interaction across numerous fora including the radioisotope trade, fundamental research and learned societies, many of which will prove significant later in this study. As such, it will demonstrate how the first instances of Anglo-European nuclear cooperation were more substantial and occurred much earlier than has previously been appreciated. Furthermore, this chapter will also highlight how Britain's advisory channels for deliberating foreign policy evolved during this period from a series of disconnected advisory committees to the formation of a new Atomic Energy Authority (AEA) in 1954 that brought with it a more direct method of relaying expert advice to ministers. By combining several previously disconnected case studies addressing disparate aspects of Britain's atomic project, and by adding important new cases, this chapter will thus demonstrate that by the mid-1950s London had established a considerable body of international exchange despite the *prima facie* restraints placed upon such activity.

The Received Wisdom

To consider Britain's early post-war nuclear engagement with Europe properly, we must briefly recount the events that led to London's atomic isolation after 1946. The coming of war in 1939 had forced Whitehall to task British physicists with harnessing the military potential of uranium fission, and by March 1940, Rudolf Peierls and Otto Frisch, two refugees working at Birmingham University, had devised a memorandum that estimated the critical mass of U^{235} required to fuel an atomic bomb to be as little as 450 g. The pair forwarded their work to Henry Tizard, chairman of the Aeronautical Research Committee, who immediately formed the 'MAUD Committee' to discuss the practicality of a British nuclear weapon. The group comprised chairman George Thomson of Imperial College and Cambridge University's John Cockcroft, alongside Liverpool's James Chadwick, Birmingham scientists Mark Oliphant and Philip Moon, and Manchester physicist Patrick Blackett. Ironically, however, the recently-naturalised Peierls and 'enemy alien' Frisch were initially refused the security clearance needed to attend the group and so their services were retained only through a purpose-built sub-committee.[7]

Nevertheless, although British experts had acquired the *theoretical* knowledge to make a bomb, constructing the facilities needed to produce a weapon usable in the present struggle against Germany remained daunting. Alongside an unrealistic requirement for 20,000 men (a quarter of them skilled), half a million tons of steel and 5000 MW of electrical power, the necessary plant (including a British diffusion facility, Canadian plutonium plant, and factories to produce heavy water and uranium metal) might cost £75 m and take five years to build.[8] Accordingly, the 1943 Quebec Agreement signed between London and Washington (with Canada observing) proclaimed that in the 'wise division of war effort' Britain would merge its atomic research, codenamed 'Tube Alloys', into the American Manhattan Project in exchange for all research derived from the venture. A Combined Policy Committee (CPC) was then established to decide mutual strategy, while British scientists were redeployed, with Cockcroft sent to direct the Anglo-Canadian reactor project at Chalk River, and Chadwick, Peierls, Frisch and ace bomb-maker William Penney leaving for America. Importantly, the Quebec Agreement's fourth clause stipulated that 'the Prime Minister expressly disclaims any interest in industrial and commercial aspects beyond what may be considered by the President of the United States to be fair and just'.[9] This was a crucial concession: developing civil atomic energy in Britain would henceforth require American permission, while Quebec also bound its signatories not to transmit data to third parties 'except by mutual consent', thereby establishing a principle of atomic interdependence between Britain and the United States.

With these terms agreed, transatlantic nuclear relations improved markedly and Churchill, as Washington's atomic kingpin Leslie Groves would later recall, became the 'best friend the Manhattan Project ever had', wielding his personal influence to keep the programme moving rapidly.[10] C.J. Mackenzie, head of Canada's National Research Council, also singled Chadwick out for praise, lauding his role in making Anglo-Canadian collaboration effective.[11] Indeed, so satisfied were the Allies with their arrangement that at Hyde Park in September 1944, Franklin Roosevelt and Churchill agreed that Anglo-American atomic cooperation should 'continue after the defeat of Japan unless and until terminated by joint agreement'.[12] It was a fleeting moment of nuclear optimism: Roosevelt's death in April 1945 and Britain's general election the following July soon undermined the intimate Atlantic dynamic, leaving new Prime Minister Clement Attlee and President Harry Truman to conclude the war having never met and with Truman ignorant of the secret Quebec Agreement.[13] Despite the successful atomic bombings of Japan in August 1945, then, the 'special relationship' quickly soured amid uncertainty about how nuclear arms would be accommodated in a volatile world.

The attainment of nuclear arms by the United States rapidly rendered atomic energy an international concern, and on 15 November 1945, Attlee, Truman and Canadian Prime Minister Mackenzie King issued a declaration in Washington calling for the establishment of a new United Nations (UN) commission to restrict international atomic development to peaceful applications. The next day, however, Sir John Anderson, the erstwhile uranium chemist who had supervised Tube Alloys through his wartime tenure as Lord President (and who was now, despite his Conservative credentials, chairman of Attlee's new Advisory Committee on Atomic Energy (ACAE)), signed with General Groves a *secret* agreement which both confirmed that atomic weapons would be used only with tripartite consent and also prohibited information exchange with any external party. Anxious meanwhile to preserve recognition for Britain's wartime work, Attlee argued in Parliament that atomic energy was the *shared* property of both Quebec signatories and proposed that fourth-party technical exchanges be negotiated through the new nuclear commission proposed at Washington.[14] In this way, as James Gormly has suggested, Britain could simultaneously 'influence Washington to support internationalization and contribute to world stability while helping itself'.[15]

Yet even these modest notions of continued cooperation soon proved optimistic, and the progress through winter 1945 of Senator Brien McMahon's proposals to isolate atomic information within the United States worried Attlee considerably, prompting a letter to Truman in April 1946 requesting an explanation for the refusal of American experts to share information useful in constructing British atomic plants.[16] Truman replied that, in his view, the Anglo-American agreements were 'very general' and did not oblige him to offer practical post-war assistance.[17] Quoting the Washington Declaration and the Groves-Anderson Memorandum in schoolmasterly fashion, the President countered that 'such co-operation, recognized as desirable in principle, shall be regulated by such ad-hoc, *repeat ad-hoc*, arrangements as may be approved from time to time by the Combined Policy Committee as mutually advantageous'. Furthermore, Truman contended that he would hardly have authorised an agreement intended to directly assist Britain having signed a declaration supporting a UN atomic commission only the previous day.[18] International controls were popular among leading American scientists including Edward Teller, and compelled in any case by a belligerent Congress, Truman signed the McMahon Act into law on 1 August, transferring the American atomic portfolio from defence interests to a new civilian Atomic Energy Commission (AEC).[19] Importantly, the new legislation prohibited the transmission of atomic information to *any* outside power, instantly severing British and Canadian scientists from their American research hubs.[20] Both states, then, recalled their cadres of nuclear physicists and engineers, and with them their experience and knowledge of wartime research.

These worrying signs of emerging American recalcitrance had long caused disquiet in London, and by early 1946 at the latest it was clear that Britain would require an expensive independent nuclear project. Yet although it possessed both the scientific experts and political will necessary to prosecute this vision, the task of organising the effort nonetheless remained monumental: establishing domestic infrastructure required the construction not only of new research establishments, but also of methods of coordinating their activities effectively.[21] Militarily speaking, British acquisition of nuclear weapons was axiomatic: the atomic bombings of Japan had inflicted mass casualties and the potential for similar havoc in the densely-populated UK quickly became a credible threat. As early as November 1945, Attlee had noted that Britain was 'peculiarly vulnerable to attack by atomic bomb owing to her geographical position and her concentration of population', while international inspection systems were dismissed by the Prime Minister as a 'highly dangerous sham'. Under such circumstances, Attlee contended, the only security lay in 'trust reinforced by the certainty of swift retribution if the trust is broken'.[22] Many influential scientists concurred, with Churchill's personal scientific adviser Lord Cherwell arguing that without atomic weapons, Britain would be 'in the position of savages armed with boomerangs [...] confronting armies using machine guns', and Chadwick believing that the bomb would (perhaps paradoxically) render war unthinkable.[23]

Yet despite the clamour for a British nuclear weapon, the civil applications of atomic energy were also appreciated by ministers in London from an early stage. As a result of Attlee's dogged negotiating during the Washington meeting, the Groves-Anderson Memorandum had tasked the CPC with drafting a new agreement to supersede Quebec, theoretically terminating Clause IV and freeing Britain to develop industrial nuclear power independently.[24] Such machinations quickly proved prudent, as brutal winter weather in 1946–1947 forced many coal-fired power plants to close, exposing Britain's weak energy infrastructure. Furthermore, after an initial post-war fillip, British coal production soon began to plateau while the proportion of output consumed by native power plants rose steadily. As a result, an energy gap loomed and coal exports crumbled, leading Foreign Secretary Ernest Bevin to complain in late 1950 that Britain's close political ties with its main European markets (Scandinavia, Italy and Spain) were being eroded by its inability to supply fuel abroad.[25]

Oil, meanwhile, was made unattractive both by its cost and its geopolitical drawbacks, having been integrated into a policy enacted via the Marshall Plan to render Europe dependent on American fuel firms.[26] Although in its absolute infancy, atomic energy thus presented a novel solution to both quandaries, even if its economics were still ill-defined.

With a native project thus militarily and economically validated, in January 1946 Attlee ordered a programme to produce fissile material 'as circumstances might require'.[27] The next month, Lord Halifax, London's ambassador to Washington, informed the CPC that Britain would construct a new Atomic Energy Research Establishment (AERE) at Harwell which would involve itself 'as much with the development of atomic energy for peaceful purposes as with its military application'.[28] Initially, Harwell would build facilities to separate the isotopes needed for chemical testing, but Halifax announced that Britain also desired a plutonium pile to underpin both its military and its industrial research.[29] Meanwhile, a Production Group to study civil nuclear energy was formed at Risley near Warrington under former Great Western railway engineer Christopher Hinton, while Britain's bomb was trusted to Penney's Weapons Group, based first at Woolwich and later at Aldermaston in Berkshire.

The strategic advantage of domestic infrastructure was even compelling enough to force the politically disastrous termination of London's partnership with Ottawa. Such a decision could not be taken lightly: as Margaret Gowing has highlighted, Britain had the manpower to vivify effective collaboration while Canada possessed an embarrassment of atomic riches in its uranium, pure graphite, heavy water, cheap power and remote sites.[30] Furthermore, continued post-war cooperation appealed to leading British scientists: Cockcroft encouraged joint development from the outset, highlighting that it need not weaken London's domestic work, while Chadwick warned against pushing Ottawa 'into the arms of the American octopus' or prompting a Dominion project beyond London's control.[31] Nevertheless, with Canada lacking the industrial muscle to support a large programme by itself, Whitehall withdrew in order to construct the secure domestic laboratories which could more rapidly realise its aims. To remove British personnel from North America had previously been considered diplomatically unwise, but Whitehall, emboldened by the Groves-Anderson memorandum, now recalled Cockcroft and installed him at Harwell with extensive authority over research planning.[32] As a result, although UK scientists maintained their access to Canadian research facilities, the breakdown would nevertheless poison London's nuclear relations with Ottawa for many years.[33]

So far we have seen how the early post-war years were clearly marked by a process of atomic retrenchment, with Washington cutting itself off from its nuclear allies and Britain forced in turn to abandon its Canadian ally and look to its own ingenuity. With nothing to lose, however, Attlee's Cabinet nevertheless designated the restoration of Anglo-American information-sharing relations to be *the* overriding atomic foreign policy consideration for the foreseeable future. Analysing this decision, Robin Edmonds has argued that the strategy was undertaken because select 'atomically initiated' elites (both political and scientific) in London considered nuclear energy crucial to the Atlantic relationship as a whole, and saw moreover that Britain's best chance of achieving technical success lay in mollifying a reluctant Congress and gleaning what information they could from the United States.[34] In turn, the debate over Britain's early nuclear diplomacy has been dominated by scholars who have identified how Whitehall's appeasement strategy inevitably mandated the continual rejection of serious atomic information sharing elsewhere. Margaret Gowing, for example, has judged that Britain's desperation to appease Washington effectively killed any chance of early collaboration with Europe or the Commonwealth, a process which started when London was compelled to ignore its moral obligation to compensate Paris for the patents French scientists had contributed to Britain's nuclear research in 1940.[35] Quoting Cockcroft, Gowing consequently describes Britain's attitude towards European collaboration during 1946–1951 as one of 'masterly inactivity' enforced by the constant threat of American displeasure.[36] With exchanges requiring enormous expediency to unlock even grudging concessions from Washington, 'no rational line' could be taken by London towards cooperation overseas, in turn allowing the need to find bespoke 'special positions' for partners to cause disproportionate delay.[37] The year 1951 has similarly been identified as a turning-point by Septimus Paul, who has charged that only in its death throes did Attlee's government reconsider cooperation with the Dominions and Europe, with the newly returned Churchill instead regarding a British bomb as the true key to restored Atlantic exchange.[38]

Such notions also pervade specific case studies, and Jacob van Splunter has shown how Britain's attempts to supply small quantities of uranium oxide to the Dutch in 1950 were severely retarded by compulsory American scrutiny.[39] Furthermore, Lawrence Scheinman has noted how Anglo-American agreements prevented Britain from supplying U^{235} to France, while Astrid Forland has revealed how such concerns also stopped Norway from buying British technology and materials.[40] Outside Europe meanwhile, Wayne Reynolds has revealed how the Atlantic entente 'put a brake on Australian ambitions' of working with London, while Lucky Asuelime too has shown how American paranoia prevented Britain's three southern Dominions from receiving any valuable technical information in exchange for the raw uranium they were requested to supply to London.[41] Notably, however, Gowing contends that Britain made 'the best of a bad job' under these conditions, exploiting the declassification of heavy water and graphite research reactors in 1951 to foster limited cooperation with its European neighbours.[42] Furthermore, she recognises Cockcroft's role in forming personal relationships which 'kept channels of communication open and held several countries at least potentially within the British orbit', although these vectors are not elaborated further.[43]

The general conclusion of this brief survey is that Britain's ability to engage its European partners was continually stymied by the need to appease Washington by foreswearing collaboration abroad, and that these strictures were only eased by a slight softening of American recalcitrance in 1951 and by the ability of British scientists to keep personal communication alive. Importantly, however, there remains a substantial body of evidence to show that London *did* in fact engage with its continental neighbours where possible during the immediate post-war years. Across first the Commonwealth and then Europe, scientists were able by various means to keep communication channels open, an action often supported by political actors who recognised the value of maintaining Britain's scientific influence abroad. Nor were these interfaces mere tokens of insignificant value, with several of the collaborative ventures established in this period forming the mainstay of Britain's projection of its nuclear influence for much of the next decade. Perhaps inevitably with the first germs of cooperation, such instances arose in parallel across several sub-fields: with direct cooperation on the design and construction of nuclear power plants obviously prohibited, tentative cooperation began initially across diverse 'safe' aspects of nuclear energy such as radioisotopes, fundamental research and unclassified health and safety information. Although some of these interfaces have been analysed by previous scholars, no study has yet combined these isolated narratives with new research to compose a larger, truer picture of Britain's early post-war nuclear interaction with Europe. This is the main purpose of this chapter.

Arguably the most pressing stimulus driving Britain towards international collaboration was its need to use overseas recruitment to overcome its domestic manpower shortages. The April 1946 'Barlow Report' had identified that the UK would produce only two-thirds of its projected scientific manpower requirements by 1954, and recommended that 'everything possible should be done to meet the demand of students from the Commonwealth and from foreign countries for places in British Universities'.[44] Desperate to prevent this dearth of skilled talent from hampering Britain's nuclear effort, Attlee consequently entreated his Dominion counterparts to second their nuclear specialists to Harwell, a request they granted at the Commonwealth Prime Ministers' Conference the following month.[45] Accordingly, as the British contingent from Canada returned home during 1946, Cockcroft requested that three New Zealanders join him at the AERE. Among them was the engineer Charles Watson-Munro, who began work on GLEEP, Britain's new experimental reactor.[46]

While indispensable to Britain's nuclear effort, however, incorporating Dominion talent at Harwell soon encouraged the donor states to ask for reciprocated assistance. Sensing an opportunity to leverage its skilled manpower to secure British nuclear aid, Wellington consequently probed Cockcroft regarding the possibility of an atomic pile in New Zealand. A full atomic *energy* programme was scarcely feasible: in 1950 New Zealand had a population of barely two million spread over a landmass equivalent in size to the British Isles. Instead, it desired an experimental reactor to produce radioactive isotopes for biological and agricultural research—two fields with largely negligible security implications. To this end, Wellington was given *unclassified* technical assistance by Cockcroft, who prepared a report on New Zealand's potential for atomic energy in conjunction with Watson-Munro and Ernest Marsden, Wellington's Scientific Adviser. The trio recommended that New Zealand build a modest graphite uranium pile using cast-off British materials offered by Cockcroft to reduce costs, but the issue unfortunately became embroiled in arguments over security, underlining Harwell's limited ability to facilitate overseas development during these early years.[47] Nonetheless, Cockcroft was encouraged by the exchange, drafting a memorandum identifying three imperatives promoting Commonwealth cooperation. Firstly, there was Britain's dependence on its former colonies for uranium, alongside the secondary objective of fostering peripheral technical nucleii capable of facilitating future Commonwealth programmes. Crucially, Cockcroft commented also on the 'political importance of avoiding a feeling of frustration in the Dominions in this important field', highlighting the mutual interest of Harwell and Whitehall in atomic collaboration.[48]

With Anglo-American agreements greatly limiting atomic interaction abroad, the growing requests for assistance from Commonwealth states placed Britain in a quandary. However, the first of Cockcroft's concerns, obtaining uranium, provided a potential solution. As stated previously, the Quebec Agreement had established a tripartite Combined Policy Committee, an organ augmented in June 1944 by a Combined Development Trust (CDT) designed to corner global supplies of uranium and thorium. Importantly, the CDT was joint-funded by Washington and London, giving Britain *equal* control over CDT ores and enabling London to pay in sterling, a great boon in the dollar-scarce post-war years. Yet by 1947, American planners were already chafing at this arrangement, which in practice starved their larger programmes of fuel while leaving uranium stockpiles idling in British warehouses.[49] Thus, Washington was forced to negotiate a settlement against its isolationist instincts, presenting British scientists with an opportunity to negotiate the release of more nuclear information. In exchange for adjusting the division of uranium obtained by the Combined Development Agency (as the CDT became) from fifty-fifty to a basis where each partner could satisfy its minimum requirement from the central pool (in practice greatly boosting Washington's share), Cockcroft consequently secured information exchange in nine key fields, including designs for natural-uranium-fuelled reactors and reports from three American low-power reactors.[50] It was a significant coup, and in winning these concessions from his opposite numbers Vannevar Bush and James Fisk, Cockcroft highlighted at an early stage the ability of gifted scientist-diplomats to prevail where politicians had stumbled.[51]

The new agreement was ultimately framed as a *modus vivendi*, an instrument which allowed Truman to circumvent the McMahon Act by producing a declaration of intent rather than another original treaty.[52] Importantly, the covenant identified Britain as the gatekeeper of Commonwealth uranium resources, a significant role given the increasing contributions to world supplies expected from South Africa in particular after 1950. In order to 'secure information' held by Dominion scientists, the agreement thus defined Britain's commitments to its erstwhile colonies, allowing the transmission of basic atomic knowledge (particularly regarding uranium extraction) and the communication to Wellington of experience from GLEEP, as discussed previously. Nevertheless, although the Commonwealth had achieved partial recognition for its wartime assistance and uranium deposits, the limits of collaboration were now unmistakable: Britain could not assist the Dominions further with their native nuclear projects without incurring Washington's wrath, and Anglo-Commonwealth interaction would henceforth be restricted to Dominion scientists staffing Britain's domestic project. Consequently, although it briefly energised hopes of restored Anglo-American collaboration, the *modus vivendi* in fact confirmed rather the opposite. Less a solid treaty than an agreement to tolerate an untidy situation, Truman's use of the mechanism indicated that Britain had reached the threshold of what Washington could concede without unpicking the McMahon Act, forcing Whitehall to reappraise its atomic foreign policy. Perhaps the *modus vivendi*'s most important legacy, then, was its codification of a declassification guide: revised at nine conferences between 1947 and 1958, the handbook thus detailed the technical limits of interaction in unequivocal fashion.[53]

At the same time as this limited Anglo-Commonwealth interaction was grudgingly being conceded by Washington, Britain was also awakening to the potential for cooperation with its European neighbours. Indeed, hoping partly to revivify scientific exchange and to secure markets for sales of specialist equipment, British scientists and officials were soon keen to tap the political goodwill which a leading role in European technical collaboration could unlock. Britain's commitment to Europe had already been confirmed at a fundamental level when in March 1948 it signed with France and the Low Countries the Brussels Pact, a treaty which guaranteed 'collaboration in economic, social and cultural matters and for collective self-defence', and bound its participants to resolve economic conflicts and so promote European recovery. Yet although French ministers were placated by a clause ensuring collective action against German revanchism, the 'antediluvian' mood in France, to borrow historian Paul Kennedy's term, was soon dispelled by Soviet belligerence during the 1948 Berlin Airlift.[54] Spurred by Bevin, in April 1949 the Brussels Treaty was therefore expanded into the North Atlantic Treaty Organisation (NATO), binding the United States, Canada and ten European states into a mutual defence treaty.[55] The pact was sold to Congress as a measure to contain Soviet expansionism and to Paris as a guarantee for European defence: in the famous words of Lord Ismay, NATO's first Secretary-General, the aim was to 'keep the Americans in, the Russians out and the Germans down'.[56] In any case, NATO was significant not only for confirming a permanent Anglo-American military interest in Europe, but also for signalling unprecedented cooperation between continental states during peacetime.[57] Thus, as Bevin identified, Britain's splendid isolation was emphatically finished: instead, what was required now was 'close consultation with each of the Western European countries, beginning with economic questions'.[58]

Such thinking was soon adopted by political actors who appreciated the traditional independence and objectivity of science as a super-cultural tool useful in fostering democracy in Europe.[59] In its broadest sense, continental interest in scientific cooperation with Britain also remained considerable. Although atomic energy had been removed from the portfolio of the Department for Scientific and Industrial Research (DSIR), the department retained responsibility for basic physics research alongside an array of wider issues including conventions on agriculture and fuel, and kept abreast of Anglo-European scientific interaction via its Committee on Overseas Scientific Relations (COSR). Pursuing its aim of attempting 'to secure and strengthen the position of the UK in relation to European scientific life', the COSR monitored eight principal vectors for exchange, namely; departmental activities including permanent attachés, the British Council, the Royal Society, universities, the Society for Visiting Scientists, 'several bi-lateral Cultural and Scientific conventions', the scientific instrument industry and, finally, foreign scientists resident at their respective national embassies in London.[60]

Among these myriad scientific interfaces between Britain and its neighbours, perhaps the most direct were the visits to the UK by foreign scientists and the activities of Britain's overseas attachés. In the first instance, the COSR ensured that foreign scholars were offered every assistance short of financial subsidy during their visits, and deepened relations by consulting with foreign scientists regarding projects underway at official establishments.[61] Furthermore, in order to ensure that European laboratories were efficiently utilised, the committee promoted collaboration and prompted British scientists to work in Europe while encouraging their continental counterparts to reciprocate. Importantly, the COSR also diversified exchanges away from its traditional Commonwealth partnerships by identifying quickly the great potential for European cooperation: during 1949, the plurality of *foreign* (i.e. non-Commonwealth) scientists visiting departmental establishments came from France (119), followed closely by the USA (112), while the next largest delegations travelled from the Netherlands (87), Sweden (75) and Denmark (52).[62] Opining that the best collaborative interfaces lay in meetings between heads of research institutes rather than formal governmental activities, the COSR therefore recommended that Britain promote scientific cooperation *under the auspices of the Organisation for European Economic Cooperation (OEEC)*, thereby boosting the dissemination of research around Europe.[63]

The growing demand for contact also strained Britain's network of scientific attachés. In 1950, the only such representatives overseas were the long-standing delegation to Washington and a new Paris office, but the opportunities for deeper continental engagement were proliferating, with the Paris attaché reporting a mounting workload in the Low Countries and Italy, and the COSR recommending the establishment of a new Scandinavian office.[64] In addition, DSIR undertook to support the 'return to normal scientific and technological life in Western Germany' by establishing a *de facto* attaché there to assist intergovernmental communication.[65] The activities of these representatives were initially fairly general, but they soon complained of increasing if not overwhelming demands on their time. For example, on his first visit, the Scandinavian attaché reported an encouraging local thirst for interaction which would be 'of value to the U.K., both scientifically and politically', and reflected that although scientific collaboration with Europe was still young, the role of overseas scientific representatives was evolving from merely attending conferences towards becoming a day-to-day necessity requiring a permanent resident.[66]

The pattern was similar in the other vectors of exchange monitored by the COSR. The scientific instrument trade, for instance, was considered by the committee to be a vital export industry whose health was also crucial to maintaining Britain's defence capabilities, while DSIR announced that it 'would most cordially welcome' proposals for more exchanges of technical literature between Western European research centres.[67] Such interactions, then, demonstrate an increasing awareness by DSIR of Europe's rising scientific potential and an interest in monitoring developments. Although much of this desire originated in Britain's need to ensure healthy markets for instrument exports, it was obvious that assigning only one British representative to such large regions was inadequate, increasing the pressure for deeper scientific representation abroad and lending legitimacy to the idea of permanent European scientific establishments.

In atomic energy specifically, Anglo-European cooperation had shaped Britain's venture from the outset, and Tube Alloys had gratefully welcomed several refugee scientists fleeing Nazi Germany including Rudolf Peierls, Klaus Fuchs, Henry Seligman, Otto Frisch and Joseph Rotblat. After the war, these émigrés demonstrated little desire to repatriate; Peierls and Rotblat returned to university work in Birmingham and Liverpool respectively, while Seligman and Frisch both joined Harwell to lead the laboratory's Radioisotope and Nuclear Physics divisions, in turn. Outside this national context, however, Britain had made little effort to collaborate with its neighbours beyond settling its complex wartime agreements. Among these were the uranium contracts with Belgium and Portugal which were extended after 1945, allowing Britain to fuel its nascent research project.[68] France too had contributed to the Allied bomb project, supplying patented information and donating 150 litres of heavy water during the flight of its physicists Hans von Halban and Lew Kowarski to Cambridge in 1940. Encouraged by London's post-war atomic isolation from Washington, Paris' atomic High Commissioner, Frederic Joliot-Curie, therefore proposed a joint Anglo-French nuclear programme. Incentivised with France's valuable patents, the scheme offered an adroit solution to an untidy intellectual property dispute and consequently aroused some interest in London.[69] However, the Official Committee on Atomic Energy (a cross-departmental advisory organ comprising leading civil servants—see Table 2.1) rejected the idea as incompatible with Britain's need to propitiate Washington, where distrust for Joliot-Curie's communist sympathies abounded. The continuing culture of appeasement thus prevailed and the French, as Gowing has contended, were left to consider alternative friendships in Norway and the Low Countries.[70]

Yet while joint projects remained diplomatically impossible, British scientists were nevertheless keenly aware that prevarication would damage their ability to influence European atomic activities. Indeed, the benefits of even limited cooperation were potentially significant: collaboration could free the intellectual (and financial) capital and laboratory capacity of partner states and accelerate work directly benefiting Britain. It could also establish Harwell and Risley as Europe's dominant atomic hubs, in turn allowing Britain's establishments to consolidate their advanced position by dictating the terms of future exchanges. Any change of policy in this regard would require American consent, however, and so in late 1948 the Official Committee distributed a memorandum authored by Cockcroft to the Foreign Office and Britain's Washington embassy to be drafted into a brief to help British officials secure such approval.

Cockcroft's report criticised the 'unwholesome atmosphere of secrecy' surrounding atomic energy as embarrassing and destructive, forcing potential partners into makeshift agreements *with each other*, thereby reducing both their chances of success and Britain's atomic influence.[71] Accordingly, he recommended that Britain pursue a 'more positive policy' with Europe and pressure Washington to approve a relaxed strategy.[72] In particular, Cockcroft deemed it important to acknowledge the growing body of research emanating from France and Norway, and his original

Table 2.1 British committee organisation in the nuclear field

Advisory Committee on Atomic Energy (1945–1947)[a]	
Purpose: 'To investigate the implications of the use of atomic energy and to advise the Government what steps should be taken for its development in this country either for military or industrial purposes'	
Sir John Anderson (*Chairman*)	
Sir Alexander Cadogan, Foreign Office	Sir Henry Dale, President of the Royal Society
Sir Alan Brooke, Chief of the Imperial General Staff	Patrick Blackett
Sir Alan Barlow, Treasury	Sir James Chadwick
Sir Edward Appleton, Secretary of DSIR	Sir George Thomson
Ministerial Committee on Atomic Energy (1947–1951)[b]	
Purpose: 'To deal with questions of policy in the field of atomic energy which require consideration by Ministers'	
Prime Minister (*Chairman*)	
Secretary of State for Foreign Affairs	Secretary of State for Commonwealth Relations
Chancellor of the Exchequer	Minister of Supply
Minister of Defence	
Official Committee on Atomic Energy (1947–1957)[b]	
Purpose: 'To consider questions in the field of atomic energy which call for discussion between Departments […] to make recommendations to Ministers; and to settle questions on which reference to Ministers is unnecessary'	
Mr. R. M. Makins, Foreign Office (*Chairman*)	
Mr. D. F. C. Blunt, Treasury	Sir John Stephenson, CRO
Mr. R. R. Powell, Ministry of Defence	Mr. F. C. How, Ministry of Supply
Brigadier A. T. Cornwall-Jones, Chiefs of Staff	Mr. M. W. Perrin, Ministry of Supply
Atomic Energy (Review of Production) Committee[b]	
Purpose: 'To review the scale of atomic energy production in relation to defence requirements'. Reported to Chiefs of Staff	
Lord Portal (*Chairman*)	
Sir James Chadwick	Mr. M. W. Perrin, Ministry of Supply
Assistant Chief of Naval Staff	Mr. R. R. Powell, Ministry of Defence
Deputy Chief of the Imperial General Staff	Representative of the Controller, Admiralty

(*continued*)

Table 2.1 (continued)

Representative of the Treasury	Mr. F. C. How, Ministry of Supply
Assistant Chief of the Air Staff (Technical Requirements)	
Defence Research Policy Committee[c]	
Purpose: 'To advise the Minister of Defence and the Chiefs of Staff on matters connected with the formulation of scientific policy'	
This committee featured a flexible and broad range of technical opinion, and was presided over by four chairmen: Sir Henry Tizard (1947–1952), John Cockcroft (1952–1954), Frederick Brundrett (1954–1959) and Solly Zuckerman (1960–1963)	
Atomic Energy (Defence Research) Committee[b]	
Purpose: 'To keep under review and report on the relations between defence research programmes as a whole and atomic energy defence research'. Reported to the Defence Research Policy Committee	
Sir Henry Tizard (*Chairman*)	
Sir James Chadwick	Sir Ben Lockspeiser, Ministry of Supply
Deputy Chief of the Imperial General Staff	Dr. W. G. Penney, Ministry of Supply
Assistant Chief of Naval Staff	Mr. M. W. Perrin, Ministry of Supply
Assistant Chief of the Air Staff (Technical Requirements)	

[a]Advisory Committee on Atomic Energy: Composition and Terms of Reference, 20 August 1945, TNA, CAB, 134/7

[b]Committee Organisation for Dealing with Atomic Energy Matters, Note by Norman Brook, 10 February 1948, TNA, CAB, 129/24

[c]Jon Agar and Brian Balmer, "British Scientists and the Cold War: the Defence Research Policy Committee and Information Networks, 1947–1963," *Historical Studies in the Physical and Biological Sciences, 28* (1998), 249–252

draft was therefore unequivocal in its demand for Britain to show initiative, insisting that 'on political grounds it is most important that Western European countries and India should look to the United Kingdom for assistance in atomic energy development and that we should be able to exercise a guiding and co-ordinating influence over their efforts'.[73] The draft was subsequently edited by Deputy Under-Secretary Roger Makins at the Foreign Office to include a *shared* responsibility between Washington and London in this regard, but the committee's intention was nonetheless clear: Britain should engage where possible with European nuclear development to ensure that research was kept under surveillance and that continental states did not seek partnerships with each other instead.[74] To facilitate this new openness, the Official Committee consequently urged the authorities to declassify low-power heavy-water reactors and to supply foreign states with the uranium to operate them, whilst also hosting international scientific conferences to foster confidence.[75] Importantly, then, within three years of the war's end, Britain's scientists were conscious of Europe's hunger for cooperation, and politicians aware of the benefits of feeding it.

The cautious response in Washington to Cockcroft's proposals has been held by Gowing to be responsible for Britain entering a period of 'masterly inactivity' which only a change of government in 1951 would ultimately remedy.[76] Importantly, however, such views require some refinement: while large-scale atomic cooperation obviously remained forbidden, proponents of collaboration instead sought less contentious pathways to achieve their goals. Among the first of these alternative interfaces were numerous activities surrounding radioisotopes, the commercially and diplomatically valuable radioactive isotopes of elements such as carbon which Harwell had produced from an early stage in its life. To facilitate Britain's commercial penetration in this field, in early 1949 Harwell recommended that industrial firms form an agency to sell isotopes alongside the electronic equipment they already distributed in Europe. Such an undertaking would enable both the isotope producers in Harwell and Amersham and the instrument manufacturers to exploit European markets more successfully by utilising depots already established for the instrument trade.[77] However, departmental figures, notably Michael Perrin (Deputy Controller of Atomic Energy at the Ministry of Supply) and D.E.H. Peirson (Private Secretary to the Ministry) insisted on keeping such a group strictly British, emphasising that the Americans would dislike the transmission of atomic knowledge to European firms and consequently recommending that an offer from Philips to provide such an agency be declined.[78] Thus, while US interests continued to loom large in the minds of Whitehall officials, an awareness was also developing of Britain's growing civil atomic competence and the potential for an independent UK sales drive.

This desire to aggressively expand British commercial interests was certainly logical given that Britain's superior geographical position made radioisotopes a field in which it could immediately outperform the United States. As London's Scientific Mission in Washington advised in late 1949, the transport costs and short half-lives of unstable isotopes meant that Harwell would always enjoy a competitive advantage in shipping products to Europe.[79] Furthermore, overzealous security restrictions limited the

American ability to exploit growing markets while Harwell, enjoying less obstructive protocols, rapidly established itself as the premier continental supplier.[80] Indeed, between late 1949 and mid-1952, British isotope exports to French laboratories outstripped American sales by a factor of almost forty.[81] Furthermore, by 1952, Cockcroft reported that '800 units a month' were being distributed from Harwell and that demand for radio-isotopes was still rising, while in the related field of stable isotopes for medical research, he was confident of producing material sufficient for Britain, Europe and even the Commonwealth combined.[82]

As a showcase for pacific atomic energy, radioisotopes inevitably generated considerable propaganda value, and Alison Kraft has highlighted how humanitarian applications were lauded by governments eager to offset the negative publicity surrounding a primarily militaristic technology.[83] British scientists, too, used the field to forge new relationships on politically-safe ground, constructing an Isotope School at Harwell to train domestic and foreign scientists alike. The venture was particularly well-received in Europe, and disproportionately large numbers of foreign students came from Germany, Belgium and Scandinavia, while Harwell also assisted Spain's atomic industry by providing training opportunities.[84] Commercial pathways thus succeeded in alloying government and scientific interests: in addition to generating positive propaganda, radioisotope production was the only section of Britain's atomic effort initially organised on a commercial footing, eventually returning sizeable profits.[85]

Yet even this supposedly depoliticised field could not entirely escape Britain's ongoing appeasement strategy. Ironically, Harwell quickly became almost *too* successful in advertising its exports and the AERE soon garnered interest from politically-contentious customers behind the Iron Curtain. As early as 1948, a Czechoslovakian institution sought to bypass Washington's bureaucracy by purchasing radioisotopes from Britain, unsettling American officials who asked Harwell to refuse the contract. The British, sensitive as ever to such edicts, cancelled the consignment and agreed to consult Washington before releasing any radioisotopes that *could* conceivably be diverted for industrial applications.[86] Oddly, then, Britain's need to foster American goodwill produced a paradox in which Harwell actively competed with Oak Ridge in the radioisotope marketplace while concurrently propitiating its 'partner' for security reasons. This contradiction rankled with several leading scientists, and historian Nestor Herran has identified how isotope chief Henry Seligman's belief in 'isotope sciences as a peaceful enterprise which should be free from diplomatic interference' led him quickly into dispute with the Foreign Office.[87] Indeed, Seligman was frequently warned over his lecture material, on one occasion being barred from discussing fall-out on the grounds that this risked jeopardising diplomatic negotiations.[88] Despite these internal protestations, however, Harwell conformed to London's anti-communist agenda, embargoing radioisotope exports to, and visits from, Eastern European states. Nor was this a knee-jerk response: although the export ban was finally lifted in 1954, access to the Isotope School for Eastern European scientists remained prohibited until the courses were relocated away from Harwell's main site in 1959.[89]

Ultimately, then, although radioisotope science was noted for its comparatively harmonious Anglo-American relations, the policy of mollifying Washington nonetheless weakened London's ability to exploit opportunities in areas where it was better-positioned than its erstwhile partner. Eventually, foreign states began to establish their own radioisotope industries, with France satisfying its domestic demand by the mid-1950s and even Washington realising, as Angela Creager has noted, that the opportunity to 'show itself generous with its radioactive resources was closing', prompting a policy reversal.[90] Nevertheless, radioisotopes remained an invaluable vector for preserving post-war contact with Europe, with Britain's training schools (discussed further in Chap. 3) becoming the mainstay of its nuclear soft power. By providing a 'safe' avenue of engagement, radioisotopes enabled Britain during the early post-war years to demonstrate its openness towards its European neighbours and to establish itself as the continent's nuclear leader.

The personal connections between European scientists were exercised further in promoting continental cooperation in 'fundamental research' projects which aimed to uncover basic principles for scientific interest, rather than for military or commercial gain. In contrast to atomic energy work, fundamental research offered an uncontentious avenue for European physics collaboration while still involving many of Britain's nuclear specialists. Although the most significant of these projects, the series of particle accelerators built by CERN, has been discussed extensively by authors including John Krige and Dominque Pestre, it will nonetheless be useful here to highlight the similarities between the laboratory and parallel initiatives in the energy field.[91]

Speaking at a UNESCO meeting in 1950, the American physicist Isodor Rabi theorised the construction of regional science centres to encourage international collaboration in research where 'the effort of any one country in the region was insufficient to the task'.[92] Rabi's idea was progressively refined to particle accelerators, a field in which British universities presided over the most powerful machines in Europe (notably at Liverpool), although even these were dwarfed by those located across the Atlantic.[93] Unfortunately, however, British officials were unprepared for such a request, and the Nuclear Physics Committee which had been established by Blackett to inform the ACAE was now tasked, under Chadwick, with advising Whitehall on how to respond to the project. Chadwick's initial reaction towards a new laboratory reflected indifference bordering on scorn, and in a letter to Ministry of Supply officials in January 1951 he fumed that he had 'heard more than enough' about Rabi's proposals and expressed a hope that he would not be dragged into formal meetings to arrange the issue, trusting instead to reach some 'modified agreement by correspondence'.[94] Chadwick's scepticism was not unique: on hearing the proposal, Blackett himself exclaimed, 'if France can afford all that money, why don't they […] build up their Physics again into a decent state?'[95] Seeking an alternative therefore which would deflect Rabi's idea into something more palatable, Chadwick subsequently backed a suggestion by Dutch scientist Hendrik Kramers to graft a new laboratory onto Niels Bohr's Copenhagen Institute, a compromise which utilised the personal connections between British scientists and the 'father' of European nuclear physics, whom they affectionately titled 'Uncle Nick'.[96] Such notions inevitably angered the Franco-Belgian-Italian lobby, led by Pierre Auger, who demanded a new European laboratory scaled to match the best American machines. This was the idea that led to the European Organisation for Nuclear Research, or CERN.

Initially, Britain's response betrayed its lack of clear communication channels: theoretically, the responsibility for the negotiations fell under the jurisdiction of DSIR, but deciding British participation in CERN became an exceedingly byzantine process, with Harwell dispatching advisers to the CERN Committee on an unofficial basis and Thomson also visiting intermittently as Britain's representative. At Whitehall, negotiations began between DSIR and the Foreign Office, itself advised by another committee chaired by Chadwick, while DSIR's Overseas Liaison Committee undertook prolonged negotiations with the Treasury regarding the treaty's financial clauses.[97] Into this cacophony the scientists too poured their opinions, and Chadwick wrote to Makins at the Foreign Office to insist that the Royal Society, as the only organisation qualified to 'speak for scientists as a group', be consulted before any decisions were taken.[98] In this way, Chadwick hoped, the Society could 'provide a safeguard against too enthusiastic and too optimistic- and too expensive-proposals'.[99] These repeated delays quite naturally caused London's prospective partners to lose patience and in mid-1952 Britain's representatives were made aware that CERN would now proceed regardless of London's attitude. With his hand thus forced, Chadwick altered course and wrote again to Makins to argue that, while Britain's best chance of making a 'real contribution to European science' still lay in working with Bohr, he now accepted that Britain should join CERN in order to retain a degree of control over the organisation's activities.[100] This attitude was mirrored in Whitehall: in a report to the Cabinet Committee on International Organisations, DSIR presented CERN as a *fait accompli* and contended that the government's inability to commit was beginning to 'embarrass' British representatives.[101]

With time running out, British scientists and politicians alike became anxious to define clearly their relationship with the accelerator project. Three possible solutions to this problem were suggested by J.M. Cassels, a scientific officer at Harwell, who contended that Britain could abandon high-energy physics entirely, thereby damaging scientific morale, or negotiate an agreement with CERN to share the Liverpool and Geneva accelerators. Alternatively, Britain could also construct its own machine, an undertaking which would be extremely expensive in both engineering and financial terms, and one which Britain would be unable to man fully in any case.[102] Summarising, Cassels concluded that there was little difference between building a new native accelerator and joining the new European venture, provided that *something* was done to preserve Britain's cutting-edge position and world-leading scientific corps.[103] Plainly visible, then, were parallels with the motivations propelling Anglo-European interaction in atomic energy: as a Great Power, Britain was compelled to seek control over those continental activities that represented London's best hope of maintaining the leading position which its scientific prestige and morale demanded. After months of debate, Chadwick finally assented to Britain's membership of CERN in November 1952.[104]

The plunge into the European pool taken, British scientists turned their attention to rendering CERN politically palatable. For his part, Chadwick focused on tightening the organisation's draft convention to define strictly the laboratory's scientific scope, believing that it should 'feed existing laboratories, not rob them'. Ben Lockspeiser, head of DSIR, concurred, assuring Chadwick that Britain would cooperate only in areas of active interest.[105] These reassurances were reciprocated, and Cockcroft wrote to the Ministry of Supply in December 1952 to remind them that CERN would examine particles around 600 meV and that Britain's atomic energy work, by contrast, dealt only with particles below 10 meV and would thus be unaffected.[106] In this way, fundamental research was safely depoliticised through timely intervention from eminent scientists.

Albeit brief, this comparison between Britain's attitude towards CERN and its atomic energy diplomacy reveals two clear parallels. Firstly, as in the nuclear energy world, Britain failed to coordinate its response to collaborative opportunities in fundamental research effectively. Existing commentaries have traditionally identified two forces promoting CERN, namely the contemporary fervour for European collaboration and the physicists' 'understanding' that large machines required a continental effort.[107] However, this theory has been rejected by official historians Dominique Pestre and John Krige, who have theorised that the principal proponents of CERN were autonomous from *both* scientific establishments *and* state bureaucracies because most European nations 'had neither a clearly formulated policy for science nor organs of state in charge of such questions'.[108] Although several of Britain's negotiators *were* connected with atomic energy establishments, these assertions are nonetheless correct: Whitehall's organisation was certainly confused, as shown by the numerous committees involved in decision making.[109] Caught off-guard, London failed to state its preferences quickly enough and the potential for non-governmental cooperation evaporated, leaving it in a reactive position with DSIR now presenting CERN as a *fait accompli*. The only remaining option thereafter was to join the laboratory partly to control it, in a manner similar to that often advocated by proponents of nuclear cooperation.

The second important comparison is that CERN represented the first successful European project of its kind, and one moreover which demonstrated the ability of scientists to depoliticise such creations to secure governmental support. Analysing this trend, Pestre and Krige have argued that scientists acted as 'champions' selling distinct 'products' to government, notions proven by Chadwick's lengthy redrafting of Britain's commitments to ensure that Whitehall knew precisely what it was supporting.[110] More pertinently, however, CERN marked a departure from Britain's traditional scientific foreign policy: now a permanent laboratory, described by both authors as an '*unnatural, multinational* creation', it would be built abroad and staffed with a British contingent.[111] Indeed, John Heilbron has identified CERN as pivotal in Europe's scientific culture, turning it from shared classical heritage towards the pragmatic scale of American science.[112] Presenting a blueprint for cooperation, CERN also strengthened the links between continental scientists and Britain's nuclear specialists, therefore providing valuable contact with partners excluded from Britain's atomic energy work. Continental scientific cooperation, then, was entrenched as both possible and productive, leading Britain's atomic planners to question whether this success would encourage imitators elsewhere.

Such concerns were quickly realised as European atomic scientists, encouraged by the success of CERN, began to request their governments to countenance greater international contact while looking expectantly also to Britain for leadership. Whitehall's continuing reluctance to engage its neighbours had led continental atomic authorities to form conglomerates among each other, the foremost of which was JENER, the Dutch-Norwegian Joint Establishment for Nuclear Research, which hosted a conference on heavy water at Kjeller in August 1953. During the gathering, the Norwegian physicist Gunnar Randers proposed the foundation of an informal organisation, eventually titled the European Atomic Energy Society, to arrange regular meetings of continental atomic scientists.[113] Randers' methods in this regard were instructive: the Norwegian contacted John Cockcroft directly to consult his opinion on organisational issues and asked him to cosign the letter calling for the first meeting in a bid to lend weight to his proposal. Indeed, Randers himself offered to sign mainly as an act of continuity from the Oslo Conference, clearly identifying Britain as the atomic pioneer whose prestige would add credibility to the scheme.[114]

In concrete terms, the EAES aimed to promote regular meetings of atomic scientists and engineers, circulate unclassified reports, work for the standardisation of atomic nomenclature, promote the study of hazard and safety measures and consider a new journal and information centre for the promotion of these aims.[115] For their part, Harwell's officials were keen to accept Randers' offer, claiming that British interests were best served by effective leadership, particularly as other states would doubtlessly proceed anyway.[116] At Whitehall, however, the Ministry of Supply disagreed, claiming that government should not fund private societies and that existing publications were sufficient to communicate unclassified information.[117] The Foreign Office also demurred, airing again its long-standing antipathy towards additional international organisations.[118] Undeterred by such pessimism, Cockcroft prepared a memorandum for the Official Committee in which he asserted that much of Europe's atomic research was now 'quite good' and that many continental atomic projects would soon be sufficiently proficient to undertake mutually beneficial cooperation. Accordingly, Cockcroft proposed to minimise the financial burden of the EAES and reiterated the prestige benefits of taking a leading role in Europe.[119] It was enough to persuade the Foreign Office, and the EAES held its first meeting at the Royal Society in June 1954, with the membership covering most of Europe's core scientific states in Belgium, France, Italy, the Netherlands, Norway, Sweden, Switzerland and Britain.

However, London's new openness did not extend beyond Western Europe, and in the EAES, as with CERN, Britain forced an addition to the statutes which meant new applicants could accede only with unanimous acceptance by existing members, and that this rule itself could be amended only with the same procedure.[120] Nonetheless, a Yugoslavian delegate, Stevan Dedijer, was invited to participate as an observer on the grounds that he already possessed membership of the CERN Council. This desire to homogenise the memberships of the organisations reflected the developing lines of communication between the same European states that had joined CERN. Consequently, although John Cockcroft still had to apply for Foreign Office approval for all his invitations, the inclusion of a scientist from an Eastern European communist state was testament to the success of the scientists in depoliticising the society in the eyes of government.[121] Nor did the connections with CERN end there, and the society's small Working Group was suggested by Kowarski on the grounds that such minimalism had worked well at Geneva, illustrating further the connections between Europe's newest scientific organisations.[122]

Although overlooked in existing literature, the EAES underlined the rising capability of eminent specialists to conduct diplomacy, and a tendency on the part of scientific organisation-builders to placate government by highlighting the national benefits of participation. The challenges of spreading atomic information were well-known to the society's first President: Cockcroft often spoke about atomic power as a great force for good but, as director of a national atomic energy institute, he was also aware of the interests of his country and the value of classification. Thus the EAES proceeded at the most basic organisational level: that of personal relationships built initially around personal patronage with minimal governmental assistance. As a result, atomic scientists successfully depoliticised their work, demonstrating the increasing ability of the scientific establishment to conduct international negotiations, in turn forcing existing organisational methods under scrutiny. Consequently, then, although Britain's continuing propitiation of Washington had left it reactive to external suggestions, it had nevertheless assumed leadership of this important forum, significantly fortifying its influence abroad.

Perhaps inevitably, Britain's early atomic interaction with Europe quickly began to resemble a mosaic of different interfaces each with their own limitations and opportunities. Within this patchwork lie rich possibilities for comment, and by comparing each case we can draw fresh conclusions about Britain's engagement with Europe beyond the obvious notion that such interaction was hampered by American interference. The first assertion, then, is that it often fell to scientists to question classification regimes and initiate international contact. The EAES, CERN and the radioisotope trade succeeded as vectors of exchange because local champions such as Randers, Cockcroft or Seligman assuaged governmental concerns by depoliticising their projects, highlighting existing strengths in the scientific community and the national benefits of participation. Often, as in the EAES (but not, eventually, with CERN), this was coupled with promises that government need not assist the project financially. Secondly, Britain was frequently reactive to requests for assistance: hampered by political timidity and organisational inertia, British officials dithered in considering external opportunities. As a result, London's participation was often predicated on the need to control continental activities. In both the EAES and CERN, ministers were informed that Europe would proceed without London, leaving limited room for manoeuvre for Britain to capitalise on its technological cachet. Surveying the nuclear field as a whole therefore demonstrates how the implementation of strict classification from above did not terminate atomic interaction in its entirety, but rather forced it instead along less contentious pathways. Thus although Washington's opinion was highly influential even in supposedly safe cooperative fields, Britain was nonetheless able to foster collaboration sufficient to establish itself as Europe's informal (if hesitant) nuclear leader.

Reforming Britain's Nuclear Diplomacy: The Atomic Energy Authority

By 1954, Britain had participated in several collaborative ventures with its European neighbours. Importantly, however, this agglomeration of minor successes nevertheless revealed a weakness in British nuclear planning which had been typified thus far by *ad hoc* case-by-case negotiations, with no clear strategy in place other than to maintain London's influence abroad in a general sense. Indeed, Britain had more than once been left in a reactive position to external proposals, forced to participate in order to maintain control of European ventures from within rather than seizing the initiative and determining the direction of travel from the outset. With Britain's atomic competences now rising at a considerable rate and the clamour for nuclear cooperation rising in direct correlation, it soon became clear that London must adopt a new, more efficient method of deliberating its nuclear diplomacy.

In part, Britain's travails had been caused by a lack of coordination between scientific experts and ministers at governmental level, where scientific advisers found themselves spread across numerous overlapping committees, hampering the creation of concerted technical and diplomatic advice. Being few in number, Britain's atomic elites attained an advisory influence magnified by their scarcity, but Attlee's ACAE nevertheless experienced confused jurisdictions from the outset. Represented on the committee were the Department for Scientific and Industrial Research (DSIR), the Royal Society, university-based scientists including Chadwick and Blackett, the Chief of the Imperial General Staff and officials from both the Treasury and Foreign Office. Indeed, even this diverse array of opinion proved insufficient, and Blackett appended a Nuclear Physics Sub-Committee of leading scientists chaired by Chadwick to provide the ACAE with specialist advice.[123] Ultimately, these committees proliferated almost mitotically, with myriad groups (often featuring the same scientists) tackling specific sub-fields of technical policy (see Table 2.1). As Margaret Gowing has asserted, therefore, 'under neither the Labour nor the Conservative government was the machinery planned as an interlocking whole. It just grew'.[124]

This problem was particularly pronounced with regards to foreign policy: with no committee established to deliberate Britain's overseas contacts specifically, diplomatic issues fell to the Official Committee, a body with only indirect access to expert opinion through the Ministry of Supply. The Ministry, however, exerted only weak control and lacked in-house technical personnel, allowing the establishments to assume undue policy-making power. Consequently, the atomic hubs remained an uncoordinated association rather than an integrated unit: as Sir John Anderson was later to complain, 'when the technical directors do meet, they come together as heads of establishments conferring one with the other rather than as a collectively responsible Board'.[125] With inadequate supervision from above, there was thus no central forum in which to formulate diplomatic advice agreed by all the provinces of Britain's atomic empire, a failing which worsened significantly as the clamour for European cooperation intensified.

Naturally, these advisory committees comprised of invited scientists were not all-powerful, and their recommendations remained subject to scrutiny and possible rejection by executive authorities like the Ministry of Supply. Nevertheless, a key trend is clearly visible: from the outset, Britain's new atomic hubs failed to synchronise successfully, hampering the creation of concerted technical and diplomatic advice.[126] This problem of constructing effective mechanisms for proposing a rapid response reached a peak in late 1953, as growing demand for European atomic cooperation exposed the need for Britain to reform its domestic organisation to meet the diplomatic workload expected of it. As such, this chapter will conclude by highlighting how Britain's drive to become a modern nuclear state was accompanied by new machinery to help it better interact with its neighbours.

Despite its boost of wartime research, by 1951 Britain had still not attained its atomic goals, a factor rendered all the more concerning by Moscow's first nuclear test in 1949. The campaign to reform Britain's premier 'Big Science' initiative was led by Cherwell, who railed in the House of Lords that departmental control was simply the wrong tool for the job: 'you cannot expect to win a tennis championship', he fulminated, 'if you insist on using a niblick instead of a racquet'.[127] Fortunately for the agitators, the return of Churchill in October 1951 gave Cherwell, the Prime Minister's Paymaster-General, the opportunity to criticise the centralised control of atomic energy as a perversely British compromise, arguing that 'the United States has its semi-independent commission; take Canada, South Africa, France, Sweden, Norway: there is not one of these countries that is trying to carry out atomic research and development in a Government Department'.[128] In contrast to previous proclamations of Britain's pioneering position, therefore, foreign successes were now being used to highlight its ineffectual organisation. Nevertheless, it would be another eighteen months or so before opposition to Cherwell's proposals slowly began to dissipate among Cabinet members fearful of tinkering with Britain's nuclear research at this advanced stage. The reason for this was the progressive achievement of London's main nuclear objectives, beginning in October 1952 when Aldermaston's £100 m weapon programme finally produced Britain's first successful nuclear bomb test in Australia. Four months later, Whitehall also commissioned

Britain's first PIPPA (Pressurised Pile for Producing Power and Plutonium), symbolically transferring the responsibility for its construction from Harwell to Christopher Hinton's Production Group.[129] With both its key atomic goals secured, the political path was thus clear for Whitehall to relax departmental control of atomic energy while reforming Britain's diplomatic channels to better process the interest generated by its prestigious achievements.

After prolonged discussion during the winter of 1952–1953, Cabinet was finally convinced by Cherwell's exhortations and entrusted the issue to the 'Waverley Committee' under John Anderson (since 1952 Viscount Waverley). Reporting its recommendations in a White Paper, Anderson's committee paid especial attention to the nebulous governmental decision-making processes, noting that 'atomic energy matters have been dealt with *ad hoc* by the Cabinet or Defence Committee' and that Cherwell had exercised 'special responsibilities allotted to him by arrangements made in April 1952'.[130] Aiming to streamline these byzantine procedures, the report therefore proposed to reorganise atomic energy into a corporation akin to an industrial concern. The United Kingdom Atomic Energy Authority (UKAEA) was consequently created in 1954, granting technicians greater autonomy while retaining overall financial control for government.

The Authority introduced a Board, with Cockcroft, Hinton, Penney and three part-time members serving under the chairmanship of Edwin Plowden, formerly Chief Planning Officer at the Treasury and a man with extensive experience of Britain's European economic policy.[131] Although ultimate responsibility for the Board's composition was transferred to the Lord President, the Atomic Energy Act clearly stated that no policy directives could be issued '*except after consultation with the Authority*', and that the Lord President '*shall not regard it as his duty to intervene in detail* in the conduct by the Authority of their affairs' (author's emphasis).[132] Additionally, financial provisions were altered so that funds voted by Parliament were assigned as a grant-in-aid rather than administered directly by the Minister of Supply. Following Cockcroft's earlier request that any atomic organisation 'include a high proportion of technical Directors on its board—following the pattern in progressive industry', the new system reduced overt government control by constructing a bedrock of experts whose performance was channelled through the Chairman's industrialist-civil service experience, before reaching Cabinet scrutiny.[133] Significantly, then, although Whitehall's committees would remain in place, the crucible of scientific advice would now be the Atomic Energy

Executive, the Authority's Board which could coordinate the three arms of Britain's atomic project and dispense recommendations to the Lord President accordingly.

Considerable changes were also afoot in Britain's atomic foreign policy, a field in need of streamlining given the increasing demands for overseas assistance and the importance of coordinating international bodies such as the OEEC and CERN. Importantly, Anderson accepted unquestioningly the Foreign Office's demand that the AEA refrain from contacting foreign governments directly in case they prejudiced international relations, reporting that 'the Corporation should at the outset be given a directive requiring it to consult the Official Committee on all matters of external policy. The channel of communications for agreed decisions on such matters of policy should be through the Foreign Office or the Commonwealth Relations Office as the case may be'.[134] Nevertheless, beyond this obligatory acknowledgement of the right of the diplomatic departments to vet international atomic exchange, the technicians were granted more substantial foreign policy autonomy. Indeed, the Foreign Office contended that the Official Committee should focus mainly on screening applications for cooperation from states with no or only 'exiguous' previous atomic contact with London, accepting, with the CRO, that 'where valuable scientific contacts exist or in routine matters', the committee need not be consulted.[135] Under such circumstances, the role of the Official Committee was reduced to that of gatekeeper rather than invigilator.

In addition to implementing this concession to speed, Anderson's committee also reinforced Britain's geopolitical stance by supporting the CRO's request 'that the closest possible contacts at all levels should be developed between the Corporation and the authorities concerned in Canada, Australia, New Zealand and South Africa'.[136] Yet despite the absence of any specific mention of Europe in Anderson's report, it was also readily apparent that Britain's overseas interests were diversifying. Alongside the CRO's dogmatic demand that 'maximum co-operation' be fostered with the Dominions, therefore, the Foreign Office opined that the AEA's main diplomatic tasks should be to court the USAEC, maintain important agreements with Norway, Belgium and Portugal, and to foster new engagements with Argentina, Germany, Italy or Japan.[137] Importantly, then, the Waverley Report remained clear: Britain required administrative mechanisms which would allow it to respond quickly to opportunities with *all* potential partners.

In sum, the transfer of atomic research to an autonomous organisation reflected not only a concession to scientific autonomy but also the acknowledgement by government that novel technologies could be more productively advanced using hierarchies and pay-scales modelled on private industries.[138] As David Edgerton has highlighted, 'of the seven non-administrative posts at permanent secretary level in 1953' three were occupied by Britain's atomic troika, and nuclear experts had replaced naval engineers as 'the highest paid technical officers of the state'.[139] The change also signalled a commitment to Britain's nuclear future beyond the bomb: civil atomic energy had profited disproportionately from the expansion of government R&D expenditure under Attlee and would enjoy continued support from Churchill's Conservatives, who levelled-off science funding elsewhere to compensate.[140] The AEA thus represented perhaps the most significant devolution of power to an expert body in Britain's history. Henceforth, Britain's atomic establishments would be able to respond more quickly to foreign initiatives and to compete effectively for manpower, strengthening their position at home and abroad.

Conclusion

So what does this analysis of Britain's overseas nuclear activities and of its domestic atomic organisation tell us about Whitehall's attitude towards European cooperation during the earliest post-war years? The first charge made in this chapter is that we need to reconsider the assertion, prevalent in existing literature, that an overwhelming preoccupation with appeasing Washington precluded any early atomic interaction between Britain and Europe during the late 1940s and early 1950s. As this chapter has highlighted, Anglo-European scientific cooperation in a general sense was growing rapidly after the war, with officials at DSIR not only aware of the growing interest on the continent for collaboration with Britain, but in fact keenly nurturing Britain's place at the core of European scientific life in order to boost London's commercial prospects, defence capabilities and political image. To be sure, the threat of American opprobrium regarding *nuclear* cooperation remained highly influential in this period, and Britain's atomic planners were repeatedly obliged to accept high levels of interference and scrutiny (including occasional vetoes) from Washington with regards to their engagement overseas. Yet against these diktats, officials in Whitehall also had to accept that remaining completely aloof would raise the spectre of European atomic partnerships arising outside British control, and so they pressed Washington for a milder classification regime while quietly sanctioning deeper interaction in unclassified activities. Indeed, several specific case studies of Anglo-European interaction in such avenues have already been undertaken, with John Krige's seminal analysis of CERN and Nestor Herran's exploration of Britain's early radioisotope trade providing but two examinations of early Anglo-European scientific cooperation. To these works one can now add the activities of the EAES, a society spurred by enthusiastic individuals who helped to keep the flame of cooperation alive by carefully stressing to Whitehall the prestige and control benefits of participation. Thus, by relocating existing studies and contextualising them with new reviews of other collaborative interfaces to produce a more complete picture of Britain's overseas engagement, it becomes apparent that Britain did both undertake significant atomic cooperation with Europe, and that this process began before the fulcrum of 1951 identified by Margaret Gowing and Septimus Paul.[141]

Stymied by diplomatic edicts, atomic interaction resembled a river encountering a great dam: unable to pass this obstacle for the most part, tangential rivulets instead sprouted in a bid to find another way forward. Although small, these streams were *just* enough to keep nuclear exchanges between Britain and Europe alive during a period of great uncertainty, with the EAES providing a forum for interpersonal contact while CERN and Harwell's radioisotope school enabled European scientists to collaborate in 'safe' aspects of the technology. Crucially, initiating such contact often fell to scientific internationalists who depoliticised collaboration and stressed the national benefits of participation in an attempt to synergise with the desire of political actors to release the propaganda and prestige benefits of cooperation. Although these cooperative ventures often originated overseas, leaving Britain to participate reactively in order to preserve both its prestige and influence, such schemes were nonetheless instrumental in confirming London's position as Europe's nuclear hegemon. Indeed, as we shall see later in this study, these efforts were so successful that Britain's radioisotope schools and leadership of the EAES became central components of London's alternative 'offer' of European atomic collaboration as it tried to compete with the model of supranational nuclear cooperation being proposed by the Six Messina Powers after 1955.

The second major claim made here has been that the formation of the AEA in 1954 brought with it a significant improvement, both in speed and quality, of Britain's ability to produce technical diplomatic advice. Weakened by disjointed organisation which saw Britain's three atomic legs initially fail to keep step, and a plethora of byzantine committees with overlapping memberships and jurisdictions, Whitehall was slow to respond to external stimuli. The system also rendered policy overdependent on the biases of eminent individuals who were not necessarily representative: Chadwick's initial disgruntlement with CERN contrasted markedly with the enthusiasm for cooperation demonstrated by men like Seligman, while Cockcroft's prestige lent him great personal influence at the EAES. With the implementation of a coherent atomic Board, issues would now be debated by all provinces of the atomic kingdom and scientists were given greater freedom to conduct routine interaction without political scrutiny. It was a prescient move: as Britain's atomic interests became more commercial, the growing importance of diplomatic issues could be readily accommodated, leading ultimately to a Member for Overseas being appointed in 1955.

Ultimately, then, by 1953 Britain had established an independent nuclear project and effective means of engaging quickly and decisively with other states. It had also built a substantial body of interaction with its neighbours, with its growing nuclear competences adding lustre to its value as a potential partner. The ramifications of this development were serious: with a substantial foothold in European nuclear cooperation established, London would be able to use its seniority in such partnerships to its future technical and political advantage. The stage was thus set for atomic energy to play its part in the important political debates about the future of the Special Relationship and the shape of European unity which were about to unfold at a crucial juncture of the Cold War. These will be discussed in Chap. 3.

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CHAPTER 3

Britain and 'Atoms for Peace', 1953–1955

In Chap. 2, we saw how the first post-war years were marked by the slow but persistent growth of Anglo-European atomic relationships across a variety of forums.[1] These developments did not pass without notice in Washington, where officials had already begun to note that American policy, predicated on isolationism and the threat that a failure on the part of Washington's allies to uphold this same aloofness would prejudice restored nuclear collaboration, was beginning to weaken in view of the considerable independent technological gains being made by those same states. Continued unilateralism under such circumstances would leave the United States unable to influence the activities of other nuclear states in a manner which would both guarantee its own security and also open these new markets to exploitation by American industry. As a result, the time was now ripe for a revolution in US nuclear foreign policy, creating both great opportunities and great dangers for Britain's fledgling civil atomic enterprise.

By 1952, it was clear that Washington's bid for nuclear monopoly had failed. Aided by information gleaned from its espionage rings in the West, the Soviet Union tested its first fission bomb in August 1949, while Britain too eventually joined the nuclear table in October 1952. More was to follow: within a year of Britain's A-Bomb test, Moscow trialled its first hydrogen weapon, an achievement gained by Washington only nine months previously. In eight short years, the Cold War had witnessed the evolution of nuclear weapons from fission bombs to hyper-destructive thermonuclear

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armaments, and the proliferation of both types outside the United States. Forced to confront this threat, American defence planners thus set about devising a creative solution to the nuclear problem while also creating a new strategy in which Washington would deepen its European alliances.

Success in this regard was far from assured: Britain was already preoccupied with prosecuting colonial conflicts in Kenya and Malaya, as well as contributing to UN forces in Korea, and this 'multiplicity of problems', as Anthony Adamthwaite has termed it, had rendered the position of Foreign Secretary all but intolerable. Indeed, as the incumbent Anthony Eden complained, the job had 'killed Bevin and destroyed Morrison', and British diplomats remained hopelessly overworked.[2] These disparate struggles also exposed the poor communication between London and Washington, and a particular lack of coordination over the ongoing Middle Eastern disturbances which threatened Britain's oil supplies. Relations between London and Iran had already been severed following the latter's nationalisation of the Anglo-Iranian Oil Company in 1951, and now the new Egyptian President Muhammad Naguib too had begun to protest Britain's presence in the Suez Canal zone. Looking across the Atlantic for assistance, in March 1953 Churchill wrote to President Eisenhower to beg that, if he could not support him outright, to at least avoid giving the impression that Washington opposed British policy in Egypt. 'I am like the American', Churchill wrote earnestly, 'who prayed "Oh Lord, if you cannot help me don't help the bear"'.[3]

Nor was the situation in Europe any less precarious. The West had been strengthened by the formation of NATO in April 1949, but the question remained of how to incorporate West German armed forces into a military bulwark capable of guaranteeing continental security. An attempt at solving this problem was first made in May 1952 through the establishment of a European Defence Community to which Bonn could contribute troops. Yet despite being supported by Washington and ratified by West Germany and the Benelux states, the treaty stalled amid the political turmoil in Paris that saw twenty-two changes of government during the twelve-year lifespan of the Fourth Republic. The first years of the 1950s were consequently plagued by global uncertainty over nuclear weapons and a significant localised concern for European defence.

On the nuclear front meanwhile, Britain's independent bomb project had grown to the point where some advisers now claimed that London no longer required American assistance beyond the transfer of some information on weapons effects.[4] This progress was mirrored in the industrial sector as Whitehall commissioned Britain's first PIPPA power reactor in February 1953. Growing in technological proficiency, London consequently faced increasing requests from states in the Commonwealth and Western Europe to provide assistance, while Soviet nuclear advances simultaneously encouraged communist satellites to contemplate native research projects. In the absence of an international atomic control system, such developments therefore portended the possibility of nuclear proliferation outside American control, and conversely the opportunity for Washington to profit by instituting such a regime. Politically speaking, this period also witnessed the slow transition of Winston Churchill between what Kevin Ruane has identified as the second and third of the Prime Minister's nuclear ages. With his first life as wartime atomic bomb-maker long behind him, by 1953 Churchill's second role of atomic diplomatist was also evolving as he reimagined himself as a nuclear peacemaker capable of placating both Moscow and Washington.[5] Indeed, the election of Dwight Eisenhower in January 1953 and Stalin's death the following March had reset the diplomatic dynamic across the Iron Curtain, legitimating fresh initiatives to thaw the post-war frost. Among these were proposals to employ peaceful atomic energy to reduce tension and restore international faith in Washington's desire for peace. In a speech in December 1953, Eisenhower therefore launched 'Atoms for Peace', a plan for nuclear states to contribute fissionable materials to an international bank in order to assist global civil nuclear development, a programme eventually accompanied by aggressive sales of American reactors.

The importance of Atoms for Peace to our story lies in how the initiative affected Britain's domestic nuclear project, and with it London's ability to use its civil atomic prowess as an international diplomatic tool. This chapter will therefore begin by showing how Churchill was drawn into Eisenhower's scheme by a belief that the plan constituted an initiative worthy of great statesmen, without giving real consideration to how participation would disadvantage Britain's atomic project. In so doing, he overruled several of his political and technical advisers, creating conflict between those who supported Britain's right to sit at the top table and those favouring its immediate civil nuclear interests. With this story established, this chapter will demonstrate how participation in Atoms for Peace hindered Britain's atomic effort at a time when its key nuclear alliance was transforming from one based on ensuring global security to one of outright competition. Forced to contribute manpower and materials which it could ill afford to an international agency, Britain's already limited ability to intervene in foreign nuclear activities was thus further burdened at the exact moment that international atomic exchange was beginning to blossom. Consequently, this chapter will demonstrate how Washington's re-entry into the global nuclear marketplace presented Britain's atom with both considerable risks and lucrative opportunities.

Accommodating the Rise of Atomic Energy in Europe

Despite Washington's isolationism and London's deeply cautious attitude towards collaborating with its neighbours, by 1953 several European states had nonetheless obtained considerable nuclear capabilities. In time, such gains naturally caused Whitehall to reconsider its stance towards continental atomic cooperation, a calculation unavoidably complicated by contemporary moves to incorporate West Germany into defence agreements that restricted Bonn's ability to prosecute a sovereign nuclear programme. As such, although Britain was slowly awakening to Europe's partnership potential, it remained restricted from exploiting these opportunities by a rapidly evolving diplomatic environment and a perennial lack of spare atomic resources.

The legacy of war had shaped the atomic development of European states for long after 1945. Alongside Belgium, whose atomic story was briefly discussed in Chap. 2, France remained the only other European nation in possession of substantial nuclear expertise in 1945, thanks in large part to the escape to Britain in 1940 of 'the Cambridge Group' of scientists who later played an important role in the Anglo-Canadian nuclear projects at Montreal and Chalk River. Lacking the facilities and years of intensive development that had spurred the North American projects, however, France's post-war nuclear programme was unique among the first nuclear nations in that it was conducted almost exclusively during peacetime and without the immediate goal of building nuclear bombs.[6] French atomic expansion was certainly rapid, and the Commissariat à l'Énergie Atomique (CEA) constructed its first reactor at Châtillon in 1948, while simultaneously recruiting large numbers of scientists and engineers.[7] After the dismissal of communist sympathiser Frederic Joliot-Curie as its leader in May 1950, the CEA also underwent a substantial reorganisation which saw physicist Francis Perrin appointed High Commissioner and the Commissariat open a research centre at Saclay under the directorship of chemist Jules Guéron, a former 'Cambridge Group' alumnus. This rapid expansion was not to everyone's satisfaction, however: disillusioned with the lethargic pace of construction at Saclay, another erstwhile Cambridge Group physicist Lew Kowarski left the CEA in August 1951.[8] Nevertheless, the French produced their first atomic Five Year Plan in 1952 and, lacking the know-how to enrich U^{235}, opted instead to produce plutonium for peaceful purposes.[9]

With its domestic operations growing, the Commissariat soon became eager to explore the prospect of mutually beneficial international collaboration. During a visit to France in April 1951, for example, Michael Perrin of Britain's Ministry of Supply reported the enthusiasm of CEA Administrator-General, Raoul Dautry, for a French-led European atomic energy conglomerate. Such notions remained subject to refinement, however: Dautry regarded Belgium's atomic project as merely symptomatic of national pride and considered that Brussels' main contribution to a European venture would instead come through its chemical industry, while Kowarski and the chemist Bertrand Goldschmidt disputed whether collaboration with Sweden would in fact prove more promising.[10] During a visit to France's atomic establishments, Cockcroft too reported that French scientists desired better-organised collaboration in order to prevent overlapping national projects from duplicating research and thus overtaxing scarce resources. Under the umbrella of such an agreement, France might construct a research pile while another nation built a power reactor, allowing a shared heavy water plant to be developed communally. Cockcroft himself was requested to supply both small quantities of metals and unclassified information on magnesium cladding and heavy water production.[11] Importantly, then, capacity shortages were encouraging European states to cooperate at an early phase of their atomic development and, as a nuclear pioneer, Britain retained a considerable ability to influence these nascent projects through appropriate and timely interventions.

Elsewhere in Europe, the early 1950s also witnessed a growing atomic proficiency among states who had not participated in the Allied wartime projects. After several years of subjugation under the 1949 Occupation Statute, West Germany's nuclear options were finally clearly defined under the 1952 EDC Treaty (discussed below), while the natural leader of Bonn's atomic effort, Werner Heisenberg, battled to separate peaceful atomic energy from the spectre of German rearmament.[12] Once more, Britain's nuclear achievements were deemed inspirational by European scientists: Harwell was considered a benchmark of organisational excellence while Heisenberg was also much impressed by Britain's elite personnel. Indeed, historian Michael Eckert has noted that by successfully combining scientific eminence with institutional power, 'Cockcroft represented the advisory function of scientific men of excellence in the manner Heisenberg hoped to assume for himself in the FRG'.[13] Ultimately, then, some limited nuclear work was conducted with Allied approval in Göttingen's Max Planck Institut and by Bonn's Innenministerium under the auspices of civilian defence or medical research.[14]

Like Germany, pre-war Italy too had haemorrhaged many of its physics experts, most notably Enrico Fermi, the man responsible for the world's first nuclear reaction at Chicago in 1942. Nonetheless, a National Centre for Nuclear Research (CNRN) was established in 1952, although, as Leopoldo Nuti has noted, this may have reflected the need to entrench Italy within *international* organisations like CERN rather than immediate designs for domestic development.[15] In any case, Italy's interest in the atom was well-established by the mid-1950s, even if the comparative weakness of the CNRN did lend the sector a somewhat 'anarchic outlook'.[16] In Scandinavia meanwhile, Norway completed its first research reactor under the tutelage of Gunnar Randers in 1951, although, as Astrid Forland has shown, there was little desire to complement this with military capabilities.[17] As mentioned in Chap. 2, Oslo had also established a significant joint enterprise with the Dutch at Kjeller in 1950, to which Norway supplied heavy water and the Netherlands natural uranium.[18] Here, Britain had played a crucial role: unable initially to offer uranium to JENER due to domestic shortages, Cockcroft later agreed with Dutch physicist Hendrik Kramers to exchange 5000 kg of Dutch uranium ore for three tons of cast-off British uranium metal rods.[19] Importantly, the tripartite exchange demonstrated once more the significance of personal connections between elite scientists, and Kramers, Randers and Cockcroft excluded national parliaments from their discreet negotiations, while Washington was also calmed by the modest scale of the venture.[20] Effective as it was, however, such close identification between individuals and projects nonetheless fomented discord elsewhere on the continent, and Goldschmidt criticised JENER's 'forced' nature as merely a matter of 'personal prestige' for Randers, while the French observed jealously the assistance lent by Harwell to the conglomerate.[21] Finally, in 1954, Sweden too built its own 1 MW reactor using Norwegian heavy water and uranium loaned from France.[22]

By around 1954, then, Europe had spawned several national atomic programmes and witnessed the beginnings of international cooperation, including a few minor interventions by the UK. However, these new capabilities (and in particular the ability to produce nuclear material) consequently became intertwined with broader strategic initiatives to incorporate Bonn into Western defence networks. This issue stretched back to August 1950, when the Council of Europe had approved Churchill's proposal for a European army capable of cooperating with the United States and Canada.[23] Two months later, French Prime Minister René Pleven, a man later described by Eisenhower as his 'best friend' in Paris, suggested that such a force come under the control of a European Defence Minister as a means of including Germany.[24] A treaty establishing a European Defence Community was signed in Paris on 27 May 1952, but it remained subject to ratification from national parliaments. For the French in particular, the concept proved contentious because, as Alan Milward has identified, 'a sovereign German army in a politically unified western Europe was seen almost as much as a threat to security as its future guarantee'.[25] The significance of the EDC in a *civil atomic* context lay in Article 107 of the treaty, which specifically banned the production of 'war materiel' and atomic weapons, with Article 106 proposing a communal research programme instead.[26] The 'atomic weapons' themselves were closely defined, and signatories were limited to producing just 500 g of material 'primarily useful in nuclear weapons' (Pu, U^{233} and U^{235}).[27] Such miniscule quotas threatened not only France's access to nuclear armaments but also its ability to conduct civil atomic research.[28] Thus, while the EDC treaty was swiftly ratified by five states, Paris alone prevaricated, causing prolonged uncertainty over European nuclear collaboration.

Further obstacles arose as a result of Britain's hesitance. Hitherto, Whitehall had been a cautious partner in the nuclear field: in connection with their work at CERN, German scientists including Heisenberg had attempted to visit Harwell in 1953 but had been refused security clearance because the Foreign Office felt compelled to veto such trips until the Allied occupation regime was terminated and the Germans had something to offer in return.[29] Although acknowledging that the political situation remained subject to change, Cherwell had also decreed that no German could enter the AERE, embarrassing those British scientists attempting to facilitate European cooperation.[30] By denying foreign scientists such contact, Britain thus limited its ability either to influence Bonn's activities or to inspect the new 1 MW reactor which the Germans were now permitted to build.[31]

By this point it was clear that Britain needed to devise and prosecute a consistent policy towards European atomic cooperation, and so in February 1954 the Department of Atomic Energy issued a memorandum addressing the issue directly. Summarising the present situation, the

Department noted that British policy hitherto had been 'to help European projects in an informal way by the supply of small quantities of uranium', while also providing advice on research reactors and information concerning health and safety. Furthermore, unclassified reports had also been exchanged with several nations, allowing Britain to establish an 'informal leadership' over its continental partners. Retaining such flexibility, the Department argued, was crucial in calibrating cooperation: British expertise had cost considerable time and money to compile and to trade it cheaply would consequently negate Britain's technological lead. Yet there were also strong arguments in favour of more decisive intervention: the AEC published its unclassified work freely, and withholding British information would therefore leave potential clients dependent on American methods while depriving Britain of beneficial external input.[32] It was also important to ensure that cooperation between continental states did not duplicate research across parallel projects, thereby wasting resources and slowing the growth of the current state of knowledge. Consequently, the Department made three important recommendations. Firstly, Britain 'should *actively* encourage groupings between European countries for the purpose of atomic energy development' and secondly make unclassified data on existing pile designs 'freely available' to continental states while withholding valuable information on chemical separation and enrichment techniques. Finally, the Department recommended that Britain attack the market in atomic fuels by offering to extract uranium metal from its ore, to process irradiated material and to re-enrich uranium on behalf of interested clients.[33]

Considering these proposals, the Official Committee on Atomic Energy accepted the first notion provided that it 'implied no governmental action', resulting in the word 'actively' being removed from the draft. The concept of trading unclassified data was also amended to omit references to 'free' exchanges of information: instead the committee recommended that Britain should extract something from *all* its atomic dealings, whether from the 'sale of processed material (the price of which would include an element for "know-how"), the exchange of information, revenue from patents, and, ultimately, the sale of plant and equipment'. In this regard, the committee also supported the Department's recommendation that Britain establish itself as a supplier of processed material, because such action would generate financial returns while concurrently granting Britain 'a measure of control over what the other European countries were doing in this field'. However, the Official Committee also stipulated clearly that such activity could not prejudice domestic requirements: in practice, any overseas contracts would have to remain within the spare productive capacity of Britain's new uranium metal factory at Springfields.[34] Thus, although Whitehall was awakening to the political and technical value of cooperation, capacity concerns would limit British engagement to *quid pro quo* exchanges: nothing could be given away for free.

Perhaps the best example of how such restrictions influenced British policy arose in December 1954, when Francis Perrin asked Cockcroft to consider whether UK firms would consider building a French gaseous diffusion pile capable of enriching uranium to 2.1% U^{235}.[35] Evaluating the proposal, J.C. Walker of the Atomic Energy Authority's Overseas Relations Branch linked the idea to an earlier suggestion by Cockcroft that Britain might build its own diffusion plant at a cost of £2 m (£50 m in 2016), to meet export needs. The economic case, Walker claimed, was self-evident: any country able to supply enriched uranium would 'in a comparatively short time attract a considerable volume of business, limited only by the capacity of its plant and by political and raw material supply considerations'. However, practical concerns soon outweighed the plan's potential benefits: Britain did indeed lack the raw materials necessary to legitimate additional plant either at home or abroad, and was consequently prevented from trading in enriched uranium. Nevertheless, Walker contended that it might be possible for Risley to assist the French without compromising their restrictions on classified information, although the financial advisability of Paris pursuing such a plant was low.[36] In any case, it was clear that, despite a more liberal outlook in Whitehall, Britain could not yet afford to divert resources from its domestic project to facilitate development abroad.

So far in this chapter we have seen how the early 1950s were marked by mounting continental interest in atomic energy and the beginnings of tentative cooperation between European nations outside British control. Although London understood that its neighbours had desired to cooperate since at least 1948, Harwell's response had hitherto been to provide only the informal assistance allowed by its strict security protocols.[37] Yet the growing competence of Europe's national atomic programmes also prompted Whitehall to acknowledge that political change, as well as an expansion of its nuclear plant, manpower and resources were required if Britain was to retain its premiership and its potential influence abroad. Consequently, Britain entered the new decade in the awkward position of lacking the spare resources to exploit its technological superiority: Harwell and Risley may have established themselves as global pioneers, but this did not yet imply a readiness, in capacity or developmental terms, to share their techniques without suitable recompense.

Churchill Commits to Atoms for Peace

Away from Europe, the rising international tensions that had stimulated the EDC proposal also led Washington to reconsider its defensive capabilities and foreign alliances. Aiming to greatly expand the American nuclear arsenal as an economical alternative to maintaining huge conventional forces, President Eisenhower also opted to utilise Washington's massive resources to liberalise civil atomic exchange as a screen to his military aspirations. These developments were highly significant to Britain, marking as they did a return to the atomic marketplace of the world's foremost economic power and with it an opportunity to join a new international control system designed to guarantee international nuclear harmony. Driven by his 'Great Power' instincts to support highly political initiatives designed to ensure peace, Churchill thus lumbered Britain's atomic project with additional commitments at a time when Atlantic relations were descending into thinly veiled competition.

Aside from their obvious destructive power, atomic weapons had fundamentally altered the strategic landscape by allowing technologically advanced states to compensate for their inferior manpower with superior firepower. President Truman had in January 1950 already commissioned the first American hydrogen weapons, a controversial decision that caused Hans Bethe, former head of Theoretical Physics at Los Alamos, to briefly resign from his consultancy position on the project.[38] Eager to exploit Washington's nuclear lead, and acting against the wishes of leading scientists like Vannevar Bush who preferred to see government funding poured into bomb defences, Eisenhower's administration therefore spent autumn 1953 formulating a 'New Look' defensive plan in which a nuclear deterrent would play an increased role.[39] The 'New Look' was couched foremost in economic reality: in his 'Chance for Peace' speech in Washington in April 1953, the President had proclaimed his sadness that the world was 'spending the sweat of its laborers, the genius of its scientists, the hopes of its children' on weapons instead of people. In real terms, the President argued, 'we pay for a single fighter plane with a half million bushels of wheat'.[40] Importantly, however, the new strategy also mandated that the United States shield itself behind a screen of strong allies, and so in his speech Eisenhower reaffirmed his support for the EDC while noting also his willingness 'to foster a broader European community, conducive to the free movement of persons, of trade, and of ideas'.[41] Thus, the new American military stance was from its earliest days inherently intertwined with plans to incorporate Bonn into a robust continental bulwark.

To secure support for these initiatives, on 8 May 1953 the National Security Council released NSC 151, a recommendation to educate the public on the arms race.[42] Such notions pleased American scientists: a report by the State Department's panel on arms control, supervised by Bush and Robert Oppenheimer, had earlier that year endorsed a similar outpouring of frankness with the unofficial intention of encouraging taxation to fund bomb defences.[43] In any case, this 'campaign of candor', as Ira Chernus has termed it, would need to promote the 'morally neutral atom' to gainsay the destructive image of hydrogen weapons.[44] The task of writing a speech to launch the new plan fell to Eisenhower's psychological warfare specialist C.D. Jackson, who soon found the project's multifarious aims difficult to control. Ideas were circulated around Washington, and throughout the summer Robert Bowie (the State Department's Director of Policy Planning), Jackson, Secretary of State John Dulles and AEC Chairman Lewis Strauss debated the proposals. Initial suggestions for disarmament talks were unproductive: as Gunnar Skogmar has highlighted, direct US-Soviet discussions would compromise European defence integration by giving the impression of fractures in the Western alliance.[45] Forced therefore to search for an alternative 'package', Jackson settled on 'Atoms for Peace', a proposal for a pool of fissionable material to be controlled by an international agency tasked with directing the resources towards peaceful applications.[46] The mechanics of the idea were deceptively simple: by fixing contributions of material at a level within the productive capacity of the United States but which would (over)tax Soviet output, Eisenhower's administration hoped to ensure, as John Krige has highlighted, that other states 'devoted their limited nuclear resources to civil programs under international surveillance'.[47] Such a policy was not fool-proof, however: responding to questions from Eisenhower's National Security Advisor, Robert Cutler, Strauss criticised the lack of intelligence regarding Russian stockpiles and warned that encouraging Moscow to expand its fissile material production could potentially disadvantage Washington considerably.[48]

The clear shift in the American worldview represented by Atoms for Peace has traditionally been held by historians to have arisen from Washington's need to recapture the nuclear initiative after the failure of the McMahon Act to protect its monopoly from Soviet and British advances. Shane Maddock, for example, has identified how foreign achievements exposed the 'myopia of nuclear nationalism', while Michael MccGwire has highlighted how American 'complacency was shattered' by Moscow's acquisition of the bomb in 1949, four years sooner than Washington had considered possible.[49] Nor was the United States unchallenged in industrial atomic technology: by the time of Eisenhower's announcement, work on the world's first full-scale nuclear power station at Calder Hall was already six months old. In the opinion of William Walker and Måns Lönnroth, then, Atoms for Peace was designed to address the isolationism which had left the United States vulnerable to being overtaken in civil atomic energy.[50] Unquestionably motivated by superpower considerations, the President was more exercised about encouraging action from Moscow than from his allies as he attempted to launch a new atomic order with Britain involved only in a 'minor way'; nevertheless, London and Paris would be consulted for their opinions of the new scheme and retained a considerable ability to influence it.[51] The President's fear, as Richard Hewlett and Jack Holl have affirmed, stemmed from the fact that Russia now possessed the first weapon that could threaten American industry, 'the winning factor in all major conflicts since the Civil War'.[52] As the President told Jackson; 'we never had any of this hysterical fear of <u>any nation</u> until atomic weapons appeared upon the scene' (Eisenhower's emphasis).[53]

The problem identified, attention turned to rendering Washington's armament drive palatable to the world. American thermonuclear testing and its *twenty-two-fold* increase in stockpiles during Eisenhower's tenure had lent Washington a belligerent image, culminating, as John Krige has shown, in a public relations disaster.[54] The issue at the White House, then, was to control the proliferation of nuclear arsenals while simultaneously reclaiming the moral initiative and nurturing the rising international interest in peaceful atomic energy. The situation was summarised succinctly in a draft speech sent by Strauss to Jackson in November 1953: 'In 1946 we enjoyed a monopoly of atomic armament' Strauss wrote, and continued 'This position has been lost. In 1953 we have an advantage of atomic plenty, which position will relatively deteriorate. Our problem is to capitalize on this existing advantage while there is time to do so'.[55]

In order to realise his remaining nuclear advantage, Eisenhower's upcoming speech to the UN, at which Atoms for Peace would be launched, would need to downplay the unpredictable economics of civil atomic plants. Indeed, Bowie contended in a private note that the President had in fact greatly overemphasised the present scope of industrial nuclear power: with even a 100 MW facility costing $100 m, poor states would be isolated from the technology not by fuel price but by the enormous capital cost of plant.[56] Additionally, it must also be remembered that the United States was not even the world's primary *civil* atomic power at this stage, having been eclipsed by Britain during its isolationist McMahon years.

With Eisenhower's idea defined, the road was now clear to consult London and Paris. A tripartite conference was arranged for December in Bermuda, granting Whitehall time to prepare for discussions on the Anglo-American nuclear relationship. Foremost in Churchill's mind was the need to clear the air across the Atlantic by ensuring the publication of the Quebec Agreement, a suggestion which greatly disturbed his scientific guru, Lord Cherwell. In Cherwell's view, publication of the Agreement would embarrass Churchill for his past role in disclaiming Britain's interest in industrial reactors, particularly after Attlee's hard-won achievement in regaining the right in 1948.[57] Churchill responded furiously, lambasting his predecessor's 'feeble and incompetent' efforts in alerting the Americans to the secret wartime agreements and highlighting that they had caused Britain to suffer eight years of 'deprivation' and over £100 million in additional expenditure.[58] Enacting an atomic bank would also be very difficult: as Cherwell reminded Churchill shortly before talks began, Moscow would press for a *qualitative* contribution of fissionable material from existing stockpiles, perhaps asking that all national holdings over a certain threshold be entrusted to the international agency. By contrast, a *quantitative* contribution based on pure tonnage would favour the Americans, who could more easily afford the deduction from their preponderant stocks.[59]

With Churchill clear of his aims, the 'Big Three Meeting' took place from 4 to 8 December 1953. The tripartite element of proceedings soon ran into difficulties: in Eisenhower's own words, the French had been invited largely due to their 'inferiority complex', and negotiations were further hampered by the limited remaining lifespan of Joseph Laniel's government.[60] Indeed, these concerns were vindicated almost immediately when French Foreign Minister Georges Bidault listed several concessions necessary for Laniel to secure parliamentary approval of the EDC.[61]

Key among these was a settlement of the Saar question, but Bidault also requested that British and American forces remain in Europe *at essentially their present strength* for another twenty years, a commitment he considered reasonable for asking France to integrate its military with that of its traditional enemy.[62] Apoplectic, Churchill accused his French counterparts of betraying years of work to secure what had originally been a French initiative, and of merely 'giving excuses' for their renewed impotence.[63] If France would not comply, Churchill threatened, there would be no alternative but to rearm West Germany to guarantee Western security.[64]

In contrast to this inauspicious start, the subsequent Anglo-American discussions on atomic energy proved considerably more fruitful. Seizing his chance at his meeting with Eisenhower, Strauss and Cherwell on 5 December, Churchill physically presented the Quebec Agreement to the table. Tellingly, Strauss was totally unaware of the agreement, although he noted that it had in any case long been superseded by the 1948 *modus vivendi*.[65] Nevertheless, the group decided to produce an 'agreed history' of Quebec and the succeeding 1944 Hyde Park Agreement in the hope that explaining the facts would render the American public more amenable to cooperation with Britain. Despite opposition from several high-profile actors, notably Eden, Roger Makins, and of course Cherwell, the Prime Minister thus prevailed, finally allowing Quebec to be published eleven years after it had been signed.[66]

Concerning Atoms for Peace, the President had furnished the British with the latest draft of his speech on arrival, but soon expressed frustration with Churchill's lethargic response: the Prime Minister, it seemed, could not 'help thinking he himself is the world's only statesman today; it is almost impossible for him to see anyone else proposing an idea of any general importance to the world'.[67] Indeed, Churchill did not even read Eisenhower's speech until the last moment, delegating the task to Cherwell, who reported that the idea was 'unexceptionable in tone and aspirations', if somewhat vague. Furthermore, Cherwell highlighted that Eisenhower's derogatory references to ridding the world of 'obsolete colonial mould' would assuredly offend Europe's colonial powers, notions which Churchill redacted before forwarding the rest of Cherwell's memorandum to Eisenhower.[68] Pausing only to mildly reprove the President's anti-imperialist language, the Prime Minister considered the draft a 'very fine speech' which tackled the issues with 'courage and candour'.[69] The offending references were removed from the final copy, and Churchill wrote to Eisenhower once more to relay his excitement: 'we live under a system of Cabinet Government', the Prime Minister wrote, 'and not one of our colleagues has even dreamed of the departure that you are going to make'.[70]

While not greatly significant in pure political terms, the Bermuda conference was far more important for its impact on the nuclear world in that it allowed Churchill and Eisenhower to salve their nation's long-festering atomic wounds. By drawing a line under Quebec, Churchill acknowledged the contemporary atomic environment and laid the ghosts of 1946 to rest. The President's revelation of his 'New Look' armament programme, however, had provided a shocking glimpse of a world in which the failure of great statesmen had left a world on the brink of thermonuclear war. Startled as he was by these revelations, Churchill recommitted himself to calming Eisenhower and seeking a summit meeting with the Russians at which he was sure he could deliver nuclear peace.[71] Committed then to Atoms for Peace as an initiative capable of fostering better relations between the superpowers, Churchill's support for the scheme nonetheless raised conflict between Britain's political and sectoral objectives: by behaving as a great statesman responsible for ensuring peace, Churchill relegated atomic concerns beneath his wish to relieve international tension. In doing so without properly appreciating how Eisenhower's Plan would potentially affect Britain's burgeoning atomic project, the Prime Minister thus exposed his nation's scientists to undefined new challenges to add to their existing workload.

Eisenhower made his speech before the UN General Assembly on 8 December 1953.[72] Acknowledging that the American nuclear monopoly was long dead, with the 'dread secret' of nuclear weapons now understood by multiple parties, the President therefore invited responsible governments 'to make joint contributions from their stockpiles of normal uranium and fissionable materials to an International Atomic Energy Agency'. Established under the United Nations, the agency's key function would be 'to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine, and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world'. In this way, the President announced his hope that nuclear energy could 'serve the needs rather than the fears of mankind', while stressing also his desire to find 'an acceptable solution' to the armaments race currently underway.[73]

The speech was well-received by the international community, and Eisenhower remained confident that he had finally spurred Moscow into a meeting.[74] Such notions were soon imperilled, however, by a Soviet note on 21 December proposing a total nuclear moratorium.[75] Writing to Eisenhower to discuss this gambit, Jackson opined that 'the Soviets had taken your simple, understandable and doable proposal and had surrounded it with a lot of old disarmament spinach, all of which had been proven unworkable in the past'.[76] Continuing the culinary metaphor, Jackson concluded that the Russians were therefore merely making 'small potatoes' of Eisenhower's offer, but the proposal nonetheless sparked heated debate as the State Department's receptive attitude was tempered by the Defense Department's concern that it could not match Moscow's conventional forces.[77] In any case, it was vital not to allow the Soviet counter-proposal to crystallise in the public mind: as Jackson recommended, this could best be achieved by several small measures, first among which was to stress that the President had made two *distinct* proposals, one to discuss disarmament and one for the atomic bank.[78] Eisenhower concurred, signalling a critical juncture for both American and British nuclear diplomacy: long overshadowed by its military cousin, civil atomic energy had become a foreign policy initiative in its own right.

In summary, then, Atoms for Peace was not merely a peace initiative but a multifaceted scheme designed to address simultaneously several of Washington's objectives. Alongside the need to screen Eisenhower's nuclear proliferation behind positive propaganda, as John Krige has identified, it was also important to terminate the nuclear isolationism which, according to William Walker and Måns Lönnroth, had become an 'embarrassment' in American relations with Europe.[79] The growing civil atomic capabilities of Britain (and Canada) threatened to leave Washington marooned by its own obstinacy, leaving it no choice but to reverse its policy and actively pursue global pre-eminence if it wished to retain any influence over foreign nuclear activities.[80] Additionally, Matthew Fuhrmann has noted how Eisenhower devised Atoms for Peace as an arms control measure which rendered foreign atomic projects dependent on materials and technology from supplier states. Acknowledging that continued aloofness would reduce Washington's ability to ensure that foreign nuclear programmes remained civil, Eisenhower thus moved to direct intervention, a plan which Fuhrmann argues may actually have backfired by providing states with a platform from which to eventually produce weapons.[81]

To these notions one must now add the implications of Britain's role at Bermuda. 'Atoms for Peace' was approved at the highest level in the UK government: acting with his familiar passion for statesmanship, Churchill aimed to bolster Britain's status by participating in grand schemes designed to relieve international tension, and so supported Eisenhower's Plan without consulting anyone but the cagey Cherwell. As a consequence, he committed Britain to a new global initiative without considering how such proposals, including the commitment of fissionable material to an international bank, might hinder Britain's domestic atomic effort.

A Double-Edged Sword: Britain's Response to the Eisenhower Plan

The atomic bank proposals elicited a mixed reaction from Britain's nuclear elites. Shortly before Bermuda, Cherwell had suggested that Britain was finally 'about equal' with the United States in peaceful atomic energy, and the responses to Eisenhower's Plan consequently reflected a heightened concern for Britain's promising technological position in both a commercial and geopolitical sense.[82] Sceptical as ever of American intentions, Christopher Hinton feared that Eisenhower's proposal would allow Washington to increase its already-questionable claims on uranium while establishing the United States as the dominant force in civil reactors. Such an upswing in American influence could only work 'to the detriment of our position in the Commonwealth and in the overseas markets', highlighting the threat posed to Britain's emerging commercial prospects in nuclear engineering. Finally, only the Americans had the spare manpower to staff a new international organisation, while Britain's overburdened project would struggle to second elites to such an agency.[83]

For their part, John Cockcroft and William Penney received Atoms for Peace with greater enthusiasm, endorsing the notion of an atomic bank that could be made safe from attack. The pair were also supportive of an international agency which could 'save a great of duplication of effort, particularly if the small European projects were integrated into the new Agency', although huge investment would be required to increase global power production. Nonetheless, there still remained considerable scope for Britain to use its influence more effectively in pursuit of its own aims, with both scientists remarking that 'the Western European nations are already moving towards integration of their work towards nuclear power production' and concluding, tellingly, that 'we might do more'.[84] Indeed, Cockcroft theorised a combined European atomic effort, similar in size to Harwell but operating as an 'International Laboratory for Nuclear Energy' in which the comparatively small programmes of Norway, Sweden, the Netherlands, Belgium, France, Switzerland and Italy could combine to develop power reactors of a scale and scope not possible individually.[85] Consequently, Britain's atomic elites supported the scientific elements of Eisenhower's Plan, but noted with caution the potential of the proposal to prejudice Britain's burgeoning commercial interests.

Such concerns were mirrored in Whitehall, where officials debated how Britain should respond in the event of a refusal by Moscow to join Eisenhower's Plan. As Cherwell told Churchill in unambiguous terms, 'if the Russians do not come in, such an agency might well cut across our plans for building up something on similar lines with the Commonwealth (and possibly some European countries) a scheme which would be commercially more attractive to us'.[86] The scientific and economic sacrifices entailed by British participation in an atomic agency were already significant, and the Foreign Office was clear that Soviet non-involvement would render membership in what amounted to an atomic 'Marshall Plan' seriously disadvantageous.[87] Perhaps influenced by the Francophilic tendencies of its head, Eden's department wished also to foster greater harmony between the Western nations by discussing the Eisenhower Plan in a subcommittee of the UN Disarmament Commission alongside French and Canadian representatives.[88] These wishes, however, directly contradicted the prevailing opinion at the State Department, where Dulles told Makins that he would prefer a tripartite meeting between the nuclear powers. The French position was the Secretary of State's main worry: Paris had no technical qualification to participate and its global status was described as 'very shaky', demonstrating Washington's growing propensity to regard the atomic world in bilateral terms.[89] Clearly visible, then, was a conflict between Dulles' notions of superpower diplomacy and London's desire to unify the Western Allies in the face of Soviet scrutiny.[90]

Eisenhower's progress in securing his desired amendments to the US Atomic Energy Act were followed with great interest in London by ministers keen to ascertain how such changes might benefit Britain. In his appeal to Congress, Eisenhower emphasised heavily how existing legislation, tailored to suit post-war conditions, was already 'inconsistent with the nuclear realities of 1954'.[91] Instead, the President stressed the benefits of international cooperation, arguing that Washington's defence could be achieved only by informing its allies of new developments in atomic warfare. Accordingly, Congress was requested to allow the transfer of fissionable material and 'Restricted Data' outside the United States, while Eisenhower also asked that firms be permitted to manufacture reactors under AEC supervision, paving the way for a commercial nuclear industry.[92]

The proposed amendments enjoyed a mixed reception in London, where the Official Committee convened a week after Eisenhower's message to Congress to agree new policies for Makins to use in his discussions with the Americans in light of these new circumstances.[93] At the meeting, the gathered officials identified four key motivations behind Eisenhower's plan and discussed Britain's position accordingly. Firstly, Eisenhower's desire to communicate information on the tactical effects of nuclear weapons could prove disadvantageous if the Americans restricted their outpourings to a level appropriate for the 'least secure NATO country' (i.e. France), because it would prevent Whitehall from capitalising on the privileged position it had won since 1945. Secondly, Washington's offer of atomic information to uranium-producing countries would erode Britain's technical lead, while alterations to American vetting processes could conceivably facilitate communication between the Atlantic powers. Saving arguably the most important factor for last, the committee also identified the President's wish 'to give American industry a flying start' in civil atomic energy, a factor that might provide a more liberal declassification regime from which Britain could potentially benefit.[94]

Taken in sum, however, the Committee expressed their disappointment in the President's proposals. Even if the Atoms or Peace proposal passed through Congress unscathed, London only really required information on weapon design and production, fields expressly beyond the plan's scope. 'At the risk of appearing to look a gift horse in the mouth', diplomat Harold Caccia therefore told Makins, the Committee were unsure that the proposed revisions would 'give us all we want'.[95] Indeed, as Caccia opined, Britain's industrial atomic sector was now directly threatened by the spectre of competition, because an amendment would allow the Americans 'to cast off their self-imposed handicap and catch up with us'.[96] The danger was summarised succinctly in the Committee's notes on the subject: 'once the U.S. <u>legal</u> barrier to the communication of classified information to friendly countries is raised, we can no longer enjoy the benefit of their self-imposed handicap and we shall have to rely solely on the <u>quality</u> of our research to maintain our lead in the atomic field in Western Europe and the Commonwealth, since we cannot hope to compete with the scale of U.S. technical resources and production' (original emphasis).[97] The timing of Eisenhower's announcement was certainly unfortunate when considered in this light: Westminster had commissioned Britain's first PIPPA in February 1953, and harboured notions of exporting its expertise and designs for considerable profit.[98] Arguing meanwhile that an 'overwhelming counter-offensive with the most powerful nuclear weapons' offered the only chance of salvation in the event of war, the Chiefs of Staff also persuaded Cabinet to authorise British thermonuclear weapons in July 1954, reaffirming London's commitment to being a nuclear power in every possible sense of the phrase.[99]

And yet the problem persisted of what to do in the event of Soviet non-participation in Eisenhower's agency. The issue eventually came to a head in early June, when a working party of the Official Committee observed that the Eisenhower Plan would proceed regardless of Russian opinion (a view confirmed by Britain's Washington embassy two days later), and recommended that Whitehall should consider its response accordingly, given the economic and atomic disadvantages inherent in participation.[100] From an atomic perspective, the essential problem was that the Eisenhower Plan would demand materials and manpower which Britain could ill-afford to divert from its domestic programme. Quantities of uranium ore or fabricated fuel which were trivial to the Americans were extremely valuable to London, while Britain could not spare its elite scientists for international duties as easily as Washington could. Nevertheless, as the officials continued, 'we were however prepared to pay this price in the interest of securing Soviet co-operation […] and to consider our contribution to the Agency as assisting to secure a relaxation of international tension'.[101] With British participation thus dependent on Soviet reciprocation, deciding what to do if Eisenhower proceeded without Moscow thus became diplomatically imperative. Put simply, Britain could not for both highly political and nuclear reasons bluntly refuse to participate: London's global standing demanded that it support attempts to relieve tension, while Whitehall's atomic priority was to nurture Anglo-American relations.[102] Consequently, the brief recommended that British officials do nothing to discourage Washington, and that they should prepare for a request to join the IAEA. In the event of such an invitation, Britain should not refuse, but rather remain guarded about its contributions until it could ascertain what the minimum requirements of participation might be.[103]

With Moscow still prevaricating, Eden finally lost patience in mid-June and vented his frustration in a memorandum: 'this scheme is not in our interest. It has no international value without the Russians' he wrote. Displaying an advanced appreciation for Britain's atomic interests, the Foreign Secretary concluded sharply, 'I am not prepared to disadvantage Britain for a scheme that has become useless merely to please the Americans'.[104] In Cabinet, Eden persuaded his colleagues to preserve Britain's flexibility in negotiating with 'potential customers' who might purchase their fissionable materials from the UK, and secured their support for an attempt to discourage Eisenhower from enacting his plan without Russian membership.[105] The AEA was consulted, and following a report by Plowden, the Foreign Office telegrammed Makins in Washington with precise instructions: 'we should have been prepared to proceed with this idea as a means of securing Soviet co-operation in the President's plan, but now that the Russians are obviously not going to join, I see no point in proceeding', Eden stated.[106] Only after visiting Washington in June 1954 to speak with Dulles and Eisenhower personally did Eden finally accept that there was clearly 'no way of stopping' the Americans, persuading him that Britain should participate in order to influence proceedings from within.[107] He was not alone: persuaded by Dulles that its best interests lay inside the international agency, the Soviet Union too finally acquiesced in September 1954.[108]

In brief, it was clear that Eisenhower's proposals had generated considerable technical and political disagreement in London about the merits of participating in Atoms for Peace. The continued notions of Great Power status lodged irretrievably in Churchill's mind in particular bound Britain to support schemes to relieve global tension, but its technical elites remained rightly sceptical of a plan which prejudiced both Britain's commercial prospects and its nuclear resources. These objections were shared by politicians who criticised Eisenhower's miserly offer of weapons data while noting also the threat now posed to Britain's exports by American competition. Eden in particular denounced the proposal, believing it an expensive sop to American egotism unless Moscow too would accede. With Soviet participation eventually secured, it thus remained to be seen whether Britain's nuclear project could weather the international return of the American atom.

Washington Makes Its Move

For better or worse in British minds, Washington was now poised to pursue new partnerships with client states overseas. Ostensibly undertaken in the name of global security, such engagement would undoubtedly also bring stiff competition to bear on Britain's commercial prospects and in so doing altered the established pattern of Anglo-American atomic diplomacy. In turn, Britain's hesitant post-war engagement with Europe was soon shown up for its complete inadequacy by the rapid atomic exchange now unfurling between the United States and other nations.

Despite considerable Democratic opposition, Eisenhower's revised Atomic Energy Act became law on 30 August 1954. On a technical basis, the Act now permitted the AEC to 'cooperate with any nation or group of nations by distributing special nuclear material [...] pursuant to the terms of an agreement for cooperation [...] which is made in accordance with section 123'.[109] Section 123 itself then provided strict requirements for cooperation, including the provision of a clearly-defined treaty and system of safeguards, and affirmed the right of Congressional committees to scrutinise each agreement.[110] Finally, Section 144 allowed the AEC to communicate to foreign nations 'Restricted Data' surrounding several sensitive aspects of civil nuclear energy, including uranium purification and reactor development.[111] In short, the Act represented the most serious liberalisation of American atomic foreign policy yet witnessed in the technology's brief history.

It was an offer with which Britain would struggle to compete, a fact quickly exposed when Washington requested assistance from its nuclear allies. In addition to the expectation that Britain would contribute valuable fissionable material to an atomic bank, Eisenhower also requested that Harwell offer its world-leading training facilities to help foreign scientists gain experience with nuclear technology. During September 1954, the AEC developed a series of interim measures to be used until the IAEA became fully functional, among which was a suggestion that Canada and Britain provide advanced training courses in the classified aspects of reactor management.[112] Although a compliment to British prowess, the plans quickly troubled London's overstretched research establishments: asked by the State Department to enumerate the training opportunities that Britain could offer foreign scientists, Cockcroft was able only to weakly suggest the existing four-week course at Harwell's Radioisotope School. Furthermore, as he warned the Foreign Office, Harwell could not spare British instructors to teach additional courses, and might at most be able to arrange for visitors to the Unites States to give lectures during their research trips.[113] Harwell's only alternative educational institution, its new Reactor School, was barely operational and was in any case already oversubscribed for the next nine months.[114] Indeed, the Authority guarded their new School jealously: as Friston How of the Atomic Energy Office informed his Foreign Office colleagues, 'while a few Commonwealth scientists are admitted, there is certainly no room for foreigners'.[115]

Against these meagre offerings issuing out of Harwell, the American proposals for opening access to its facilities were comparatively gargantuan: the Radioactive Tracer School at Oak Ridge offered sixty vacancies to international scientists for three-week courses annually, and Argonne's Cancer Research School contemplated 150 vacancies per year at its facilities. Furthermore, there were proposals to offer sixty places for three-month courses on industrial medicine at various universities, alongside seventy places at Brookhaven's Radiation Medical School.[116] Dismayed by the apparent lack of competitiveness shown by British laboratories, the Foreign Office queried the Authority's response to Washington's request, forcing atomic officials to defend their record on overseas cooperation.[117] Although 'informal and unspectacular', as J.C. Walker admitted in his reply, Britain's engagement with Europe nonetheless remained significant. Despite security restrictions and capacity limitations, Britain now had established relationships with several continental states, and exchanged information regarding the design and supply of specialised instruments and materials.[118] Importantly, as the draft noted, much of Britain's contribution had hitherto been on a 'scientist-to-scientist' basis, highlighting further the value of interpersonal communication. In contrast to the hesitance displayed by government in previous years, such interaction was therefore now offered as evidence of Britain's commitment to Europe.

Yet whatever the interpretation of Britain's civil atomic engagement with its continental neighbours, there could be no doubt that Whitehall's efforts paled in contrast with the frenzied activity triggered by Washington's nuclear liberalisation. Under the so-called '123 Agreements' (named for Section 123 of the Atomic Energy Act), the AEC agreed to provide clients with 6 kg of uranium enriched up to 20% in U^{235}, which would be returned to the United States for reprocessing.[119] Beginning with Turkey on 10 June 1955, twenty-five research and fourteen power agreements were signed with thirty-seven countries, alongside eleven mutual defence agreements and three special arrangements with Euratom and the IAEA.[120] Within this framework, the United States also reset its relations with London, signing new military and civil atomic agreements in June 1955. Having secured political partnerships, Eisenhower also ensured that his scheme was not prejudiced by economic concerns: at Pennsylvania State on 11 June, the President announced that Washington would contribute $350,000 a piece to halve the cost of American research reactors.[121]

For London, the implications of this *volte-face* were unmistakable and one of the most promising vectors of British atomic influence was now threatened by an ally that was economically and technically able to undercut Britain's research reactors. Having failed to become the world's leading supplier of radioisotopes (a position lost to Britain, as detailed in Chap. 2), the United States would now also instead assist clients with constructing their own radioisotope-producing reactors, further blunting London's competitive edge.[122] British industry also had grounds for concern in the realm of power reactors, where it was hoped that the Magnox model, as the first proven commercial-scale system, would eventually produce lucrative exports. Instead, as Richard Hewlett and Jack Holl have observed, Washington pursued an 'aggressive implantation of the foreign power reactor programme', even prioritising such engagement over its commitments to the IAEA.[123] It was, in historian Shane Maddock's view, the antithesis of Truman's belief that military and civil technologies were inseparable; indeed, Eisenhower pointedly refused to acknowledge that 'nuclear plowshares could be recast as swords'.[124] Importantly, therefore, the two applications of nuclear energy were now explicitly separated in the mind of the President.

Historiographically, Eisenhower's plan has excited much debate between analysts who consider it an arms control measure and others who highlight the project's propaganda role.[125] Alternatively, Martin Medhurst has contended that Atoms for Peace was multifaceted, being 'designed to help take the curse off the atom and thus create the time and psychological space needed to effect completion of the New Look'.[126] In John Krige's view, Atoms for Peace is also better regarded as a 'polyvalent policy initiative' with four key pillars.[127] Firstly, the scheme would 'displace public attention from the military to the benign atom' and render credible Washington's moral crusade, while also enhancing American security by compelling Moscow to contribute scarce fissionable material to an atomic bank.[128] Thirdly, Eisenhower utilised patriotism to chivvy American firms unwilling to invest in uncompetitive nuclear power, and finally garnered support among scientists by arranging a conference on civil atomic energy in Geneva in August 1955.[129] Yet however one interprets Eisenhower's motives, it is undeniable that Atoms for Peace accelerated global nuclear development: as Avner Cohen has identified, the scheme underpinned notions that Israel's survival depended on technological superiority, prompting the purchase in 1955 of an American reactor.[130] Furthermore, Atoms for Peace eclipsed the early contributions made by Britain and

France to Sweden's nuclear project: as Maja Fjæstad and Thomas Jonter have asserted, without American assistance, 'it is hard to imagine the evolution that took place in the 1950s and 1960s, i.e. the development of the first basic nuclear infrastructure in Sweden'.[131]

To these important assertions we must now append a new understanding of how Eisenhower's 'Atoms for Peace' plan affected Washington's key ally and nuclear rival. This chapter has demonstrated how the scheme presented London with a double-edged sword. Received with cautious optimism in Whitehall and at the AEA, Atoms for Peace portended an explosion in nuclear trade but also a stiff commercial challenge from a competitor superior in capital and materials. Furthermore, the initiative would compromise Britain's atomic agency abroad by demanding from it contributions of men and uranium which it could ill-afford, leading Eden in particular to question Churchill's enthusiasm for Washington's plan. Thus, while welcoming the attempt to thaw superpower relations, scientists and politicians alike noted with considerable concern that the Anglo-American nuclear relationship had now fundamentally changed.

Epilogue

Ultimately, the EDC met an ignominious end as Prime Minister Pierre Mendès France, unwilling to sanction German rearmament after France's humiliation in Indochina, allowed the French Parliament to reject the plan in August 1954.[132] In Paris that October, the Brussels Treaty Organisation was overhauled and rechristened the Western European Union, but French ministers again vetoed plans to grant Bonn entry into NATO. Fearful of alienating West Germany, London and Washington both refused to condone any Four-Power summit until the Paris Agreements were ratified, forcing the new French government under Edgar Faure to finally allow German accession to NATO in February 1955.[133] Importantly, the EDC's failure also inspired Jean Monnet, who had supported the community primarily as a means of creating the *political* institutions necessary to direct it, to change course and pursue instead what Renata Dwan has termed a 'gradual integrative approach' driven by European elites.[134] Resigning the ECSC Presidency, Monnet formed the Action Committee of the United States of Europe, a 'quasi-official, quasi-lobbying organisation' that brought together leaders of pro-European political parties and prominent trade unionists.[135] Although temporarily frustrated, the integrationist impulse was thus not extinguished.

Conclusion

Although considerable space in this chapter has been devoted to Eisenhower's 1953 reappraisal of Washington's atomic policy, it has also highlighted the significance of Britain's response to the President's proposals. Possessing growing civil nuclear capabilities of their own and keenly aware of their country's future potential as a leader in the nuclear field, Britain's ministers and scientists were confronted with decisions which reveal much about the paradox of London's will to retain its Great Power status through technological leadership. As such, Whitehall's reaction to Atoms for Peace was important for two key reasons.

Firstly, American actions to reduce international tension were welcomed by Churchill who, consulting only Cherwell, committed himself wholeheartedly to Atoms for Peace without considering how British participation would affect its native atomic project. The experience of the Blitz had convinced many British ministers that they would be the primary target of any Soviet nuclear strike: indeed, much of the opposition to the atomic bank stemmed precisely from the fact that Russian *non-participation* would render the organisation redundant. Importantly, then, such concerns alloyed with Churchill's taste for great statesmanship, leading him to associate with grand schemes which only the United States had the resources to prosecute. By committing Britain to Atoms for Peace, Churchill thus unilaterally embedded Britain as a stakeholder in a new atomic order which its ministers and technicians had not had time to consider fully.

Secondly, this chapter has demonstrated how several aspects of Atoms for Peace directly contradicted British civil atomic interests, causing conflict both within the AEA, as well as between the Foreign Office and Downing Street. Although sanctioned by Churchill, there were serious concerns that participation in a supposedly 'international' arrangement would leave Britain once more playing by American nuclear rules after spending eight years and £100 m to avoid precisely such a fate. The question of resources was also paramount: IAEA membership would divert men and uranium from domestic research, and British elites would also need to assume senior positions if the organisation was not to become dominated by American scientists. Finally, renewed American interest in exporting power and research reactors threatened Britain's potentially lucrative commercial interests. With Britain simultaneously facing additional drains on its resources and considerable competition across the entire reactor spectrum, Atoms for Peace thus underlined a new competitive dynamic in the Atlantic relationship.

Against the backdrop of these changes, it was clear that the growth in informal European cooperation (described in Chap. 2) and the burgeoning nuclear competence of continental states now meant that Britain would increasingly be able to profit by international cooperation, a fact proven by Cockcroft's conception of an aggregated continental research effort comparable to that of Harwell. Determined to passively encourage European atomic collaboration, however, the AEA found its agency restricted by Britain's limited capacity: although it was asserted that Britain *should* supply uranium and other materials, officials would not commission additional plant to increase production rates purely to meet export demands, while nuclear information would only be distributed on a *quid pro quo* basis to ensure that every exchange reaped tangible rewards. In summary, then, Atoms for Peace marked a vital turning point in Britain's atomic history. Restricted by its limited resources from engaging with its neighbours more seriously in the nuclear field, Britain was also threatened with being commercially outgunned by a superior competitor. With Washington now fully embedded in the international atomic scene once more, it was clear that, for Britain and for Europe, the rules of nuclear engagement had fundamentally changed.

Notes

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CHAPTER 4

Finding a Buyer: Atomic Exports, 1953–1957

By 1953, Britain had successfully established an expensive but independent atomic research nucleus. A string of impressive military achievements had been made, and the first successful test of a British fission bomb in Australia in 1952 prompted Aldermaston's weaponeers to set their sights on a far greater objective: a hydrogen weapon. In civil applications too, Britain had established itself as a world leader, with Harwell constructing several experimental reactors including the GLEEP and BEPO graphite-moderated research installations and the ZEPHYR fast reactor. Furthermore, a design for a PIPPA-type reactor had been produced, enabling the AEA's Industrial Group, supported by British turbine and civil engineering firms, to commence construction of the world's first full-scale nuclear power station at Calder Hall in summer 1953. Away from hardware, Whitehall's 'soft' nuclear power was also expanding rapidly, as the AERE's training facilities entrenched Harwell as an educational hub of considerable global renown. With foreign scientists flocking to Britain's nuclear training schools, and with domestic industries noting with growing interest the potential for cheap atomic energy, the UK had thus battled its way to becoming the centre of the civil nuclear world.

The confluent demand for weapons and economical electricity had provided Britain's technicians with a wealth of practical experience in research techniques and engineering not yet attempted by many other industrialised nations. Such prowess, and with it the demonstration that civil atomic energy could be harnessed effectively (at least experimentally),

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naturally garnered much interest abroad, a factor only intensified by the liberalisation of global atomic exchange signified by 'Atoms for Peace'. Acknowledging this changing landscape, Britain's atomic policymakers were consequently obliged to reconsider which partnerships would best benefit the next stage of Britain's atomic development. Despite the continuing pleas for deeper cooperation that stretched back to the earliest days of Britain's nuclear programme, and their generous offers of uranium ore and remote bomb testing ranges, the nations of the Commonwealth could not provide the energy-hungry metropoles which could legitimate the construction of civil atomic plants in their domains. Instead, the initially uneconomical nature of electricity generated by nuclear methods ensured that markets would first develop only in the densely populated cities of Western Europe and Japan, where reconstruction was creating energy shortages similar to those experienced in the UK.

In order to maximise Britain's atomic influence overseas, ministers in London would need to offer attractive technical and material assistance to European states wishing to investigate native nuclear projects. Yet against the obvious prestige and financial benefits of exporting nuclear systems, Britain needed also to weigh its own demand for installed generating capacity. Domestic firms lacked the resources to both support exhausting construction projects at home while simultaneously exporting their wares abroad, in turn dogging their efforts to intervene in foreign nuclear activities and to thereby lock clients in to native technology at an early stage. With their hand thus restricted, the British were consequently forced at both government and scientific level to consider how to maximise their competitive position, and to ponder their attitude to international partnerships during a period when Britain's global identity was arguably at its most malleable in decades.

Tackling these issues directly, this chapter will not only elaborate Britain's difficulties in achieving commercial penetration for its atomic wares overseas, but also highlight the reasons propelling Britain's nuclear reorientation from its traditional scientific networks in the Commonwealth towards Europe's industrialised markets.[1] In turn, it will consider Britain's response to the paradox wherein the states most interested in civil atomic energy were also those industrialised nations most able to use nuclear assistance as a springboard to rapidly narrow London's technological lead, and will reflect on the concerns raised by British electrical firms about exporting to traditional competitors. Importantly, it will also show how technical problems with research reactors damaged British attempts to compensate for its limited capacity by fashioning a tailored model of cooperation in which it would utilise bilateral treaties to carefully define its commitments to partner states. In this way, this chapter will demonstrate how London's independent atomic programme, despite the effort invested in making it the global civil atomic pioneer, nonetheless presented a disappointing offer to customers at the same time as American politicians were awakening to atomic energy's considerable potential as a diplomatic tool.

The Decline of the Commonwealth Option

Beyond the overriding imperative of improving relations with Washington, Britain's prevailing post-war atomic foreign policy interest had been to maintain contact with the Commonwealth. The reasons for this were obvious: in addition to the traditional ties which bound the Dominions to their scientific fulcrum, Commonwealth scientists had provided vital manpower to the Allied wartime atomic projects at Chalk River, Los Alamos and elsewhere. As a consequence, the Dominions had gained privileged access to Allied technical information under the 1947 *modus vivendi* (detailed in Chap. 2) and retained considerable influence with the Combined Development Agency by virtue of their large native deposits of uranium. However, as Britain's atomic energy programme matured, the focus of its engagement abroad began to turn away from the procurement of raw materials and manpower, and towards the identification of industrialised markets such as would purchase British hardware. After 1953, then, Europe slowly began to replace the Commonwealth as the sphere which officials in London considered most appropriate for Britain's commercial ventures.

Since 1945, Commonwealth states had pressed London for deeper atomic collaboration and had endured repeated deferrals from ministers fearful of American opprobrium. Instead, officials had sought to incorporate the Commonwealth's resources into Britain's domestic nuclear programme, and the 1946 London Prime Minister's Conference had accordingly established the principle that the peripheral Dominions would dispatch men to Harwell while surveying their domestic uranium resources.[2] This prioritisation of London's independent project was further underlined by Britain's withdrawal in September 1946 from the wartime Anglo-Canadian joint nuclear venture at Chalk River, while subsequent requests for Anglo-Dominion collaboration were rejected by

Attlee on the grounds that such activity might violate the declassification regime agreed with Washington under the *modus vivendi*. Such prevarication frustrated Dominion and British officials alike, with Tizard complaining that 'it is a shame that we cannot discuss these matters with our sister countries in the Commonwealth without first asking the leave of a foreign nation'.[3]

Nevertheless, in order to trigger the information exchange promised by the *modus vivendi*, London's negotiators had been forced to allow Washington unfettered access to the Allies' communal uranium stockpile under the auspices of the CDA, encouraging British diplomats to consider using their nation's newfound atomic prestige to negotiate *independent* uranium agreements overseas. This would require London and/or its partners to identify and develop new mining sites outside of existing Agency territories, and to contract local companies to supply uranium to the home nation directly. Britain's initial overtures in this regard were unsuccessful, however, and in 1948 the potential importance of South Africa to London evaporated when the anti-British government headed by Daniel Malan ended the costly uranium prospecting commissioned by predecessor Jan Smuts.[4] Henceforth, Pretoria would supply uranium through the CDA only, albeit at the low price consistent with the industry's nature as an offshoot of gold mining.[5] In Canada the situation was similarly unfruitful, and British diplomats were unable to secure economical supplies of non-CDA uranium from the Eldorado mine in the Northwest Territories.[6] Thus, the only option remaining within what Wayne Reynolds has described as a 'tilt to the empire' lay in Australia.[7] Yet here too, there was much work to be done: Prime Minister Robert Menzies' request for assistance in building an Australian reactor had been rebuffed in 1951 because Attlee had feared potential American disapproval, while existing uranium agreements guaranteed production from Australia's Rum Jungle and Radium Hill mines to the CDA *for defence purposes* until 1960 and 1963 respectively.[8] Therefore, as in the South African case, existing Anglo-American agreements prevented Britain from obtaining an independent fuel stream, dampening its bid for true nuclear independence.

Stymied by the ever-present threat of American anger, the prospect of Anglo-Commonwealth nuclear cooperation did not really begin to improve until autumn 1951. By this point Attlee's atomic policy, like his government in general, was foundering. Whitehall's continued rebuttal of the Dominions became increasingly indefensible in the face of its inability to restore collaboration with Washington, where Britain's reputation lay tattered by the recent Klaus Fuchs and Cambridge spy scandals. The return of the Conservative Government in October consequently offered a crucial change in political dynamic as the departing Labour regime, preoccupied with domestic social policy and the construction of a welfare state, was replaced with a Conservative Cabinet steered by a prominent international personality focused fully on diplomacy. The switch thus signified not only an ideological shift but also an opportunity for fresh initiatives unconstrained by existing policies, an opportunity quickly appreciated by Lord Cherwell who stressed that Britain's mollification of Washington was producing nothing while precluding Britain from deepening relations with those Dominions which were rapidly becoming the world's leading uranium producers. By exchanging technical information, which he now believed to be 'derived from our own researches', for the raw materials necessary to fuel a domestic industrial nuclear programme, Cherwell proposed to revitalise atomic relations with Australia in particular. In this way, the Paymaster-General hoped not only to secure a firm grounding for civil atomic plants but also to turn Anglo-American relations about, allowing London to take a 'rather stiffer line' with its erstwhile partner.[9]

The opportunity to procure additional oxide for industrial purposes from non-CDA sources was attractive to the British government, and so in April 1953 the Cabinet decided to offer 'close technical co-operation' to Canberra to incentivise an independent agreement.[10] Churchill, encouraged by his Chancellor Rab Butler, blamed American intransigence for Britain's historically lacklustre efforts in forging cooperation with the Dominions and stressed to the Australians, in a telegram drafted by Cherwell, that London had now lost hope of 'really useful collaboration' with Washington.[11] Framed as 'a future joint power programme', Churchill's proposal to collaborate with Canberra consequently underlined his belief that Britain's atomic project was now sufficiently mature to legitimate a binary division of information into that of 'United States origin' and researches which Whitehall contended had been independently won, allowing the distribution of *British* atomic knowledge to the Dominions without concern for Washington's position.[12] Hopeful that this distinction would be enough to underpin a new deal, Cherwell flew to Australia at Menzies' suggestion in October 1953 with the intention of exchanging information for uranium rights.[13]

Arriving in Canberra, Cherwell was greeted enthusiastically by the Prime Minister, although the zeal of Australia's ministers remained tempered by the prospect of upcoming federal elections. Nevertheless, the

Australian Atomic Energy Commission (AAEC) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) had both already blessed Cherwell's proposal in advance of his arrival, with AAEC Deputy Chairman J.P. Baxter and CSIRO Chief Executive Frederick White reporting in September that cooperation would rapidly terminate Australia's technological inferiority to the three atomic allies. Baxter and White consequently advocated an 'overall Commonwealth programme' with Australia participating as an equal partner, sending manpower to the UK and receiving industrial technical information in return. The report also envisaged a power plant staffed by Australians trained at British facilities, and sketched a network of laboratories and university departments to be sub-contracted to the project.[14]

On the British side, Cherwell's aims were clear: he requested the Australians to prospect uranium outside the existing CDA territory at Rum Jungle and offered technical knowledge worth £150 m in trade. Detailing his plan further, Cherwell proposed the establishment of a joint mining corporation, funded two-thirds by London and one-third by the Australians. The contract would last ten years, sufficient for the capital investment to be redeemed by profits, after which Australia would own the mines and Britain an option to purchase up to two-thirds of output.[15] As such, the plan would allow Britain to comb the tangles out of its wartime agreements and produce new, independent streams of fuel and information; in addition to demarcating the nuclear information held by the UK into 'US' and 'British' categories, London would also delineate an ore stream from the Commonwealth outside existing CDA arrangements.

Yet despite the apparent symbiotic benefit of Cherwell's proposal, his negotiations soon stumbled. Intending originally to swap British expertise for large options on local uranium, Cherwell succeeded only in guaranteeing Britain's 'preferred customer status'. The bargaining-chip of technical know-how was also downplayed by Menzies' Cabinet, and Cherwell reported indignantly that the local public and media had 'grossly inflated ideas about the value of their uranium deposits'.[16] Much of this 'violent press campaign', as Cherwell termed it, was stoked by Harry Messel, a physics professor at Sydney University, who kindled nationalistic sentiments over uranium resources within the public and media. Whilst acknowledging that Australian defence depended on supplying *some* uranium to Washington and London, Messel implored Canberra to ensure that future generations would not be 'left with just holes in the ground—

where Rum Jungle and Radium Hill once stood—and nothing to show for it'.[17] Instead, in opinions reported widely in national newspapers, Messel entreated Australia's private firms to sponsor uranium mining and thereby build a 'Fort Knox which will completely dwarf anything the Americans ever thought of'.[18] These views were supported by several Australian ministers, who downplayed Britain's technological premiership and contended that, because Australia did not yet require civil atomic energy, it could acquire the 'know-how' from Britain or 'somewhere' in due course.[19] After the breakdown of cooperation with Canada and the failure to obtain ore from South Africa, the final opportunity for full Anglo-Dominion collaboration was therefore lost.

This setback quickly prompted a strategic retreat in Britain's atomic foreign policy. When asked in Parliament that November if he would henceforth treat atomic energy as a Commonwealth rather than a purely domestic issue, Churchill equivocated, while in Cabinet the Lord President, the Marquess of Salisbury, shrugged that 'it's their fault, not ours' and lamented Canberra's apparent naivety in trusting to the generosity of its domestic private capital.[20] Yet as condescending as these dismissals were, they could not mask Whitehall's surprise at being ungraciously received by a nation it had expected to be thankful for scientific assistance. Moreover, the chastening confrontation with burgeoning Australian nationalism, alongside its ongoing financial commitments, meant that Britain was forced the following spring to renew the wartime contracts it had signed with Congolese mines, returning London to the American-dominated market it had sought to escape.[21]

Left to absorb the lessons of Cherwell's failure, British officials now appreciated uranium's political weight, and with it the importance of Dominion purchases. At the Treasury, Butler in particular understood the symbolic value of token uranium acquisitions from Canada and Australia, contending that Britain should not commit so heavily to CDA supplies that it 'no longer had the need or the resources to buy from the Commonwealth'.[22] Nevertheless, these proposals fell far short of what had often been envisaged by officials on both sides, and when an agreement was finally secured in 1956 for Australia to supply Britain with uranium, it was as part of a bilateral exchange for a British research reactor, rather than as a symbiotic project.[23] The promise of the Commonwealth had not been fully realised.

The growing drift between Britain and its erstwhile colonies was also visible in the realm of nuclear exports. Despite the tough attitude of antipodean negotiators, Cherwell had reasoned that 'it would still on balance be worthwhile to make an offer of full technical assistance' to Australia, demonstrating the degree to which Britain now depended on its Dominions for a secure energy future.[24] In London, ministers digested the disappointing response and Lord Salisbury accordingly rebriefed Cabinet in early January 1954 on British atomic policy towards Australia and South Africa.[25] Supporting Cherwell's zeal for maintaining the offer of technical assistance, Salisbury highlighted the advantages of tying Australian technology to British models, including the likelihood of future uranium and plutonium sales to the UK. Additionally, Salisbury wished to pre-empt any American overtures to uranium-producing states that might arise from Eisenhower's 'Atoms for Peace' initiative, and encouraged his colleagues to incorporate Australia into Britain's atomic sphere with all haste.[26] Such proposals employed sensible industrial logic; as Henry Nau has stressed, cooperation would render clients dependent on British designs and information, creating a permanent monopoly.[27] Indeed, the Commonwealth was already a valuable market for standard electrical plant: in 1954, Britain exported 67% of its equipment there, compared with just 17.4% to Europe.[28]

Yet such notions conformed poorly to economic reality, because the purpose of a Commonwealth programme had been primarily to supply fuel, with secondary consideration given to transferring reactor technology back to the Dominions. As Menzies' ministers had already identified, although blessed with uranium deposits, the sparsely-populated vast lands possessed few highly-urbanised areas that would require atomic energy. Such limitations had been known to British scientists for some time, and as early as 1946 Alexander King, head of London's Scientific Mission in Washington, had reported that, 'Canada of all countries has perhaps the least need of atomic energy for industrial purposes because of the enormous hydro-electric potential of the Dominion. She has, therefore, no great interest in production piles but wishes merely to […] improve her knowledge of basic techniques and applications'.[29] Alexander's views were shared by British industrialists who, in discussion with Authority officials in late 1955, quickly asserted that prestige was leading the Commonwealth to prematurely pursue installed atomic capacity. In the words of Claude Gibb of turbine firm Parsons & Co., therefore, 'the desire to build reactors in such countries as Australia and South Africa was very often more on the part of the physicists than of the engineers responsible for electricity supplies'.[30] During talks the following month the industrialists thus delivered their unpromising prognosis for the Dominions, contending that natural uranium reactors would be economical only in Sydney and Calcutta.[31]

Reacting to this information, Plowden established a Working Party under his subordinate William Strath to consult further with domestic industry on Britain's potential export markets. In turn, this party established two clear principles, namely that the only states with an economic case for atomic energy were those experiencing fuel shortages like those in the UK, and that exports to smaller nations were practically prohibited by the fact that the PIPPA model required comparatively large 50 MW sets to compete with conventional plant.[32] Consequently, the recommendations made by the committee in its March 1956 report were concrete: although the Commonwealth would eventually show promise for a few reactor sales, the most rapidly developing export market would undeniably lie in Western Europe.[33] In time, the AEA would also acknowledge other energy-hungry nations like Japan, where, as the Authority's third annual report contended, 'the problem of maintaining a sufficiently rapid expansion of power supplies is like that of the UK'.[34] By contrast, the case for civil atomic energy was not strong in either the Dominions or the wider Empire, and in 1956 the Colonial Office issued a blanket memorandum discouraging all colonies from investing their meagre resources into independent research and development, encouraging them instead to utilise the training schools at Harwell to gain experience of the medical and agricultural radioisotopes likely to be of most immediate value.[35] The size and space of the Commonwealth, so useful for siting experimental reactors and testing atomic weapons, was ironically therefore its greatest downfall in terms of building an entire transnational nuclear industry.

In summary, the period after 1953 was marked by a pronounced decline in the relative importance of the Commonwealth to Britain's atomic project, not only in the context of a full joint project, but also because of the inability of the Dominions to provide the industrial markets required to further Britain's atomic development. To an extent, this was an inevitable consequence of political will conforming poorly with economic reality, because the abortive attempts to form a Commonwealth programme were designed to reinvigorate the British hand *vis-à-vis* Washington rather than to underpin large-scale development in Australia or elsewhere. In seeking fuel for a technological advance that only it required, the metropole had therefore paid insufficient heed to the limitations of the periphery and it soon became clear that if Britain was to build a significant export business it would need to reorientate away from the Empire towards its energy-starved neighbours.

Finding Mechanisms for Exchange

Having identified Europe as the region best primed for exports of British atomic goods, officials in London were now obliged to identify how such exchanges would proceed. In order to maximise the commercial benefit of nuclear exports while also guaranteeing national security, Britain's atomic policy makers therefore placed their faith in the flexibility of bilateral treaties which would allow Britain to specifically tailor its obligations to, and expectations from, each client, thereby protecting it from the open-ended commitments threatened by multilateral (and particularly supranational) organisations. In this regard, Whitehall officials and AEA scientists alike keenly advocated a uniquely British interactional model based on careful and nuanced planning, as distinct from the more general offers of nuclear assistance slowly emanating from Washington. The construction and pursuit of this model were to prove vital for the rest of the period covered by this book.

As the Australian debacle had demonstrated, there was significant scope for Britain to influence foreign nuclear activities by tying partners into its technology at an early stage. Atomic exports had long been appreciated by Whitehall for this very reason, but as Britain's nuclear programme progressed from experimental possibility to industrial reality such notions began to receive sharper definition. Lord Salisbury in particular was quick to laud both the economic and prestige benefits of healthy exports, highlighting the 'commercial advantage of putting our engineering consultants and industry in the position to sell abroad power reactors and the associated plant, equipment, materials and technology', in addition to which there would 'clearly be a political advantage in being first in the field, which should enhance our influence in both foreign and Commonwealth countries'.[36] Exports were also a popular topic with the AEA, which noted that sales could encourage a partner state 'into adopting a form of development which will be of benefit to itself and which will also, through the exchange of information, be of benefit to the Authority'.[37] Furthermore, export contracts would enable British industry to gain experience with both full-scale plant construction and small equipment, and so, Authority officials concluded, 'while exports are not likely to be of major importance in the immediate future, UK industry is being given every possible assistance to prepare itself to take part in what may well become an export trade vital to this country'.[38] By around early 1955, therefore, ministers and AEA officials alike were aware of the commercial, technical and political attractions of atomic sales and were tentatively planning to use the immature technology to increase Britain's influence abroad.

With the importance of exports thus established, London was challenged to decide what hardware it could offer to potential buyers. By mid-1953, Britain's atomic energy research was sufficiently advanced to require a power-producing reactor for experimental purposes, while the military too requested more weapons-grade plutonium for their defence programme. American-style reactors, which used enriched fuel and pressurised or boiling water as a moderator, were uneconomical in Britain because they derived their competitiveness from the fractional cost of American uranium and of the vast quantities of electricity required to run the diffusion plants necessary to separate the element's isotopes.[39] Water-cooled installations were also undesirable in the United Kingdom, because there was insufficient space to contain leaks in the event of an accident.[40] Clearly, Britain's lack of remote sites was a disadvantage, and one which a joint undertaking with Canada or Australia could have remedied. Instead, the British were forced to contain their reactor designs within their own geographical reality.

Ultimately, Churchill's government decided in the interests of haste to construct a PIPPA reactor using natural uranium fuel, graphite moderators and carbon dioxide coolant. Construction of the first plant of this type, nicknamed 'Magnox' for its magnesium oxide fuel cladding, began at Calder Hall in July 1953, using a design intended to promote research on future reactor types rather than to provide a prototype for large-scale construction. The choice was not universally appreciated, with some American critics regarding the design as 'a rather plebeian Model T, soon to be relegated to an atomic historical museum'.[41] Up at Risley, however, Christopher Hinton was more favourable, contending that Britain's unspectacular design could nonetheless provide a benchmark for many years. Honouring his roots with the Great Western

Railway, Hinton contended that 'what we are doing today will look as clumsy and costly in a hundred years' time as Watt's early steam engines look to us, but we may well be opening the door to similarly important advances'.[42] In any case, it was clear that development priorities would ensure that the PIPPA was the only power reactor that industry could export for the next decade, essentially committing Britain to a generation of plants with competent but basic designs and a limited window in which to prove competitive.[43]

There was certainly no doubting the foreign interest in Britain's technology, and the AEA were underprepared for the upsurge of enquiries caused by Eisenhower's Atoms for Peace project. At the suggestion of his atomic chief Lewis Strauss, the President's plan had called for a scientific conference on atomic energy to take place after the Four-Power Conference held in Geneva during July 1955, and British firms were keen to demonstrate their newfound abilities at what was essentially the first international nuclear trades fair.[44] Such enthusiasm, however, was soon tempered by Authority officials who remained pragmatic about Britain's ability to export, and in his pre-conference briefing to Britain's delegation, Plowden warned against 'promising what we cannot perform' amid the wave of optimism which was bound to crest at the event. Drawing a direct comparison with the American programme, Plowden accepted that Britain's offerings would be inherently less impressive in terms of quantity and variety than those of its competitor, especially because Britain could not afford to offer half-price research reactors in the same manner as the Americans proposed. Furthermore, domestic plant construction would demand priority over resources, as would existing exchanges with Commonwealth and European states.[45] Nonetheless, Britain's performance at the International Conference on the Peaceful Uses of Atomic Energy, held from 8–20 August 1955 was commendable, and, as John Krige has highlighted, 'the British were the stars. No fewer than fifty companies from Britain (compared with sixteen from the United States) aggressively promoted nuclear technology. They reputedly received serious inquiries from thirty-three countries within days of the conference's opening'.[46] Indeed, British officials also arranged for delegates to undertake day trips to Harwell in order to meet researchers and inspect new engineering equipment.[47]

Yet these demonstrations of British prowess inevitably stimulated requests for more substantial assistance and the Authority, as Plowden had warned, soon encountered a conflict between the expectations of foreign states and the limitations of what Britain could actually deliver. Procedures for handling such requests had not yet been deliberated, and at a meeting of the Atomic Energy Executive in August 1955, Cockcroft noted that industrial firms had begun to criticise the Authority for lacking clear guidelines on fuel and reactor exports.[48] In response, Whitehall quickly opted to back the traditional system of bilateral treaties familiar to diplomats, hoping, as Salisbury contended, 'that such a policy, rather than general offers of particular types of assistance to all countries, will in the long run be of greater benefit both to the recipient countries and to our own future exports of atomic 'know-how', materials and plant'.[49] In making his oblique reference to Eisenhower's 'Section 123' agreements, the standardised offers of nuclear aid made to all free nations under the umbrella of Atoms for Peace, Salisbury joined the chorus of officials who identified an advantage for Britain in a more nuanced approach. Indeed, officials at the AEA's Collaboration Branch considered that providing 'tailored' assistance would derive greater benefits than would a series of 'general and sweeping promises', confirming that Britain's best strategy lay in cherry-picking a few lucrative contracts with larger partners.[50] Furthermore, intergovernmental treaties retained the important advantage of maintaining control over the foreign activities of industrial firms, which were forbidden from transmitting nuclear fuel or plant abroad without permission.[51] In any case, these preferences were made abundantly clear both to existing and potential partners: during a meeting with Friston How in 1957, Bonn's Atomic Minister, Siegfried Balke, was told that Britain's predilection for bilaterals stemmed from the fact that 'these agreements could be fitted as appropriate to the particular state of technical development in the partner state'.[52] In contrast to the 'standard' packages offered by the American 'Section 123' agreements (detailed in Chap. 3) therefore, the British aimed to provide a 'Savile Row' approach as a superior alternative to the cheaper, mass-produced reactors of their rivals.

Between 1955 and 1960, Britain concluded treaties with nine West European states for cooperation in civil atomic energy. The undertakings were enormously popular, with Bonn in particular wasting no time in signing up: at a meeting between Chancellor Konrad Adenauer and Cockcroft in October 1955, Adenauer raised the possibility of an agreement on peaceful atomic energy, but both parties were stymied by the absence of either a German atomic authority or an atomic law. A Bundesministerium für Atomfragen (Federal Ministry for Atomic Questions) was duly established that same month, and in December Bonn's new Atomic Minister, Franz-Josef Strauß, visited Salisbury, Plowden and Cockcroft to reaffirm his government's case. By May, the Germans were able to open discussions, and a treaty was signed in July 1956. Indisputably, then, such haste only underlined how magnetic British atomic assistance had become during this crucial period.[53]

In most cases, Britain's atomic agreements were constructed either as a bilateral treaty or as an 'exchange of notes' to formalise politically the technical agreements made between national atomic agencies. Although mutually distinctive, these agreements unavoidably contained similarities which are worth noting in detail. Generally, the British agreed:

1. To supply research reactors.
2. To supply fuel elements for research reactors.
3. To process the spent fuel in UK facilities.
4. To advise on the design, construction and operation of research reactors.
5. To supply research quantities of materials required for atomic energy R&D abroad.
6. To provide training to foreign scientists at AEA facilities.[54]

In essence, London offered primarily to export the research installations that were within its capacity to supply. In turn, this would propagate the nuclear competence of the foreign client, enabling Britain hopefully to exploit these primed markets at a point in the future when its own domestic construction drive had cooled down. Once again, Harwell's educational facilities were offered as an incentive, while Britain guaranteed security by both supplying and reprocessing the fuel used in foreign reactors. Before such a time as the IAEA could establish viable international atomic controls, the AEA would insist on periodic inspections of foreign facilities and on receiving operating reports concerning burn-up rates to ensure that fuels supplied for research purposes were not abused to produce plutonium. Accordingly, Britain's prerogative to supply and reprocess nuclear fuel marked the only clause consistent across all the bilateral treaties it signed during this period.

In any case, agreements supporting research programmes were signed with West Germany and Scandinavian nations, while more substantial power reactor contracts were signed with Italy, Japan and Spain. These latter agreements obliged British authorities to assist their partners, *on commercial terms,* in designing, constructing and operating facilities to manufacture and process nuclear fuels locally. As Table 4.1 demonstrates, in practice few agreements were identical, with each partner appending clauses addressing its own needs, like the 1957 treaty which allowed Euratom to assume the obligations of its member state, Italy. A final noteworthy point is the presence of Japan, which was the only industrialised state outside North America and Europe with which Britain had significant atomic dealings during this period. Driven by heavy industrialisation, Japan's economy underwent significant growth during the mid-1950s, and Britain's interaction with Tokyo therefore reveals the important fact that British atomic policy was not immediately designed to engage European neighbours specifically (for political gain or otherwise), but rather to attract any nation that could stand to benefit by atomic power.

In summary, by late 1954 it was clear that British nuclear exports would provide a valuable vector for maintaining influence over, and profiting from, foreign atomic activities. In turn, the growing interest in British atomic goods visible on the continent stimulated Whitehall to help British industry compete with its American rivals by defining engagement within intergovernmental bilateral treaties. Consequently, although predicated initially on strengthening the atomic competencies of clients through the provision of research reactors, by 1956, Britain's atomic prowess had garnered more significant interest. Now, the world waited to see what London could deliver, given the nation's other development priorities.

The Difficulties of Exporting: Domestic Capacity Shortages and Technical Problems

As stated earlier in this book, existing scholarship has primarily attributed Britain's poor nuclear export performance to the limited development potential of its Magnox reactors. C.M. Buckley and R. Day, for instance have noted how, in contrast with the American model of engaging private industry at the prototype phase, the AEA's monopoly over reactor designs left Britain committed to just one reactor type, while Robert Boardman

Table 4.1 UK nuclear bilateral treaties, 1955–1960[a]

		UK supplies fuel	*UK reprocesses fuel*	*Exchange of unclassified information*	*IAEA/ENEA clause*	*Inspections/operating reports*	*Supply training facilities*	*Supply UK power reactors*	*Supply UK research reactors*	*Supply technical information on power reactors*	*Supply technical information on research reactors*	*Partner personnel to work in UK*	*Assistance in building domestic reactors*	*Information on facilities to produce/process fuel*	*Duration*
November 1955	Belgium	X	X	X						X		X	X		10 Years
July 1956	W. Germany	X	X	X	X	X	X		X		X				10 Years
July 1957	Norway	X	X		X	X									10 Years
September 1957	Sweden	X	X	X	X	X	X		X						10 Years
December 1957	Italy	X	X	X	X	X	X	X	X					X	10 Years
June 1958	Japan	X	X	X	X	X	X	X	X					X	10 Years
July 1958	Portugal	X	X	X	X	X	X		X						10 Years
January 1960	Spain	X	X	X	X	X	X	X	X					X	10 Years
May 1960	Denmark	X	X		X	X			X						10 Years

[a]Agreement between the Government of the United Kingdom and the Government of the Kingdom of Belgium for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1955, XLIV.81), Cmd. 9632; Agreement between the Government of the United Kingdom and the Federal Republic of Germany for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1956, XLIV.535), Cmd. 9842; Exchange of Notes between the Government of the United Kingdom and the Government of the Kingdom of Norway Regarding Co-operation in the Promotion and Development of the Peaceful Uses of Atomic Energy (Parl. Papers, 1957, XXXIII.455), Cmnd. 277; Agreement between the Government of the United Kingdom and the Government of Sweden for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1957, XXX.611), Cmnd. 290; Agreement between the Government of the United Kingdom and the Government of the Italian Republic for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1958, XXX.245), Cmnd. 458; Agreement between the Government of the United Kingdom and the Government of Japan for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1959, XXXIV.95), Cmnd. 625; Agreement between the Government of the United Kingdom and the Government of Portugal for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1958, XXX.469), Cmnd. 513; Agreement between the Government of the United Kingdom and the Government of Spain for Co-operation in the Peaceful Uses of Atomic Energy (Parl. Papers, 1961, XXXIV.879), Cmnd. 1427; Exchange of Notes between the Government of the United Kingdom and the Government of the Kingdom of Denmark Regarding Co-operation in the Promotion and Development of the Peaceful Uses of Atomic Energy (Parl. Papers, 1960, XXXVI.235), Cmnd. 1127

and Malcolm Grieve have highlighted how domestic models were often unsuitable for use in foreign markets.[55] Importantly, however, there is more to be said: Britain's overstretched atomic resources were torn between the need to install domestic generating capacity (thereby reducing coal imports), and the prestige and commercial benefits of exporting reactors. Furthermore, British research reactors encountered problems with operating at the lower fuel enrichment levels now demanded by international protocol, hampering Britain's ability to prosecute the bilateral cooperation detailed previously. Finally, the concerns expressed by industrial firms about exporting to technologically-advanced neighbours offer valuable new insights into the attitude of Britain's atomic industries towards European cooperation. As a result, this section will expand scholarship by contending that Britain's export effort was almost immediately hampered by a broader array of capacity, political and technical problems than has hitherto been allowed.

The most important issue in this connection was the growing demand for installed atomic generating capacity in the UK. By late 1954, construction at Calder Hall was half-complete and Salisbury accordingly felt encouraged to redefine Britain's developmental priorities, circulating to his colleagues a memorandum from the Ministerial Committee on Atomic Energy and the AEA highlighting the need for an industrial atomic programme. Striving for efficiency, Salisbury's key recommendation was to divide research and engineering activities between the AEA and domestic industrial firms in order to allow research to continue unimpeded by plant construction.[56] Britain's atomic capacity was already stretched, he argued, making it imperative to divide the workload to keep current designs competitive while also maintaining research into future systems. Catalysed by Salisbury's request, a White Paper outlining Britain's first atomic energy programme was presented to Cabinet in February 1955. Unavoidably, the proposed programme relied extensively on guesswork, and the report's authors admitted freely that 'technical developments in nuclear energy are taking place so fast that no firm long-term programme can yet be drawn up'. Instead, all it could offer was 'some indication […] of the probable lines of development so that the necessary preparations can be made in good time'.[57] Nonetheless, the report called for a significant investment to be made into British atomic plants, recommending the installation of 2000 MW (saving the equivalent of 5 m–6 m tons of coal annually) of generating capacity over the next decade, with the expectation of healthy demand for further construction thereafter.[58]

In a bid to alleviate the strain caused by the new programme, the White Paper proposed a new mechanism in which industrial firms, none of whom were sufficiently large to act independently, would form consortia to construct atomic stations for the three nationalised Electricity Authorities, who would in turn receive operating advice from the AEA.[59] To diffuse the necessary knowledge into the private domain, the Authority would train industrial engineers at its establishments and spread new techniques through its domestic contracts, in turn freeing its own staff to concentrate on developing new reactor types.[60] Nonetheless, despite these concessions to the limited capacity of industry, nuclear energy was not (yet) conceived of as a panacea, and the White Paper contended that atomic plants would be expected to meet only 25% of the voracious demand for *additional* new generating capacity. Instead, nuclear facilities would merely augment conventional stations, freeing coal for alternative uses.[61] The significance of the 1955 White Paper under such circumstances, then, lay in the commitment made by government to a new energy source with little more than blurry economic projections on which to base their choice. As a result, the decision to pursue a substantial atomic energy programme *before the first plant was even operational* represented a significant obligation of funds, manpower and material, and the prioritisation of a domestic power programme over an immediate export drive.

This commitment to atomic energy was soon galvanised by the alarm over fossil fuel supplies caused by the nationalisation of the Suez Canal by Egyptian President Gamal Abdel Nasser in July 1956.[62] Retaliating against this hostile act, the British commenced a bombing campaign (codenamed *Operation Musketeer)* and secured the canal zone, but these reprisals merely led Nasser to sink ships in the channel and to render it unusable for six months. The resultant blockade of such a major trade artery threatened to starve a recovering Europe of fuel, a serious concern considering that 58% of British oil imports travelled through the canal, while Anglo-French aggression also antagonised Washington, occurring as it did just as American statesmen were denouncing Soviet intervention in Hungary.[63] With his re-election campaign foremost in his mind, therefore, Eisenhower pointedly refused to meet with Prime Ministers Anthony Eden and Guy Mollet until they complied with the UN's request to retreat. The Americans applied further pressure by refusing Britain a loan from the International Monetary Fund to relieve the pressure on sterling, and facing overwhelming opposition and the exaggeration of Britain's financial peril from his Chancellor Harold Macmillan, a beleaguered Eden ultimately ordered a withdrawal.[64]

The humiliating climb-down provided a frank reminder that an over-reliance on oil imports carried serious geopolitical risks, and demonstrated moreover that Britain was unable to resist American interference in this regard.[65] With domestic coal production stagnant and with the first flush of domestic nuclear plant construction appearing to be a comparative success, the crisis therefore inspired Whitehall to re-evaluate Britain's energy options, culminating in the 1957 report of the Nuclear Power Working Party, in essence a new White Paper superseding its 1955 predecessor. Backed by the Minister of Power, Lord Mills, the new plan recommended that Britain triple its installed atomic plant capacity from ~2000 MW to 6000 MW by 1965, and advocated also a subsequent redoubling to 12,000 MW by 1970 in a bid to reduce coal and oil consumption.[66] Indeed, fuel security was a paramount concern: the 1953 Anglo-Iranian oil controversy and the Suez Crisis had both highlighted the uncertainty surrounding Middle Eastern supplies and by contrast, uranium-producing nations in the Commonwealth appeared to be paragons of stability. Directly referencing Suez, Mills therefore backed uranium implicitly, noting 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 present oil shortage'.[67] By pursuing a substantial nuclear programme, then, the report hoped not only to improve Britain's geopolitical position but also to reduce purchases of foreign coal and oil.[68] Thus, London's policy was decided: the greatest benefit that nuclear power could make to the national balance of payments would be from savings on imported fuels, not from exports of atomic equipment abroad.[69]

The limited attention paid by the 1955 White Paper to Britain's export potential had effectively postponed the issue, reiterating instead the Authority's commitment to international exchange along basic avenues such as Harwell's training schools and the supply of research reactors. Such undertakings were necessary to prepare export markets for future exploitation, but they also granted Britain time to standardise its machines and thus stabilise their costs. Once such improvements had been made, it was contended, 'we shall then be in a position to fulfill our traditional role as an exporter of skill'.[70] This non-committal attitude continued in the 1957 White Paper. Although the report noted the growing demand for atomic energy overseas, it also conceded that the best potential markets would be industrialised states which could supply all electrical equipment except the atomic reactors and the associated specialised components for themselves. However, the report remained ambiguous about timescale, noting that there would almost certainly be no exports before 1963 but that a boom was expected after 1965, at which point British industry could use the capacity freed from the slowdown in its domestic construction programme to build nuclear stations abroad.[71] In this way, the report optimistically considered that Britain could afford to wait *for eight years* before launching a serious attack on export markets.

It was a brave move: having identified the developing market for European nuclear facilities, Whitehall chose to postpone exports in favour of improving its domestic infrastructure and balance of payments situation. In turn, this scramble to construct plant meant, as R.F. Pocock has highlighted, that Britain would pursue ‘a relatively large programme based on a proven reactor system which could be manufactured with existing techniques and materials’ but which left little capacity free for research into future systems.[72] Indeed, as Christopher Hinton himself argued, technological progress ‘was retarded by the large, obligatory, nuclear power programme of 1957’ which committed the UK to a generation of mediocre plant, while designing bespoke reactors for export was left to those consortia already struggling to satisfy domestic demand.[73] By electing to install a substantial quantity of generating capacity so soon, Cabinet thus cashed in Britain’s nuclear advances at the earliest conceivable moment.[74] For a brief period beginning in late 1956, then, Britain alone held the key of proven installed systems but denied itself the chance to exploit this diplomatic opportunity in favour of an ambitious domestic project. As Pocock has stated, therefore, ‘there was to be no development of any reactor system for its export potential alone, the consortia were to be occupied virtually to the exclusion of all other activities on the construction of the Magnox stations, and the Industrial Group of the Atomic Energy Authority was to expend the greater part of its energies in the development of the Advanced Gas-Cooled reactor’.[75] Undeniably, then, the gluttony for domestic plant reduced both Britain’s ability to develop future systems and its ability to establish itself as the technological hegemon in markets ripe for nuclear power.

These political decisions to pursue Britain’s first nuclear programmes have excited much scholarly debate, and existing literature has generally adopted a negative outlook on Britain’s first atomic programmes. Roger Williams, for instance, has highlighted how the uncompetitive economics of Magnox stations forced the Central Electricity Generating Board to pass high electricity prices on to consumers, engraining it with a hostility towards nuclear power from which it never recovered.[76] Polemic accounts, such as those by Duncan Burn, have also criticised the 'illusion of British leadership' by contending that large outputs of uncompetitive nuclear electricity did not constitute true dominance.[77] Nor has time dulled scholarly antipathy: forty years after the 1955 White Paper, historian Richard Green labelled Magnox 'an expensive mistake' which should have been overlooked in favour of greater conventional plant construction.[78] Importantly, however, these exhaustive construction drives had a greater impact on Britain's overseas influence than merely compelling native industry to forsake foreign contracts in favour of domestic projects. Tied to the Magnox model as they now were, domestic industry was also beleaguered by the uncertainty of the four 'PIPPA firms' (the engineering companies who could export nuclear plants of the Calder Hall type) over how to approach new industrial markets. Cockcroft's earlier complaint that Britain lacked a concerted export policy had proved catalytic, stimulating the Atomic Energy Executive into the dual action of asking the Authority's Economic Adviser, J.A. Jukes, to prepare a report on export potential while also inviting industrial representatives to discuss the matter with Strath.[79] The views of private enterprise were subsequently summarised at a meeting in December 1955 by Claude Gibb of C.A. Parsons & Co., the firm supplying steam turbines to Calder Hall. Sketching Britain's nuclear export potential to Strath, Gibb disdained Europe's larger nations, believing France unattractive and 'notorious for granting export subsidies and not encouraging foreign competition'. West Germany too was considered guilty of subsidising exports, and was regarded unanimously by the PIPPA firms as a potentially dangerous competitor. Consequently, although Germany's growing economy would undoubtedly demand some foray into atomic energy in which foreign firms would be granted a token footing, Gibb contended that hunting these commercial crumbs would merely hasten the day when Germany could compete with the UK.[80] Importantly, however, such fears were *economically* rather than *politically* motivated, and states outside Europe were also treated suspiciously, notably during June 1956 when the PIPPA firms expressed their fear that Japan's reverse-engineering capabilities could soon transform a lucrative client into a dangerous competitor.[81] The concern for Britain's industrial lead consequently persuaded many industrialists to eschew obvious markets for fear of stimulating competition from foreign states with traditionally strong competences in the electrical industries.

Such disappointing reports from industry encouraged the AEA to reconsider its position, and Authority economists were tasked by Plowden in early 1956 with establishing a working party to evaluate Britain's export capabilities and strategy. Although the party shared elements of Gibb's Germanophobia, their report adopted a more optimistic line, contending that there was no reason why 'UK firms should not profit by Germany's need to buy her way into this new field'.[82] Looking ahead, it was also thought possible to attack the substantial market provided by those European states too small to enact independent atomic programmes, while the report further hoped that British exports would be boosted by the taste for free trade which was visibly developing on the continent.[83] With this being the case, the working group identified a comparatively brief window in which Britain could benefit from exports to Germany and France before those states became competent enough to design native reactors, and a subsequent gap before Europe's smaller nations would in turn be sufficiently developed to require civil atomic energy for themselves. Despite the hopeful outlook of the AEA's officials, however, the issue of using exports as political tools still raised a fundamental conflict between ministers in Whitehall, who were keen to promote sales, and the overburdened industrial firms that reserved the right to select their markets using cold commercial logic. This schism opened barely three months later in June during the discussions between the AEA and industry on how to engage with Japan, during which the PIPPA firms declared that, although they would export to contentious nations if the government requested it in the national interest, they would require financial insurance in case such undertakings failed.[84] In response, officials asserted that it was 'not the policy of H.M.G. to prescribe' markets to British firms, highlighting how Britain's commercial penetration overseas was blunted by the unwillingness of both the Authority and government to enforce exports without the consent of industrial firms.[85]

The essential problem for British planners was how to protect native firms from foreign competition as they executed export contracts. In this regard, Gibb had recommended the provision of 'turn-key' contracts which would grant the entire enterprise of fulfilling a purchase order to a single British contractor, who could then be expected to sub-contract aspects of the work to other native firms and thereby maximise the benefit of each project.[86] In contrast to the standard Central Electricity Authority practice of splitting undertakings between firms, it was therefore considered 'essential that the design and construction of nuclear power stations should be under unified control'.[87] According to industry, the ideal *theoretical* market for British atomic hardware would therefore be a heavily-industrialised nation with few native fossil fuel resources. This client would also, paradoxically, possess only weak electrical industries, rendering it dependent on Britain for *continuing* assistance. In this sense, a 'turn-key' model would enable UK firms to sell not only reactors, but much of the necessary additional equipment and support services too.

The need to maximise nuclear plant sales by involving auxiliary contractors was especially pertinent considering that Britain's electrical industry was a key export breadwinner, worth some $118.4 m in 1954, second in global terms only to the United States ($142.9 m).[88] However, the distribution of Britain's exports was instructive: in comparison with West Germany's fairly uniform global spread in its sales, London was heavily dependent on Commonwealth markets, with South Africa alone consuming exports ($25.8 m) totalling more than all Europe combined ($20.7 m).[89] In order to overcome competition in European markets, then, a clear export policy would have to be agreed by both state and industry, and in this regard the British were frustrated by considerable scepticism from industrial firms and the AEA alike regarding both Britain's capacity to sell plant and the desirability of doing so in Western Europe. Thus, as Robert Boardman and Malcolm Grieve have noted, 'though a flourishing export trade had developed in fuels, radioisotopes and certain kinds of equipment and related materials, the bigger prizes of turnkey contracts […] eluded Britain's grasp'.[90]

Britain's frustration in the field of full-scale power plants was also mirrored in the poor performance of its research reactors, although here the failure was technical rather than political. As Britain's bilateral treaties had identified, sales of research reactors were important for developing export markets: indeed, as Jukes contended, such activity, 'may not be large in absolute terms but it will be important in that it will build up connexions and open the way for bigger markets in later years'.[91] As a successor to GLEEP, Harwell had designed 'DIDO' a research reactor which went critical in November 1956. Built to test materials for advanced reactors, the new machine was cooled and moderated with heavy water, fuelled with enriched uranium and promised to reduce testing times by a factor of twenty-five.[92]

The model originally enjoyed a promising export profile and one DIDO was quickly sold to Australia, with construction beginning at Lucas Heights, outside Sydney, in October 1955. However, no sooner had another sale to Denmark been contracted than the process fell foul of agreements made with Washington in autumn 1955 to limit exported fuel to a maximum of 20% enrichment in U^{235}, the same percentage provided in American fuel supplied to client states under Atoms for Peace.[93] The Australian DIDO and a smaller set promised to India both pre-dated the understanding, but the issue nonetheless forced Strath to ask Jukes in March 1956 to evaluate the case for redesigning DIDO to operate using fuel within the agreed enrichment limits for export purposes.[94] A simple diplomatic negotiation was soon dismissed after consultation with Roger Makins revealed that any request to revise the 20% limit would cause 'grave difficulties' with the Americans, and so Authority designers hurried away to find a technical solution.[95] It was initially thought that a redesign of DIDO would be simple, but subsequent testing proved that fuel enriched to 50% was the bare minimum for satisfactory performance and that lower concentrations would necessitate a total redesign of the reactor. As a compromise, Jukes contemplated switching from metal to oxide fuel to compensate somewhat for the 20% restriction by allowing higher heat output, but it was soon determined that such alterations would almost certainly delay the rebuilding project by a year and would even then only produce output around 75% that of the original design, rendering the reworked machine still inferior to the earlier DIDO model.[96]

In addition to these technical failings with its larger research machines, the precise market for Britain's *small-scale* research machines was also uncertain. The most basic 'swimming-pool' reactors, such as those constructed by Britain's Associated Electrical Industries, generated comparatively meagre heat output and low neutron flux (100 kW and 10^{12} neutrons/cm^2/s), requiring long periods for irradiation experiments.[97] Consequently, it was envisaged that the inexpensive nature of these basic sets might attract developing countries such as India, which received AEA assistance in designing a research reactor in late 1955.[98] Among the big research reactors, however, DIDO had a higher heat output and neutron flux (10 MW and 10^{14} neutrons/cm^2/s) whilst the larger American Experimental Test Reactor produced greater still results (150 MW and 10^{15} neutrons/cm^2/s). High-flux reactors allowed experiments to be conducted more quickly, increasing capacity, but for this reason only France, Germany, Japan and possibly a Scandinavian combine would require such plant.[99] There was therefore no case for redesigning DIDO for export purposes using 20% enriched fuel, and although the British honoured their obligation to Denmark, they also opted not to inform Washington of their liberal reading of their bilateral understanding.[100] Assuredly, then, Britain's export potential in the research reactor field was severely limited by the lack of widespread need for its products and by the presence of serious American competition.[101]

In the rapidly developing field of research plant, then, the British were unable to quickly offer a definite product to excited potential customers, much less compete with subsidised American machinery. Perhaps the clearest demonstration of this failure lay in the number of sets exported: in 1956, an Authority Working Party had anticipated sales of eight DIDO-type reactors *abroad*, but ultimately only six *in total* were ever built, three in Britain (DIDO and PLUTO at Harwell, DMTR at Dounreay) and one each at Lucas Heights, Australia (1958), Risø, Denmark (1960) and Jülich, West Germany (1962).[102] In contrast, by summer 1956, Washington had already signed agreements to supply research reactors to twenty-six nations, as shown in Chap. 3.[103] Thus, DIDO foundered in the face of stiff competition, threatening to embarrass the Authority after its strong showing at the Geneva Conference. As an Authority official reminded Jukes, there was more than just financial profit at stake and Britain's prestige was threatened: 'the UK has indicated that she is in a position to export to several countries' he argued, 'to have to withdraw this statement and advise them to purchase American equipment would be most undesirable'.[104]

Existing writing on Britain's inability to secure nuclear exports highlights the uneconomical nature of its Magnox plants as the principal reason for its failure. In Duncan Burn's view, for example, the uncompetitive nature of early Magnox reactors left them 'unexportable', a notion expanded by C.M. Buckley and R. Day, who have argued that high capital costs left Britain with just two power reactor sales.[105] Indeed, even these successes have been scrutinised, with William Walker and Måns Lönnroth contending that these purchases merely represented an affectation by foreign governments to associate with new technology 'for prestige and demonstration purposes'.[106] Importantly, however, it has been shown in this chapter that these issues ran much deeper than has previously accepted, as Britain's export offering was almost immediately dealt *several* body-blows from which it struggled to recover. The ambitious domestic programme proposed in 1955 tested seriously the capacity of British industry and its 1957 successor, inspired by a knee-jerk reaction to the Suez Crisis, placed meaningful exports further out of reach. A poorly-defined export policy on the part of the Authority was also exacerbated by a paradox wherein the states most suitable for atomic development were also those already possessing substantial native electrical industries, leading to difficulty in securing lucrative turn-key contracts amid trepidation for continental competition among British industry. Finally, design issues severely downgraded Britain's premier research reactor type, weakening its attractiveness in comparison with half-price research reactors offered by Washington and preventing Britain from embedding itself effectively in the early nuclear development patterns of other industrialised states. Taken in sum, therefore, these shortcomings rendered Britain's export offering numerically, economically and technically inferior to that of its principal competitor.

Conclusion

This chapter has demonstrated how, despite becoming the world's first civil atomic power, Britain's influence abroad was reduced by its inability to make other states dependent on its hardware and methods. In so doing, it has revised the traditional criticisms repeated by Burn, Buckley and Day that the Magnox design alone was responsible for this failure, by demonstrating how Britain's export drive was in fact hampered by a far broader series of issues.[107] First among these was the fact that by 1953, Europe was replacing Britain's traditional Commonwealth dependants as the main focus for its nuclear exports. Enjoying little commonality in industrial geography or need for large atomic programmes, the Dominions could not legitimate nuclear capacity installation like that desired in continental Europe: as a result, by March 1956, the Under-Secretary of State for Commonwealth Relations was forced to concede that the 'wide dispersion of the Commonwealth' rendered the establishment of an atomic community like Euratom impossible in the group.[108]

Britain's atomic evolution therefore demanded both a fresh geographical perspective and new mechanisms to facilitate the exports which were now considered a key vector for its atomic influence. In response, Whitehall trusted to the bilateral arrangements which allowed it to tailor its assistance to potential clients, thereby maximising its limited spare capacity and protecting its nuclear lead while granting it an early foothold in markets which it optimistically decided would await later exploitation. Yet this strategy, in which research reactors would prepare foreign markets for future sales, stalled when technical problems with DIDO crippled Britain's premier model just as Washington was starting to deploy its gargantuan resources in support of its own atomic foreign policy. Thus, by alloying these findings with Rowland Pocock's existing assertion that power reactor exports were crippled by an exhausting domestic construction programme, it becomes clear that Britain's offering was in fact weaker than has previously been allowed, being unable to secure *either* future markets or immediate exports.[109]

Further important dynamics were exposed by the paradox of exporting cutting-edge technology to states with traditional strengths in electrical engineering. Desperate to protect their privileged position, British firms feared that exporting to France and Germany would merely slingshot Europe's industrial giants into the lead in nuclear technology, a concern extended also to Japan, whose reverse-engineering capabilities were legendary. Thus, although British industry retained a global perspective in seeking new markets, their timid defence of Britain's lead fundamentally weakened their commercial penetration. With Whitehall unwilling to subsidise or offer financial insurance against the failure of such transactions, much less force industry to engage unattractive markets, Britain consequently did not capitalise on the interest raised by its strong performance at Geneva.

In short, the nuclear optimism of 1955 arrived too soon for British technocrats who had not yet formulated plans for exporting reactors and in any case had little spare industrial capacity to do so. Calder Hall was still a year from completion and blurry economic projections did little to strengthen Britain's commercial case, a significant weakness given the contemporary desire to deepen the economic and political cooperation begun with the ECSC. As Lawrence Scheinman has highlighted, Europeanists like Monnet believed that atomic energy 'was the right star to hitch [the] European wagon to', in turn dividing them from British officials intent on supporting the bilateral system more conducive to their political and technological aims.[110] Instead, the political pressure on London to assist European atomic development encouraged British officials to explore alternatives such as those offered by the variable geometry of the OEEC, wherein the AEA could offer reduced manpower and financial contributions in return for a share in communal activities. Accordingly, it remained to be seen whether London's passive atomic foreign policy could compete with the more direct approach favoured elsewhere in Europe. This will be discussed in Chap. 5.

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CHAPTER 5

Diverging Paths: Euratom and the OEEC, 1955–1958

By the mid-1950s, the energy shortages that had pushed Britain into pioneering civil atomic energy were also beginning to bite elsewhere. In turn, this potentially disastrous shortfall led organisations which had been established after 1945 to facilitate European reconstruction to gradually turn their attention to expanding continental generating capacity as a means of guaranteeing economic stability. The opportunity to develop Europe's power resources communally was also appreciated by the supporters of supranationalism, who saw such collaboration as another potential weapon in their quest to ensure lasting peace between France and West Germany. Consequently, energy supplies and cooperation in the fields of electrical generation and transmission quickly became intermeshed with broader politico-economic visions as the new communities were increasingly supported by an American establishment determined to promote a strong, anti-Soviet Europe.

In considering their approach to this malleable geopolitical situation, ministers in London would be required to navigate two apparently contradictory goals. Firstly, London's longstanding macroeconomic policy dictated that it preserve its scheme of preferential tariffs towards Commonwealth states. Yet in order to maximise the benefits derived from Britain's technological lead in civil nuclear energy, ministers would also need to create a position of leadership in Europe without concurrently prejudicing their newly restored nuclear relations with Washington. This delicate balancing act was complicated further by a shortage of time: after

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the collapse in 1954 of the European Defence Community (EDC), a scheme to produce an integrated European army of sorts, officials across the continent undertook a *relance européenne*, a re-energised campaign to promote integration through a common market and a combined atomic agency. The rush to deliver these authorities caused considerable confusion in London, a situation exacerbated by the fact, as Mervyn O'Driscoll has identified, that the EDC's failure had naively led Whitehall to assume 'that the European integrative impulse was spent'.[1]

The resolution of the six Messina powers to integrate their atomic activities presented London with arguably the greatest challenge of its contemporary civil nuclear diplomacy. A neighbouring industrialised market of 170 million people could not easily be overlooked by Britain's commercial interests, and Whitehall was soon obliged to acknowledge Washington's growing promotion of the Messina model and to negotiate the attendant fissuring of Western Europe into two economic camps. As the leading power outside the Messina group, London would now need to construct and energise a platform for intergovernmental continental atomic cooperation which, although not incompatible with that of the Six, would nonetheless provide a competing alternative to supranationalism. This new diplomatic environment was further underlined by political changes in London: disgraced by the Suez Crisis, Prime Minister Anthony Eden was replaced in January 1957 by his Chancellor Harold Macmillan, a man with comparatively little of what Peter Mangold has termed the 'special affection' for France and Charles de Gaulle demonstrated by his predecessor.[2] A staunch Atlanticist, Macmillan also enjoyed popularity in Washington for his willingness to climb down from Empire by negotiating the progressive independence of British colonies, thereby healing a relationship much strained by the Anglo-French misadventure in Sinai.[3]

So how did Britain attempt to use its civil nuclear prowess to influence the political shape of Europe? To answer this question, this chapter will make two key contentions, the first of which will be that Britain's difficulty in delivering an alternative to supranationalism was as much a product of organisational misfortune as its own recalcitrance. In this regard, it will demonstrate how the lethargy of the OEEC committee established to propose communal action in nuclear energy blunted Britain's nuclear offer at a time when key political events elsewhere were determining the shape of Europe. With states on both sides of the Messina divide insisting that London select which model of nuclear cooperation would be the most appropriate for all continental states to pursue, British ministers contented themselves with merely awaiting the committee's findings, granting the Europeanists the gift of valuable additional time with which to seek other partners and evaporate Britain's bargaining position.

Secondly, this chapter will challenge the currently accepted understanding of the Atomic Energy Authority's attitude towards European cooperation by highlighting that the corporation in fact proposed a *positive alternative* to supranationalism which was more extensive than just a nuclear free-trade area.[4] Indeed, it will demonstrate that the Authority supported a 'middle course' that aimed to avoid charges of recalcitrance by undertaking intergovernmental cooperation sufficient to maintain British agency abroad. Furthermore, this chapter will analyse more closely the internal debates between scientists, engineers and officials that shaped the Authority's recommendations. In particular, it will elaborate how the scientists' internationalist instincts were moderated by hard-headed AEA bureaucrats, in turn leading the Authority to advise government along lines conducive to its commercial aims. In this way, this chapter will reappraise the Authority's actions by asserting that, while it disdained integration, the corporation did not oppose cooperation *per se*, hoping rather to frame such activities in contexts it considered politically, technically and commercially acceptable.

Rebuilding Europe's Energy Economy: The OEEC and the Six

The energy situation confronting Europe after 1945 was a distinctly unenviable one. In order to fuel the reconstruction of industry and infrastructure required to restore the continent to economic good health, officials from all nations were obliged to locate economical energy sources in the face of mounting geopolitical problems. Traditional fossil fuel sources were overstretched, and plateauing coal production had already stimulated a substantial increase in oil imports; for example, in Belgium purchases of foreign supplies multiplied fourteen-fold between 1950 and 1958.[5] In addition to their impact on balance sheets, imports of this nature also exposed Europe to undesirable external forces, such as Washington's manipulation of the Marshall Plan to control the continental oil economy, or to Soviet machinations in the Middle East.[6] Such concerns were further exacerbated by events like the Suez Crisis, as nationalist forces in the Arab world demonstrated their growing ability to starve Western states of fuel. The decline of coal also had hidden political effects: as John Gillingham has shown, Britain's coal exports dwindled during the interwar period, leading its supplies to the continent to decline after 1920 before terminating completely by 1945. This dearth in turn drove France and the Low Countries to form a dependence on German Ruhr coal, while the effort of restructuring the French economy, as Dietmar Petzina, Wolfgang Stolper and Michael Hudson have asserted, led Paris to break 'decisively with the liberal economic anti-planning traditions of the interwar period', thereby laying the foundations for later integration.[7]

Yet for all their newfound urgency such problems had long-established roots, and since the early twentieth century technocrats had been mooting the possibility that a continental electrical grid could synchronise European societies and industries.[8] The idea had been halted by war, but after 1945 the growing demand for energy returned the matter of cooperation in the field of electrical power to the attention of agencies already engaged in promoting economic stability. To such organisations, however, communal atomic development presented manifold problems and few European states could marshal the financial, manpower and industrial resources necessary to launch effective autonomous nuclear projects, causing much duplication of effort between smaller programmes. This asymmetry soon raised the possibility of joint establishments or, more loosely, the formation of alliances to tackle different aspects of atomic energy according to the specific priorities of the participants. For many countries, interest in nuclear technology would cease at isotope production, while for others, a full power programme was desirable. Some bilateral efforts had already been agreed in this regard (for example JENER, described in Chap. 2), but by the mid-1950s there was obvious scope for grander multilateral organisations to promote atomic technology more directly. With continental economic recovery thus predicated on economical energy supplies, greater cohesion would be required to realise the communal potential of Europe's states. As the region's most advanced nuclear power, Britain's role would therefore be critical.

As discussed in Chap. 4, the need to organise atomic collaboration had divided Europe between those states who treated the problem primarily as an economic concern, and those who appended broader political objectives. Leading the former camp was London, where macroeconomic policy had since 1945 been predicated on maintaining the integrity of the Commonwealth. This was no small issue: as numerous authors have highlighted, British post-war exports were based on re-establishing Sterling Area markets as a means of accessing the American hard currency needed to pay for vital imports.[9] Imperial Preference thus enjoyed a high priority in London and was supported by a strong domestic lobby including the Federation of British Industries and Leopold Amery, the former Secretary of State for India.[10] Yet alongside such concerns, Britain also had a crucial role to play in reconstructing Europe: according to Patrick Gordon-Walker, Attlee's Secretary of State for Commonwealth Relations in 1950, Britain's foreign policy therefore rested on two key pillars, namely:

1. The need to play our full part – and indeed, to take the lead – in revivifying Europe while at the same time –
2. Not engaging ourselves in anything which was likely to do damage to our relationship with other Commonwealth countries.[11]

These dual pressures often proved difficult for ministers in Whitehall to reconcile. In order to secure funds for reconstruction, Britain was forced to support measures designed to prevent any return to the protectionism that had marred the interwar period. As a means of appeasing the United States, which was attempting to construct what Paul Kennedy has labelled 'a new world order beneficial to the needs of Western capitalism' with itself at the helm, Britain grudgingly supported the General Agreement on Tariffs and Trade (GATT), a system of reducing tariffs by rounds of negotiation.[12] Importantly, however, British ministers were able to resist dismantling Imperial Preference entirely by persuading Washington, in the interests of Cold War alliance-building, to countenance product-by-product rather than linear tariff reductions.[13] Whitehall's response in this context thus represented an important reassertion of Britain's economic sovereignty, and Richard Toye has concluded that GATT demonstrated 'that power does not merely result from the possession of superior resources. It is a product of how those resources are wielded, and the attitudes and capabilities of those over whom one would exercise it'.[14]

With Britain's officials thus encouraged to explore methods of engaging Europe which did not prejudice its economic bias towards the Commonwealth, Whitehall opted to support intergovernmental cooperation within the umbrella of the OEEC. Established in 1948 to distribute Marshall Aid among war-torn European states, the OEEC was originally designed to facilitate Washington's aim of European economic integration. Ironically, however, such notions soon proved unworkable due to differing national preferences between those states whose major economic partners lay in Europe and those, like Britain, who conducted most of their trade elsewhere.[15] Consequently, as Alan Milward has shown, by 1949, the organisation had 'faded rapidly from the forefront of European politics and began its transition to honest statistical toil', leading it to merely promote economic efficiency and trade instead.[16] Rather than institutionalising Europe's economic interdependence, then, the OEEC actually consolidated exchanges in the context of the nation state, ultimately making the organisation the chief competitor to the High Authorities attempting to build a supranational Europe.[17] Believing therefore that the mechanisms for coordinating Europe's productive forces already existed, the British Cabinet decided to conduct their collaboration on initiatives designed to develop continental electricity production and peaceful nuclear competences via the same avenue.

Since the early 1950s, European energy consumption had grown at around 10% per annum, encouraging officials to continually identify and procure new energy sources.[18] Coal production in several continental states (notably Britain) had peaked, and plugging the demand for new resources with Middle Eastern or American oil was unattractive to nervous decolonising imperial powers and proponents of a self-reliant Europe alike. Fearing for continental recovery should these shortages worsen any further, in June 1955 the OEEC appointed Louis Armand, the chairman of France's state railway, to evaluate Europe's energy situation. Armand immediately discouraged the pursuit of oil as a substitute for coal, citing the low cost of electricity generated in atomic stations predicted by Britain's recent White Paper (described in Chap. 4) as evidence that such plant could easily succeed elsewhere. Contending therefore that 'intra-European co-operation is certainly more vital in connection with atomic energy than in any other field' Armand recommended that the OEEC request Britain to drive nuclear collaboration in Europe, and identified three avenues along which communal activities could be funnelled, namely the exchange of nuclear knowledge, the pooling and rational organisation of fissile material supplies and finally, joint plant construction.[19] As the first two fields were already suitably covered by CERN, the EAES and the IAEA, Armand argued that the latter option of joint infrastructure offered the most appropriate way of promoting atomic energy under the umbrella of an organisation whose members possessed dramatically asymmetric competences.[20] Should such cooperation be forthcoming, he argued, even small states would be able to contribute to communal work, allowing Europe eventually to generate electricity as competitively as the United States.

At the same time of Armand's report, plans were also afoot to break permanently the cycle of competition and violence that had plagued relations between France and Germany since 1870. In May 1950, French Foreign Minister Robert Schuman announced ground-breaking proposals to pool the coal and steel industries of France and Germany, hoping thereby to win back greater control from Allied occupying powers without yet returning to Bonn full sovereignty over its two most potent war industries.[21] As such, the move signalled a step-change in how European reconstruction was administered, away from the national contexts of the Marshall Plan and towards supranational integration under communal High Authorities.[22] For this reason, the resultant European Coal and Steel Community (ECSC) was treated with scepticism in London, where Attlee's deputy Herbert Morrison famously rejected British participation on the basis that 'the Durham miners won't wear it'.[23] Instead, British ministers diplomatically accepted non-binding 'associate' status with the community while mocking behind closed doors the new six-power bloc they labelled 'Schumania'; an unknown quantity too peculiar to contemplate abetting.[24] As Tony Judt has highlighted, the ECSC was consequently seen as 'the thin end of a continental wedge in British affairs, whose implications were the more dangerous for being unclear'.[25] Such concerns were certainly credible, and in addition to factionalising Europe, the successful subjugation of the continent's primary energy source to a common authority encouraged Europeanists to contemplate similar action in the field of civil nuclear energy.

Schuman's precedent prompted discussions in May 1955 between Johan Beyen and Paul-Henri Spaak, the respective foreign ministers of the Netherlands and Belgium, and Joseph Bech, the Luxembourgian Prime Minister. Aiming to restart the integration process that had collapsed with the EDC debacle the previous year, the talks produced a memorandum which highlighted 'transport, energy and the peaceful uses of atomic energy' as the fields ripest for renewed integration initiatives.[26] These proposals subsequently set the agenda for the Messina Conference of Foreign Ministers in June, at which representatives from West Germany, France, Belgium, Luxembourg, the Netherlands and Italy convened to examine their common interests. A united Europe, the participants declared, could come about only by the 'development of common institutions, the progressive fusion of national economies, the creation of a common market and the progressive harmonisation of social policies'. To this end, two key media for collaboration were identified, namely a common market and an atomic community capable of providing cheap power to the growing economies of the Six.[27] At this early stage, it was assumed that the new nuclear agency would pursue four key aims, namely:

1. The establishment of a common fund derived from contributions from each of the participating countries, from which provision could be made for financing the installations and research work already in progress or planned.
2. Free and sufficient access to the raw materials, and the free exchange of expertise and technicians, by-products and specialised equipment.
3. The pooling of the results obtained and the grant of financial assistance for their exploitation.
4. Cooperation with non-member countries.[28]

The Messina powers established a committee led by Spaak (the important 'Spaak Committee') to evaluate proposals for atomic integration and to consider suggestions made by departing ECSC President Jean Monnet for an entirely new High Authority in a field which displayed a natural confluence of interests.[29] It was an inspired idea, given the ongoing difficulty of reconciling Bonn with Paris: for German industry, the best chance of nuclear advancement lay in bilateral cooperation with London or Washington, forcing Adenauer to accept an atomic pool only as a concession to incentivise French agreement on a common market, while Alan Milward has conversely identified atomic cooperation as 'the one further step' towards European integration that the Gaullists in Paris could tolerate.[30] Euratom was therefore vital in sustaining the Europeanist cause during the period of its difficult rebirth, leading historian Mervyn O'Driscoll to assert that 'to ignore nuclear energy's role in keeping the light of integration alive during 1955 and 1956 is tantamount to historical amnesia'.[31] The linkages between Euratom and the Common Market have been exhaustively detailed elsewhere and need not be reiterated here.[32] What was important was that the *relance* had begun.

A mere week after Messina, officials from the OEEC states convened in Paris to discuss their counterproposals. The delegates were certainly aware of the pressing need for new energy sources: in addition to Armand's report, the 1956 Hartley Report would also advocate utilising a mix of both natural gas and atomic energy to reduce Europe's developing reliance on Middle Eastern oil.[33] Accordingly, the OEEC Council of Ministers adopted Armand's report in June 1955, and forwarded the findings to a new working group chaired by Greece's chief delegate, Leander Nicolaides.[34] Unfortunately for the British government and its allied supporters of the OEEC model, however, Nicolaides' group took over eight months to make its preliminary enquiries, granting credence to notions that Whitehall was indulging such a tardy process merely as a means of dragging its feet. Addressing the OEEC Council in February 1956, Spaak consequently seized the opportunity to fundamentally criticise intergovernmentalism as a concept, labelling it a 'bonus to national egoism' that allowed states to participate only in projects which benefited them rather than binding them to a common task.[35] Instead he highlighted that, while not necessarily detrimental to the OEEC's plans, Euratom nonetheless provided 'more definite and more complete' solutions to Europe's growing energy problem.[36] Determined as they were to await Nicolaides' report before deciding their next move, then, Britain's atomic diplomats were consequently unable to discredit such allegations by taking affirmative action against them. As such, the natural champion of the intergovernmental approach remained idle amid the growing clamour for action. It was a dangerous delay.

Britain Declines Messina: The Maxim of the 'Middle Course'

The rapid division of Europe into two civil atomic blocs presented a ripe opportunity for Whitehall to act decisively in the civil nuclear field. The smaller nations on the continent required leadership, and even the Six expressed a wish for Britain to assert which pattern of nuclear cooperation it would energise with its considerable resources and expertise. However, exhibiting a muted response to a supranational concept which it barely understood and could in any case not support, London failed to seize the initiative which its technological position could lend it. Integration, then, was rejected on both a macroeconomic and a technical level.

Simply put, the concept of a common market was anathema at Westminster. This fact caused no little friction across the Atlantic: as President of the Empire Industries Association, Amery personally led the charge in criticising Washington's hypocrisy in supporting the Schuman Plan nations who had integrated despite being signatories to GATT, warning of the agreement's total incompatibility with Imperial Preference.[37] At the 1952 Conservative Conference he went further, asking his audience; 'we have just shown the world how to make our own atom bomb; why not show the world that we know our own way to recovery?'[38] Such views resounded with ministers: as Piers Ludlow has highlighted, Whitehall's initial reaction to Messina was dominated by the Treasury, which supported 'monetary convertibility and global free trade' and advocated that these goals be achieved through intergovernmental rather than supranational means.[39] This euroscepticism was compounded by a change of leadership as the ageing Churchill finally made way for his heir apparent, Anthony Eden. The former Foreign Secretary's stock was high after his work in 1954 to promote the Western European Union, a defence package designed to rescue some aspects of the defunct EDC, but he nevertheless remained what D.R. Thorpe has labelled a 'European agnostic' who regarded the Atlantic and Commonwealth as preferable sources of British power. To this end, Eden joined the political consensus in Whitehall of lauding the OEEC and avoiding the dubious gamble of continental federation.[40]

London's ongoing preoccupation with Commonwealth commerce and its poor understanding of the supranational process led the Board of Trade to dispatch only one of its more minor officials, Russell Bretherton, to the conference of the Six held at Messina in June 1955. Described by Bonn's Ambassador in Paris as an 'unimposing but tough negotiating partner', Bretherton was instructed mainly to observe proceedings but remained amiable to his hosts, impressing upon the German delegation that British non-participation at the crucial meeting did not imply a lack of interest in Europe's future.[41] Nevertheless, the attitude towards atomic collaboration expressed by Britain's officials in their report from Messina was clear: Britain had already established a base of cooperation via the OEEC and through bilateral agreements with France and Belgium, and would therefore have 'much to give and little to gain' by joining a supranational pool from its scientifically superior position.[42] Instead, London preferred ad-hoc participation in specific research projects and aimed chiefly to sell its reactors and expertise at a rate calibrated to its current capabilities.

In London, meanwhile, perhaps the best snapshot of contemporary ministerial thinking was offered by the discussions held at Westminster in June 1955 between Beyen and Chancellor Rab Butler, Lord Salisbury, President of the Board of Trade Peter Thorneycroft and William Strath, a minor Treasury Official. Delegated to speak with one voice for the foreign ministries of the Six, Beyen detailed to his hosts the conclusions reached at Messina and proposed that action be taken to better coordinate the overlapping activities undertaken by the OEEC and the Six.

The envisioned solution would take the form of a 'community' with an executive authority responsible to a common assembly, rather than a 'multiplicity of high authorities' or a system of intergovernmental treaties.[43] In response, Butler highlighted the threat posed by the proposed Common Market to the OEEC's objective of encouraging free trade. The Chancellor further questioned the stability of the European Investment Fund (crucial to any prospective atomic agency) proposed at Messina and underlined Whitehall's inability to participate in the discussions raised by Spaak's Committee without 'considerable further study'.[44] With the supranational concept thus rejected by Whitehall at the most fundamental economic level, discussion moved to the atomic sector.

Taking the initiative, Beyen advised that if a new overarching atomic body proved impossible to organise, the Six and OEEC should at least coordinate their nuclear activities to avoid duplicating research. Salisbury again replied in the negative, reasoning that because the model of international cooperation had 'not yet crystallised' Britain could not commit to any communal effort until the upcoming Geneva Conference had taken place and the Nicolaides Working Group, commissioned just that month, had submitted its report.[45] Importantly, then, ministers stymied at the outset discussions aiming to reconcile the intergovernmental and supranational approach to nuclear cooperation: by declining Beyen's overtures and committing instead to wait for Nicolaides, an early opportunity to amalgamate the OEEC and Messina models into a mutually acceptable framework was spurned. Although Salisbury and his colleagues were careful to represent their views to Beyen as a desire to maintain compatibility and to avoid wasting the combined potential of Europe's states, such attitudes reflected the basic belief at Whitehall that the Six should coordinate atomic work through the OEEC alone. Indeed, this perspective dominated the next Cabinet meeting on 30 June 1955, at which Butler criticised the apparent lack of common goals within the Six, claiming that the Dutch coveted financial gain, the Germans political validation and the French and Italians trade benefits.[46] Addressing atomic energy specifically, Salisbury too remained aloof, opining somewhat vaguely (and to a serious extent incorrectly, as argued in Chap. 4) that there were 'more profitable channels for international discussion' than Europe.[47] Thus, the two key proposals mooted at Messina, a single market and an atomic community, were both openly rejected at the earliest conceivable moment by Whitehall.

In London, the task of devising Britain's counterproposals to the Messina atomic plan fell to the OCAE's Working Party on International

Collaboration, which met in July under the chairmanship of Friston How, the Secretary of the Atomic Energy Office. Featuring representatives from the Foreign Office, Commonwealth Relations Office, AEA and Treasury, the Working Party was given the important task of evaluating multilateral cooperation in the context of preserving sectoral relations with Washington and the Commonwealth while also considering Britain's limited industrial capacity.[48] The group did not delay in concluding that Britain needed to strike at foreign markets while its atomic iron was hot, and in its first meeting the Working Party consequently adopted a proactive outlook. Economic considerations, they argued, would eventually force European states to investigate the potential for civil atomic energy regardless of Britain's attitude, and in this endeavour they would inevitably seek help from Washington instead of from London. The recent Geneva Conference had only narrowed the technological and scientific knowledge gap between Britain and its nearest neighbours, and thus the possibility for London to gain by collaboration was growing every day.[49] The group therefore argued that Britain's core nuclear strategy under such circumstances should be to 'prevent the United States dominating the development of nuclear energy in Europe' while still pursuing a model of cooperation that stressed the global, rather than purely European, aspects of Britain's atomic interests.[50] To do this, it was considered 'essential that Britain should find a middle course avoiding any accusation that we are "dragging our feet" while at the same time not imperilling our relations with the United States nor entangling ourselves so closely with Europe as to prevent full cooperation with the Commonwealth'.[51] It was, in effect, Churchill's 'three circles' reimagined as a vicious trilemma.

Yet in order to prosecute this 'middle course', Britain would need to navigate the complex mosaic of interests left by the OEEC/Euratom split. Chief among the opponents to intergovernmentalism was Monnet, who valued atomic energy as another important step in his quest to deepen integration in Europe: as Alan Milward has attested, 'nuclear energy had a strong and more positive appeal; a science-based industry, a new and more potent symbol of modernization […] and a business unencrusted with the barnacles and weeds of long years of national regulation'.[52] As such, Monnet was keen to implement his vision even if it meant proceeding without Europe's leading nuclear power, writing to US Secretary of State John Dulles that integration could not 'be opposed by a single Government which might happen to be of a different opinion, even if it is the UK Government'.[53] Influential Europeanists concurred, and Franz Etzel, ECSC Vice-President from 1952–1957, advocated a *politik der kleinen Schritte* within which Euratom would provide another small but solid step towards a United States of Europe.[54]

Monnet was also ably supported by members of Eisenhower's Cabinet. Just as the Treasury had become the foremost authority on European integration in Whitehall, so too had the State Department prevailed in its quest to assert that integration was the appropriate method of forging European economic and atomic cooperation. Such preferences were rooted firmly in the context of Washington's Cold War struggle, and Dulles wrote a friendly letter to Macmillan in December 1955 explaining his preference for the supranational method as a means of binding Germany tightly 'into the whole complex of Western institutions-military, political and economic' in order to prevent Bonn ever accepting rapprochement with Moscow in exchange for reunification.[55] In response to these implied criticisms of Britain's preferences, London's officials could defend their position only in gentle terms: in Washington, British ambassador Roger Makins criticised the 'air of unreality' surrounding France's willingness to integrate and highlighted Britain's commitment to GATT as grounds for declining participation, while Eden and Foreign Secretary Selwyn Lloyd informed Dulles during their visit to Washington in January 1956 that Britain's intertwined military and civil atomic programmes would prohibit its accession to Euratom.[56]

These complaints went largely ignored across the Atlantic, and Eisenhower underwrote Dulles' proposals to 'study on an urgent basis moves which the United States could make in the atomic energy field to encourage six-country integration', and to ensure that existing nuclear bilateral agreements did not obstruct Washington's 'larger objectives'.[57] In turn, Dulles reassured Monnet that Eden's opposition 'did not dampen our hopes and desires', and that he eagerly awaited the development of an integrated nuclear agency which the United States could nourish effectively.[58] Such assurances quickly became transformative in persuading European leaders to countenance atomic integration without Britain. They certainly influenced choices made in Bonn, where Adenauer considered European technological pooling vital to German security after the collapse of the EDC.[59] Indeed, as the Chancellor told his ministers in early 1956, 'as they have officially declared, the Americans see in a European Atomic Community with—in contrast to the OEEC—its own rights and responsibilities, a decisive moment in political development. They are prepared to support such an atomic community with all necessary vigour'.[60] Bonn's Foreign Ministry concurred, arguing that Britain's inextricable civil-military nuclear complex and its Commonwealth preferences rendered it highly unreliable as a potential partner.[61]

As Alan Milward has highlighted, Monnet's thirst for atomic integration perfectly complemented Washington's zeal for establishing European agencies to which it could release fissile material and information.[62] By providing an alternative source of sustenance, this axis would inevitably marginalise London, where skepticism about the value of a British seat at the Euratom table reigned supreme. Thus, as Henry Nau has demonstrated, the birth of Euratom witnessed a blend of strategic motivations in which the United States emphasised the 'specific' nature of technological research and development, whereas Europeanists were attracted by the 'structural' allure of atomic integration. Britain, finally, disdained the 'symbolic' aspect of the project, preferring to restate its nuclear *independence* for both sectoral and high political reasons.[63] Accordingly, while officials in Washington professed their apparent satisfaction with both the OEEC and Euratom methods of unifying Europe's nuclear resources, Eisenhower and Dulles were in fact growing increasingly resolute (and public) in demonstrating their preference for supranationalism.[64]

Yet despite the formidable opposition arrayed against it, London's approach still resonated with several influential groups including the USAEC, whose chairman Lewis Strauss defended the system of bilateral treaties proposed by Eisenhower under Atoms for Peace.[65] Distrusting the French in particular, Strauss feared for global nuclear security should nuclear technology spread too far beyond American control but he nevertheless saw his influence progressively weakened as Eisenhower instead supported Dulles' quest to forge a unified Europe which could provide a fertile market for American reactors.[66] Ironically enough, Strauss' views were mirrored among technocrats in Paris, where the CEA opposed the political interference in their sphere caused by the Foreign Ministry's zeal to reconcile with Bonn, preferring instead to pursue the bilateral agreements that could more rapidly speed French acquisition of an isotope separation plant.[67] British ideals were also popular in Germany, where Adenauer's Economics Minister Ludwig Erhard advocated that integration proceed on merit of function rather than institution, and lauded instead the liberalisation achieved by 'organic' organisations such as the OEEC and GATT.[68] Furthermore, the Bundesverband der Deutschen Industrie (Federation of German Industry) opposed the monopolistic material procurement protocols envisioned by Euratom, a concern shared by Bonn's Atomic Minister Franz Josef Strauß, who also raised concerns that a Euratom without Britain would constitute 'five blind and a half-blind man'.[69]

Nor were such parties shy in making their feelings known. Strauß communicated his reluctance to accept a communal organisation without London's participation in early 1956 to Frederick Hoyer Millar, British Ambassador to Bonn, who in turn recommended to Harold Caccia at the Foreign Office that Britain engage with whichever organisation would drive European atomic cooperation most effectively. By supplying Europe with 'that British lead for which they so often profess to be waiting', Millar argued, Britain might provide smaller continental states with an alternative to German domination.[70] Meanwhile, Britain's OEEC delegates also opined that there was substantial body of continental opinion in favour of Britain's stance, and they detailed which groups in particular wished to see the OEEC approach validated with action. Smaller European nations that could not justify large atomic programmes, particularly in Scandinavia, felt squeezed between the uncertain prospect of intergovernmental cooperation and the rapidly evolving monolith of Euratom. In this regard, the Norwegians in particular considered the British attitude 'decisive'; if London would vivify OEEC activities then continental states would enjoy a realistic alternative to domination by the Six.[71]

Even the Six themselves were waiting for Whitehall to act. As Hugh Ellis-Rees, Britain's Permanent Representative to the OEEC, reported in February 1956, 'the representatives of the six Powers have constantly said in O.E.E.C. that the initiative rests with the United Kingdom and if we were to declare our intention to participate in major projects in O.E.E.C. the situation would be changed'.[72] In response to these requests, Britain had hitherto offered little but polite requests to await the report of the Nicolaides Working Group; in the words of Ellis-Rees, 'we have been unable to say anything to [...] deny the innuendos that we do not mean to cooperate'. He added: 'unless we make some advance and show that there is something more than mapping out an organisation we may be faced with a difficult situation before the Ministerial Council'.[73] Perhaps most importantly, Monnet's Action Committee also declared unequivocally that while the integration process must proceed in any event, 'everything must be done to obtain the participation of Great Britain' in the atomic activities of the Six.[74] Once more, therefore, it was clear that European states on both sides of the supranational divide were looking to London to animate the OEEC approach. Instead, British officials stalled, with their continuing inflexibility on the topic of the Nicolaides Working Group giving the impression of recalcitrance and lethargy.

The argument made here is that 1956 marked the fulcrum of Anglo-European civil atomic engagement during the period covered in this book, and with it a point of missed opportunity. Since 1945, continental states had persistently requested atomic assistance from London, a desire now peaking amid serious concern for the shortages emerging in Europe's energy economy. However, while Britain's diplomats were right to assert that European states would consider carefully any proposals that Britain offered to support materially in the atomic field, it was clear that this situation would not continue indefinitely. Euratom's popularity in Washington meant that the Six for the first time possessed the means to drive atomic development without British assistance, and that London's technological premiership would henceforth be a declining asset. In adopting the supposedly reassuring maxim of the middle course, Britain had instead given the impression of ambivalence which the slowness of Nicolaides' Working Group did nothing to improve. As a result, Whitehall missed an opportunity to intervene at the high point of European interest in atomic energy, encouraging the most powerful continental states to consider alternative mechanisms for communal development at the exact time that Washington was attempting to coordinate the formation of an integrated European bloc.

Finding Another Way: The UKAEA Rejects Euratom

Naturally, Britain's response to European integration in the nuclear field was not determined solely by officials in London. Indeed, although the supranationalist approach had already been rejected by Cabinet, the issue nonetheless caused a schism to emerge at the AEA, pitting internationalist scientists who valued the traditional exchange of scientific ideas across borders again the hard-headed bureaucrats who prejudiced ministers against pooling the researches the Authority had fought so hard to gain. Importantly, however, such protests did not betray a fundamental unwillingness to cooperate with Europe or even with supranational organisations: instead, jealously guarding its sovereignty and technical lead, the Authority re-emphasised its adequate channels for international exchange, and expressed its willingness to continue building connections overseas which it considered beneficial.

The growing relevance of European (and indeed all international) civil nuclear issues had quickly been appreciated by the AEA, and in October 1955 William Strath, a Treasury Secretary with considerable experience of European diplomacy, was awarded the new position of the Authority's 'Member for Overseas and Industry'. Strath was immediately tasked with streamlining Britain's atomic effort into fewer projects, and so in February 1956 Harwell's Director, John Cockcroft, circulated an optimistic paper exploring ideas for European civil nuclear cooperation.[75] Like Armand, Cockcroft praised the EAES as a forum for exchanging declassified scientific information and lauded Britain's leading role in the group, but his paper also proposed to deepen cooperation with the continent by providing information, fuel, and assistance with plant construction and logistics.[76] However, the concept soon encountered opposition from bureaucrats within the AEA: Cockcroft's ideas hinged on the assumption that Whitehall would sanction cooperation to a level just shy of joining Euratom, a premise the Authority's economic adviser, J.A. Jukes, considered flawed from the outset because 'in practice no UK Government is likely to collaborate to such an extent that our own programme would suffer severely'.[77] This was the nub of the issue: Britain would not donate valuable information to potential competitors in Europe as it had once proposed to do for Australia.

Further criticism came from the Authority's Collaboration Branch, who questioned Cockcroft's insinuation that Britain's role in CERN proved the value of UK input, arguing that European states 'might not want advice from someone who was largely outside or at best sitting on the fence'.[78] In a memorandum to Strath, J.C. Walker of the Branch instead encouraged a policy which would free Harwell from the burdensome export business, liberating its overstretched productive capacities for fresh research initiatives. Manpower constraints were certainly having a deleterious effect on the Authority's ability to meet all its commitments: in fact, in February the AEA reported to the Cabinet Mutual Aid Committee that it was offloading many of its training duties onto universities in a bid to increase space in its establishments, and noted also that international cooperation would unfortunately be hampered by the time it would take to properly train staff.[79] Thus, those scientists like Cockcroft who wished to promote atomic interaction between Britain and foreign states found themselves fighting not only political hesitance in Whitehall but also those interests in the AEA who demanded that Britain's technological lead and precious manpower be preserved at all costs.

The attitude of this latter group continued to harden throughout the next year, crystallising ultimately in little more than outright hostility. During a meeting in February 1957, the Atomic Energy Executive considered a paper authored by Strath which contended that the minimal reasons for joining Euratom were ‘mainly political, usually ill-informed and generally muddled’.[80] Criticising the organisation as an inferior alternative to the OEEC, Strath contended that Britain should not restrict itself to engaging with only *part* of Europe in this manner, and posited that exchanges of nuclear materials could be better facilitated under a Free Trade Area like that currently being proposed by London (discussed in Chap. 6). The fear of Germany’s considerable industrial potential also resurfaced, with Strath maintaining that Britain’s national frameworks had granted it a pioneering position which would only be eroded all the more rapidly by undertaking any effort to assist Germany.[81] From a technical standpoint, therefore, Strath’s arguments against joining Euratom boiled down to five key contentions. Firstly, it was clear that Britain must maintain its own independent uranium procurement mechanisms if it was not to prejudice its military programme. Secondly, London did not wish to join an organisation which acted as a foreign policy bloc because such an arrangement would combine it with less atomically-proficient states, in turn diluting its prestige and rendering it a less attractive partner (particularly *vis-à-vis* Washington). Thirdly, Euratom security controls were considered by Strath to be a hopelessly inadequate ‘embarrassment’, while the compulsory pooling of British patents to Euratom would rob the UK of one of its most promising commercial technologies. Finally, joining Euratom would force Britain to spread its already stretched manpower into communal research and development projects, prejudicing its own domestic ventures.[82]

Strath’s finding were accepted unanimously by the leaders of Britain’s nuclear establishments. From Harwell, Cockcroft worried that provisions in Britain’s bilateral treaties with Euratom members would be extended to cover the whole Community, while Aldermaston’s chief bombmaker William Penney was concerned that Euratom was a subterfuge by the Six to obtain sensitive military information. Representing Risley, Christopher Hinton stressed that atomic energy could no longer be considered a research project but now represented a considerable commercial asset, with the United States evidently prepared to go to ‘extreme lengths’ to dominate the European market. Concurring with this view, the Executive therefore accepted that because Britain ‘could not compete with the

Americans in obtaining European business by means of sweeping and expensive concessions' it should regard its domestic market as its main source of business while nonetheless trying to win a handful of export orders. Intimidated by Washington's capacity for subsidy, Britain's agency abroad would therefore be restricted to a few sales of PIPPA reactors and licensing agreements with European firms.[83] The decision by all three legs of Britain's atomic troika to reject Euratom entry was supported in Parliament by Lord Chandos, who contended that Britain's technological lead, attributed to the hard-won right of the AEA to determine its own research programme, would be destroyed by the need to consult 'a tribunal whose interests do not coincide with ours'.[84] These attitudes were henceforth made clear to dignitaries: during a visit in July 1957, delegates from Bonn's atomic ministry were informed that London wished to continue its military atomic project unhindered, and moreover was unwilling to donate any information gratis; instead, Britain demanded proper recompense for its costly researches.[85]

The Executive reconvened in late June to convince Cabinet that joining Euratom was dangerous, with even the mild-mannered Cockcroft now criticising Euratom's desire to access Britain's most promising projects, finance and manpower.[86] Importantly, however, such polemics did not represent an attack on the concept of cooperating with Europe as a whole, but rather on the currently proposed model for doing so. Indeed, Authority officials remained open to alternative forms of cooperation with Britain's neighbours: writing to Macmillan, Plowden railed against insinuations that Britain's technological lead could not withstand the superior resources of Euratom's American backers, arguing that the Authority's best chance of success lay in pursuing a model of continental interaction which preserved its sovereignty.[87] Highlighting the existing base of cooperation with Europe including nine bilateral agreements, the provision of training places at British establishments and an extensive programme of staff exchanges, Plowden claimed emphatically that 'there is no question of the UK setting herself up in opposition to Euratom or trying to preserve ivory tower isolation. We are cooperating extensively and wish to go on doing so'. Indeed, Plowden highlighted the Authority's willingness to provide Euratom with reactor fuel and information, its aspiration to participate in new OEEC joint projects, and his personal enthusiasm for a new joint committee to facilitate contact between the two authorities.[88] For UK technicians, then, Britain's best hope lay in a free tree area which would *augment* its existing strong base of cooperation by providing a framework within which Britain's atomic expertise could be traded advantageously and its technological sovereignty preserved.

To an extent, this rejection of Euratom reflected the Authority's changing priorities. As the AEA had expanded a number of ex-departmental officials had joined its Board, and such figures increasingly began to exert a moderating influence on the comparatively liberal suggestions of the scientists. Within this new bureaucratic milieu, men like Plowden, Strath, Jukes and Walker adopted more conservative and pragmatic attitudes, and the Authority's recommendations consequently received moderation from specialists with expertise in the economic or diplomatic aspects of atomic energy. Despite the internationalist instincts of eminent scientists, therefore, these more business-like individuals concluded that participation in Euratom would be strategically, financially and most of all materially undesirable to the UK. Analysing this vehement opposition, Alan Milward has identified the AEA as a brake on ministerial moves towards Europe, castigating the Authority's 'indefensibly unrealistic' desire to halt British association with Euratom and promote instead a nuclear free-trade zone.[89] Fearing for its continued relevance, Milward argues, the Authority in fact 'greatly exaggerated' Euratom's power in order to deter ministers from considering association with the community, while offering only token collaborative gestures to the community in a bid to achieve 'leadership on the cheap'.[90] Mauro Elli, too, has asserted that the Authority manipulated ministerial notions of Britain's 'Great Power' status by exaggerating the impact on Britain's military security, uranium supplies and foreign relations which membership would wreak.[91] Under such circumstances, Elli argues, the growing pragmatism towards the Six exhibited by the Foreign Office was contradicted by the Authority's 'politically-tinted' concept of 'technology as a substitute for power'.[92] Taking this notion further, Stuart Butler has identified a 'pitched bureaucratic battle' in which the Authority promoted 'splendid isolation' and the Foreign Office nuclear integration as the best method of balancing Churchill's 'three circles'.[93]

While true in essence, however, such views focus almost exclusively on the *negative* impact the Authority's stance had on ministerial moves towards Europe, while their *positive* alternative proposal has been ignored. It is the contention of this book that the view of the AEA as a wholly Eurosceptic entity requires refinement. As described in previous chapters, the Authority believed that it had *already established* a solid framework for international cooperation consisting of bilateral treaties, training provision, information exchange and participation in the European Atomic Energy Society. To be sure, these efforts appeared somewhat lacklustre when tasked with incentivising highly political initiatives of paramount importance, but to judge such attempts too harshly is nevertheless to ignore the slow but steady growth of Britain's civil atomic engagement with Europe since 1945. In short, the Authority was not 'atomically aloof' as claimed by Butler and Elli, but merely opposed to the supranational model which Britain was increasingly being forced to come to terms with at political level.[94]

Washington Moves In

With Britain's ministers taking their time to determine their desired nuclear role on the continent, American officials seized their opportunity to exploit Europe's emerging atomic market for their own purposes. This manipulation by Washington of a nascent technology to facilitate its aim of furthering European integration was naturally heavily influenced by its prevailing Cold War strategy, and Euratom has been treated in existing scholarship as such. However, the entry by the United States into the continental atomic arena also significantly influenced Britain's agency abroad by presenting London with a politically motivated competitor whose nuclear resources (and its willingness to deploy them against its own best commercial interests) were vastly superior to its own. As such, we must now consider how Britain's reluctant attitude cost it the initiative at a time when American intervention and key events were determining the shape of Europe.

Perhaps the most challenging aspect of instigating continental multilateral cooperation was the need for Britain to arrange for the secure control of nuclear fuel, a concern which had hitherto been addressed in bilateral agreements via guarantees that partners would obtain their initial supplies and then reprocess their spent fuel in the UK. However, the steady movement by the Six towards a prospective supranational authority also brought with it the possibility of communal plants, and most notably plans for a uranium enrichment facility. The stakes were high and the notion assumed a symbolic relevance far beyond its technical specifications: indeed, as Britain's delegation at the OEEC remarked, 'a number of countries regard this question […] as the key issue and they judge the attitude of the United Kingdom towards European co-operation in the field of nuclear energy in the light of our attitude to this particular project'.[95]

This view was particularly pronounced in Paris, where ministers aggressively defended France's right to construct both atomic weapons and the gaseous diffusion plant necessary to enrich U^{235} to the required potency. Euratom membership played a crucial role for France under such circumstances: as Alan Milward has highlighted, integration with Bonn on this matter would enable Paris to coopt the German engineering expertise and financial muscle it required to realise a new coowned separation plant. Such installations would also soon be of high commercial value, because reactors fuelled by natural uranium, such as the British Magnox and French UNGG models, suffered from limited power output due to the high neutron absorption ratio of the cladding materials. Indeed, future designs such as the Advanced Gas-Cooled Reactors (AGRs) then under consideration by Harwell, were already anticipating the need for fuel enriched to ~3.5% in U^{235} content in order to drastically improve their output.[96] To expedite their ability to access this latest technology therefore, the Six established a working group to consider the possibility of a European enrichment facility and desired a common fund to finance any resultant plant construction.[97]

The move towards constructing plant on a multilateral basis provided a clear opportunity for Whitehall to act on the frequent assertions made by both Euratom and other continental states that British assistance in constructing such facilities would energise and thus validate the OEEC approach towards atomic cooperation.[98] In fact, the opportunity to seize the initiative in this manner was rendered all the more crucial by London's exclusively negative track record on communal plant, with the issue resurfacing as it did relatively swiftly after a rejection by Britain in February 1955 of proposals made by Paris for a joint isotope-separation facility, during which London had cited the adequate production levels at its own newly-commissioned enrichment plant at Capenhurst.[99] Additionally, officials in London were still anxious not to offend Washington by assisting foreign states in acquiring their own separation plants, and so in November 1955 the OCAE declared that if Britain were to require additional diffusion capacity it would in any case prefer a project coordinated within the Commonwealth.[100] As Makins condescendingly observed, therefore, 'the European pressures for acquiring gaseous diffusion facilities was like that of a child who wanted the one toy being denied him by his godparents'.[101]

Yet despite the negativity on show in London, the diplomatic value of assistance was still appreciated by Britain's delegation at the OEEC, who implored the Foreign Office to sanction the contribution of British technical knowledge to states interested in building their own joint plant under the auspices of the OEEC. In this way, Britain could 'breathe new life into the Organisation at a critical juncture' which would 'be the most effective way of meeting the challenges we are facing from Euratom'.[102] The alternative threatened by the delegates was that Euratom (and once more the Germans specifically were identified as the malevolent orchestrating power) would develop the plant for itself with assistance from the Americans who would 'not have the same scruples as ourselves about providing classified information', in turn denying Britain any commercial or political profit from its hard-won expertise.[103] Reconciling their position as the atomic pioneer with diplomatically profitable action therefore presented Britain's government and atomic authorities with a conundrum. Most continental states were immediately interested in constructing plant that Britain had already obtained, or worse, had no need of. Assisting their efforts in this regard would therefore produce no scientific profit for Britain while further straining its already overburdened domestic resources. Additionally, the danger persisted that London would jeopardise its technological lead by actively assisting other states without obtaining suitable commercial or political recompense. For these reasons, then, London did not seize this early chance to construct and thus control Europe's key atomic infrastructure.

With Britain continuing to sideline itself in this manner, the uncertain civil atomic situation in Europe soon led to debate in Washington between Lewis Strauss' AEC and the State Department, where Dulles remained keen to assist Euratom in constructing a joint uranium enrichment plant. In a rare victory for Strauss, however, the AEC Chairman persuaded Eisenhower instead to decrease the price of *American* low-enriched uranium to a third of the price such fuel would cost to fabricate in a European diffusion plant, thereby destroying any economic justification for such a facility outside the United States.[104] At a stroke, this 'extraordinary dumping operation', as Joachim Radkau and Lothar Hahn have termed it, smothered notions of true European atomic independence and caused conflict between Europeanists and those 'French nuclear nationalists' who desired full autonomy over their fuel cycles.[105] Importantly, then, Washington had seized the initiative and made Europe dependent on its supplies of enriched fuel, essentially depriving Britain of this valuable leverage. Indeed, by removing a 'major irritant in the formation of Euratom', Mervyn O'Driscoll has identified that the provision of enriched uranium 'paved the way for an almost complete US takeover of the European market in future years. Consequently, Britain lost the battle for the leadership of Europe's nuclear power industry and squandered her initially strong bargaining position'.[106]

The absence of a concerted OEEC approach to European nuclear cooperation, and Whitehall's apparent lethargy in organising it, was only accentuated by the speed with which Euratom was now reconciling its major protagonists. In Bonn, Adenauer was keen to undertake any policy which might strengthen the Franco-German axis and supported Euratom despite considerable expert opposition at home. Indeed, West German scientists were not even consulted on the treaties' aims, while the country's leading physicist, Werner Heisenberg, opposed any agreement which might drag the Federal Republic into nuclear weapons projects.[107] As Radkau and Hahn have asserted, such behaviour was symptomatic of a Chancellor who cared little for the peaceful atom and regarded the technology as a 'means to an end' in his quest for European political unity.[108] Consequently, despite the opposition of German industrialists which had weakened Euratom's value as an instrument of integration, atomic energy was considered a useful prop for the Chancellor's political vision.[109]

Adenauer's will was certainly tested by the antagonistic reaction of his economic and atomic subalterns to Euratom. In a meeting with American officials in October 1956, F.J. Strauß defended the notion of private ownership of fissionable materials and expressed his concerns that French Socialists would insist on public control of the nuclear sector.[110] Although supported by prominent figures in Germany, this attitude made little impression on Adenauer, who dismissed such arguments as 'rather absurd' when even the United States, with its deep historical commitment to private enterprise, had sanctioned a government monopoly over domestic fissionable materials.[111] In a bid to palliate the obstruction caused by Erhard and F.J. Strauß (who had now become Bonn's Defence Minister) at the Saint Cloud ministerial meeting on 30 October, Adenauer thus met with French Prime Minister Guy Mollet in Paris on 6 November 1956; prepared to compromise on Euratom in order to resolve the disagreements surrounding the Common Market. In so doing, the Chancellor signalled his intention to override two ministries and a substantial body of industrial opinion to maintain the Europeanist momentum.[112] At the meeting, Euratom's monopoly over uranium provision was finally addressed, with the two leaders agreeing that members states could seek foreign supplies only 'if the Agency was incapable of satisfying their demand or if it applied conditions where prices were excessive'.[113] In addition to resolving atomic issues, however, the engagement also confirmed an era-defining reorientation in French foreign policy. Occurring at the height of the Suez Crisis, the meeting provided the perfect platform for a demonstration of Franco-German solidarity: officials in Paris were certainly furious at Eisenhower's use of financial diplomacy to bring Whitehall to heel, and at London too for leaving France's standing in the Middle East ruined.[114] With this anger foremost in his mind, Mollet swallowed his Anglophilia and committed instead to Adenauer's suggestion that 'Europe will be your revenge'.[115]

Nor did the legacy of Suez end there: faced with French intransigence regarding atomic weapons and still desperate to deliver the common market, Adenauer was forced in January 1957 to accept that Euratom would exclude military matters and would exercise authority over civil atomic activities only.[116] It was a controversial move, and Spaak bemoaned Mollet's 'plain foolishness' in pursuing an independent nuclear deterrent as a means of restoring French prestige after its consecutive humiliations in Suez and Algeria.[117] The Suez Crisis also resounded in Britain, where Macmillan, having outmanoeuvred his rival Rab Butler by first supporting and then decrying intervention in Egypt, now succeeded Eden as Prime Minister.[118] With a fresh face in Downing Street, the path became clear for Anglo-American reconciliation, and Macmillan's prime foreign policy concern, the 'Special Relationship', was reaffirmed in March 1957 when he hosted Eisenhower for a conference in the British territory of Bermuda. As the Prime Minister therefore wrote to his Australian counterpart Robert Menzies: 'things are back on the old footing'.[119]

The Adenauer-Mollet meeting removed the last obstacles to European atomic cooperation, encouraging Monnet to spur the initiative. In conversation with Douglas Dillon, Washington's Ambassador to Paris, Monnet expressed his hope that American support for a supranational atomic effort would cause an effect 'comparable to that of the Marshall Plan', and so three 'Wise Men' were appointed on 16 November to draft a report on production targets and planning for the new organisation.[120] The trio were all leading figures in Europe's energy and industrial sectors: working alongside Armand and Etzel was Francesco Giordani, the former head of Italy's atomic commission. They were given just sixty days to make the necessary visits, and officials in Washington quickly seized their chance to influence proceedings. Rather than awaiting a request from the 'Wise Men', Dillon recommended that Dulles invite the delegates himself to provide a 'timely reaffirmation of the sympathetic support the President and you have shown toward Euratom'.[121] Importantly, the decision to invite the Wise Men's to America in February 1957 also forced Washington, as Richard Hewlett and Jack Holl have shown, to ‘hammer out a policy for Euratom that would conform to the bilateral agreements already in force’.[122] Strauss was consequently placated by Monnet, while Dulles cleared the path for Euratom’s future by ensuring that foreign states henceforth ‘confined their bilateral requests to specific projects, which could later be encompassed with the Euratom community’.[123] Furthermore, Dulles arranged for Eisenhower to meet the Commisioners in person to reaffirm directly his support for their project.[124] At the meeting, Eisenhower asked his guests to accept that collaboration offered the only way of saving Europe, and proclaimed that Euratom would be to the ‘benefit of the United States, of the Atlantic community, and of all the world’.[125] Nor did American support end there, and in July another fifty-two Euratom officials were granted a seventeen-day tour of facilities across the United States, while Armand himself returned in spring 1958 to facilitate discussions.[126] Indisputably, then, Euratom was now entrenched as a keystone of Washington’s global strategy.

Following their American tour, the Wise Men visited Britain on an excursion which underlined clearly the difference in attitude shown towards Euratom by the two Atlantic powers. In contrast with their ten-day stay in the United States, which had included meetings with AEC officials, industrialists and the President himself, as well as visits to the Shippingport power plant and Oak Ridge laboratory, the Wise Men spent barely four days in Britain, with only a brief visit to Calder Hall.[127] From the outset, the British treated their guests as a trade delegation rather than as political emissaries; indeed, the Foreign Office sanctioned the trip only on the understanding that the Wise Men were making technical enquiries rather than acting as ‘evangelists for the Euratom approach’.[128] In a similar vein, Plowden wrote to Salisbury asking him to restrict his exchanges with his guests ‘to technical questions and questions of cost, and not get drawn into political discussion’.[129] Instead, the British took pains to facilitate their PIPPA exports, with Plowden diligently reminding the Wise Men that the only way to install nuclear capacity by the early 1960s was to buy British.[130] Consequently, while Euratom’s scouts had acknowledged both major atomic powers on their travels, Washington had undeniably been the more effective suitor.

The report authored by Armand, Etzel and Girodani, entitled ‘A Target for Euratom’, was published in May 1957 and began by outlining Europe’s serious energy problems. The abundant coal that had carried the continent through industrial revolution was no longer sufficient to support continued economic growth, while the report railed against rendering Europe dependent on the Middle East for supplies of additional fossil fuels, declaring it 'essential that oil should be a commodity and not a political weapon'.[131] Instead, the report recommended that Euratom 'either buy some reactors from the United States and the United Kingdom or build them under license' before constructing 15,000 MW of its own native generating capacity by 1967.[132] Finally, the Wise Men supported Eisenhower's offer of enriched uranium, highlighting that American supplies could bridge the gap in supplies which would occur before Euratom's own plant could begin production.[133] In this way, the Six quickly developed a firm written concept of both their own capabilities and Washington's position as Europe's new nuclear leader.

The integrationist momentum in the atomic field was mirrored in Paris, where Mollet's 'revenge' for Suez peaked in March 1957 as the Six signed the Treaty of Rome establishing a common market and common atomic agency. It was a major political moment, demonstrating conclusively that the unity of the Six was not merely fantasy while, as Wolfram Kaiser has shown, also marking a comprehensive rejection of the intergovernmental 'British Europe' that had hitherto coexisted alongside the Messina initiative.[134] British proposals for continental cooperation would henceforth be treated with extreme suspicion, and new post-Rome suggestions to reform the European communities were often dismissed as efforts to 'drown Europe in the Atlantic'.[135] Nevertheless, the success of atomic integration has remained contentious. Among the critics of Euratom, Roy Ginsberg has opined that the common market had a 'much broader impact on the interests of national governments than would have been provided by a single-sector enterprise represented first by coal and steel, and then by atomic energy'.[136] Additionally, Christian Deubner has labelled Euratom a 'stillborn' scheme which paid lip-service to a common supply agency and allowed members to approach Washington individually, lending the community 'minimal relevance as an instrument of European integration'.[137] Responding to these criticisms, however, one must acknowledge that the sector-by-sector approach was not without its limitations but, in a field as vital to national health as energy, Euratom nevertheless presented a serious challenge to British atomic pre-eminence and created a Europeanist force to which London was forced to propose an alternative. By refusing to participate in a common enrichment plant, Britain allowed the United States, as the only state capable of supplying sufficient quantities of enriched uranium, to dominate the European atomic scene forthwith.

Washington's commitment was underlined by its generosity towards Euratom's founding fathers, while Britain's narrow commercial approach quickly paled in comparison with American munificence. The delay was costly, and with the Suez debacle leading Paris to commit irreversibly to European economic and atomic integration, Britain would face a monumental task in animating an intergovernmental nuclear alternative.

Constructing Cooperation Under the OEEC

Euratom's birth had only emphasised how wide the supranational schism had grown in both the atomic and the political fields. Indeed, the rift so worried Macmillan that he privately contemplated exchanging Britain's military nuclear secrets for a square economic deal with the Six. In the civil nuclear field, meanwhile, Britain had encountered considerable and costly delays in constructing the overarching intergovernmental framework it had long professed to desire. As such, this chapter will conclude by demonstrating how these delays, already burdensome in a strictly atomic sense, were also rapidly beginning to cost Britain the initiative amid a series of important political events.

Apologising for his tardiness, Nicolaides finally delivered his report in February 1956. In it were contained three concrete proposals, namely:

1. The establishment of a Steering Committee for Nuclear Energy responsible to the OEEC Council which would promote joint undertakings, harmonise legislation, work for standardisation and devise proposals for international trade.
2. The formation of a Control Bureau to regulate fissile material.
3. The formation of joint undertakings as and when required, run with management independent of the OEEC Council.[138]

The projects envisaged by the group included a uranium enrichment plant, a chemical irradiation facility, joint experimental reactors and a heavy water production works.[139] Under this framework, the OEEC would act as a bulletin board, allowing member states to select on a case-by-case basis which projects to participate in while preserving their national sovereignty. As Jean-Marc Wolff has asserted, then, the OEEC 'considered itself a service provider, a forum in which projects could be proposed, and not a place for spending all allocated funds, unlike the situation at EURATOM'.[140]

The publication of the report by the OEEC re-energised Macmillan, who understood clearly the potential of atomic energy to invigorate the organisation's approach in the manner earlier highlighted by Ellis-Rees. As he told the OEEC Council in mid-1956, solving the atomic problem thus presented 'an opportunity as striking and as dramatic as that which those who came before us seized at a vital moment in the world's history seven years ago'.[141] In turn, an OEEC Steering Committee for Nuclear Energy was established in July 1956, again chaired by Nicolaides. Unlike the Wise Men, who had been pressed hard to deliver their report inside two months, however, the Steering Committee took almost fifteen. Requiring deadline extensions, it eventually reported only in late September 1957, recommending the formation of an agency to promote peaceful atomic development in Europe.[142] These findings were lauded by the Treasury, who hoped that they would 'maintain the impetus' of atomic cooperation between the Six and other states, while simultaneously checking the potential for nuclear weapons proliferation.[143] Nevertheless, the decision also sent delegates racing to find an agreement which could work under the umbrella of the OEEC before the representatives of the Six individual national governments were replaced in the new year of 1958 by a single delegate from the nascent Euratom Commission, a change that would surely set negotiations back to square one.

Despite this need for haste, discussions were almost paralysed from the outset by the Six's insistence on constantly consulting an Interim Commission, highlighting the growing aloofness of the Messina states and their rising tendency to operate in unison. In response, some of the non-Six participants complained that the Commission's technical experts were 'not acting in good faith' and that the body, although not yet statutory, was issuing orders to reject what the British and their supporters considered entirely reasonable proposals. When confronted on this point by Ellis-Rees, Baron Snoy, the Commission's chairman, confessed he had 'never been able to control the nuclear experts' and that there was constant disagreement between the Benelux representatives and Carl-Friedrich Ophüls, Bonn's ambassador in Brussels.[144] Ten days later, an exasperated Ellis-Rees, driven to distraction by the French delegation's insistence on telephoning Paris over every amendment, accepted the best compromise he could obtain without forcing national ministers to step in and completely overhaul discussions.[145] His patience was rewarded, and in late December 1957, the Council established the European Nuclear Energy Agency (ENEA). Although successful, therefore, Ellis-Rees' eleventh-hour travails thus underlined starkly the frustrations inherent in reconciling a supranational core with an organisation having decidedly looser aims.

After these inauspicious beginnings, the ENEA was tasked with 'furthering the development of the production and uses of nuclear energy for peaceful purposes by the participating countries, through co-operation between those countries and a harmonisation of measures taken on a national level'.[146] Essentially, this would involve the communication by states of their atomic plans, estimates and progress to the Agency, while the organisation itself would increase communal efficiency and security by both promoting joint undertakings and establishing a nuclear inspection system.[147] In this way, the ENEA would prevent a European atomic bloc and enable Britain to preserve contact with its leading external partners including the United States and the Commonwealth.[148] As Henry Nau has contended, the organisation therefore 'reflected an existing organisational consensus on issues of external relations 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'.[149] The ENEA was also of domestic political significance, allowing Macmillan to tell Parliament in March 1958 that Britain was finally offering Europe an alternative to supranational integration.[150] Importantly, the agency also enhanced Whitehall's cherished bilateral system by providing a forum where multilateral projects could be organised on a scale hitherto inconceivable. In this way, it served the OEEC's main aim of increasing the *quality* of experimental projects by preventing members from researching similar designs simultaneously, thus deepening their collective potential.[151]

In sum, by early 1958, Britain had finally constructed a framework through which to promote intergovernmental cooperation. However, the time taken to form the ENEA demonstrated only too well how seriously Britain had lost the initiative in atomic collaboration. During a crucial eighteen-month period beginning in February 1956, Whitehall slipped from a position where almost every state in Europe awaited its decision, to reactively rushing to complete the deal in December 1957. Arguably, then, this was the point where Britain's atomic premiership in Europe, and its ability to influence the future shape of the continent, was irretrievably lost.

Conclusion

This chapter has demonstrated how the issue of organising civil atomic energy on a multilateral basis in Europe became increasingly divisive during the 1950s. Hungry for new energy sources, continental states were encouraged to consider communal technological development, splitting them between those who supported supranationalism with its attendant political objectives from those charging that energy supplies were an economic issue best handled by intergovernmental action. As Europe's most proficient atomic power, Britain consequently enjoyed considerable authority, and during spring 1956 it became clear that practically all Europe expected London to select a model of cooperation.

Whitehall's response in this regard was retarded by a series of OEEC committees whose lethargy was exacerbated by the urgency of Euratom's scouts. Having once enjoyed a commanding position, Britain allowed Euratom to steal a march on the OEEC: from its inception in June 1955, the Nicolaides Committee reported in February 1956 and its subsequent Steering Committee issued its recommendations only in September 1957, and this at a time when Europe's smaller states were only too keen to initiate collaboration among each other and with the UK. Officials in London repeatedly begged foreign dignitaries for patience, while atomic integration was relegated down Cabinet agenda sheets at every discussion, in turn allowing OEEC nuclear collaboration to remain an empty promise for too long. Indeed, the eventual rush to form the ENEA during winter 1957 showed just how quickly Whitehall's quest for intergovernmental cooperation had become a hasty reaction rather than an assertive policy. In this way, London allowed a valuable opportunity to evaporate at precisely the same moment as the French, humiliated by their failure in Suez, finally committed to a European future.

Elaborating on existing criticisms that Britain's political unwillingness to engage the Six was matched by the aversion to supranationalism expressed by its technical bodies, this chapter has also contended that the AEA was more amenable to international exchange than has previously been accepted. Although officials certainly rejected Euratom participation outright, they did so not merely to protect their lead or prestige, as Milward and Elli have respectively contended, but because they believed that appropriate channels for exchange already existed. As this book has already shown, Britain's nuclear engagement with Europe was a slowly evolving process which led the AEA to endorse free trade and exports as Britain's main vectors of intervention, and consequently they conceived of Euratom essentially as a unified market. Nevertheless, the Authority realised the political value of cooperation, and were prepared to pursue a 'middle course' within which some limited collaboration would be undertaken to retain the goodwill of Britain's neighbours; an effort ultimately scotched by Britain's determination to await the recommendations of the tardy Nicolaides committees. Unfortunately for Authority officials, then, the protocols that had proved adequate in a narrow technical sense were now being asked to perform a vital diplomatic role, rendering them too passive given the political context forced upon them.

Faced with such intransigence, Euratom's midwives orientated instead towards Washington, where Dulles remained only too keen to see the community prosper. Offering to supply large quantities of enriched uranium (and thereby essentially to export cheap American energy), American statesmen successfully subsidised nuclear power in the Six and left Britain marginalised. Ultimately, therefore, Britain's atomic premiership was devalued, and a new era of direct Anglo-American competition had begun.

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CHAPTER 6

Britain, the United States and Euratom, 1958–1960

On New Year's Day 1958, both the Common Market and its sister nuclear community, Euratom, came into being. For the Europeanists and their American backers, it was a triumphal moment: Jean Monnet's optimistic vision had endured despite considerable opposition from numerous influential groups across Europe. From London's perspective, however, the situation was decidedly less rosy. With the Treaty of Rome now in effect, time was short before the EEC states would enact their first internal tariff cuts on 1 January 1959, beginning the rising discrimination by the Six against their OEEC partners. Desperate to prevent the economic polarisation of Western Europe into two competing camps, Prime Minister Harold Macmillan therefore adopted a strategy of publicly lauding the Messina project while seeking to broker a free trade area that could bridge the impending schism and avert catastrophe.

In the atomic sector, meanwhile, Whitehall had finally achieved its long-standing aim of restoring military nuclear relations with Washington. Driven partly by the launch of the Soviet *Sputnik* satellite in October 1957 but also by Britain's successful hydrogen bomb test in the Pacific the following month, the United States marked its rapprochement with London in July 1958 by signing a new Mutual Defence Agreement which enabled the exchange of classified atomic weapons information. Of the importance of the agreement to Washington there can be no doubt: as Eisenhower's Under Secretary of State Christian Herter reported, the United States had

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M. Theaker, *Britain, Europe and Civil Nuclear Energy, 1945–62*,
Britain and the World, https://doi.org/10.1007/978-3-319-73927-4_6

accelerated its timetable 'very materially' to rush the accord through Congress.[1] As Simon Ball has opined, then, the new arrangement finally reconciled Whitehall's predilection for collusion with Washington's new desire for a defensive nuclear umbrella comprised partly of British atomic weapons.[2] In the civil nuclear world, however, the situation remained more precarious. As shown in Chap. 5, by the late 1950s the United States had become heavily engaged in encouraging a supranational European atomic community to which it could supply fuel and other material assistance. Indeed, as Joachim Radkau and Lothar Hahn have asserted, Euratom's role as a 'counterweight' in the continental nuclear balance was greatly appreciated by an American establishment which 'saw Britain as their main rivals in the potential global nuclear market'.[3] By comparison, Britain had failed to engage decisively with the new integrated community during its formative years and had not yet posited a meaningful alternative for multilateral nuclear cooperation via the OEEC. Put simply, ministers considered Britain too technologically advanced to make pooling its resources and research a profitable exercise, an attitude exemplified by the brief supplied by the Atomic Energy Office to Macmillan before his visit to Bonn in May 1957; 'our atomic edifice is already several storeys high' it argued, 'we could not demolish this structure in order to join others in a new "building"'.[4] The only course of action left under such circumstances, therefore, was for British diplomats and scientists to define methods of engaging with Euratom which recognised their nation's inability to match the vast resources of the United States, but which simultaneously maintained the allure of British nuclear technology to ensure its continued value as a diplomatic tool.

This chapter will demonstrate how Britain and Euratom enjoyed little commonality in their perceptions of the supranational community, and will contend that British officials mismanaged their relations with Euratom's elite at a crucial juncture by failing to produce a competitive alternative to American domination which reached beyond London's existing commercial bilateral predilections. Next, it will highlight how fossil fuel fluctuations blunted the diplomatic usefulness of nuclear energy, before demonstrating how the joint projects promoted by Britain and the OEEC as an alternative to supranational development projects were manipulated by politicians to validate the intergovernmental approach at a time when Britain needed to fortify its wider economic proposals. Key among these was Macmillan's suggestion for a Free Trade Area (FTA) to be constructed within the OEEC which could solve the emerging

Six-Seven split. When this proposal failed in 1958, Whitehall was forced to settle for a European Free Trade Area (EFTA) comprising Europe's peripheral economies, and so this chapter will conclude by showing how the association, already unsatisfactory for British industry generally, was doubly so for the nuclear exporters who required access to Europe's largest markets.

The Eclipse of Britain's Atom

As identified in Chap. 5, the creation of Euratom had elicited far more enthusiasm in Washington than in Whitehall. For the United States, Euratom presented the dual opportunity of further unifying Western Europe while also providing a sandbox for American technicians to experiment with technology that was at present uneconomical domestically.[5] Yet although authors including Alan Milward, Richard Hewlett and Jack Holl have respectively asserted that Washington's intervention was key in both compelling London to acknowledge that it must engage with the Six and in establishing the United States as Europe's dominant nuclear partner, there has been little analysis of how American machinations affected Anglo-European nuclear relations.[6] As such, this chapter will show how Britain's ability to use its technological lead to influence the Six consequently came under serious threat from the American nuclear behemoth.

The potential for American nuclear competition in European markets had been a constant worry for London's strategists ever since Britain had started to produce its first commercially viable nuclear products in the late 1940s. Such concerns had crystallised during the next decade, with Atoms for Peace marking the undeniable return of the United States to the international nuclear scene. Nevertheless, the open support offered by American diplomats to the Six's new nuclear project elevated the pitch of Washington's intervention still further, prompting the AEA in spring 1957 to despatch an official, H.R. Johnson, to visit Euratom's headquarters in Luxembourg. Reporting back on his meetings with senior Euratom officials, Johnson noted that despite its political roots, the agency was now being directed by 'hard-headed businessmen' who wished to see it establish a serious power programme rather than a 'nebulous research enterprise'. Washington's policy of supporting Euratom through no fewer than three simultaneous interfaces (the State Department, AEC and private industry) was also beginning to reap political and economic dividends, Johnson noted, as the former's image as a 'benevolent uncle' was being used to mask the commercial opportunism of the Commission and American exporters. Standing in direct comparison with Washington's nuanced approach however, Britain was conveying the 'unfortunate impression of adopting an exaggerated commercial attitude towards Euratom', a stance that made it difficult even for Anglophile members of the community to support cooperation with London.[7] As Alan Milward has noted, the problem was compounded by the fact that it took over four months for British officials to even visit Euratom after its inception, reinforcing perceptions that London was deliberately ignoring the Six.[8] Finally, London's ambassador to the ECSC's High Authority, William Meikelreid, was also restricted by London to meeting only with representatives of the coal and steel union while his American counterpart, Angus Butterworth, experienced no such restriction, cementing further Britain's lackadaisical image in the parliaments of the continent.[9]

This growing conflict of interest between Britain and the United States was also well-understood by officials in Washington. In November 1957, the National Security Council issued a report on civil atomic energy which mentioned specifically the 'active competition' faced by American firms from British industry.[10] Analysing the Euratom/OEEC divide, the report also stressed that Euratom now had the option of choosing between British, American and Canadian reactor designs, and that the OEEC was finally beginning to arrange joint projects with flexible membership.[11] In order to promote Washington's dual interests of developing atomic energy for eventual domestic use while also promoting the technology abroad, US authorities were therefore actively engaged in designing reactors *specifically for use overseas*, highlighting Europe's value as a proving-ground for American business.[12]

American industry itself had not been slow to appreciate the potential for exports to the Six, and Washington was soon lobbied by firms eager to explore the new market offered by Euratom. One such approach was made in April 1958 when William Knox, President of Westinghouse, wrote to Lewis Strauss at the AEC to complain that although US plants were competitive with UK designs in terms of capital cost, their fuel cycles remained over twice as expensive as British models. To compensate for this failing, Knox demanded that 'immediate measures' be taken in Washington to offset the looming threat that American companies would lose upcoming reactor contracts in Italy and Belgium.[13] Knox continued his campaign in a letter to the White House, in which he affirmed Westinghouse's support for nuclear power as a solution to both Europe's overexposure to

Table 6.1 Comparison of 'Calder Hall' and 'Yankee' reactors

	UK 'Calder Hall' plant	*US 'Yankee' plant*
Capital charges (mills/KWh)	4.9	4.8
Operating cost (mills/KWh)	1.2	1.0
Fuel cost (mills/KWh)	3.14	5.93
Total (mills/KWh)	9.25	11.73
2012 value (p/KWh)[a]	6.5	8.3

ETE Belgian project: Cost comparison of Calder Hall type reactor vs Yankee type reactor, attachment by William E. Knox to a letter to Lewis Strauss on 2 April 1958, 25 March 1958, HAEU, JMDS, 110
[a]1 Mill = One-thousandth of $1, i.e. 0.1¢

Arab nationalists and its vulnerability to the 'blackmail position' of the USSR. Attempting to obviate these geopolitical problems, Knox consequently endorsed the immediate installation of European generating capacity, regardless of output cost.[14] In a bid to outgun the British and their policy of subsidising fuel elements, Knox therefore demanded a similar undertaking in order to preserve the competitiveness of American machines, and suggested that such action be undertaken via Washington's existing bilateral treaties rather than awaiting a request for action from Euratom.[15] Such fears were certainly credible: because of their lower fuel cost, British Magnox reactors produced electricity more cheaply than similar-rated American 'Yankee' designs, as shown in Table 6.1.

Yet despite the comparatively superior economic performance of British nuclear plants, American firms still retained an important trump card. In light of their perception that American machines provided greater stability than British models, European utilities stated that they would favour US systems if the price of the electricity they generated could be reduced to within 1 mill above that of British plant.[16] Washington acquiesced to this demand for subsidy, and so on 29 May in Brussels and 18 June 1958 in Washington, Dulles and Strauss signed with Euratom officials including Armand, Enrico Medi and Heinrich Krekeler the most significant agreement in the community's early history. The new US-Euratom agreement laid the foundations of a programme to install 1000 MW of generating capacity from American-designed reactors in Europe within five years, with European capital sources providing $215 m and the United States extending a line of credit worth $135 m. Importantly, the agreement also enabled Washington to supply Euratom with 30,000 kg of uranium (enriched to contain around 1300 kg of U^{235}), thereby reducing the cost of nuclear electricity generated by American systems relative to that of their British competitors.[17] By sanctioning the deployment of subsidies the agreement thus represented a powerful assertion of Washington's ability to compensate for its immediate inferiority to the UK in a technology which promised a rapid pace of development. Indeed, as John Krige has contended, 'the United States may not have been ahead in the development of civil nuclear power. But it had other assets: the prestige that went with being the leading post-war scientific and technological power […]; immense financial and industrial resources; and vast quantities of enriched uranium'.[18]

It was an offer with which London would struggle to compete and Britain's ambassador in Washington wasted no time in protesting that these American actions would distort the market for nuclear equipment in clear contravention of GATT.[19] Although these allegations were strenuously denied by the State Department, there could be no doubt that the US-Euratom Agreement would severely compromise Britain's ability to export its wares on a competitive basis. Indeed, the possibility that Britain might be excluded from European nuclear markets has led some scholars to connect this sectoral failure with far more wide-ranging ramifications. Alan Milward, for instance, has identified that while the need to secure atomic exports had always been a sub-set of Britain's desire to patch the EEC with an OEEC-wide free-trade area, the 1958 US-Euratom Agreement nevertheless prompted British officials to finally accept that London's prolonged exclusion from the EEC would have 'serious future consequences' for the economy as a whole.[20] Yet while the new accord has been appreciated for its impact in the political sphere, there is more to be said, and it is important to consider also the reverse proposition of how the US-Euratom deal challenged Britain's atomic ambitions in Europe and its ability to use its technological lead as leverage for its own political aims.

In London, the task of proposing a counterstroke against the American offer to Euratom fell to the Atomic Energy Executive, where no pretence was made of the fact that Britain could not match Eisenhower's largesse. The reasons for this were simple: firstly, Britain's industries were overstrained by their intensive domestic plant construction schedule and equipping European states with valuable materials and expertise would unavoidably retard these vital undertakings. The political atmosphere in Whitehall also left ministers unwilling to provide financial resources to subsidise Euratom's activities, while the AEA too would not permit any exchange that would give commercially valuable information away for free. Finally, the British could not guarantee their fuel prices (itself an indirect subsidy) to Euratom to the same degree as Washington was proposing to do. In short, as the Executive conceded, London could not compete with the American offer without a 'significant departure' from its stated policy, while the resources available to Macmillan's government were in any case 'not sufficient' to produce anything other than a 'pale imitation' of Eisenhower's munificence.[21] Instead, they asserted that Britain would have to rely on the PIPPA reactors to sell themselves on their technical credentials using the established commercial channels, with the Executive merely positing the construction of a 'framework for normal commercial transactions' which would 'inevitably be somewhat restricted'. Within this comparatively rudimentary forum, Euratom, the Executive envisaged, would be invited to purchase British power and research reactors while Britain would supply and reprocesses fuel, and provide training, scientific knowledge and technical advice.[22]

In Whitehall, meanwhile, ministers continued to support the notion that any Anglo-European undertaking be directed in the form of bilateral agreements with individual Euratom members, and so Macmillan's Paymaster-General, Reginald Maudling, wrote to Armand in mid-May 1958 to underline Britain's commitment to these existing treaties and to propose a discussion on an agreement between Britain and the new community.[23] As Geoffrey Kirk, a diplomat at Britain's Dutch embassy, would later note, the principal concern for Whitehall during these days was that the US-Euratom agreement would lead to the Six becoming 'accustomed to think in terms of United States equipment and techniques', a problem to which an Anglo-Euratom programme could serve as an 'antidote'.[24] However, any optimism felt by officials in Whitehall in this regard was quickly tempered by Euratom's hardening attitude towards any new treaties. At a meeting of the Euratom Council in July, Krekeler announced that the organisation welcomed the existing bilateral treaties between Britain and its member states because they would advance the state of knowledge in the community, but he nonetheless requested national governments not to conclude any *fresh* agreements that might affect areas of communal concern such as security protocols. In this way, Krekeler established the principal that collective bargaining between Euratom and the UK would guarantee the best terms for the Six governments and their industries alike, thereby marking the homogenisation of the community into a unified diplomatic bloc.[25]

Britain's engagement was further hampered by the lack of common interest between the AEA and Euratom. In January, D.E.H. Peirson and H.R. Johnson of the Authority and Arthur Tandy from the Board of Trade met with Euratom officials including Ettore Staderini, Eildert Stijkel and Jules Gueron in Brussels. At the meeting, Gueron communicated that Britain should be prepared to 'prime the pump' for its export trade by supplying Euratom with information sufficient to enable the community to form a powerful scientific nucleus. The British delegation responded that they were primarily interested in establishing industrial connections for the benefit of UK industrial consortia, but their counterparts could offer no commitments in this regard save the possibility of constructing a joint fuel plant. In conversation with Johnson, Stijkel underlined the conundrum of Britain's relationship with Euratom: without an agreement between London and Euratom on a long-term large-scale joint power programme, the agency would be unable to advise continental utilities to build British-designed reactors and would instead only be able to supply them with information on American models. In response, Johnson reiterated once more that Britain could not sell reactors as part of an all-embracing 'package' and that London instead sought long-term partnerships that would enable its engineering firms to develop new reactor types in conjunction with its clients. The AEA thus defined itself at this stage as a supplier of information to plant operators and manufacturing industries, while Stijkel envisaged Euratom initially as a planning organisation from which national governments could request advice.[26] Clearly visible in these muddled negotiations therefore was a fundamental lack of commonality between Britain and the Euratom states with regards to their perspectives and plans.

Yet despite its strong and clearly defined self-image, the Authority still retained a vested interest in repairing relations between itself and the community and so launched a new attempt to curry favour with Euratom's representatives. At the invitation of William Strath, the AEA's Member for Overseas and Industry, in December 1958 Euratom officials led by Stijkel visited the AEA's offices in London as well as its stations at Risley, Calder Hall, Springfields and the new power plant currently under construction at Bradwell in Essex. From the earliest stage, the AEA's Technical Branch were aware of 'the importance that the Euratom Commissioners attached to protocol and their sensitivity in all matters where their prestige is concerned' and consequently made greater efforts than they had previously to impress their guests.[27] The trip itself was a marked success, and the representatives of the Commission's Industrial and External Relations divisions returned a detailed report to their headquarters indicating their satisfaction.[28] Nonetheless, in a discussion with Dr Rudolph, the head of Euratom's Economics Division, Authority officials were able to ascertain that Krekeler himself had specifically chosen not to revisit Britain, having been 'outraged by the very poor reception' that the Three Wise Men had received there during their 1957 trip. By contrast, Rudolph claimed that 'whenever one mentioned the U.S.A. to Krekeler a light could be seen in his eyes', highlighting only too clearly the preference of one of Euratom's leading figures for transatlantic as opposed to cross-Channel cooperation.[29]

The next stage of Britain's diplomatic initiative was to arrange a meeting between Euratom's commissioners and Macmillan in London in February 1959. The briefing supplied to the Prime Minister by the Foreign Office (after a natural consultation with the AEA's officials) provides a clear insight into the state of Anglo-Euratom relations in early 1959. Importantly, the document betrayed the continued poor understanding of the supranational concept possessed by British officials who contended that 'we do not yet know how important the Euratom Commission is going to be—e.g. how much influence it will have on the placing of orders for nuclear equipment which British firms would like to obtain'.[30] Accordingly, the brief asserted that the principal logic for welcoming the dignitaries was to emulate the Americans, who had 'gone out of their way to cultivate the Commissioners' in the hope that a friendly reception would atone for the poor impression afforded the Three Wise Men in 1957.[31] Macmillan himself was consequently advised by his foreign policy experts to reaffirm his belief in the European ideal to the visitors and to laud the success of the Rome powers, albeit within the strictly defined context that such a grouping could potentially be of *general* benefit to European economic power. Furthermore, although Euratom had already accepted that Britain could not subsidise its reactors in the same manner as the Americans had, the brief nonetheless counselled Macmillan to persuade the visiting Commissioners to both contemplate occasional purchases of British reactors and to countenance a free trade area for nuclear materials and equipment within the OEEC.[32] Such an area already existed within Euratom, but OEEC attempts at achieving similar liberalisation between its members had met with little success and so Macmillan's advisers recommended that their master request Euratom to lower its tariffs against other OEEC members.[33] In this way, the brief underlined both the ambiguity of British officials towards Euratom's representatives, and Whitehall's persistently commercial perspective towards European nuclear exchanges.

Britain's predilections for bilateral treaties were formalised on 4 February 1959 when Selwyn Lloyd and Reginald Maudling signed with Commissioners Medi, Paul de Groote, Krekeler and Emanuel Sassen a treaty for cooperation between the UK and Euratom in the peaceful uses of atomic energy.[34] Set out across nineteen articles, the agreement ensured foremost that commercial information would be released only on a normal basis, but guaranteed that the AEA and Commission would assist each other in obtaining information on reactor design, construction and operation, and would make mutually available on commercial terms the licences to all patents in their possession. Each side agreed to consult the IAEA and ENEA on nuclear safeguards, and committed to seconding both expert and trainee scientists for visits between the authorities. The AEA also agreed to provide Euratom's Supply Agency, on commercial terms, with fuel sufficient to operate research and power reactors obtained from Britain, and also to process irradiated fuel produced within the Community. Politically, the treaty also enabled the Community to assume where possible the rights and responsibilities derived from Britain's existing bilateral agreements with its constituent states. In this way, the agreement clearly protected Britain's commercial sensibilities whilst guaranteeing mutual access to the expanding knowledge pool that both parties expected to generate.

Yet despite its success, the agreement had still come eight months after its American counterpart, engendering some anxiety within British firms who feared that they would no longer enjoy fair competition in a market now saturated with American subsidy.[35] This worry was confirmed also by Cockcroft, who outlined Britain's position to European industrial delegates at a speech in Milan in summer 1959. 'The U.K. is not in a position to make financial contributions to the cost of developing nuclear power in Europe on the lines of the U.S./Euratom agreement' he argued, 'but the U.K. has a large and progressive research and development programme, of which the benefits are available to European countries on a reasonable economic basis'.[36] This, then, was the essential difference between the British and American exchanges: whereas Washington was prepared to subsidise Euratom to vivify an effective politico-economic bloc, London's objective was to foster *quid pro quo* exchanges to recoup some royalties from sales of its expensive researches. Thus, as John Krige has opined of the atomic community, 'for Washington, the political objectives of the program far outweighed the commercial dimensions; for London, the commercial aspects were crucial, the political intentions misguided'.[37] Nevertheless, the agreement provided a vital salve for an Anglo-Six diplomatic relationship strained by political mistrust, and at the subsequent press conference Krekeler announced happily that the Community now enjoyed formal relations with the world's two foremost civil atomic powers.[38] De Groote then detailed how Britain's agreement would complement its American counterpart, and took pains to stress that the 1000 MW target agreed with Washington was well within the Community's capacity to reach quickly, leaving ample space for additional reactor purchases. The UK-Euratom Agreement, it was contended, would also standardise Britain's continental nuclear responsibilities: at present, only Italy and Belgium had bilateral treaties with London regarding power reactors and so, de Groote argued, the new deal would grant all community members the same access to British wares.[39]

With Britain compelled to acknowledge and also to engage with Euratom, conflict soon arose between those departments in Whitehall who were eager to mollify the community further and the AEA, where the preference for bilateral collaboration remained steadfast. The dispute had been sparked by the Euratom Commissioners, who during their visit had averred that the new UK-Euratom agreement now rendered individual treaties between Britain and individual member states unnecessary and that such approaches should be discontinued forthwith. Eager to maintain good relations, the Foreign Office pressed the nuclear lobby on its reasons for maintaining the system of bilateral treaties, to which the Authority responded that the Commissioner's anxieties contradicted what they had previously been given to understand by Siegfried Balke (F.J. Strauß's successor as West Germany's Atomic Minister) and Bonn's delegation to Euratom in particular. Furthermore, it was clear from the behaviour of its officials that Washington did not consider that its agreement with Euratom would exclude the institution of further bilateral agreements if necessary, and so the Authority defended jealously its ability to use the mechanism to fix flaws in agreements drafted outside London's control, such as indemnities for third-party liability that were absent from the Euratom Treaty.[40]

To British eyes, the purpose of the Euratom treaty had been to establish a vector for their commercial interests to access Europe's new nuclear common market, a priority soon demonstrated by the joint technical committee established under the agreement.[41] The group's first meeting was kept deliberately brief: a British official opined it was 'difficult to imagine that the discussions with Euratom could go on usefully for more than one day' while the Atomic Energy Executive admitted that its main aim was to maintain Euratom's goodwill by discussing technical details of British reactors 'sufficiently to advance the prospects of export business in these fields (while stopping short of giving away valuable technological detail)'.[42] Consequently, the group was conceived of by Authority officials more as a method of embedding British technology into Euratom's future plans than as a genuine forum for mutual atomic development.

Looking across these few months in retrospect, it is clear that Washington was aggressively manipulating the European market for political profit in a manner which Britain simply could not contest. Subsidies, credit lines and fuel provision all combined to offer Euratom a partnership which would severely prejudice Britain's ability to exchange its immediate technical lead for diplomatic and commercial gain. Additionally, Whitehall's agency was weakened by the lack of common goals between itself and Euratom, a situation initially worsened by the poor welcome extended to the community. Clearly visible therefore was a continuing attempt by British atomic authorities to make their need to engage the new supranational community conform to existing preferences for bilateralism and commercial pathways of exchange.

The Economic Decline of Atomic Energy

Before we can continue our investigation of Britain's stuttering engagement with Euratom during this period, we must first consider the important shifts in Europe's energy economy that reduced nuclear energy's value as a diplomatic tool during this period. As Richard Gordon has demonstrated, by 1968, no EC state was still gaining more than half of its energy requirements from burning coal.[43] Britain's coal consumption peaked in 1956, after which London slowly amplified the role of oil-fired stations in its energy production mix, in line with trends witnessed across Europe.[44] As a result, the immediate need for nuclear power which had pervaded much of the 1950s was blunted and the technology's status as a diplomatic tool swiftly weakened. With Britain's nuclear reactors marketing themselves strongly as the only systems capable of quickly providing nuclear electricity, these dynamics consequently damaged the likelihood of Magnox sales and with it Britain's ability to use its technological prowess to facilitate its other aims.

The reasons for this cross-national shift from coal to oil were manifold. As J.A. Hasson has identified, Britain's atomic project remained uneconomical throughout the 1950s and required substantial political support to stay operational.[45] Pursuing this notion further, in fact, Benjamin Sovacool and Scott Valentine have contended that state backing has actually been vital for *any* national nuclear industry, as the sector represents the acme of 'economic interventionism' in which only 'gargantuan public subsidies' can propel nuclear power to a position of eventual commercial maturity.[46] Indeed, atomic energy was indicative of what David Edgerton has termed a British 'techno-nationalism' which saw importing technology as a 'national disgrace', allowing the sector to benefit from a disproportionate share of Britain's growing post-war research and development expenditure.[47]

In an environment in which atomic energy could survive initially only by state intervention, changes in fossil fuel availability consequently had the potential to erode what had previously been emphatic political support for nuclear technology. As George Hoffman has demonstrated, many nations nationalised their collieries after 1945 in order to depress prices, an action which prevented the industry from accumulating reserves sufficient to handle subsequent crises and causing a growing dependence on oil once uneconomical mines began to close. Conversely, in 1958 Eisenhower limited imports of oil into the United States, producing a glut on the European market as exporters sought alternative buyers, in turn pressuring coal producers still further.[48] In Hoffman's analysis, then, the vacuum created by the decline of coal, which had provided the ostensible rationale for Europe's atomic industries, was instead being filled by plentiful supplies of cheap oil. Thus, while the *geopolitical* security offered by nuclear power remained undiminished, the *economic* rug had been whipped from under those supporting an immediate expansion of European atomic generating capacity.

Acknowledging this change, European officials now dismissed the Hartley Report and the findings of the Three Wise Men as alarmist and out-of-date. Instead, they reformulated their energy plans on the assumption that coal would progressively lose competitiveness, that oil would steadily cheapen, and that the diverse new oil sources discovered since the Suez Crisis would provide adequate security against monopoly and any ensuring abuse. Nuclear power, meanwhile, continued its promise of becoming 'seriously competitive within the next ten years' but its speedy implementation was no longer, as Tandy informed Lloyd, an 'emergency operation'.[49] The press were less forgiving: as the *Economist* stated in late 1959, Euratom's target of installing 15GW of generating capacity by 1967 had now become hopelessly unrealistic, with no more than 2GW guaranteed by 1965. Any fresh expansion would thus require the 'hope that curiosity and the urging of a new technique will induce some public utility concerns to co-operate in putting up stations that they would never be able to justify on purely commercial grounds'.[50] Nor were the Six alone in trimming their projections, and even Britain's grand atomic programme was rationalised in 1960.

This trend is perhaps best represented in the yearly expenditure advanced from the Atomic Energy Office to the AEA (Fig. 6.1) which peaked in 1959, at which point increased receipts and reduced spending on services, plant and machinery lowered the state's annual contribution to the Authority's coffers. By 1959, Britain's atomic effort had begun to mature and expenditure on it fell for the first time since the war, although manpower levels rose further before plateauing in 1962. This increased wage bill was more than compensated, however, by growing receipts from appropriations-in-aid (sales of radioactive substances and services) and the reduction in expenditure mentioned above.[51] The declining urgency surrounding nuclear power was matched by a crash in the global uranium market when in 1956 both the AEA and AEC declared their demand for ores sated, causing most uranium exploration to cease and many mines either to fold or to stretch out their existing contracts.[52] Finally, a mild

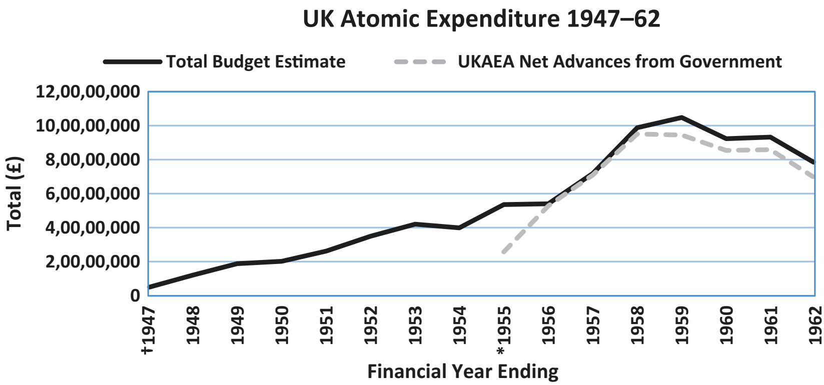

Fig. 6.1 UK Atomic Expenditure, 1945–1962. For 1947–1953, see Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy 1945–52*, Volume I: Policy Making (London: Macmillan, 1974), 86; for 1953–1954, see Report of the Committee on the Future Organisation of the Atomic Energy Project, 23 July 1953, TNA, Cabinet Papers (CAB), 129/62; for 1955–1962 see the UKAEA Annual Reports in the Bibliography

recession during the late 1950s ensured that European energy consumption declined after 1956, eventually recovering only in 1960.[53]

Amid these turgid economic conditions, only two Magnox power reactors were ultimately exported to Italy and Japan in 1959; successes which, in Robert Boardman and Malcolm Grieve's estimation, failed to 'create a momentum of success in foreign markets'.[54] This poor performance cannot be laid solely at the British door and it became clear within only a few years that the nuclear euphoria of the mid-1950s had in fact represented something of a false dawn. Indeed, as Roger Makins (by then the Authority's chairman) admitted to a Parliamentary Select Committee in 1962, the market for reactor exports had 'fallen far below expectations which were held in 1955'.[55] Perhaps unavoidably, Britain had again suffered from being the pioneer: as Duane Bratt has eloquently summarised, therefore, 'being first, did not necessarily mean being best'.[56]

By 1959, nuclear energy had been conclusively blunted as a diplomatic tool. This is not to say that atomic energy's long-term importance had diminished, but rather to affirm that the receding danger of energy shortages reduced the technology's salience as a *political* priority. Recently conceived of as a panacea for both the economic and geopolitical ills of fuel supplies alike, atomic energy was now downgraded to the status of promising prospect, hampering Britain in two ways. Firstly, the political prestige of being the atomic pioneer was diluted, reducing the technology's value as collateral in negotiations with the Six. Secondly, and more important, was the impact on British export prospects: the much-vaunted Calder Hall-type reactor had marketed itself as the only immediately available reactor with a successful operational history. Consequently, the short window of competitiveness afforded to such designs was already closing rapidly.

Validating the OEEC: The Joint Projects

Away from the realm of power plant exports, Britain was still seeking to fortify the OEEC as the leading forum for continental nuclear collaboration. As seen in Chap. 5, the OEEC had identified at an early phase that Europe required several infrastructural nodes that could be developed communally to benefit large and smaller nations alike. Among the facilities suggested for such cooperation, of most immediate concern were plans for an isotope separation plant, a chemical irradiation centre, joint experimental reactors and a heavy water production facility.[57] As described above, however, notions of a European enrichment plant were crippled by Eisenhower's subsidisation of American enriched uranium, while Britain and France had initially pursued graphite-moderated reactors precisely because they wished to avoid becoming dependent on American heavy water supplies.[58] Consequently, the OEEC targeted for its communal activities research into future reactor systems, thereby setting itself apart from the large capacity installation programmes proposed by Euratom. Finally seizing the initiative in this regard, Britain was able to assist several research projects, albeit ones which often owed more to the diplomatic skills of individual British scientists than Whitehall's enthusiasm for cooperation.

During the 1950s and early 1960s, the OEEC supported three communal nuclear projects; a chemical irradiation facility at Mol in Belgium named Eurochemic, a boiling water-type reactor at Halden in Norway, and Dragon, a high-temperature gas-cooled reactor in Dorset. These schemes have been analysed individually in several works: Jean-Marc Wolff's history of Eurochemic and E.N. Shaw's examination of the Dragon reactor offer thorough engineering case studies, for example, while Henry Nau has also used the project to support his argument that national politics remain the key determinants of international technological development, particularly when considering Washington's support for European integration.[59] However, although Rowland Pocock has identified that Britain participated in the otherwise-unattractive Halden reactor in order to win support for Dragon, existing studies have underappreciated the interplay between technical and political expediency in Britain's OEEC activities.[60] Accordingly, this chapter will now demonstrate how British scientists and politicians alike manipulated the OEEC's activities to release the political capital of cooperation while fulfilling their technical objectives. Moreover, it will make the important contention that such cooperation often owed more to the diplomatic abilities of Britain's internationalist scientists than its formal political strategists.

The first OEEC joint project, Eurochemic, was arguably the least successful from a political standpoint. Indeed, Britain immediately declined to join the scheme because it had already developed its own such plant at Windscale, but the idea remained popular elsewhere.[61] Four countries offered to host the plant, but the final choice of Mol in Belgium has been criticised by Jean-Marc Wolff as a pertinent example of political decree overriding technical practicality.[62] Indeed, the Eurochemic model was derided at the time by AEA officials who criticised the scheme as representative of bad planning habits that should be avoided in future discussions.[63] Despite these criticisms the organisation forged ahead, however, and work began in December 1957 with Germany and France the primary stakeholders. Turning to the potential of researching future systems in unison, the OEEC was acutely aware that atomic engineering remained in a state of rapid development. If smaller nations were therefore to conduct meaningful nuclear energy work without expending ruinous sums, joint experimental establishments would be required to divide the burden of research. The first such scheme was proposed by the Norwegian Atomic Energy Institute, which offered its boiling water reactor at Halden for the OEEC to take over as a communal project. However, the uptake of Oslo's offer among Europe's other nations was sluggish: the AEA could find only 'marginal technical reasons' for participation while Euratom's leaders also only agreed to join if London would reciprocate, making numerous last-minute financial objections 'to the point of outright offensiveness' which had to be hurriedly addressed by OEEC mandarins.[64] Indeed, Jules Gueron, the Commission's delegate, commented privately to Cockcroft that the Six were in fact not particularly interested in Halden and were contributing mainly for political reasons.[65]

From the British side, the political arguments for joining the Halden enterprise were championed by Cockcroft, who found his cause alloying with that of ministers who were uncommonly keen to support atomic interaction due to their wariness about the ongoing discussions over Britain's FTA proposal. His persistent application of his personal prestige to promote the venture in this manner paid off and so, in a bid to avoid being seen as 'adopting a negative and uncooperative attitude to nuclear work in OEEC' the Joint Working Party on European Nuclear Co-Operation (representing the major departments) recommended declaring an interest in Halden.[66] For their part, the AEA was also eventually swayed by an American offer to contribute knowledge on boiling water reactors, tipping the balance in favour of the agreement as a useful vector for obtaining valuable information.[67] Indeed, this offer was identified by Strath as a key turning point in the project's fortunes: the AEA had initially opposed the idea as technically insubstantial but was forced to persevere by ministers keen on maintaining Britain's presence in the continental atomic field. Once the Norwegians had trimmed the scope and financial requirements for the project, the additional bonus of American knowledge made the agreement attractive to the technicians once again.[68]

The Halden Agreement was signed in Oslo on 11 June 1958 by Norway, Austria, Denmark, Euratom, Sweden, Switzerland and the UK. The project was initially given a lifespan of three years and a budget of 3.86 m EPU units, of which Euratom and Norway each shouldered 27% and Britain 18%.[69] London's participation had the desired diplomatic effect: at the post-signing dinner, J.C. Walker of the AEA's Collaboration Branch quoted Gunnar Randers as mentioning that, 'while the UK was always slow to enter international activities we could always be relied upon, once we had entered, to be the very first to make real contributions in the way of staff, money and so on'.[70] The project was also technically successful, eventually meriting an eighteen-month extension at the cost of 2.1 m European Monetary Agreement (EMA) units.[71]

Yet the major purpose of participating in Halden, at least to British eyes, had been to impress states outside the Six and to win support for more ambitious projects. By 1956, Harwell had concentrated its future reactor research and a committee was established under Strath to assess development priorities. The committee's decision, active from 1958, was to prioritise four designs: the fast reactor at Dounreay was the favoured scheme, occupying 37% of manpower by 1962, followed by the advanced gas-cooled reactor (AGR: 26%), high-temperature gas-cooled reactor (HTGC: 18%) and heavy water reactor (HWR: 13%).[72] A site at Winfrith Heath was obtained for HTGC reactor experiments, and the new undertaking was supported enthusiastically by Cockcroft, who once more smoothed feathers at the Treasury by breaking down his cost estimates into microscopic detail, from reactor materials right down to canteen facilities.[73] The importance of frugality in convincing officials was logical: such was Cockcroft's understanding of the attraction of thrift that he even proposed (unsuccessfully) to annexe land from the Admiralty Gunnery Establishment in nearby Portland to reduce costs.[74]

In the European arena, the AEA had been committed to an OEEC reactor project for some time, but had been unable to act because the Industrial Group and British firms had refused to collaborate on any reactor type which they hoped to eventually exploit commercially, ruling out both the AGR and fast reactors.[75] Instead, Britain had initially offered to cooperate on a Homogenous Aqueous Reactor (HAR), but in March 1958 Cockcroft had switched his attention to a HTGC project, believing it presented superior prospects.[76] The HAR project, supported mainly by the Dutch contingent, was subsequently shelved although the Netherlands maintained an interest in reviving the idea at a later date.[77] The Foreign Office heard of the difficulties and wrote an anxious letter to Friston How at the Atomic Energy Office, warning that unless an acceptable alternative to the HAR project were found, the Europeans might infer that the

HTGC scheme was a 'typically British device for wriggling out of our undertakings'.[78] How responded in placatory terms, encouraging the Foreign Office to trust Cockcroft, who enjoyed 'an enormous reputation with his opposite numbers in Europe', to use his personal magnetism to convince his continental colleagues. As such, the approach highlighted again the important agency of eminent scientists over activities of political value.[79]

With focus thus returning to Cockcroft's HTGC proposal, Harwell asserted that the project, despite being assured of reasonable funding were it to remain a domestic venture, would require the construction of an experimental installation before it could be considered a realistic prospect. Britain's burdensome AGR research placed such a request outside its financial reach, and so Cockcroft deployed his diplomatic skills to both rally support for a joint venture among his European counterparts and simultaneously to persuade domestic officials of the scheme's advantages.[80] In so doing, he successfully married the project's need for funding with the political desire for a cooperative project to validate the OEEC approach, all while protecting Britain's true technical interests. As Cockcroft himself identified: 'we could give them a project which holds good promise for useful economic development, without taking anything of immediate importance away from the Authority's own reactor programme. **The H.T.G.C in fact appears to represent the best compromise between offering OEEC something which is either so good we should develop it ourselves or so unpromising as not to warrant serious study**' (emphasis added).[81] Assuredly, then, the HTGC would provide an important new addition to Harwell's design library while keeping Britain's prize technological assets away from European eyes.

But how was such a joint arrangement to be paid for? For their part, the Authority understood the importance of securing sizeable financial contributions from their prospective OEEC partners and warned Cabinet against making an oversized monetary commitment to maintain the fig-leaf of an 'international' project when the results of the work would become available to Euratom as partners anyway.[82] The project was thus caught between two stools: it would eventually be conducted independently and would be internationalised only with sufficient foreign support, with little middle ground for tokenism. Yet Cockcroft's hand in raising interest overseas was strong: in addition to his personal prestige, Harwell's conviction in its research and Britain's participation in Halden both combined to persuade neighbouring nations of London's sincerity. In Paris, the OEEC's Scientific

Advisory Committee reported that most continental states were interested, with West Germany especially keen to explore HTGC reactors.[83] Furthermore, the German delegation at the OEEC were impressed at Britain's apparent will to prosecute the project independently if a collaboration agreement could not be reached, interpreting it as evidence of the project's 'practical technical importance', and so requested their masters in Bonn to support the project for political and technical reasons.[84]

As events transpired, London was eventually required to reinforce its sincerity by paying more than its share of Dragon's costs, and in January 1959 the AEA confirmed its decision to spend another £3.6 m on top of its existing £4.34 m contribution to ensure that the project (and its political benefits) stayed alive (Table 6.2).[85] This action was accompanied by a redoubled concerted diplomatic effort to win funding from overseas, with the Foreign Office briefing Macmillan that 'from the political angle we would deplore the collapse of the joint project at this moment. Moreover, it would be an unfortunate omen for future United Kingdom/Euratom cooperation if the latter were to decide that they could not offer to take part in the most promising project we had been able to suggest for joint research'.[86] Consequently, the Prime Minister was asked to use his considerable influence at the highest level to persuade Euratom to participate. Despite Britain's urgency in pursuing foreign support, it thus emerges that the decision to internationalise Dragon was not merely a desperate plea for funding, and that the AEA was clear of both its technical terms *and* the

Table 6.2 Contributions to 'Dragon'

Participant	*1st Contribution (5 years)*	*2nd Contribution (+3 years)*
Euratom	(31.9%) £4,340,000	(46%) £11,500,000
UKAEA	(58.4%) £7,940,000	(40.8%) £10,200,000
Aktiebolaget Atomenergi (Sweden)	(3.2%) £440,000	(4.4%) £1,100,000
Swiss Government	(2.4%) £330,000	(3.3%) £825,000
Danish Atomic Energy Commission	(1.5%) £200,000	(2%) £500,000
Austrian Government	(1.4%) £185,000	(1.85%) £462,500
Institutt for Atomenergi (Norway)	(1.2%) £165,000	(1.65%) £412,500
Total	**£13,600,000**	**£25,000,000**

OEEC Dragon high temperature reactor project First Annual Report: 1959–1960, Annex B: Scale of contributions, July 1960, TNA, AB, 32/26; revised agreement concerning the high-temperature gas cooled reactor project, Annex B: Scale of Contributions, undated, TNA, AB, 32/24 political value of the project. A Briton would be installed as managing director and the project would be forced into existing national administrative structures to facilitate speed. Additionally, it was decided that the scheme should cease after the experimental phase, and that if Dragon looked capable of producing commercially valuable power systems at that stage then each participant should pursue the HTGC concept independently.[87] As Britain's OEEC delegates put it, the project therefore prized the 'creation of knowledge not of physical assets'.[88] The AEA concurred, desperate to avoid 'an elaborate and high-sounding organisation on the lines of Eurochemic'.[89]

The Dragon Agreement was signed in March 1959, but despite representing a considerable diplomatic victory for the AEA, the project's significance as an international organisation has been contested.[90] In his analysis, Henry Nau has contended that only 'low-priority' projects were offloaded to joint schemes, a view contradicting historian Roger Williams' later assertion that the HTGC system was a significant prospect marginalised only by Britain's overriding and resource-intensive AGR programme.[91] While the project was certainly not immediately of vital domestic importance, leading Cockcroft to seek funding overseas, the low fuel costs promised by HTGC machines rendered them attractive for future development and they were consequently far from trivial.[92] Indeed, Cockcroft's analysis is instructive: an insignificant project would have little value in encouraging international cooperation, and so it is possible to expand Nau's definition by contending that, at least in the case of Dragon, there was a minimum salience required for collaborative projects to succeed. Also important was the fact that, by contributing to Halden, Britain had gained much larger investment for Dragon, representing a piece of good business negotiated through what Rowland Pocock has called 'the unexpected diplomatic talents' of John Cockcroft.[93] A boiling water reactor was not among Britain's R&D priorities, but participation in Norway was nonetheless a shrewd move that capitalised on the prestige of British scientists. When combined with the political goodwill generated by driving successful projects, the exchange must therefore be identified as a significant success.

It was a timely affirmation that the OEEC could deliver useful research projects, particularly considering the rush among the Euratom states to build their nuclear infrastructure in concert. The Euratom Treaty had mandated the founding of a Joint Nuclear Research Centre, and in July 1959 the Ispra laboratory of Italy's nuclear authority, the CNRN, was elevated to this purpose. This uniquely European foray into Big Science was not problem-free, however, and a journalist from *Le Monde* noted cynically that, although it was claimed that the centre's inherent multilingualism would not lead to unnecessary confusion, neither would anybody assert 'that this diversity was enriching'.[94] Other centres were soon added to the network: in 1960 a Bureau for Nuclear Measurements was founded at Mol, while the High Flux Reactor at Petten and Institute for Transuranium Elements at Karlsruhe began work in 1962 and 1964 respectively. Furthermore, in 1961, Euratom commissioned its first in-house project, an organically cooled reactor named ORGEL. Thus, after years of being merely a hypothetical administrative entity, Euratom was finally beginning its transition into a functional network of centres supported by a strong research locus. With a bilateral treaty signed between the community and Canada in October 1959, Euratom was also rooted as a global actor, and as Commission President Etienne Hirsch later noted, the organisation was thus 'recognised as a valuable partner of the three large western atomic powers'.[95]

The significance of the OEEC projects lay as much in their political as their technical legacy. British scientists demonstrated considerable skill in navigating political channels to deliver projects that could simultaneously strengthen European cooperation while providing Britain with cost-effective access to additional reactor designs. For their part, ministers too showed flexibility in exploiting technical realities to garner prestige and to validate the OEEC approach with action. Nevertheless, although they added extra options to healthy domestic programmes, the OEEC projects restricted themselves to the safe territory of producing knowledge for scientific interest rather than commercial gain, and their reactors served the purpose foremost of trying out designs which would be useful in the future rather than as part of a rapid capacity construction programme. By choosing to attack the politically more secure space of future systems research rather than pursue a more dynamic but contentious installation programme therefore, London pinned its strategy on the hope that such interaction would be sufficient to persuade its neighbours to support its worldview. With Europe rapidly dividing on a political and economic front, it remained to be seen whether this sticking-plaster would be enough to heal the wound spreading across the continent.

Europe Divided

As has already been shown in this chapter, departmental officials in London were keenly aware that Britain should use European nuclear cooperation to incentivise its intergovernmental preferences. This concept has been a popular thesis in existing scholarship and there has been substantial discussion about Macmillan's attempts to realise a Six-compatible Free Trade Area (FTA) which would limit the damage wrought by the Messina powers against British trade.[96] Stuart Butler, for example, has noted how early notions of using potential British Euratom membership to incentivise the FTA proposals were scotched by a Treasury-AEA axis led by Roger Makins, who successfully dissuaded government from prejudicing Britain's nuclear lead in this manner.[97] Alan Milward, meanwhile, has shown how the Authority preferred a nuclear free-trade area which would nullify Euratom and prevent the Six from discriminating against Britain reactors.[98] Yet despite this interest in the FTA, analysis of the proposal's successor, EFTA, remains somewhat general from an atomic energy perspective: Tony Judt, for example, has highlighted how the tiny market offered by Britain's Alpine and Scandinavian EFTA partners was wholly inadequate in a broader sense, while Neil Rollings too has addressed nuclear issues only sparingly in his seminal study on the Association.[99] Thus, the last portion of this chapter will apply these perspectives on Britain's free trade venture, briefly, to the nuclear case.

Responding to the gradual growth of the embryonic EEC, in October 1956 Macmillan had theorised the creation of a new OEEC-wide FTA which would simultaneously prevent any discrimination by the Six against Britain's industrial goods while also excluding foodstuffs so as to protect London's Commonwealth interests.[100] 'Plan G', as it was known in Whitehall, has been lauded by James Ellison as an 'ingenious plan' to accommodate Europe's rising importance to Britain, but the scheme soon antagonised French Ministers who viewed the strategy as a tool to sabotage the Treaty of Rome.[101] Nor were such interests in Paris alone in their hostility and in spring 1958 Paymaster General Reginald Maudling was obliged to provide an instructive analysis of how the proposal had divided Europe. Supporting Whitehall were the Scandinavians, Swiss, Austrians and Benelux states, alongside the faction surrounding Economics Minister Ludwig Erhard in Bonn. Opposing Britain's free trade ambitions were Paris, Francophile Germans such as Adenauer, and the 'European Establishment' comprising European Commission President Walter Hallstein, Economic Commissioner Robert Marjolin and the ever-present Jean Monnet.[102]

Perhaps the most crucial voice had escaped Maudling's notice, however, and the conclusion of France's constitutional crisis saw Charles de Gaulle returned as Prime Minister on 1 June. Shortly thereafter, Macmillan and Lloyd met with de Gaulle and Foreign Minister Maurice Couve de Murville to discuss France's nuclear deterrent and the stalled

FTA discussions. On the first subject, Macmillan made no attempt to dissuade de Gaulle from pursuing an independent French bomb but shared earnestly his experience; 'once you started, you could not stop', Macmillan offered, 'and expenditure was appalling'. Instead, the Prime Minister contended, it would be more efficient to share nuclear weapons, a notion which de Gaulle appreciated, commenting that he might consider hosting foreign-built armaments on French soil.[103] Regarding the FTA, de Gaulle's concern for French agriculture caused him to respond non-committally to Macmillan, whose desperation to obtain agreement before the first EEC tariffs were enacted against other OEEC states in January led him to beg his counterpart to give his proposal the chance to make Europe as rich as the United States.[104] Launching a last-ditch effort to secure the FTA, Macmillan thus wrote to de Gaulle: 'I do not see how one can divorce economic and political grouping', the Prime Minister claimed, 'Europe is already tragically divided from Stettin to Trieste and I am very anxious to avoid any further division'.[105]

Unfortunately for Macmillan, his plan was abruptly terminated in November 1958 when Paris scotched any notion of a free trade area delivered via the OEEC.[106] In truth, French policy makers had previously considered extending the EEC's tariff cuts to all OEEC members, but they were dissuaded from doing so by American officials who would not tolerate such widespread discrimination against Washington's trade interests.[107] In response, London instead instituted EFTA, a free trade area comprising Austria, Denmark, Norway, Portugal, Sweden, Switzerland and the UK. In his diary, Macmillan stated bluntly the price of failure: at stake was the 'survival of the industrial life and strength of Britain'. Should meaningful opposition to the Messina powers not prove achievable, he complained, 'then we shall undoubtedly be eaten up, one by one, by the 6'.[108] After exhausting negotiations, the EFTA agreement was finally signed in Stockholm on 4 January 1960.

The importance of these events in a nuclear context was twofold. Firstly, Macmillan's pursuit of EFTA cemented the division of Europe between an increasingly confident Six and a peripheral Seven. As Dulles argued before the House Foreign Affairs Committee in early 1959, the blame for the Cold War lay squarely with Moscow, whose tireless attempts to spread communism directly contradicted Washington's desire to solve global problems such as decolonisation and atomic energy. However, the task of defending democracy was no longer purely Washington's responsibility: with Euratom and the EEC now firmly established, Dulles opined, a new

Europe was emerging which was eager to assume its global responsibilities.[109] Such notions were repeated by leading Europeanists: in a speech to American industrialists in late 1959, Hirsch explained how Euratom's aim had always been as political as it was economic, but that the time was approaching when a united Europe powered by communal energy resources could help Washington to tackle 'common world-wide tasks'.[110]

In turn, this division fed the second important problem arising from EFTA, namely that Macmillan had been unable to contrive an arrangement which preserved Britain's access to both the Commonwealth and the lucrative markets of the Six. Although the tariff reductions instituted under EFTA applied only to manufactured goods (as in the original 'Plan G'), the association's demand for industrial exports remained small, and so, as Tony Judt has argued, Europe's 'peripheral' nations offered poor compensation for the Six's discrimination against Britain.[111] Pressing enough in most sectors, such concerns were exacerbated in the nuclear field by the fact that only the largest continental nations could immediately justify purchases of the power reactors which Britain aimed to export. Indeed, preserving Britain's access to European markets was imperative: as Alan Milward has shown, the AEA wished in fact to abolish tariffs on nuclear equipment between itself and Euratom in the hope of eventually dominating Europe's reactor market.[112] Yet Milward's brief analysis understates the severity of Britain's need to secure such an arrangement: briefing Macmillan over his meeting with Euratom's Commissioners in early 1959, the Foreign Office stressed the need for a nuclear free-trade area *with or without* a general FTA arrangement, highlighting how critical nuclear trade had become as an objective in its own right. Significantly, their brief thus advised Macmillan to offset the caustic response of some members of the Euratom Commission by launching a charm offensive against representatives of national governments who distrusted the Commission's 'empire-building' to ensure that British reactors were not discriminated against.[113] By neither securing Britain's access to the Six nor providing a satisfactory alternative market of comparable size, EFTA consequently did little to further Britain's nuclear commerce.

With Britain's access to Europe's primary markets jeopardised, the attempt to patch the 'Plan G' area with EFTA, as Neil Rollings has shown, began a trend in which British business gradually lost faith in Whitehall's European policy, leading it to lobby for EC membership with increasing vigour.[114] Macmillan's hesitant approach only allowed such fissures to deepen, and by early 1959 the French ambassador in London reported to

Couve that British public opinion was witnessing a steady growth in support for EC accession.[115] Undertaking a proactive review of Britain's European policy, Macmillan consequently commissioned a Cabinet reshuffle, transferring Prime Ministerial responsibility for atomic energy to Lord Hailsham, who was made Minister for Science. Furthermore, Edward Heath was effectively created Deputy Foreign Secretary, tasked, importantly, with special responsibility for 'European questions'. This was Macmillan's solution to the increasing pertinence of continental diplomacy: while not creating a Minister for Europe as he had often been advised, the Prime Minister now delegated European issues to a dedicated representative.[116]

Existing literature has identified EFTA as something of a runners-up prize in Britain's economic strategy. John Young, for instance, has asserted that by instituting EFTA to succeed the failed FTA proposals, Macmillan in fact cemented Europe's division and bound Britain to a bloc treated instantly as a 'virtual irrelevancy' by the Six.[117] In addition to such claims, however, one must also acknowledge the grave consequences for Britain's nuclear sector wrought by Macmillan's deployment of EFTA as a substitute for his failed FTA proposal. In addition to worsening the split between Six and Seven, EFTA did nothing to provide Britain's civil atomic exporters with alternatives to Europe's largest markets, a fact only confirmed by the tariff barriers erected by the EC after 1959. With Euratom now firmly established, Britain's nuclear prowess was thus experiencing a rapid decline in its value as a diplomatic tool.

Conclusion

As identified in the introduction to this chapter, existing scholarship has readily accepted the interplay between atomic energy and Macmillan's FTA proposals, analysing how Britain's interaction with Euratom was deemed a vital tool in the battle to reconcile the Six with other OEEC members. Indeed, Alan Milward has argued conclusively that the US-Euratom Agreement effectively terminated notions that Britain could remain aloof from the EC and survive. With the importance of atomic issues thus underlined, this chapter has demonstrated how Britain's nuclear diplomacy after 1958 was weakened by numerous problems including American competition, limited capacity, poor diplomacy and modal shifts in continental fuel supplies.

Assuredly defending its technological lead, Britain was progressively replaced as Euratom's principal partner by Washington, where officials considered the community a crucial component of continental strength. The 1958 US-Euratom Agreement guaranteed the community's first 1000 MW of installed capacity to American firms, and Eisenhower brazenly extended subsidies to ensure the economic superiority of US reactor models. Pursuing doggedly the nuclear free trade area demanded by the AEA, Britain promptly devised a counterstroke agreement that protracted its established system of bilateral treaties but which offered no direct or special support to the new community. A lack of spare money and other resources thus encouraged London to adopt a commercial attitude based on *quid pro quo* exchanges that would compensate its expensive researches. Put simply, Britain and the United States were not playing the same game.

Britain's position was further weakened by the AEA's inability to address the lack of common ground shared by itself and the community. Euratom's self-appointed target was to create a technical nucleus of equal stature to the UK, while British interests demanded the Messina powers remain technologically inferior in order to facilitate the exploitation of their markets by native firms. These structural concerns were further exacerbated by a lack of tact: Whitehall continued to regard Euratom as a commercial entity and thus failed to cultivate good relations with the community's commissioners, allowing relations that were already strained on an ideological level to become deep-rooted personal disagreements. Nor were these problems helped by the rebalancing of Europe's fuel economy during 1958–1959. Responding partly to Eisenhower's import quotas, crude oil prices fell after Suez and Europe accordingly began to prioritise oil-fired plants over ruinous atomic energy projects. With the energy crisis thus abating, the window of opportunity available to Britain's PIPPA reactors, which depended on their immediate availability to secure sales, rapidly slammed shut.

Yet although Britain's commercial position was undermined, its approach to European nuclear collaboration enjoyed some limited success. This chapter has examined the important political dynamics which propelled the OEEC nuclear activities undertaken by Britain as it sought to incentivise its FTA proposals. Accordingly, it has argued that British scientists and politicians alike expertly navigated contemporary technical realities to produce communal projects which released important political capital while also supplementing the AEA's domestic research. Nor were these projects mere gimmicks undertaken to promote a veneer of British cooperation: Dragon in particular was an important experiment which the Authority would eventually have enacted themselves. Consequently, one must defend London's approach from Alan Milward's assertion that such action represented 'leadership in Europe on the cheap'.[118] Nevertheless, although it represented a diplomatic coup, Dragon remained an isolated undertaking instead of a concerted programme to install generating capacity in its participant states. Moreover, neither Halden nor Dragon were true 'cooperative' projects, comprising as they did of existing domestic schemes which were internationalised temporarily with the intention that they revert to domestic control at the conclusion of their respective cooperation agreements. As such, it must be contended that such projects, while more technically substantial than critics have historically allowed, remained an important but restricted success.

Finally, this chapter has elaborated further the AEA's preference for a nuclear free trade area identified by Milward and Butler, and contended that traditional criticisms that EFTA did not grant Britain the large industrial markets its exporters demanded are particularly pertinent to the nuclear case.[119] With Europe about to experience the first EEC-wide tariff reductions in 1959, Macmillan's failure to secure Britain's unhampered access to the Six via either the FTA or EFTA left its atomic firms isolated from the only markets which would conceivably require their wares, severely blunting their penetration overseas. When combined with the declining economic case for nuclear energy, the technology was by late 1959 significantly devalued as a tool capable of resolving Whitehall's need to accommodate the Six. Europe was dividing into a supranational core and a peripheral Seven, and it was this political environment more than the technical interests of the AEA which would determine the ultimate end of Britain's atomic sovereignty analysed in this book's final chapter.

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CHAPTER 7

Atomic Energy, the Cold War and the EEC, 1960–1962

Britain entered its third nuclear decade with the political and economic situation in Europe still in a dangerously unbalanced state. On 4 January 1960, the EFTA Convention was signed in Stockholm, while the threatened implementation of common external tariffs by the Six that summer also began to widen the schism emerging between the two economic blocs. The growth of this fissure could scarcely have been more ill-timed, coinciding as it did with a slump in relations between the Cold War superpowers that underlined all too clearly the need for greater European unity. A disastrous four-power summit in Paris in May 1960 and subsequent crises over Berlin and Cuba animated Washington into reconsidering the hostility towards Moscow that had hitherto, in historian David Reynolds' words, rendered 'serious summitry' impossible.[1] Designed to relieve tension, these frequent talks also forced an aging Harold Macmillan to become, as William Wallace has noted, 'the first British Prime Minister to make constant travel a feature of Britain's claim to exceptional international influence'.[2] Marked by discord and distrust, the early 1960s were consequently punctuated by constant meetings which would test political and technical officials to their limits.

With this uncertain diplomatic landscape as its backdrop, the cause of European unity assumed a new relevance, and existing scholarship has identified how these years were characterised by Macmillan's struggle to 'come to terms' with Britain's declining position relative to the Six. The Prime Minister was faced during this period with the impossible task of

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maintaining equilibrium between London's traditional 'three circles' and his fear of an economically disastrous exclusion from the Six led him in 1961 to apply for membership of the group, a gambit which Wolfram Kaiser has argued did not represent 'a radical change in British foreign policy' but rather a calculated ploy to prolong London's influence by enabling ministers to 'put on a new mask which would enable them to play the traditional world power role'.[3] Such notions have been disputed by John Young, however, who has contended that a combination of American unilateralism towards Moscow and British fears surrounding a unified Six-power diplomatic bloc in fact *forced* the Prime Minister into his application.[4] Finally, Anne Deighton has noted how Britain's traditional assets, namely its Commonwealth and Atlantic connections, had by 1960 become 'millstones' in its attempts to find a satisfactory settlement with Europe.[5]

With their aloofness engendering increasing impatience in Bonn, Paris and Washington, ministers in London now returned to the notion that cooperation on atomic technology could provide valuable collateral in their bid to secure a satisfactory political and economic resolution. This chapter, therefore, examines how the failure of Britain's abortive attempt in 1960 to join the ECSC and Euratom as a means of staving-off full-blown EEC membership (described here as 'partial integration') marked the death of the notion, active since 1955, that civil atomic cooperation retained the allure to solve any diplomatic problem. With this failure described, this chapter will then evaluate how Britain's atomic authorities planned for life within the supranational organisation that they had always opposed, and will contend that UK technicians faced this challenge by adopting a subtle subterfuge in which they would appear to be the 'best Europeans' in order to maximise Euratom's investment in British nuclear facilities.[6] In this way, it will restore to the general narrative the nuclear story which has hitherto been sidelined in existing literature by the political aspects of Macmillan's 1961 EC application.

Racing the Clock: Macmillan and Partial Integration

The years after 1960 are often characterised as the period in which Macmillan slowly reconciled himself with the need for Britain to join the Six Messina powers. Facing increasing hostility from Paris, Bonn and Washington, the Prime Minister was pressured by numerous forces at home and abroad first to attempt to negotiate special arrangements from his major European neighbours, and subsequently to apply for full EC admission. A key aspect of this slow transition was the realisation in Whitehall that civil atomic power could potentially if belatedly offer the bargaining chip so desperately needed to entice a satisfactory political and economic agreement from the Six. As such, this chapter will demonstrate how the gambit marked a crucial turning-point in nuclear energy's role as a diplomatic tool.

1960 began promisingly for Macmillan: spearheaded by Washington's Under Secretary of State Douglas Dillon, a Special Economic Committee met in Paris on 13 January to devise a working group capable of resolving the ongoing impasse between the Six and Seven.[7] Their recommendations were approved by the OEEC Council the following day, and both parties, as Dillon subsequently reported to Eisenhower, could now see the 'possibility of settling their differences by submerging them in a larger program of cooperation including the U.S.'.[8] Addressing the Council of Europe a week later, British Foreign Secretary Selwyn Lloyd also struck a conciliatory note with his continental neighbours, communicating his regret that Britain had declined to join the ECSC and stressing that, although London remained unable to integrate with the Six, British ministers would continue to pursue the development of a 'peculiarly European association' as the best hope of unifying the continent.[9] Nevertheless, these appeasing overtures were still unsustainably meagre in comparison with the integrationist momentum which was building across the Channel. On 3 March, EEC Commission President Walter Hallstein issued his plan to accelerate the community's implementation by increasing the reduction in *internal* tariffs between member states scheduled for July 1960 and January 1962 from 10% to 20%, and by bringing forward the implementation of a common *external* tariff by eighteen months to July 1960. Supported by Eisenhower and other influential players in the Republican administration, Hallstein's proposals effectively sabotaged any reconciliation between Six and Seven, in turn inspiring the German weekly *Der Spiegel* to assert that 'to the seven EFTA states, as well as the Federal Economics Minister and West German industry, the gauntlet has been thrown down'.[10] Such notions naturally caused considerable alarm in London, and Macmillan was forced to amend the agenda for his hastily arranged trip to Washington to discuss a nuclear moratorium to also include time to debate the Hallstein problem.[11] On 28 March 1960, Macmillan therefore emphasised to both Dillon and Secretary of State Christian Herter the serious damage to Britain's trade that would be wrought by its exclusion from the Common Market. At present, the Prime Minister stated, around half of British exports to the Six faced a 10% discriminatory tariff, but this would rise to 94% if the Hallstein proposals were implemented fully. The political result of this, Macmillan warned, was unthinkable: falling exports would weaken sterling and encourage trade deliberalisation, while the British public would no longer sanction the spending of £60 m of public money a year to maintain troops in Europe 'as they would feel their economic distress was caused by German discrimination'. Under such circumstances, he reasoned, the British Army of the Rhine would have to be withdrawn and European security would essentially collapse.[12]

Accompanied by his atomic weapons guru William Penney, Macmillan spent his time with Eisenhower discussing nuclear weapons, and scored a considerable success in negotiating the purchase of American Skybolt missiles in exchange for allowing the United States to use submarine bases in Scotland.[13] The achievement was rendered all the more significant by the pre-eminence of those elements hostile to Macmillan's stance: the American position on disarmament, as the Prime Minister recorded in his diary, had represented a clear 'triumph for the State Department over the Pentagon and the Atomic Energy Authority'.[14,15] Despite this victory, however, the Washington meeting also caused a public relations disaster in Europe when comments apparently made by Macmillan about the threat from resurgent German Nazism and the consequent need for a neo-Napoleonic Anglo-Soviet alliance were leaked to the continental press.[16] In a sensationalist headline, *Le Parisien* quoted the Prime Minister as promising that 'if France and Germany unify Europe, Britain would take the head of a coalition against them'.[17] Denied outright by the Foreign Office, these 'most mischievous' comments (as Macmillan described them in his diary) were nonetheless embellished and printed in several influential broadsheets, further damaging the Prime Minister's standing on the continent.[18] In Bonn in particular, outraged ministers responded by redoubling their support for the EEC, leading Adenauer's Cabinet to narrowly vote in favour of Hallstein's acceleration formula. By antagonising what Wolfram Hanrieder has labelled the 'heterogeneous group of Government critics' comprising a peculiar alliance between Erhard and the SPD, Macmillan's words consequently undermined the lobbies in Bonn historically most sympathetic to his cause.[19]

Macmillan was no more successful with the French. At a meeting at the Presidential retreat in Rambouillet during mid-March, de Gaulle informed the Prime Minister that without global disarmament, France would naturally require nuclear arms of its own.[20] Although absent from the official record, Macmillan noted in his diary that he had tentatively held out the possibility of assisting his opposite number in this matter 'either with American agreement or connivance' and noted de Gaulle's interest in working together on an Anglo-French bomb.[21] Acting without consultation, Macmillan's unexpected proposal therefore marked, as Charles Williams has observed, 'the nearest Macmillan ever came to offering de Gaulle full Franco-British cooperation on the nuclear issue'.[22] Yet it was a false dawn: enticed by Macmillan's alleged offer, de Gaulle asked him directly during their April meeting at Buckingham Palace if he would 'contemplate' joining the Common Market.[23] The Prime Minister, having just reinforced the 'special relationship' by purchasing Skybolt, and still unwilling to break economically with the Commonwealth, declined.[24] In both a strategic and a political sense, therefore, Macmillan had unambiguously prioritised America over Europe.

Continental frustration with Macmillan's intransigence was further mirrored in Washington. These feelings manifested themselves in an April 1960 telegram from John Whitney to the State Department in which the American ambassador in London reported that ministerial thinking at Whitehall was 'dominated by traditional opposition to a single large power unit on the continent' and that the EEC presented Britain with difficult political and economic questions that it would prefer to avoid. Thus, although the ambassador generously allowed that Macmillan's flamboyant references were just harmless symptoms of the Prime Minister's 'liking for historical analogy', he nevertheless concluded sharply: 'harmonizing apparent separate interests of Commonwealth, Anglo-American alliance and UK relations with Continent still eludes HMG and there is no evidence as yet of any real imaginative thinking on subject Britain's future role in Europe. Old ideas thus continue far too much to determine limits of UK policy'.[25] On the continent as in Washington, then, the problem was clearly understood: Britain's Prime Minister had been exposed as a romantic struggling to find answers to new problems in the lessons of the past. As such, any fresh initiative towards solving the impasse between Six and Seven would first require a serious reconsideration by London of its priorities.

Whitney's sobering analysis did not particularly contradict the prevalent mode of thinking in Whitehall, where ministers had also begun to comprehend their predicament. On 27 May, the European Economic Association Committee offered Macmillan two distinct choices, informing him that there could either be ‘close association’ with Europe or that Britain could remain outside the Six and attempt to mitigate the resulting economic damage.[26] In response, Macmillan circulated a questionnaire requesting further information from his subalterns, and was answered by the Economic Steering Committee on 6 July. Attempting to identify what had changed since London’s rejections of the Six in 1956 and 1959, the committee posited four theories. Foremost, the Common Market was no longer a hypothetical construct but rather a reality that British officials now better understood. Secondly, Britain had finally been disabused of the notion that the Six would be so grateful for British association with them via a Free Trade Area that they would allow London to dictate the terms of engagement. Instead, the price of accession had increased dramatically, and the priority now was to protect Commonwealth trade and domestic agriculture from devastating discrimination. Thirdly, the economic resurgence of France and Italy had increased the size of the market offered by the Six and with it Britain’s need to join the grouping, while finally, it was now plainly obvious that the United States was prioritising its political goals over its economic imperatives. Since 1956, ministers had believed that Washington would oppose the imposition by the Messina powers of tariffs against its trade, but now, in defiance of GATT, it was clear that American statesmen were prepared to accept ‘a measure of discrimination’ against American exports as the ‘commercial price’ for realising the Common Market.[27] Thus, Macmillan was brought up to speed in unambiguous fashion: Washington’s support was no longer assured and Britain risked increasing international isolation.

With the pressure to find an innovative solution mounting on the government, Conservative backbenchers were encouraged to consider alternative means of breaking the deadlock between Six and Seven, including the possibility of employing Britain’s atomic sector as a bargaining chip. In response to the Hallstein proposals, Conservative MP Peter Kirk wrote a letter to the *Times* on 6 April, highlighting that Britain was now faced with the dire choice of either accepting disastrous discrimination against its trade or beginning an all-out economic war between Six and Seven. Seeking to obviate this dilemma, Kirk therefore proposed that Britain join the ECSC and Euratom in order to rebuild continental trust. ‘So far as Euratom is concerned’ Kirk wrote, ‘our basic objection to that seems to have been that we would have been giving far more than we would have received; I doubt if that was ever true, and even if it is true now, it would certainly not be true in 10 or 15 years’ time’. Instead, the atomic sector could be sacrificed for political advantage, with Kirk skilfully downplaying Britain's loss of sovereignty by highlighting its diminished relevance in the era of the hydrogen bomb.[28]

The letter enjoyed considerable success in the corridors of Whitehall: Lloyd considered it 'quite good' and instructed Foreign Office officials to discuss the matter in-house.[29] The response from these delegates was instructive, analysing as it did Britain's position from the distinct and separate standpoints of its political motives and technical considerations, underlining thereby the growing dichotomy of British interests. On the technical front, the officials supported the Eden government's original conclusion that there had been few incentives to join Euratom as a founding member because Britain's pioneering position had given it little reason to pool its valuable information. Additionally, the respondents noted that supranational atomic integration had originally been opposed also by German industrialists, and that Britain had wished to maintain contact with these influential firms via its traditional commercial channels. Significantly, however, this context had altered somewhat: lately, Euratom had evolved into a research-focused organisation, and the passing of the energy crunch that had peaked during 1956 also meant that industrial atomic stations would now be deployed at a later stage than had been expected during the original Community negotiations. Consequently, Plowden's exhortations that Euratom accession would drain Britain's resources and retard its domestic programme were weakened, and it was doubtful that continued isolationism would generate serious technical merits.[30]

Turning to the contemporary political context, the Foreign Office officials felt that Britain's atomic aloofness had thus far been justified by the substantial support London had assembled among European nations outside the Six. Despite the success of this strategy, however, the growing strength of the Messina powers meant that atomic integration was steadily increasing in political merit, although such a move would need to be carefully managed to avoid giving the impression to the EFTA states of a wholesale change in British policy. Lloyd's subordinates therefore concluded that while the issue remained evenly balanced, the arguments sustaining Britain's rejection of Euratom since 1955 were weakening, while the potential advantages of accession to the group were steadily growing.[31] Reporting these findings to the Prime Minister, the Foreign Secretary consequently recommended that Downing Street re-examine the possibility of Britain joining the Six in their joint atomic venture, to which Macmillan responded that such an undertaking would be a 'fine thing' and issued his instructions accordingly.[32]

So far, the notion of Britain joining Euratom had been considered purely within its diplomatic context; driven by the need to offer collateral to the Six in order to get negotiations moving again, the notion remained a *political* initiative that would now require technical scrutiny by London's nuclear mandarins. Predictably enough, this immediately proved problematic and in contrast to the positivity of the Foreign Office, the idea was dismissed outright by the Atomic Energy Executive, who contended that the logic against British participation in Euratom was even stronger now than when the issue had last been discussed.[33] To the technocrats, there was little reason to adhere to the Community aside from the non-technical diplomatic benefits, and even these were considered to be marginal. Indeed, the following week, Roger Makins, Plowden's newly appointed successor as AEA Chairman, reported to the Executive that ministers had forwarded only 'a political argument of a general nature' as a reason for joining the Six.[34] Nor were the Authority without champions at Whitehall, where their concerns were well-received by Lord Hailsham, Macmillan's Minister for Science, who in turn communicated them to the Treasury. At stake were Britain's lead and its atomic riches: 'Euratom is a bureaucracy with no assets', Hailsham argued, while 'the A.E.A. has large assets without an excess of bureaucracy'.[35] Opposition to atomic integration was thus not restricted to the technical plane.

Against the backdrop of this discord, on 5 May 1960 the Foreign Office telegrammed the British ambassadors resident in the capitals of the Six to request them to evaluate the hypothetical reaction of their respective hosts to a British effort to join Euratom and the ECSC. The political importance of the scheme was paramount, and so the ambassadors were questioned directly: 'would such a move be likely to improve the chances of a resolution of the Six/Seven problem?'[36] Fearful however that any sign of flexibility on the British side would merely encourage the Americans and French to close ranks, Macmillan shrewdly requested discretion from his diplomats and informed the Foreign Office that timing of any new initiative would be critical in the event of a favourable answer. After all, as he wrote to Lloyd, 'we do not want to give any more handle to Dillon and Co. to attack us'.[37] The brief to the ambassadors supplied by the Foreign Office was therefore written in explicit terms: 'no hint must be given of any re-appraisal by Her Majesty's Government'.[38]

In Paris, ambassador Gladwyn Jebb expected a 'guarded welcome' amid 'smug satisfaction' from the French, although he stressed that Britain's application would require the swift announcement of a fresh initiative to solve the Six-Seven problem to avoid giving the impression of a new plot by 'Perfidious Albion' to divide Europe. Additionally, London must apply for both Euratom and ECSC membership simultaneously to forestall accusations that it was either monitoring France's nuclear programme or merely joining an ageing organisation of fading relevance. Should such undertakings not be forthcoming, Gladwyn warned, Britain's offer would make little impact on a French government hostile to partial integration and would possibly even make Paris more obstinate. With this in mind, Gladwyn recommended that the government make an announcement immediately in order to pre-empt French suspicions that Britain objected *politically* to the Six.[39]

The other ambassadorial responses indicated a common deference to French opinion among the remaining five states: Brussels in particular would only agree to the scheme if it garnered French approval, while the Dutch also expected a renewed British effort to resolve the Six-Seven divide.[40] From Bonn, Christopher Steel encouraged the move to bolster opponents of Adenauer's overbearing leadership and francophilia. 'The Federal Government, for the purposes of effective action, consists of the Chancellor', Steel wrote. 'He would be intensely suspicious and probably wish to be guided by the French'. Nonetheless, it was felt that a significant offer to prevent a continental fissure would be well-received by moderate Germans and might restore their faith in British intentions.[41] Finally, Rome would reluctantly welcome the move, while Harold Caccia in Washington sensed an approval of the idea in principle, albeit once more with the caveat that Eisenhower's administration would expect an improved British offer regarding the Common Market.[42] The Americans, Caccia contended, would see a Euratom application as a gracious gesture but also as a signal that with 'one more heave' they could get Britain into the EEC; without such a follow-up any 'favourable reaction would soon wear off'.[43] These views emerged even more explicitly during subsequent exchanges: on 30 May, Arthur Tandy at the UK Delegation in Brussels reported that a member of Washington's Mission had informed Kenneth Christophas, a British official, that if London were to apply for Euratom and ECSC membership only, 'the United States Government would oppose acceptance of this by every means within their power no matter how much embarrassment was caused'.[44] Caccia's hesitant attitude was consequently validated: Britain's apparent attempts to fracture the Six in this manner would not be tolerated across the Atlantic and, rather than providing a comfortable compromise, such an attempt would instead be interpreted as a sign of weakness.

The significance of the exploratory discussions by Britain's ambassadors and diplomats was twofold: firstly, in contrast to its previous protected status, atomic energy was now conceived of in Whitehall as an instrument with which to solve the Six-Seven problem. As Gladwyn put it, applying to join Euratom and the ECSC would make a 'significant **political** gesture' and allay French suspicions that Britain had 'serious **political** objections' to the Six (original emphasis).[45] Secondly, however, such a request would also be effective *only* as a precursor to a new initiative expected of Whitehall, with the potential and serious consequence of Britain's induction into the Common Market. Henceforth, then, atomic energy would no longer be considered a protected sector but would now be irrevocably bound to the fate of notions for a wider arrangement comprising all three communities.

Having considered the warnings of his ambassadors, Macmillan opted to press ahead with his exploration of partial integration anyway, a decision that Martin Schaad has attributed to the willingness of ministers hungry for resolution to overrule Britain's cautious diplomats. As Schaad has identified, London's urgency was inspired by the abortive Paris summit of 15–16 May 1960, held immediately after the shooting down over Yekaterinburg of an American spy plane by the Soviet Union.[46] Lasting barely three hours, the conference was only saved from complete disaster by Macmillan and de Gaulle, while Eisenhower and Khrushchev pointedly refused to shake hands during proceedings, demonstrating on a symbolic level the breakdown in relations which now beset the two superpowers.[47] With the meeting's failure thus underlining the need for greater Western unity, Macmillan's ministers consequently agreed that for the first time since 1958, there seemed to be real willingness on both sides of the Six/Seven divide to find a speedy resolution and to prevent Europe fracturing just as Soviet hostility appeared to be once more on the rise.[48]

The question now arose of how to communicate Whitehall's suggestion to the Six, and the upcoming speech by Britain's Minister of State for Foreign Affairs, John Profumo, to the Western European Union presented the next available platform to officially launch the partial integration proposal. The event was carefully stage-managed by Downing Street and Macmillan repeatedly revised Profumo's cautious early drafts because they were not 'sufficiently forthcoming' for his taste.[49] Eventually taking the podium on 2 June, Profumo announced Britain's willingness to 'consider' Euratom and ECSC membership 'in the context of the wider problem'. The speech stressed the debacle at the Paris conference, and reaffirmed the need for continental cooperation, contending that 'since the collapse of the summit meeting there is a strong tide running in favour of finding some way through the technicalities to the realities'.[50] If the nations of Europe could therefore agree an innovative solution to break the Six-Seven impasse, Profumo suggested, Britain would be willing to trade its atomic prowess.

Unfortunately for Macmillan, the response to Profumo's offer soon became stymied by the fact that the WEU was not the appropriate forum for such a debate, as it held no authority over the Six in concert. With confused foreign dignitaries such as German Foreign Minister Heinrich von Brentano consequently needing to be reassured by British officials that Profumo's speech was sincere, on 16 June, the WEU Ministerial Council meekly referred the matter to an ad-hoc committee comprising Foreign Office officials and the six national ambassadors to London of the Messina powers.[51] The core problem was that partial integration would render the supranational core unsymmetrical: as Brentano highlighted, the 'European Communities had many institutions in common and the question was under study as to how the three Communities could themselves be merged'.[52] Joining two of the three Communities would therefore prohibit future amalgamation between the Six, leading Hallstein to dismiss Britain's gambit as a 'distraction' that would not address 'the whole nub of the problem', namely 'the acceptance by the United Kingdom of the political idea expressed in the Treaties of Paris and Rome'. Macmillan's gambit thus prejudiced Hallstein's objective of a united executive for the EC, a price he adamantly refused to pay.[53]

Having initiated the debate, Whitehall's unwillingness to consider EEC membership now hamstrung the ambassadors' meeting in London, where Britain was represented by Roderick Barclay, a Foreign Office Deputy Under-Secretary with over twenty-five years' experience of European diplomacy.[54] Barclay was a talented negotiator, but he could not prevent the talks from becoming ensnared in circular logic: he would only suggest terms if he felt the Six would welcome a British application to only two communities, while the Six would only consider the question once they understood the terms desired by Whitehall.[55] Britain's strategy had thus only sown confusion, and ministers in London were forced to hurriedly redefine their position. Luckily, the vague references made by Profumo in his speech to the 'context of the wider problem' provided room for manoeuvre. During an ad-hoc session of relevant Cabinet interests including Barclay, the senior Foreign Office mandarin Frederick Hoyer Millar cautioned against giving the impression that Britain would be prepared to join Euratom but not the Common Market, arguing instead that London would offer its atomic prowess only in exchange for a 'wider settlement' which might include *eventual* EEC accession.[56] Also present at the discussion was Makins, who tabled a lengthy list of objections held by the Atomic Energy Authority regarding any potential accession to Euratom. Motivated by his fear of prejudicing Britain's hard-won relationship with Washington, Makins vehemently opposed Britain's loss of atomic sovereignty and dismissed the 'floundering' ambassadorial consultation as mere 'mal engagé'.[57]

Struggling to reach a consensus on how to proceed, the British were eventually spared from having to make any decision by their continental counterparts: eight days after Makins' complaint, Tandy telegrammed the Foreign Office from Brussels, informing them that Profumo's proposal would not even be discussed by the Council of Ministers without a formal application for admission. Tandy attributed this response to the French, who were currently exhibiting a preference for intergovernmental arrangements that did not extend the powers of the communities. The message was therefore clear: the commissioners had 'written off as unworkable' the possibility that Britain might unbalance the three scales on which the Six now rested.[58] In this way, the Six had arrived at the same conclusion in rejecting the proposal that the British had already reached in making it: henceforth, any potential British cooperation in atomic energy on a supranational basis would be bound to a broader politico-economic agreement, and Euratom membership could occur only alongside full participation in the EEC.

The demise of partial integration also coincided with the weakening economic case offered by nuclear plants. As explained previously in this book, Whitehall had in 1957 made plans to install 12 GW of nuclear generating capacity by 1970. By 1960, however, the fossil fuel situation had improved markedly and of the nineteen stations originally envisioned, Britain currently possessed only two with another six under construction. In order to avoid an uneconomical crash-construction programme, the Minister of Power therefore submitted a revised White

Paper which recommended the construction of only one new nuclear station a year. In this way, it was hoped that Britain would maintain its rapid pace of civil nuclear development while sustaining 'a nuclear industry capable of competing for overseas business and of expanding to meet the higher level of our own future needs'.[59] Britain's plant commissioning, begun in 1955 and greatly accelerated two years later, therefore amounted to a false start. Such concerns also plagued Euratom's commissioner Étienne Hirsch, and historians Ian Bache, Stephen George and Simon Bulmer have argued that by the time the Commission 'really began work' in 1960, the energy crisis legitimating its existence had largely abated.[60] Thus, with the immediate need for nuclear energy declining across Europe, the technology was no longer the attractive asset that had so inspired Europeanists five years previously.

Existing works on the partial integration attempt have analysed Macmillan's proposal primarily in relation to Britain's attempts to find an acceptable compromise with the EEC, and have concluded that the gambit succeeded only in convincing the Six that Britain must accede to the ECSC, Euratom and EEC simultaneously. As Martin Schaad has consequently averred, 'ministerial activism had only given further substance to the idea that only British membership in the Common Market itself would solve the political problem'.[61] And yet the failure of partial integration was also extremely significant from a civil nuclear standpoint: the rejection of Kirk's ploy marked the death of the notion, long held by ministers in Whitehall and demonstrated in their recent attempts to incentivise Whitehall's FTA proposals and promote the intergovernmental approach to cooperation, that civil nuclear collaboration could be a decisive tool with which to fundamentally alter the shape of Europe and Britain's position therein. In historian Mauro Elli's words, therefore, by 1960 'the UKAEA had been compelled to recognize formally that political considerations pertaining to the Common Market were more important than the magic mystery of nuclear energy'.[62] Instead, in Elli's view, Britain should have joined Euratom immediately in order to control it, rather than waiting five years to merely concoct a doomed partial integration initiative whose slim chances of success were all but ended by Macmillan's need to appease Cabinet with a gentle step-by step approach.[63] These findings are highly significant when considered in the longer context explored by this book. Since 1945, atomic energy had been recognised as a diplomatic asset of such magnitude that it needed to be jealously shielded even from comrades-in-arms, but this prize bargaining chip had now become politically and economically devalued to the extent that it would no longer be enough to incentivise special terms for London in its attempt to win a satisfactory political arrangement from the Six.

Macmillan and the AEA Prepare for EC Accession

With Macmillan's partial integration attempt having succeeded only in sowing confusion around British intentions, atomic energy's salience as a diplomatic issue suffered a precipitous decline and henceforth the 'European question' would be determined primarily by economic principles. However, any optimism felt by the Prime Minister about his ability to reconcile Britain's primary economic interests with this new reality was soon checked by the ongoing concerns about Commonwealth trade, British agriculture and EFTA, and by the attitude of the French government, that fluctuated in its attitude towards any British EC application.[64] As a consequence, we must now consider the response of Britain's atomic energy lobby to the high-political machinations unfolding high above their heads.

Existing literature has correctly identified that between 1955 and 1961, the AEA successfully restrained the Foreign Office from becoming too enamoured with the idea of considering Euratom accession. Believing implicitly in nuclear energy as a symbol of British virility, the Authority refused to donate sufficiently attractive technical knowledge to the negotiating briefs prepared for London's diplomats, leaving these emissaries to table an offer described by Stuart Butler as 'obstinate and negative' and by Mauro Elli as 'comprehensively inadequate'.[65] In this way, Elli has furthered Alan Milward's long-standing criticism that the AEA fabricated numerous excuses, including concerns over manpower and uranium supplies, to portray an 'indefensibly unrealistic' antipathy towards Euratom.[66] Yet beyond these somewhat blunt statements that the AEA hampered Britain's reconciliation with the Six, there has been surprisingly little research into the atomic lobby's rationale, with authors primarily attributing the Authority's reluctance to cooperate in this manner to its self-image as a national technological champion. As such, current scholarship is largely *reflexive*, and does not evaluate the criticisms the AEA held of Euratom, nor the counterproposals contrived by the Authority to satisfy both its political superiors and its own interests. Thus, this chapter will move beyond the depiction of the AEA as a subsidiary player in the political narrative by contending that the AEA did not selfishly sabotage the Foreign Office's negotiating position, but that it instead adopted subtle counterproposals which sought to make Britain's research effort a net *beneficiary* from its amalgamation into Euratom while still protecting its most valuable projects.

Presented with a potent cocktail of American pressure, steadfastness among the Six, and Commonwealth unease surrounding Britain's place in Europe, Macmillan began around the start of the new decade to progressively withdraw the European question from open discussion. In turn, this marked the beginning of a period typified by the exploitation of what Jacqueline Tratt has labelled 'informal power', in which the government debated the matter largely behind closed doors away from public view. Edward Heath in particular, she contends, was 'exceptionally astute' at manipulating agenda sheets, and consequently 'there was no discussion of substance in the Cabinet on the European issue between 13 July 1960 and 20 April 1961—a time when British policy with regard to Europe underwent its most material modification'.[67] Focusing this analysis onto the atomic sector specifically reveals an even stronger trend: Euratom was not discussed materially by Cabinet between Macmillan's failed partial integration attempt in June 1960 and the latter stages of Britain's EEC negotiations two years later.

Yet despite this clandestine approach, the political pressure on Britain to reconsider its position was rapidly becoming unbearable and by December 1960 it is likely that Macmillan had at least privately fallen in favour of joining the Common Market.[68] Before any application could be considered, however, several political obstacles would require urgent attention. Firstly, Britain's approach was complicated by De Gaulle's wish to couple European political integration with a new intergovernmental structure and defence system in which Paris would replace Washington as the continent's military leader. This 'Union of States' would inevitably weaken the EC and was correspondingly unattractive to the remaining five Messina powers, but Adenauer nonetheless considered it prudent to entrust the issue to a committee chaired by Christian Fouchet, France's ambassador to Denmark.[69] Laborious as this process would be, the Fouchet debate thus rendered any possible British accession extremely complex for many months.

Furthermore, Macmillan had still to inform the Commonwealth of his intentions, and so on 21 July 1961 he called the Cabinet to a 3 pm meeting in his room in the Commons. The timing and location of the meeting were both peculiar, and Gill Bennett has suggested that the stifling conditions of a crowded room in mid-summer was deliberately employed by Macmillan to force a resolution from his acolytes.[70] Whether this tactic was deliberate is debateable: the London weather that day was not particularly hot (the *Times* reported temperatures not exceeding 23 °C).[71] In any case, ministers were invited to present their surveys of Commonwealth opinion regarding any potential British application to the EEC and so Duncan Sandys, the Commonwealth Secretary, reported that Australia, Canada and New Zealand feared for an Anglo-European political union which would prejudice the integrity of the Commonwealth. British concerns for its partners and colonies in Asia and Africa followed a similar pattern: although the territories there acknowledged that the decision to integrate belonged to Britain, they nevertheless remained anxious to preserve key export links with the mother country.[72] With Britain therefore tentatively but cautiously supported by its overseas interests, Macmillan concluded that it would be advantageous to open exploratory negotiations with the Six, although the formal application required to trigger such discussions would need to be carefully portrayed in public as a decision 'to negotiate' rather than 'to join'.[73] Cabinet's intention to apply for the EEC was consequently announced to Parliament on 31 July, with Macmillan arguing that European economic growth could generate 'increased demand for products from other parts of the world'.[74] The motion was carried successfully by 313 votes to five.[75]

Britain's application was communicated by Heath to the EEC ministers in Paris on 10 October. Significantly, his speech terminated conclusively the long-standing notion that atomic integration could soothe broader disagreements, with Heath accepting without fanfare that Britain would join the ECSC and Euratom as a simple corollary once EEC membership was sanctioned. Instead, he dedicated the bulk of his address to an exhaustive critique of the 'three major problems' posed to Britain by EEC accession: Commonwealth trade, agriculture, and its relations with EFTA. Employing the contemporary crisis over the rapid construction of the Berlin Wall to his advantage, Heath thus implored his continental colleagues to accommodate Britain's 'vital interests' and to sanction British accession as a demonstration of their faith in European unity.[76] The crisis in Berlin also prompted renewed Anglo-French talks and de Gaulle arrived at Macmillan's family mansion at Birch Grove in November to discuss both the situation in Germany and Britain's EEC application. The two issues were deeply intertwined, and British officials had already prepared themselves to handle de Gaulle's insistence on displaying a stiff attitude towards Khrushchev. If London were to act as a 'European' rather than 'Anglo-Saxon' power on this issue, Britain's representatives in Paris therefore contended, relations would doubtlessly improve, while any attempt to negotiate a settlement over Berlin would inevitably prompt the General to reject British accession to the EC.[77] Unfortunately for the British, however, it was a different issue that proved to be the largest stumbling block. In response to Macmillan's praise for the Fouchet Plan, de Gaulle kept the Prime Minister guessing about his attitude towards Britain's application, allowing him, as Peter Mangold has shown, to avoid either weakening France's bargaining position or empowering continental and Atlantic critics of his negativity.[78] Such a response left the Prime Minister understandably confused: Britain had always preferred intergovernmental arrangements and could envisage joining a confederation like that proposed by Fouchet. Yet de Gaulle could not overcome his suspicions of the British and their intentions; 'he goes back to his distrust and dislike', the Prime Minister wrote sadly in his diary 'like a dog to his vomit'.[79] From this point forward, then, the negotiation process would be reduced to a crawl by both sides as Britain's pledge to consult the Commonwealth and EFTA was mirrored by the Six's predilection for agreeing a unanimous position after every request.[80]

The deliberations on economic integration were matched, in intensity if not in importance, by an undercurrent of activity as Britain's technical experts debated how to integrate while preserving national interests. Ironically, despite the discord visible at ministerial level, technical exchanges between Britain and the Six were proceeding amicably. At the request of Euratom Commissioner Emanuel Sassen, a delegation consisting of Makins, D.E.H. Peirson and Hailsham flew to Brussels in late November 1960 to meet with the agency's elite. Their discussions were fruitful, with the Europeans announcing their intention to investigate organic liquid reactors and a version of Britain's AGR, and Makins detailing British progress on fast reactors. Importantly, the slowdown in nuclear plant installation had left Britain's atomic industries underemployed, and so Euratom's leaders were also told that British firms remained eager to obtain Euratom contracts where possible.[81] Despite this apparent bonhomie, however, the implications of Macmillan's policy shift for Britain's atomic lobby had long been clear and since mid-July 1961 the AEA had been bracing itself to negotiate its Euratom accession *as a consequence* of an application to join the Common Market.[82] Mimicking Whitehall's position on EEC negotiations, the Authority decided against demanding greater power within

Euratom than France or Germany, instead requesting voting parity and offering a correspondingly equal annual financial contribution of £5 m. Furthermore, the Authority began to short-list sites for a potential Euratom facility on British soil, with Culham and Wantage the early forerunners.[83]

Yet these high-level decisions could not mask the numerous problems inherent in the detail of any Euratom application and on 23 October, the Director of Culham Laboratory, J.B. Adams, wrote to William Penney (since 1959 Cockcroft's successor as Member for Research) to examine the matter. Adams criticised Euratom's scientific standing and the viability of supranational cooperation, contrasting the uncertainty surrounding the birth of the Community with that of CERN, where every participant had quickly asserted that the organisation enjoyed considerable validity. The pay scales employed by the Community were also flawed: 'I remember a ridiculous situation' he recalled, 'when two CEA staff of no great seniority sent by Euratom to Munich were found to have a net salary comparable to that of Heisenberg'.[84] Euratom's apparent weakness was further exposed by the multifarious instruments it employed to conduct research. Firstly, the community could contract work to a national or university laboratory, and the Authority were aware of over fifty such arrangements across Europe and the United States.[85] Alternatively, Euratom might establish a project staffed and financed through contributions from its members, or it could build entirely new laboratories using its own staff.[86] Nor was the community internally harmonious, Adams wrote, and the growth of the West German and Italian atomic projects had clearly tempered French enthusiasm for the Community, an assertion later proved highly prescient when de Gaulle's refusal to allow the Commission to inspect French plutonium facilities caused President Hirsch to resign in 1962.[87]

Dealing with a partner rendered unstable by its competing internal interests would therefore present a unique and unprecedented challenge to Britain's nuclear diplomats. If London were to join the Community, as seemed inevitable, it would consequently be in the Authority's interests to quickly whip the Europeans into shape. Adams' plan therefore hinged on graciously acceding to the organisation in order to 'improve' it, making it 'competent' and 'more effective' as a means of sponsoring atomic programmes. Recalling again the experience with CERN, Adams lamented the absence of Britain's 'steadying hand' during Euratom's early life and claimed, somewhat boldly, that 'there is a saying in Europe that unless the UK is a member of an organisation, there is little hope of making that organisation sensible and successful'.[88] In short, if Britain was to be forced by political edict to participate, then that participation had better be to what the AEA considered its own high standards.

Yet despite these perceived weaknesses in Euratom's organisation, Britain's technical lobby were also aware that its own bargaining position was not particularly robust and that atomic energy had lost much of its lustre in political circles. Britain's atomic lead had also diminished while the improving international fossil fuel environment had reduced the need for dramatic capacity construction, affording foreign research programmes more time within which to prove themselves. At the Authority's Industrial Collaboration Office, officials consequently began to work under the assumption that 'any bargaining power available to the UK is likely to have been largely exhausted in efforts to secure acceptable terms in the Common Market negotiations for UK agricultural and Commonwealth interests—and that any residual bargaining power over Euratom will be exhausted in efforts to exclude the defence programme'.[89] Thus, Britain's civil atomic bureaucrats would be forced to rely on their own diplomatic skills and resources to achieve a satisfactory outcome from Whitehall's political mandate.

Finding its traditional hostility to Euratom overruled by its political overlords in Whitehall, the AEA thus adopted a policy of damage limitation in which it hoped to minimise the impact of joining the Community. Of particular concern was the perennial issue of funding, because the Treasury had made clear that it would not increase its grant to the Authority to subsidise Britain's onward contribution to Euratom. Instead, the Authority would have to win back the funds that it had itself donated to the Community, and so technical officials prepared their accession strategy carefully, anticipating both their moves and the counter-bargaining expected from Europe. Certain that the Euratom Commission would be 'quick to detect and to resent' any sign of British reluctance, officials therefore recommended that the Authority fulfil all reasonable requests to ensure that cooperation gave the appearance of being 'positive, as ungrudging as possible' and 'genuinely fruitful for all parties'. By dispatching its most talented staff to fill Britain's share of Euratom posts at all levels, the AEA was confident of its ability to ensure that the organisation pursued 'sensible' lines of development without risking British national interests.[90] In short, by giving the impression of model behaviour, the AEA would attempt to infiltrate and maximise its influence inside Euratom.

In order to attack this problem effectively the Authority would need a full understanding of the current negotiating landscape and so it promptly established a Steering Committee under Penney to 'study the implications to the Authority of the United Kingdom joining Euratom as part of the process of joining the Common Market'.[91] These political assumptions were not long in being validated: on 28 February 1962, over six months after applying for EEC membership, Macmillan wrote to Couve de Murville in Paris to open negotiations on joining Euratom for precisely these reasons.[92] The application quickly provoked questions from Euratom officials over how Anglo-American agreements to share military-grade uranium would be accommodated within any accession agreement, but the agency's Council of Ministers nevertheless unanimously consented to begin discussions on 14–15 May. Just eight days later the Community's Directorate for Industry and Economy released a detailed report listing the problems posed by potential British adhesion.[93] Key among these was the issue of tax protection, because the Community's external tariff for nuclear products was significantly lower than that employed by London.[94] Furthermore, the AEA's material supply provisions were 'inconsistent with the rights allotted to the (Euratom Supply) Agency', while a full appraisal of Britain's nuclear infrastructure would also be required before Euratom could consider how to best assist the UK reactor programme financially. Nonetheless, the Euratom officials remained positive, contending ultimately that 'it does not appear that these difficulties are insurmountable'. Indeed, the technical benefits of British adhesion were profound: the AEA, in conjunction with Canada, had recently begun research into steam-generating heavy water reactors and was continuing its own work on organic coolants. Such knowledge would consequently be valuable to Euratom's ORGEL programme, and so the report concluded that 'there is no doubt that the Community industries can benefit greatly, through a system of exchanges of knowledge, from the experience gained by British industry'.[95]

From the British side, Penney's Steering Committee met six times between January and June to debate how to structure Britain's Euratom application, addressing particularly the organisational problems caused by recasting the Community's financial plans and introducing British staff into high positions. As Adams had earlier identified, significant British representation at administrative level was key, but would also need to be supplemented by plans to ensure that Britain would extract the maximum technical benefit from its membership. Consequently, the Committee presented its findings to the Atomic Energy Executive on 15 June, emphasising the need to devise strategies that would guarantee Britain the best results from participating in a larger community. Foremost, Penney's group considered it imperative to recoup the £8 m granted annually by the AEA to the Commission: £3 m of this could simply be retrieved simply through standard research expenses, they argued, but the balance could only be bridged by allowing Euratom to form an association with a major research project based in the UK. In practice, this would mean either the new 100 MW steam-generating heavy water reactor (SGHW) being planned at Winfrith Heath, or the Prototype Fast Reactor (PFR) under consideration at Dounreay. The Authority's Member for Reactors, William Cook, consequently advocated that the PFR be selected because it possessed little immediate export potential, while the SGHW provided British industry with an 'excellent opportunity of association with water reactors': accordingly, it would be 'highly desirable to keep it a national project', especially considering the retarding effect expected from any international cooperation.[96] In this way, Authority officials sought to address their twin imperatives of securing maximum reinvestment (ideally to a level exceeding Britain's contribution) whilst also ensuring that these sums did not legitimate Euratom's interference in projects that they preferred to develop independently.

On 3 July 1962, Heath opened the Euratom negotiations with ministers from the Six at Brussels.[97] Detailing Britain's many technological achievements in the nuclear field, the Lord Privy Seal distilled his proposal into three key demands. Foremost, it was imperative in the scientific interest of all that Britain be permitted to continue cooperating with third parties, either bilaterally or in concert. Secondly, Euratom had recently issued its new Five Year Plan detailing its projected work plans until 1967, and so Britain would need to be accommodated within a revised plan if it was to contribute effectively to the common cause. Finally, Heath beseeched his audience not to seek any agency over Britain's nuclear deterrent, a request he admitted that was complicated by the often-inextricable nature of Britain's atomic programme and the dual purposes of much of its infrastructure. If these provisions could be agreed to, however, Britain would be willing to subject to the Euratom Treaty all the nuclear generating stations under the Electricity Generating Boards as well as its key laboratory at Harwell and reactor test beds at Winfrith Heath and Dounreay.[98]

Heath briefed Cabinet on the latest ministerial discussions in Brussels two days later, and noted that arrangements for Britain to assume part-ownership of existing nuclear installations were proceeding smoothly.[99]

Nevertheless, the matter remained contentious at Westminster, where MPs queried the need to sacrifice Britain's technological lead and questioned too why the AEA was being requested to surrender precisely that autonomy, uniformity of purpose and capacity for swift decision making which had stimulated its creation in the first place. Adopting this cause in Parliament, Conservative MP Airey Neave challenged officials from the Ministry of Science and Foreign Office to explain Britain's position. As Member for Abingdon, a constituency close to Harwell, Neave was keen to see the Authority's sites fully utilised but nonetheless demanded a 'fair bargain' that reflected the superior state of Britain's science: only then, Neave argued, should Britain join Euratom and 'increase the efficiency of the nuclear industry in Europe'.[100] This attitude was supported by Ely MP Harry Legge-Bourke who was anxious to tie Britain's knowledge contribution to the economic arrangement it was seeking elsewhere. 'We should not go cap in hand and say, "please let us in"', he argued. 'We should say, "because we may consider negotiating with you an agreement on the economic front, leading later possibly to political co-operation, we think it is a good idea at the same time that we should contribute what we have to offer to you in the hope that you will be able to offer us something in return in the field of nuclear energy"'.[101] Attempting therefore to reverse atomic energy's declining importance, Legge-Bourke demanded that Britain's considerable technological lead be deployed to resolve both the Euratom and the Common Market negotiations in tandem.

With discussions on atomic integration due to begin in late autumn, the AEA wasted no time in planning its tactics. Importantly, Britain's atomic guardians had received word that the Six would only accept London's demands for defence exemptions if it agreed to a 'harmonisation of programmes' with Euratom.[102] Furthermore, Britain would be also expected to shoulder 22% of the Community's annual research and administration budgets, alongside a possible 'entrance fee' for access to research won under Euratom's first five-year plan. In response, British officials countered that, as a new member, it would be simpler for the UK to just enlarge the Euratom programme rather than merge into activities already begun elsewhere, because it would only contribute 22% of the extra cost while securing the bulk of this additional expenditure for work to be carried out in Britain.[103] Yet Euratom's negotiators remained steadfast, and at a lunch with Krekeler and Sassen, Barclay learned of the community's interest in Britain's fast reactor and fusion projects. The continentals also intimated that Heath had addressed Britain's financial contributions in too 'cavalier' a fashion during his opening statement and thus made themselves clear: Euratom was first and foremost interested in understanding what assets Britain could put into the communal pot.[104]

That same day, Penney devised a list of recommendations to assist British officials in the negotiations due to begin on 14 November. Exercising his well-developed diplomatic talents, Penney hatched a plan to offer Dounreay, Culham, Wantage and the UK contribution to Dragon 'at whatever stage of the Euratom negotiations is tactically advantageous'. These sites had an estimated capital cost of £49 m and required an annual expenditure of £12.5 m to run. By proposing to transfer to Euratom British research stations with a theoretical value far in excess of the UK's share of Euratom's expenses (now envisaged to be around £9 m p.a.), Penney therefore hoped to ensure that Euratom expenditure in Britain, even after it had been whittled down in negotiations, would remain at least equal to London's outlay. This offer, which he fully acknowledged appeared to be 'generous to a fault', would allow Britain to leapfrog the 'many other unsatisfied claimants' in the Six, while also scotching notions of British recalcitrance. Furthermore, Penney provided contingency plans to allow Euratom to reduce its expenditure by entering into 'contracts of association' with British establishments instead of assuming total control of them. Such logic was shrewd: if Britain offered a list of stations with a value only *equal* to its net contribution, it would surely be short-changed on the eventual negotiated expenditure received in return, rendering participation financially disadvantageous. Moreover, Penney also employed imaginative accounting practices to evaluate British installations against their *historical* capital cost rather than their current value, manipulating inflation data and thus boosting his case by skewing a like-for-like comparison with Euratom's newer plants. However, there were provisos: Penney noted Euratom's hope that association with Britain's upcoming PFR project would grant it access to information hitherto derived from the Dounreay Fast Reactor (DFR). Consequently, he argued categorically against sacrificing the 'very large and valuable commercial possibilities' of the prototype fast reactor.[105] On this latter point he was however overruled, and Hailsham reluctantly agreed to offer Britain's fast reactor work to the Europeans, tabling the issue of whether this would be best achieved by handing over Dounreay *in toto* but retaining complete control of the PFR, or by extending a limited contract of association across the entire field.[106] This proposition was significant: although not considered worthy of protection at all costs, Britain's fast reactor technology nonetheless represented a sizable gift.

Summarising these discussions, it must be contended that the AEA's negotiators were considerably astute in the way they handled their projected accession into Euratom. Expressing legitimate complaints of the agency and the way it was run, Authority officials acted not merely out of technological jealousy but out of genuine concern that research be conducted efficiently, although these sentiments were undoubtedly expressed in hubristic terms. After years of conducting atomic diplomacy across a variety of fora, Britain's technicians were thus able to use their finely tuned instincts to contrive a strategy far more sophisticated than merely crippling negotiations by offering a substandard contribution to Euratom. Instead, Penney attempted to portray the Authority as the 'best Europeans' in order to tap the political capital of cooperation while ensuring that Britain's fast reactor work remained national. In short, the Authority was probably more advanced than its political masters in playing the 'European game'.

Epilogue

Adrift now in the broader diplomatic currents surrounding its membership of the EEC, Britain's Euratom application became dependent on other forces to determine whether it would ultimately sink or swim. Persuaded meanwhile to repeatedly revise the Fouchet Plan until it resembled a scheme to place the three supranational communities 'under the hegemony of a new interstate institution', as Jean Lacouture has termed it, de Gaulle pushed the exasperated Dutch and Belgians into vetoing his proposal in April 1962, leaving him instead to embrace a deep bilateral relationship with Bonn under the 1963 Élysée Treaty.[107] Meanwhile, President John F. Kennedy's continued failure to consult his European allies on Washington's policy towards Moscow offended French sensibilities further: as de Gaulle complained to Macmillan during their meeting at Champs in June 1962, 'occasionally Mr Rusk made a flying visit round the capitals of Europe but in effect the European countries were excluded from the Russo-American dialogue'.[108] Unfortunately for the Prime Minister, his pleas for patience in this regard were damaged by Kennedy's unilateral response during the Cuba Missile Crisis that October, further angering de Gaulle, who believed implicitly that France should take a greater role in Western defence strategies.[109]

Notions of marginalisation also plagued British minds, particularly as London's fleet of nuclear V-Bombers progressively became obsolete during the late 1950s due to Soviet development of surface-to-air missiles.

In 1957, Selwyn Lloyd had proposed to erect a nuclear 'Grand Design' in which Britain would develop (thermo)nuclear weapons with Western European Union (WEU) partners as a means of both creating a second nuclear force within NATO and incentivising Whitehall's FTA proposals.[110] As Gunnar Skogmar has shown, however, with American support for Euratom dependent on promoting integration and denying Paris and Bonn nuclear weapons, Washington instead opted to distract Britain with deeper bilateral cooperation, leading in turn to the 1958 US-UK Mutual Defence Agreement which greatly enhanced the exchange of nuclear weapons information across the Atlantic.[111] Aiming to produce a home-grown delivery system, London attempted first to commission its own missile system named 'Blue Streak', but when it emerged that critical infrastructure would be vulnerable to pre-emptive strike, Macmillan agreed in 1960 to instead purchase Skybolt missiles from Washington, a deal thrown into jeopardy two years later when developmental problems caused the system's cancellation. *Blue Streak* was subsequently rehabilitated as a launcher for communications satellites under the European Launcher Development Organisation (ELDO) programme, a decision which John Krige and Michaelangelo de Maria have attributed to the project's genuine technical *and* political merits.[112] Sensing in any case that Macmillan shared his disdain for becoming overdependent on American weapons technology, de Gaulle suggested at Rambouillet in mid-December 1962 that Britain and France undertake a joint missile programme as an alternative to purchasing the new American 'Polaris' system as a replacement for Skybolt.[113] Macmillan demurred from this suggestion and, as Frank Costigliola has suggested, it may have been at this point that de Gaulle privately committed to blocking Britain's application.[114] By reaffirming Britain's Atlantic orientation while simultaneously applying for EC entry, Macmillan was therefore exhibiting precisely that duplicity that so excited de Gaulle's paranoia that Britain was becoming Washington's Trojan Horse.

Disagreements also abounded between Macmillan and de Gaulle over trade, and during the discussion on Europe later that day the Prime Minister attempted to reconcile Britain's Commonwealth commitments with its desired continental role. The Western world was 'on the eve of a new industrial revolution' wherein European economies would increasingly undertake high-end production using innovative new techniques, Macmillan reasoned. Would it not be possible for industrialising Dominions to fill the vacuum resulting from these advances by producing simpler industrial goods in exchange for Europe's more 'sophisticated products of advanced modern technology'?[115] This modernisation of Europe, within which civil atomic energy would presumably play a key role, thus presented an opportunity to marry Britain's imperial and continental interests.[116] In response, de Gaulle feared that such expansion would culminate in a 'world free trade area which might be desirable in itself, but would not be European'. Macmillan, agitated by this apparent opposition to the entire concept of British accession, challenged the point but encountered only platitudes; 'France desires British entry', de Gaulle claimed, before Prime Minister Georges Pompidou jumped in hastily to add that the issue was merely a question of timing.[117]

With Anglo-French relations near breaking point, Macmillan flew to meet with Kennedy in the Bahamas and obtained Polaris missiles which would be fitted with British warheads.[118] It was a significant act: despite the fig-leaf of operational independence, Britain would now depend on American delivery systems to utilise its nuclear warheads. Predictably, this reaffirmation of the Special Relationship caused consternation in Paris where de Gaulle protested what he saw as a 'special deal' for the UK and committed instead to an independent French deterrent.[119] The issue soon exploded, and on 14 January 1963 de Gaulle issued his historic triple '*non*', rejecting at a stroke Britain's EC accession, a multilateral NATO atomic force and the delivery of Polaris missiles to France.[120] In this respect, as Donald Watt has remarked, the keystone of Kennedy's 'Grand Design', British EEC entry, was undone by the President's offer of Polaris missiles.[121]

Britain's failed EC application provides a natural termination point for this book. By successfully restoring its atomic alliance with Washington, first through the Mutual Defence Agreement of 1958 and later at Nassau, Britain had completed the process begun in 1946 at the cost of antagonising those French interests who held Britain's EEC (and Euratom) accession in their hands. Coveting a French bomb and convinced of Macmillan's duplicity, de Gaulle vetoed London's application and with it Britain's accession to Euratom. In this way, Whitehall's propitiation of Washington, so often a limiting factor in Britain's atomic diplomacy, had guaranteed its exclusion from the Six for another decade.

Conclusion

Analysing the final period covered by this book, this chapter has made two key contentions. The first of these has been to show how Macmillan's attempts to come to terms with the EEC, already significant in a political context, also marked the conclusive death of notions long held in Whitehall and Harwell alike that British nuclear expertise could facilitate a beneficial economic and political arrangement for the UK. Eisenhower's backing for Hallstein's 1960 acceleration proposals demonstrated clearly that, without accession to the Six, Whitehall would increasingly be excluded both from the growing market of its neighbours and from American goodwill. With the spectre of deepening economic division looming, British ministers thus overruled the AEA and considered Euratom and ECSC membership in exchange for satisfactory 'association' with the EEC, a gambit which failed due to both the reluctance of the Six to unbalance their communities and the fact that there was no forum to discuss Euratom entry without a direct application. Yet although these events were significant for confirming, as Martin Schaad has averred, that Britain now faced an 'in-out' choice over integration, they also marked the death of notions held since Messina that civil nuclear interaction with Europe could be used to negotiate a political settlement with the Six. Deployed previously to incentivise both the FTA proposals and the OEEC approach, atomic energy consequently witnessed a precipitous decline in its utility as a diplomatic tool. With nuclear economics simultaneously eroded by improving fossil fuel supplies, one of Britain's post-war trump cards was thus rendered redundant.

Secondly, this chapter has analysed how the AEA adjusted its stance towards Europe after 1960. By early 1961 at the latest, Macmillan had decided to apply for EC membership, and with Britain's goodwill largely expended on excluding defence research from foreign oversight, the Euratom negotiations forced atomic bureaucrats and scientists to agree terms with little external assistance. It was a challenge to which they responded assertively: long aware that the AEA would be forced into Euratom as a corollary of EEC accession, influential scientists including Adams and Penney recognised that the next best option would therefore be for Britain to gain as much control within the community as possible. Accordingly, far from refusing to include attractive aspects of British research into the negotiating brief, Penney in fact tailored an offer which was *over-generous* in order to drown Euratom in a wealth of choices that would hopefully prevent it from gaining too much influence over any one project.[122] Years of operating within political committees and working groups had taught Britain's technocrats to be not only technically but diplomatically proficient, and they were consequently able to reserve valuable projects for national development. Key financial issues were also well-managed, and by appearing to be the *best* Europeans, the Authority developed a policy designed to reap the greatest returns for their funding contribution. As a result, one must contend that, while undoubtedly opposed to Euratom accession in principle, Britain's technicians eventually responded to Macmillan's mandate in a manner more flexible than merely resorting to 'asceticism' in order to render the Foreign Office's brief 'bare and inflexible', as Stuart Butler has charged.[123] Rather than gazing backwards and refusing obstinately to cooperate, Authority officials aimed instead to control Euratom and thereby protect their work.

Ultimately, Britain's accession to the EC was terminated for reasons far removed from civil atomic energy. French concerns for Europe's global role, exacerbated by increasingly bilateral superpower negotiations over regional crises, fostered suspicions that Britain remained an imperial power that would employ Washington rather than Europe to bolster its position. Such notions were seemingly confirmed by Kennedy's offer of Polaris missiles to Macmillan, a proposal which caused the General to veto British EEC entry in early 1963. To de Gaulle, Britain represented an obstinate obstacle to his vision of a 'European Europe' whereas to Macmillan, in Peter Mangold's words, the General was the 'almost impossible ally' bent on preventing an American-led nuclear force.[124] Consequently, the politicisation of civil atomic technology, visible throughout this book, reached its denouement in the discussions over whose vision for Europe would be realised.

Notes

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8. Ibid., 236.
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CHAPTER 8

Conclusion

In this book, we have seen how Britain evolved from a junior partner in the wartime nuclear alliance to being the world's premier civil atomic power in the mid-1950s, before finally seeing itself marginalised during the US-sponsored growth of a new Europe in the early 1960s. This period was also marked by fundamental changes in Britain's global position as its historical role of imperial power slowly morphed into that of a high-technological nation constrained within a more modest geographical reality. Blessed with a new, alternative source of power (in both the political and physical senses of the word) but compelled also to seek industrialised markets for its wares, London was consequently compelled to negotiate new relationships with the European states it had traditionally eschewed in favour of its pursuit of empire. As such, it is natural to question what the lens of civil nuclear energy can tell us about Britain's relations with its neighbours during this period.

In response, this book has contended that London's engagement with Europe during the immediate post-war years was characterised by an inability to effectively utilise its civil atomic prowess as a diplomatic tool. This failing is proven most clearly by considering the objectives Whitehall set *itself* for its nuclear diplomacy, namely the procurement of lucrative exports and the establishment of intergovernmentalism as the primary framework for continental collaboration. Looking at the first issue of nuclear exports, Whitehall's commercial goals were encapsulated in the 1955 White Paper in which ministers asserted that 'the experience gained

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by British industry in designing and building nuclear power stations during the next ten years should lay the foundations for a rapid expansion both at home and overseas'.[1] Yet by granting domestic plants priority over the scarce construction capacity of native firms, Whitehall left British industry unable to exploit what eventually proved only a brief window in which to sell its Magnox designs. Had Britain been in a position to capitalise on the post-Geneva wave of atomic optimism by exporting its wares in a quantity sufficient to exploit Europe's contemporary energy anxiety, it may have been able to embed its techniques and machinery more effectively in foreign nuclear programmes while also generating considerable goodwill. Instead, with nuclear energy economics fluctuating violently and with only two power plants ever sold abroad, it soon became apparent that Britain would not be a large-scale exporter either of plant or of the skill required to build them. As a result, the commercial engagement prescribed by Whitehall's macroeconomic policy was compromised, leaving London unable to lock clients in to British technology.

Beholden meanwhile to a worldview that designated civil atomic energy an economic issue, Whitehall also failed to energise the intergovernmental cooperation vital to its global strategy. With European states waiting for London to animate the OEEC's atomic research arm, Macmillan's hesitance instead granted Monnet and the Europeanists time to reimagine atomic energy as a spearhead of the supranational movement. Had Britain been willing and able to galvanise the OEEC approach with early action beyond two communal projects, it might have been able to submerge the integrationist impulse into a broader nuclear free-trade zone, albeit at the probable cost of moderating its domestic programme. Instead, with Washington enthusiastically sponsoring the Messina powers in their quest for atomic and economic union, Britain's intergovernmental line could not satisfy the Six's desire for rapid progress, costing Whitehall the initiative. Conclusively, then, by 1962, Britain had established neither a convincing intergovernmental nuclear framework nor an effective commercial hegemony in Europe's civil atomic field.

The reasons for this disappointment were manifold and interwoven, but can nonetheless be grouped into four categories, namely those of diplomacy, political perspective, industrial capacity and internal organisation. In the first instance, London often lacked the *diplomatic* freedom to countenance cooperation overseas, even when it felt inclined to do so. This was particularly pronounced during Britain's early nuclear life when the post-McMahon imperative of proving Britain's trustworthiness to

Washington effectively prohibited collaboration with European and Commonwealth partners alike. Indeed, Whitehall's appeasement even persisted despite setbacks including the embarrassing Nunn-May, Fuchs and Pontecorvo spy scandals, and the 1951 revisions to the McMahon Act which merely established highly-convoluted mechanisms for transferring limited defence information. Traditional analyses of contemporary Anglo-American nuclear relations have been unequivocal in their treatment of this trend and Margaret Gowing has asserted that while Britain's post-war reluctance to cooperate with third parties arose partly from a lack of credible partners, Whitehall was predominantly concerned with avoiding *anything* which endangered its 'perpetual hope' of renewed Anglo-American-Canadian collaboration; put simply, she contended, 'the United States interest always won'.[2] Arguing for a revision to Gowing's assertions, however, this book has shown how diplomatic restraints did not *terminate* altogether Britain's atomic engagement with Europe, but merely limited it to more modest vectors including informal scientific societies and interaction in 'safe' sub-fields such as radioisotopes. The significance of this contention is twofold: firstly, although Britain's low-level exchanges left Europe's more industrially advanced nations unsatisfied, in turn encouraging them to form bilateral collaborations among themselves, Britain had nonetheless established itself as Europe's *informal* nuclear leader, a position which became increasingly significant as the decade progressed. Furthermore, these exchanges highlighted clearly Whitehall's stance: although hampered by American opprobrium and a lack of spare resources (discussed below), British scientists enjoyed official connivance in fostering limited exchanges from an early stage, demonstrating London's underlying willingness to control collaborative projects like the EAES and CERN through participation.

Another important factor in Britain's diplomatic considerations was that American influence over its nuclear activities prevailed even after Washington's transition to an interventionist nuclear policy after 1953. Although Great Power ideals bound Churchill to endorse Atoms for Peace as a scheme worthy of great statesmen such as himself, the proposal in fact contradicted Britain's atomic interests by involving international agencies in its nuclear programme. Indeed, by mimicking Washington's 20% enrichment limit on exported fuel, Harwell was forced to withdraw its flagship research reactor model, while the donations of men and fissionable uranium demanded from London in order to prove its top-table status further weakened its penetration overseas. This dynamic, in which rule changes were dictated from Washington, thus left the Americans permanently in control as the Atlantic relationship evolved from a supposed alliance into thinly-disguised commercial competition. With Washington now actively aiding foreign nuclear activities, Britain's atomic engagement with Europe (including ultimately its stance towards integration) would consequently be fraught by persistent requests to emulate US doctrine.

Under such circumstances, it must be asserted that the diplomatic restraints placed on Britain's nuclear exchanges were more complex than a simple blanket ban imposed by nervous Congressmen. While there can be no doubt that a need to mollify Washington severely impeded Britain's interaction with third parties before 1953, it is clear that the British were *themselves* not opposed to cooperating with European states where appropriate, and undertook limited interaction to foster goodwill. Given a free hand, it is possible that British engagement would have been more substantial, even if such activities would ultimately have been capped instead by an inability to spare resources from London's domestic project. Furthermore, the demands made of Churchill by Eisenhower under Atoms for Peace were significant: by requesting that Britain support American non-proliferation protocols and contribute vital materials, the President further limited Britain's capabilities at a time when it most needed to lock clients in to native technologies. In sum, then, it is clear that Britain was restricted from engaging with European (and indeed, non-European) partners by *both* the isolationist and the interventionist aspects of American nuclear policy throughout the period covered by this book.

With the international landscape often unstable across a variety of dimensions, Britain's agency was further weakened by *political* preconceptions of where the greatest potential for cooperation lay, and indeed where Whitehall *wanted* such possibilities to exist. The first consideration in this regard was that London initially relegated continental atomic collaboration beneath attempts at reconciling its nuclear diplomacy with its traditional Commonwealth connections. Although restrained from formal cooperation by classification concerns, Commonwealth states were kept abreast of British research progress and gained a privileged technical position under the 1948 *modus vivendi*. Yet although useful for providing *primary* resources including manpower, uranium and testing spaces, it soon became apparent that Britain's Dominions did not yet possess the industrialised metropoles that would require native nuclear plants. Given the abundance of fossil fuels and industrial expertise in the United States, the only suitable markets thus lay in Europe and Japan.

Despite this obvious economic truth, however, British officials remained reluctant to influence European atomic development using the supranational methods then gaining traction on the continent. Dismissing the incorporation of atomic energy by the Six ECSC powers into the 'relaunch' of the integration project which had stalled in 1954, ministers baulked at surrendering atomic sovereignty to a supranational authority whose aims and powers were initially poorly defined. As officials persistently stated, Britain's 'atomic edifice' was already considerable, and Europe had nothing to trade from its technologically inferior position. Beholden to a 'one-world' economic strategy which demanded that Britain preserve its access to all its global partners, ministers and AEA officials alike instead considered intergovernmental cooperation and commercial links the appropriate vectors of Anglo-European interaction. Within this framework, Authority experts advocated a 'middle course' which would forestall accusations of recalcitrance while preserving Britain's flexibility to interact with both Washington and the Commonwealth. These preferences were represented abroad as a desire to avoid 'duplication' of effort, but in reality London's ministers did not understand the supranational concept and refused to contemplate negotiations with, let alone accession to, the Six. Importantly, then, Britain left its atomic influence in Europe hostage to its ability to implement quickly an alternative to supranational integration which validated the OEEC approach with action.

On the commercial front, the situation was similarly time-constrained. In order to construct the thriving export business which successive White Papers envisaged for them, British firms would need to make clients dependent on native designs. In response, Britain's three major interest groups, namely industry, the AEA and ministers, all advocated bilateral cooperation utilising the traditional commercial channels which would both guarantee Britain's ability to extract financial or material compensation for its goods while also preserving its technological lead by detailing closely its desired terms. Acknowledging that they could not match American largesse in this regard, British firms consequently offered a 'tailor-made service' as an alternative to Eisenhower's generic 'Section 123' wares in a bid to enhance Britain's flexibility towards prospective partners. As such, Britain's political preferences again rendered its nuclear influence dependent on its ability to tie continental clients to its technology through exports, a gambit which stretched severely its already overburdened resources.

This study has shown that Britain's refusal to countenance integration (even if only to steer the process from within) instead obliged it to both author and spearhead a distinct intergovernmental alternative around which neighbouring states could rally. Promoting this ideal, however, would be intensely problematic. Firstly, London would be required to facilitate communal activities which were superfluous to a nation in Britain's advanced position and which often burdened its overstretched resources still further. Additionally, because *experimental* reactor projects with flexible uptake were by definition less immediately useful than large-scale installation programmes designed to benefit all participants, Britain inadvertently fostered accusations that such arrangements were merely a device to wriggle out of meaningful collaboration. Indeed, Alan Milward has dismissed the AEA's June 1956 offer to help the OEEC construct a chemical separation plant (but not a heavy water facility or experimental reactors), as merely 'leadership on the cheap', an action which may have pushed disappointed French ministers into finally accepting the common market.[3] Compelled to offer a brand of cooperation which did not satisfy its larger neighbours and which it did not have the capacity to promote effectively in any case, Britain's approach was thus left critically weakened.

Such frailties were compounded by London's inability to engage effectively with the Six from outside Euratom: viewing nuclear cooperation as an economic issue validated by merit of function, London's failed either to court Euratom's representatives or to establish meaningful working arrangements with the community, allowing Washington to supplant it as Europe's primary partner. At most, Britain would accept association with Euratom, delivered through tokenistic technical committees which often existed to foster goodwill rather than to attack mutual problems. With Euratom fortified by Eisenhower's superior finance and materials, the value of Britain's trump card, its ability to provide power reactors quickly, thus declined sharply, a factor accelerated by improving fossil fuel supplies during the late 1950s. The *coup de grâce*, was yet to come, however: as tariff screens rose in 1959, Macmillan launched a last-ditch bid to exchange civil atomic integration for a special economic position. When his gambit was rejected, the message from the Six became clear: Britain's nuclear prowess was no longer sufficient to prevent European integration.

With political ideology restricting what London *would* do, it remained to reconcile such concepts with what it *could* undertake, given Britain's lack of spare industrial capacity and manpower. The resources available to

Britain's nuclear establishments were limited, with even the threadbare nuclear programme undertaken by the Ministry of Supply unavoidably draining building labour, engineering capacity, electricity and scientific manpower at a time when these were desperately needed elsewhere.[4] Applying these notions to Britain's nuclear diplomacy, this book has shown how resource constraints dogged Britain's agency abroad throughout this period, affecting even those exchanges which enjoyed political sanction. As shown in Chap. 2, domestic manpower shortages forced Britain to supplement its native scientists and engineers (many of whom were Commonwealth citizens with long-standing connections to UK universities) with hands recruited from the Dominions or from among European refugees. Nor was Britain producing enough graduate-level scientists to satisfy its research establishments, as the 1946 Barlow Report had painstakingly demonstrated. As such, Britain could ill afford to donate scientists or engineers to foreign nuclear projects or to undertake collaborative ventures overseas. More important, however, was the situation at elite level: as British policy was often predicated on joining continental scientific organisations in order to control them (as with the EAES or CERN), it became vital to install eminent British scientists in senior positions within the new hierarchies. However, with men like John Cockcroft already undertaking extensive overseas travel alongside their domestic tasks, there was little hope of seconding such elites to organisations such as the IAEA or Euratom, damaging Britain's institutional influence.

On a material front, the situation was similarly tight: Britain's domestic programme laboured under extreme pressure and Christopher Hinton, for example, is said to have chosen his uranium filters on the basis of 'samples of sludge half an inch deep in the bottom of a two ounce bottle'.[5] The scarcity of even basic resources soon hindered Britain's agency overseas, as demonstrated by Harwell's ability to offer only cast-off materials to New Zealand in 1947. Uranium shortages were also crucial: Britain's first act as an independent atomic state had been to discontinue its dollar-intensive Canadian operation in favour of a native locus which could produce fissile material, and for long thereafter supplies of both uranium ore and processed fuel were guarded jealously.[6] Indeed, Britain's relative uranium poverty was illustrated only too starkly by the contributions it made to Eisenhower's atomic bank: in contrast to the 20 kg of U^{235} sold by London to the IAEA, by 1957 Washington had released over *5000 kg* of U^{235}, demonstrating in turn how Britain struggled to establish itself as an international fuel supplier.[7] Finally, financial restrictions also blunted Britain's agency abroad, an issue which surfaced during the Atoms for Peace drive when it emerged that London could not match the half-price research reactors and cheap enriched uranium offered by Washington. Nor could Britain equal Washington's generous assistance to Euratom, proposing instead a commercial treaty which did little to affirm London as the continent's primary partner. Under such circumstances, then, we must accept that Britain's lack of men and materials forced it to watch numerous opportunities to intervene in foreign nuclear activities go unrealised.

Turning to reactors, critics have traditionally identified that Britain's exports were prejudiced both by the uncompetitive nature of Magnox stations and by the lack of spare industrial muscle required to build them overseas. Robert Boardman and Malcolm Grieve, for example, have noted how Magnox's 'limited growth potential' damaged notions that Britain's technological lead would axiomatically produce exports, while Rowland Pocock has highlighted how British firms were engaged 'to the exclusion of all other activities' with domestic plant construction.[8] Such notions are partly valid: the political desire to task barely-mature reactor designs with meeting part of Britain's growing energy demand had in 1955 produced an ambitious installation programme which was expanded beyond credible reach two years later. Despite the formation of consortia which pooled construction capacity, the huge targets set for domestic plant construction thus limited Magnox exports to just two sales. Forced by necessity to export the reactor type that it had produced for immediate domestic use, Whitehall consequently gambled on one design in comparison with the more numerous (and flexible) models produced by better-provisioned American firms. With fossil fuel supplies improving by the late 1950s, the brief window for Magnox exports was therefore lost.

Britain's poor commercial penetration was further compounded by its lacklustre performance in selling other key reactor types. From the outset, officials in Whitehall were aware that Britain would not be able to capture more than a handful of *power* reactor export contracts, and so they aimed instead to install British technology in the early development patterns of foreign states to prime them for continuing support. British *research* reactors, however, were strangled at birth by technical issues arising from Washington's 20% enrichment protocol: in comparison with Britain's three DIDO sales, by summer 1956 the US had signed twenty-six agreements with foreign states.[9] These technical problems were compounded by simple market distortion: unable to match the lavish subsidies attached to American research reactors, Britain was forced to allow the foreign interest in its products which peaked alongside the *relance* to go unquenched. Restricted throughout to pragmatic *quid pro quo* exchanges which were carefully defined in bilateral treaties, Britain's inability to compete was displayed most prominently in its relations with Euratom: in contrast to Washington's offer of subsidised fuel and plant, Britain could table only yet another commercial treaty. Furthermore, British industry remained reluctant to sell atomic equipment to competitor nations, exposing the inherent paradox in which those markets most suitable for immediate exports were those belonging to nations with the greatest ability to eventually overtake Britain in nuclear engineering.

There were other problems, too: Harwell's training schools, so fundamental to Britain's early nuclear soft power, were soon overwhelmed by the demand for places in their classrooms, as shown in Chap. 3. Consequently, having established its Isotope School as a safe and profitable avenue of international exchange, Harwell guarded the scarce places at its new Reactor School jealously, limiting Britain's ability to directly attune foreign experts to British methods. Finally, Britain's well-established atomic infrastructure obviated the need for collaboration on key infrastructural nodes, with surplus capacity at Capenhurst, for example, precluding British participation in a communal uranium diffusion plant. Inevitably, then, the only appropriate opportunity for cooperation lay in experimental reactors like Halden and Dragon, undertakings which, despite their technical validity, nonetheless sapped men and resources from central research objectives.

In summary, Britain's nuclear diplomacy was weakened by capacity issues which were not merely the product of inferior reactor designs or a lack of industrial muscle, but rather of a far broader series of material, financial, technical and institutional constraints. At a very basic level, Britain's ability to host foreign scientists was restrained by Harwell's limited training capacity, while its engagement in overseas nuclear projects suffered from a shortage of both basic and nuclear materials. Technical problems with research reactors in turn crippled Britain's efforts to lock future markets into its technology, while American subsidy destroyed any semblance of fair competition in even basic reactor sets. Finally, Britain's power reactor exports were hampered by a strict adhesion to commercial protocols and by industrial unease at exporting to neighbouring states. By synthesising these issues into a coherent whole, therefore, it becomes clear that capacity problems pervaded every storey of Britain's nuclear 'edifice', weakening its nuclear influence abroad.

A final, subsidiary, point of note made by this book is that Britain's agency was often restricted by administrative *disorganisation* which slowed its response to foreign initiatives. The committee system improvised after 1945 to steer Britain's nuclear activities, although vital in linking scientists and politicians, was weakened by a proliferation which left several bodies (often comprising the same scientists) addressing different policy sub-fields. Committees also overrepresented the opinions of mercurial personalities who, as Sean Johnston has identified, were often appointed for their compliance rather than their ethics.[10] Such concerns were well-known to contemporaries: in early 1946, Mark Oliphant wrote to Patrick Blackett to relay comments from Herbert Skinner, (later Harwell's General Physics chief) insinuating that unsatisfactory research programmes were the result of 'yes-men' rather than 'honest-to-goodness scientific men' being chosen to advise government.[11] In a diplomatic context, this reflected itself in an overreliance on key individuals to evaluate collaborative opportunities: just as Cockcroft spearheaded Britain's participation in the EAES, so too was Britain's initial bargaining position in CERN eroded by the persistent opposition of Chadwick. Instead of leading outright, therefore, Britain was often forced to join European atomic organisations as a *fait accompli* in order to retain any influence.

A full evaluation of how these ad-hoc arrangements affected Britain's atomic engagement after 1945 is beyond the scope of this book, but what *is* clear is that the formation of the AEA in 1954 greatly streamlined Britain's atomic diplomacy. By compartmentalising atomic policy and incorporating a Member specifically responsible for technical diplomacy, the reforms allowed experts to handle external requests more rapidly while also permitting 'routine' exchanges without overbearing scrutiny from the new Official Committee established to represent the departments immediately concerned with civil nuclear power. Unfortunately for London, however, these improved domestic arrangements often contrasted starkly with the slow internal workings of international organisations, and Britain struggled to lead the way in vivifying its preferred intergovernmental approach. Instead of addressing the Six/Seven nuclear split directly, London entrusted the issue to the Nicolaides Committee, whose tardy response allowed Euratom's Three Wise Men to steal a march in their plans for cooperation without the UK. Under such circumstances, Britain's diplomatic performance can best be characterised as variable, and although it eventually improved its diplomatic channels in step with the growing requests made of its atomic establishments, London did not chivvy its partners sufficiently during the transformative period between Geneva and Suez. As a result, then, one must accept that Britain's diplomatic mechanics did at various points exhibit a debilitating lethargy which damaged its agency abroad.

In summary, post-war Britain did not engage decisively with Europe in atomic energy, restrained as it was by numerous factors which prevented it either from establishing itself as the continent's dominant nuclear power, or from utilising its technological prowess to incentivise important economic arrangements. Crucially, however, this book has connected extensive new primary research with previously separate historiographies on themes such as nuclear exports and Whitehall's response to supranationalism to demonstrate how this failure derived from a blend of issues more complex than existing studies have allowed. Buffeted by diplomatic headwinds which initially discouraged third-party cooperation and then reversed to demand from Britain exhausting contributions of men and materials, London continually found itself unable to seize the initiative and act independently. With its entry-level penetration of foreign markets crippled by American enrichment protocols, Britain's agency abroad was further hampered by its political perspective: opposed not to continental cooperation but to integration, Whitehall left its influence hostage to the success of intergovernmental and commercial arrangements which it would struggle to vivify.

Such problems only deepened when coupled with the stress of developing resource-intensive technology during a period of severe economic strain, and Britain's capacity problems were far more pervasive than existing product-oriented analyses allow, with the entire spectrum of Britain's nuclear offer to foreign states from basic training to power reactor sales being affected in some way by material and manpower shortages. Finally, despite delegating considerable foreign policy power to a semi-autonomous atomic authority, Britain was also afflicted on occasion by organisational problems which left it slow to act at key junctures. An early inability to provide quick and comprehensive consultation on diplomatic opportunities left London over-reliant on the disposition of individual eminent scientists towards collaborative projects, while a failure to establish swiftly the mechanics of the OEEC approach compromised Britain's ability to capitalise on its technological superiority during the high point of nuclear excitement in 1956–1957. In this way, then, Britain suffered from the interplay between long-standing structural problems such as resource shortages, and its management of key events.

Nevertheless, this is not a declinist tale: British science and industry accomplished a phenomenal feat in launching an independent atomic project, and Britain's atomic directors were famed for their thrift in the face of astonishing financial restrictions. Instead, this study mirrors a phenomenon highlighted by David Edgerton, among others, in which it is asserted that twentieth-century Britain actually suffered only a *comparative* industrial decline 'from a position of extraordinary relative strength'.[12] Conforming to this thesis, then, the loss of Britain's atomic prowess as a diplomatic tool can best be characterised as a comparative decline from an artificially high position resulting from an exceptional political circumstance. Such hegemony was inevitably fleeting, as European states were soon able to reel in Britain's wartime boost of atomic knowledge, while Washington's application of its massive resources to continental unity shrank further the timeframe in which Britain could have utilised its nuclear prowess for wider gain. Granted a valuable but declining asset with which to work, Britain thus failed to cash in its technological lead before it became obsolete.

Reconsidering the Historiography on Britain and Europe

So how does this work advance existing historiographical themes? As highlighted previously, this study has addressed a prevailing inconsistency in which historians such as Alan Milward and John Young have contended that atomic energy was fundamental in relaunching the European movement after the failure of the EDC in 1954, while others such as John Krige have simultaneously asserted that Eden's Britain achieved a state of continental civil atomic primacy.[13] In so doing, this book has aimed to restore Britain's nuclear activities to the wider narrative and to offer fresh perspectives on Britain's relations with Europe.

The first of these concerns the 'missed opportunities' debate which has pervaded the study of Anglo-European relations since the 1960s. Employing vivid imagery of an economically prosperous Europe steaming ahead while Britain drifted aimlessly, orthodox critics such as Miriam Camps have argued that Britain 'missed the bus' by declining to join the Messina project in 1955.[14] Perhaps sensing the evocative quality of such metaphors, revisionist scholars have often attacked the 'missed bus' thesis in similar language. Wolfram Kaiser, for instance, has noted both that the bus had no guarantee of roadworthiness and that no contemporary minister 'seriously considered buying a ticket', with Macmillan eventually acting less out of Europhilic conviction than a fear of economic exclusion.[15] Under such circumstances, Kaiser concludes, Britain should have taken the Messina initiative seriously in a bid to secure the free trade area required by London's economic strategy: 'the British government did not "miss the bus" in 1955', he argues, 'rather, it failed to steer the bus towards a destination other than that of the customs union'.[16]

Meanwhile, some historians have queried whether Britain could have led the Six *at all*. John Young, for instance, has argued that Britain could not have assumed control without first accepting the supranational concept for itself, and that ministers failed to comprehend that the failure of both Bevin's 1948 'third force' proposals and the 1952 Eden Plan in fact represented a rejection of British leadership in favour of integration.[17] Such criticisms resonate elsewhere, and Piers Ludlow has contended that Macmillan's 'low-profile and cautious' attempts to promote accession domestically, alongside his inability to 'browbeat' either Adenauer or de Gaulle, caused the 'highly significant policy failure' of Britain's botched 1961 application.[18] In short, Eden's Britain in 1955 disdained integration and could not have redirected the process without a considerable political about-face.[19]

Applying these assertions to the rarefied case of atomic energy, it is clear that notions of a missed opportunity in the orthodox sense of Euratom powering ahead without Britain are inappropriate: the UK did not need to join Euratom from a research perspective, and its concerns about pooling resources and information were well-founded. Importantly, however, the revisionist assertion that European states did not *want* Britain to lead is also inaccurate: London's OEEC delegates were repeatedly told point-blank that Whitehall's support would weigh heavily in determining the shape of continental cooperation. Moreover, while economists have disputed the evidence supporting Britain's claim to a technological lead, there can be no doubt that the UK was far advanced of its neighbours in many facets of nuclear engineering. Given, then, that civil atomic cooperation *did* provide an opportunity (albeit brief) to secure political concessions as well as Britain's twin nuclear aims of preserving market access and tying clients to native technology, we should discuss what Britain's failure implies for our understanding of Anglo-European relations.

Comparing the nuclear and economic environment, we must revise Kaiser's notion of participating in international organisations in a bid to control them: although the British had exercised this tactic frequently in steering the EAES and CERN, London could not have joined Euratom in 1955 because to expend Britain's nuclear lead in this manner would have been commercially and politically preposterous. Whether Britain could have joined early and turned the Six away from a nuclear common market is debateable, but what is abundantly clear is that London would in any case have lacked the spare resources to animate Euratom with activity sufficient to satisfy Paris in particular. Instead, a core contention of this work has been that Britain left its continental influence hostage to intergovernmental and commercial arrangements which it had neither the time nor the resources to establish effectively, a task complicated further by the difficulties of establishing a multilateral regime capable of perpetuating a technological lead and promoting useful activities for partners with wildly asymmetric abilities. Partly, this was a result of political hesitance: Macmillan's indulgence of the lethargic Nicolaides Committee would certainly conform to post-revisionist notions that Britain merely muddled through key issues during this period, and ministers did not grasp quickly enough the potential of nuclear energy to strike a counterblow *against* supranational methods. Importantly, however, one cannot lay all blame at the door of ministers who were often restricted by limited resources. Without scaling-back its exhausting domestic plans, Britain could not hope to engage more meaningfully overseas—indeed, the notion of how a fictional dual-purpose nuclear programme could have met both needs would provide a valuable starting-point for future research.

To torture the 'missed bus' metaphor one last time, then, the nuclear debate is perhaps better conceived of as a race between two competing vehicles, albeit one in which Britain's threadbare entrant ran to an uncertain timetable. What the effect would have been had Britain successfully animated the OEEC's nuclear approach to continental satisfaction is beyond the scope of this study, but one thing is clear: London's failure to energise a coherent alternative to nuclear integration denied it a golden opportunity to generate significant prestige and recognition for the intergovernmental approach which would have been extremely useful in any higher discussion about Britain's desired relationship with the European Communities. Put simply, had Britain's nuclear bus been better-provisioned, Europe might have been more willing to travel in others like it.

The second major theme to which this book has contributed has been the problems associated with cooperation in sensitive technologies within the context of the Cold War. As stated in the introduction, John Krige has shown how the post-war reconstruction of European science was essentially a reaction to the technological superiority of the United States, a situation which forced continental nations to pool their money, materials and manpower in a bid to facilitate both competition and collaboration with Washington.[20] This problem was well-known to contemporaries: writing in the wake of de Gaulle's second veto of a British EC application in 1968, S.C. Leslie bemoaned the 'adherence to a regional fashion of thought' that was preventing Europe from closing the Atlantic gap, and noted the potential for contributions to a European technological pool from Britain's computer, aircraft and nuclear industries.[21] The presence of American competition, then, was a prevailing concern and one which has subsequently received more specific attention in works such as Keith Hayward's study of Airbus, and Krige's own analysis of CERN.[22]

The civil nuclear case has also contributed to scholarship which addresses the 'Europeanisation' of technologies as a means of releasing political capital. The Second World War has been seen by Helmuth Trischler and Hans Weinberger as transformative in this regard: although they remained firmly lodged in the context of national security, the interwar period witnessed several projects (such as ship-canals) which could be termed 'pan-European'.[23] This trend accelerated in the atmosphere of post-war political reconciliation, leading scholars to situate Anglo-European technological collaboration preponderantly in the context of Britain's attempts to join the EC. John Krige and Michelangelo de Maria, for example, have demonstrated how London attempted to salvage the money and research experience derived from its cancelled *Blue Streak* ballistic missile system by Europeanising the project as a civilian satellite launcher under the auspices of the European Launcher Development Organisation (ELDO).[24] Significantly, however, they also showed that although Harold Wilson's government became uneasy with the project and redirected funds towards a national launcher instead, London dared not announce its intention to withdraw until Britain's second EC rejection in 1967.[25] This strategy, as Lewis Johnman and Frances Lynch have shown, was mirrored by Concorde: unable to collaborate with its preferred American partners (whose demands for Mach 3 capabilities were deemed excessive), Britain found its 1961 EC application manipulated to force it into Anglo-French collaboration on supersonic airliners.[26]

Finally, Susanna Schrafstetter and Stephen Twigge have noted how Britain's attempts to expand its diffusion enrichment plant at Capenhurst were redirected in 1965 into plans to develop new gas centrifuge technology with West Germany and the Netherlands as a means of securing a powerful technological position *vis-à-vis* the Six.[27] The project was significant not only for terminating Britain's supplies of American fuel and for marking the first Anglo-European nuclear collaboration outside Washington's supervision, but also for excluding the French and thereby damaging the political machinations of de Gaulle. As such, Schrafstetter and Twigge conclude, the project marked a 'milestone in an ongoing process of European scientific collaboration', and demonstrated clearly that 'Britain's destiny was ultimately Europe'.[28]

The last strand within the theme of technological cooperation concerns the role of scientists as transnational actors, a trend whose development has been described by Vincent Lagendijk in his study of European electrical grids in the early twentieth century. Identifying the interplay between technological collaboration and political aims, Lagendijk noted that the predilection of electrical engineers for thinking internationally *blended* with the desires of politicians who saw in networks 'valuable tool for reworking international relations by materially linking countries together, thus enabling more interaction and trade, and creating interdependencies'.[29] Despite this apparent marriage, however, post-war European collaboration was littered with *conflicts* between scientists and overbearing politicians. As Krige and De Maria have shown in ELDO, scientists 'did not want scientific activities to be associated with an organization which was of political, commercial and military significance', while Trischler and Weinberger have demonstrated how government interference doomed the project to failure, a lesson learned by granting scientists greater autonomy over their organisational structures and research programmes in ELDO's successor, the European Space Research Organisation (ESRO).[30] Finally, Krige has also shown how excessive political interference and administration forced the resignation of both Felix Bloch and Phillip Morse, the first directors of CERN and Brookhaven, respectively.[31]

So what does atomic energy contribute to the three themes of American domination, Europeanisation and transnational scientists? At first glance, the nuclear case seems simultaneously to contradict and to affirm Krige's arguments regarding American competition: Britain began an independent project partly to facilitate restored cooperation with Washington (and indeed initially refused third-party assistance to further this end), but also sought to build an independent atomic empire to further its wartime work.[32] Importantly, however, as Britain's programme grew from a research project into a commercial enterprise, the relative weighting of these two objectives began to shift away from Atlantic collaboration and towards open competition, with Britain now seeking to outsell American reactors. Adopting a business-like perspective, Britain thus remained willing to collaborate with any partner which could strengthen its nuclear position, leading it to foster partnerships which primed new markets while preserving its technological lead. Importantly, then, by demanding *quid pro quo* exchanges which gave nothing away gratis, Britain often sought collaboration not among equals aiming to combine the sum of their parts, but rather to empower itself.

Examining next the concept of 'Europeanising' technologies, this book has assessed the interplay between technological cooperation and political concessions over a time frame longer than the focus on Britain's 1961 and 1967 EC applications commonly adopted in existing literature. During the early post-war years, Britain was obviously restricted by American edict from serious nuclear exchanges, but nonetheless undertook selective low-level collaboration to maintain the appearance of leadership: indeed, one might also consider the inverse proposition than London 'Briticised' European projects in order to supervise them, as with the EAES. Elaborating existing studies of Harwell's Isotopes Division, this study has also demonstrated how these fields, although not 'Europeanised' in the same sense, were nonetheless opened to continental participation and thus contributed also to Britain's influence. In contrast to the political world, where atomic energy enjoyed occasional popularity as a tool capable of bringing Moscow to the table, fortifying the OEEC or buying EC accession, European cooperation thus occupied a more permanent place in the minds of British scientists, who explored combined operations for some time: witness Cockcroft's early enthusiasm for a European nuclear energy establishment similar to Harwell, discussed in Chap. 3, or the debates over British assistance for a European enrichment plant which were eventually abandoned due to capacity constraints. In this way, then, it must be accepted that Anglo-European atomic cooperation was a slower-burning process than current analyses of individual infrastructural nodes such as enrichment plants or irradiation facilities (and their importance to contemporary political negotiations) allow.

Another key contribution of this work to the Europeanisation debate has been to identify how Britain adopted a two-part strategy of tying clients into tailored bilaterals which maximised the profits of such engagement while undertaking joint projects to foster political goodwill. In so doing, this book has answered Trischler and Weinberger's plea for historians to investigate more thoroughly the role of multi-purpose international organisations such as the OEEC in forging technological cooperation, and has demonstrated how nuclear collaboration was used to spearhead Britain's *alternative* model long before it was deployed to incentivise EC accession.[33] Importantly, however, these activities reflected Britain's difficulties in reconciling two different notions of 'Europe', namely the 'nuclear Europe' of atomically-advanced nations like France, Norway and the Netherlands for whom Britain's nuclear offerings would hold most immediate interest, and the 'Messina Europe' consisting of industrialised markets like Germany and Italy to which Britain needed to preserve access. By examining the interplay between these blocs, this study has thus retrained the focus of Anglo-European nuclear diplomacy away from the debates about integration towards a broader perspective analysing Britain's interactions with *all* continental partners.

Drawing a comparison between the OEEC's nuclear projects and existing studies of other Europeanised undertakings also reveals some noteworthy trends. In their study of ELDO, Krige and de Maria noted that the project possessed genuine technical value in addition to its political cache, and the same is true of Dragon.[34] Although not an absolute research priority, HTGC projects nonetheless retained significant scientific merit and were accordingly scheduled for domestic development in due course: indeed, in considering which of Harwell's reactor concepts to Europeanise, Cockcroft asserted unequivocally that Britain needed to offer its partners a project exciting enough to be taken seriously. Instead, the difference between ELDO and Dragon lay in the motivations propelling their Europeanisation: collaboration on Dragon accelerated the development of a promising future reactor design, while for ELDO, the offer of collaboration was a desperate attempt to rehabilitate a dead project and recoup lost investments. As such, one must conclude that Dragon was far more than an improved version of the 'leadership on the cheap' castigated by Milward, and instead represented a valuable opportunity to augment Britain's narrow reactor options while also bolstering its FTA proposal.[35]

With its attempts to subsume the Six into a wider free-trade area dashed by the 1960 Hallstein proposals, Whitehall turned finally to atomic energy to spur its last-ditch bid for 'near identification' with the European Communities. This was no small concession: hoping to prevent highly damaging discrimination against its trade, London attempted to 'Europeanise' the entire non-military arm of arguably its most prestigious technological jewel. When the venture failed, it became clear that even these technological concessions would be insufficient to resolve the economic problem. Importantly, this marked the end of a mode of British thinking which advocated bribing the Six with technological gifts in order to guarantee London a special settlement *outside* the EC, in turn heralding another chapter in which similar treasures were offered to get Britain *into* Europe. From this point forward, atomic energy would be deployed alongside Concorde and later ELDO as technological incentives to secure accession, a complete reversal of the original intention behind its Europeanisation. Indeed, governmental support for Britain's atomic sovereignty ultimately collapsed so completely that Edward Heath's government barely discussed the issue during Britain's successful 1973 EC negotiations.[36]

Although perhaps a subsidiary objective, the final contribution of this work has been to offer a new case of scientists performing as transnational actors. International atomic interaction both strained and cultivated relations between scientists and politicians, with the former seeking funding and political sanction for their exchanges, and the latter wishing to defend national technologies while maintaining a politically-useful cooperative image. As such, the extreme classification pervading nuclear energy encouraged scientists to challenge official strictures by negotiating a 'grey space' in which they could cooperate without invoking political opprobrium or inviting governmental interference. These motivations have already been identified by historians studying CERN, which they argue was established to maintain scientific interaction in a field unconnected with the commercial or military connotations of atomic energy.[37] Augmenting these assertions, then, this study has demonstrated how Britain's radioisotope specialists and scientific diplomats propelled a distinct phenomenon in which aspects of nuclear energy were depoliticised to foster exchange. Investing considerable energy in their pursuit of collaboration, scientists eventually became key intermediaries who convinced government to fund collaborative projects: Cockcroft, for instance, rendered Dragon financially palatable to Whitehall while simultaneously using his prestige to encourage foreign states to fund the Europeanised project. In this way, scientists seized the initiative in stimulating cooperation where government had tarried. Although this book has only gestured towards this trend, it is surely a field ripe for further investigation.

This book has also expanded existing understanding of Britain's atomic diplomacy in an institutional context: from its inception in 1954, the Authority was permitted to conduct 'routine' international exchange, with departmental scrutiny required only to sanction partnerships of conspicuous importance. As such, the Authority fostered exchange with any party useful to its cause, an approach which in practice encouraged inputs from the United States and Commonwealth and targeted exports almost exclusively to Europe. However, although Wolfram Kaiser's assertion that no minister desired to board the European bus was mirrored in the Authority's disdain for integration, this did not mean that the AEA (and much less its scientists) opposed continental cooperation *per se*. Indeed, many of the Authority's internal debates expose clearly the conflict between internationalist scientists (Cockcroft, for instance, recommended Britain adopt a position just shy of nuclear integration long before such concepts were considered by ministers in the economic sphere) and bureaucrats such as William Strath who swelled the Authority's ranks as it grew. In this way, this study has taken a more detailed look at the AEA's *internal* workings than that commonly adopted in existing studies, and has shown how Britain's engagement with Europe was not simply a case of a monolithic Authority persistently advising ministers against integration.

In summary, while it is beyond the scope of this study to chronicle exhaustively Britain's atomic exchanges with every possible foreign partner, it has nonetheless offered some new reflections on post-war Anglo-European relations. Firstly, although Britain largely remained restricted to *quid pro quo* exchanges intended to maintain its lead, London's nuclear diplomacy after 1945 was nonetheless more positive than is often depicted in integration-centric narratives. From an early stage, scientists attempted to foster cooperation where practical, in turn developing an informal 'nuclear Europe' over whom Britain's atomic offerings would hold most sway. Secondly, comparing nuclear energy with other politically-potent British technologies has revealed that atomic collaboration marked a turning-point in Britain's use of its technological jewels, being initially deployed in the *opposite* manner to subsequent schemes like ELDO and Concorde to purchase Britain a special deal *outside* Europe. Furthermore, Britain's 1960 offer to Europeanise its civil nuclear arm was arguably more significant than later proposals like ELDO, which merely rehabilitated a cancelled project, or with Concorde, where collaboration was mandatory to keep up with Washington. In re-examining these themes, then, this book has connected separate bodies of existing literature and reapplied them to the nuclear case, in turn provided novel perspectives on Britain's relations with Europe and indicating new prospects for future inquiry.

Epilogue: Lessons Learned and Brexit

Britain did, of course, eventually join Euratom as part of its third and successful application for membership of the European Communities in 1973. Since then, the agency has continued its diligent work in improving nuclear safety standards, researching radioactive substances and promoting international collaboration via the bilateral treaties it has signed with other leading nuclear powers and with the larger uranium-producing states. The focus of Euratom's work has also shifted away from fission power since Britain joined, too, and the UK has in fact benefited from the construction of significant laboratories on its soil. In the field of nuclear fusion, European designs began in the 1970s, and the Joint European Torus eventually opened at Culham in 1984. Indeed, the growth of Big Science has reached its logical conclusion in the fusion arena with the formation of a *global* conglomerate to construct a tokamak reactor in France. In addition to the European Union (EU), the International Thermonuclear Experimental Reactor (ITER) is funded by Japan, South Korea, India, China, Russia and the United States.

At national level, meanwhile, Britain's nuclear story has diverged somewhat from that of its nearby cousins. Britain's early nuclear programme was undeniably unique: London's participation in the Manhattan Project and its pursuit of nuclear weapons despite the McMahon Act gave it a unique advantage in the early atomic world, matched only by that of Canada. Throughout the 1950s, Britain remained the world's civil atomic pioneer and was for many years the only state with appreciable installed generating capacity. With Washington enforcing its own isolation, Britain thus became the only partner (except theoretically the Soviet Union) with which European neighbours could cooperate and thereby accelerate their domestic development. Britain, then, was poised to lead the field.

Accordingly, from 1956 until very recently, Britain's civil nuclear sector, in comparison with those of France and Germany, has remained largely free of foreign involvement in the construction and operation of plant. A notable exception to this rule is the Capenhurst enrichment plant, which since the 1970 Treaty of Almelo has been under the control of URENCO, a conglomerate owned by the Dutch and British governments (one-third each) and the German utilities RWE and E.ON (one-sixth each). Nevertheless, almost all nuclear stations built in the UK to date have been constructed by consortia of native construction, turbine and atomic engineering firms, imbuing Britain's nuclear sector with the confidence of the self-made man. This dynamic covered two generations of designs; the last Magnox station was completed in 1971, after which the AGR model took over, with the first reactors online from 1976. Indeed, of the twenty-six Magnox and fifteen AGR reactors constructed in the UK between 1956 and 1989, all were British-built, and only a single foreign design has ever been installed, namely the Pressurised Water Reactor (PWR) completed by Westinghouse at Sizewell B in 1995. Indeed, the AGR was retained despite reliability problems and the presence of significant foreign alternatives, a decision attributed by Simon Taylor to Whitehall's 'understandable but excessive preference for indigenous British designs over superior foreign ones'.[38] Perversely, then, Britain's civil atomic field has remained independent for much longer than its military cousin, where although Britain has always retained the ability to deploy missiles unilaterally, it has since 1962 nevertheless required American delivery systems.

Yet this apparent self-sufficiency has recently come under threat, and the shutdown date of the second-generation systems is under continual review, with all AGRs expected to be offline by 2023. In 2009, France's state-owned utility EDF bought British Energy, the privatised operator of Britain's AGR stations, and in October 2010 the British government gave permission for eight new nuclear power stations to replace ageing models on existing sites.[39] The bidding process for these contracts has seen participation only from foreign firms: although German giants RWE and E-ON stated in March 2012 that they had dropped out, EDF has committed to building four new reactors and Japanese firm Hitachi has expressed interest in supplying the remainder.[40] Among the more controversial projects was the tender for the Hinkley Point C station in Somerset, a 3200 MW twin-reactor site which was eventually given the green light by government in September 2016. Hinkley Point, built on the graveyard of two previous reactors (the Magnox Station A which began generation in 1965 and the AGR Station B which opened eleven years later), will now be financed by two foreign nationalised utilities, EDF and the China General Nuclear Power Group. With a host of dying nuclear power stations on its land, there has consequently been a sea-change in Britain's conceptualisation of its export potential: instead of sales of native plant designs and their associated equipment, Britain now wishes to capitalise on its extensive experience in waste management and decommissioning atomic stations.

By contrast, France exposed itself to foreign interest at a much earlier date. Although freeing its weapons programme from the provisions of Euratom, Paris nonetheless participated in the supranational authority and continued to profit by foreign interference. After terminating its native civil gas-graphite programme in 1970, France attempted initially to install four light-water reactors under licence from Westinghouse, before abandoning all restraint in the face of the 1973 oil crisis and ordering eleven more such plants. Importantly, however, these designs were subsequently 'Frenchified' to the extent that they became essentially native designs.[41] This standardisation, based on an initial case of 'boosterism', has thus lent the French system a distinct advantage over their British counterparts. Since then, nuclear power has been championed by Paris, now the world's leading civil nuclear power with 63 GWe of installed nuclear capacity (compared with Britain's 10 GWe), and with 75% of French energy needs now supplied from nuclear sources.[42] Thus, France has clearly profited by timely foreign intervention, in a manner which Britain would presumably like to emulate.

Another comparison of note lies with Germany, where seventeen reactors, a mix of native Boiling Water Reactor (BWR) and PWR designs all built by Siemens, remain active. As a defeated power in 1945, West Germany's best chance of atomic development lay in a European community, and so it joined Euratom in a bid to depoliticise its civil nuclear wing. Unlike Britain and France, Germany has also never pursued a nuclear weapons project beyond that undertaken by the Nazis and perhaps for this reason, as Mara Drogan has highlighted, Adenauer's government did not actively dictate nuclear capacity installation, leaving the issue to the federal *Länder* and German industry.[43] Germany's atomic development through the 1960s then, in Joachim Radkau and Lothar Hahn's words, was performed 'first ideationally, then experimentally, lastly commercially'.[44] Reacting as France did to the 1973 oil shock, Germany installed a series of native PWR and BWR reactors, but in contrast to Paris, this amounted to what Radkau and Hahn have labelled a 'nuclear pseudanthium' of unrealistic expectations for huge investments in dozens of nuclear stations that were never realised.[45]

Instead, in the wake of the Fukushima nuclear disaster in 2011 the German government declared an *Energiewende,* a publicly-popular plan to close Germany's nuclear power plants by 2022.[46] The announcement was almost unilateral in the wake of increased investment in nuclear energy by the likes of Britain and France, and promises to weaken German industries with traditional strengths in electrical engineering by killing their home market. Such policies can partly be explained by Germany's large green lobby (sixty-three Bundestag members out of 630) which in 2017 enjoys far greater political representation than that in Britain (one MP out of 650) or France (eleven senators out of 348 and four deputies out of 577). Britain, then, remains distinctive in the modern world in the sense that it is only now allowing large-scale foreign intervention in its privatised nuclear energy market. Furthermore, although increasing its percentage of electricity generated by nuclear plants, Britain occupies the considerable middle ground between France's domination of the civil nuclear world and Germany's retreat from a technology which has produced a strong domestic industry.

With foreign intervention in Britain's nuclear activities now rising to a level inconceivable in the 1950s, we must consider what lessons this book can offer for a world in which the prestige benefits of nuclear power are now much reduced in comparison with the technology's technical merits. The decision taken by the British government in spring 2017 to leave the EU (and with it Euratom) poses several questions about the shape and form of a newly independent British civil nuclear project, and it is hoped that these can be at least partly answered by the past experience highlighted in this study.

In addition to the obvious mountain of legislative and judicial work caused by Brexit, the first large issue that arises is that, once removed from Euratom, Britain must restrike the deals with foreign countries which it once had before these were subsumed into the supranational complex. To do so, it must utilise its technical prowess which, although no longer world-leading in many key aspects, still retains considerable value in specialist fields such as decommissioning. The Brexit route also flies in the face of the process, described in detail throughout this book, of Whitehall participating in international scientific and R&D organisations in a bid to control them. Should the imperative of maintaining this control (and also the access of British laboratories and universities to European funding streams) still be considered vital by British politicians, then we may yet see an attempt by London to retain its position in important technical forums while leaving the political and economic union. While such a gambit is likely to lead EU officials to demand considerable concessions in other aspects of the divorce settlement, the reduced modern importance of Euratom when compared to the high-point of nuclear excitement in the 1950s and 1960s may yet, ironically, see the realisation of Macmillan's failed partial integration effort in reverse.

On a commercial front, a related issue to part of Britain's new life outside the EU will also undoubtedly see it build a greater nuclear dependence on non-European partners, a field in which Britain has historically enjoyed little success in building relationships. The geopolitical and security concerns of non-European (specifically Chinese) investment have already caused Whitehall to implement hastily arranged special measures over Hinkley Point C to prevent foreign owners jeopardising national security.[47] On the positive side, the tripling of the global population since 1950 has opened a raft of new industrialised markets for nuclear wares which Britain may seek to exploit provided it can institute a new regime of safeguards with IAEA approval. These may once again include the chimera (described in Chaps. 2 and 4) of Commonwealth markets now that their industrial centres have had an additional seventy years to grow and mature.

The second problem arising from Britain's divorce from the EU is the damage the policy will wreak on its access to skills. As shown in Chap. 2, Britain's atomic programme has always been short of specialist manpower, and isolation from a large bloc of highly-industrialised nations will do nothing to improve this. Since 1948, manpower analysts have stressed that Britain must do everything in its power to maximise the ability of its universities to attract international students, and immigration restrictions placed against European scholars will greatly diminish the UK's claim to have the best-staffed higher education facilities in the world. In turn, this inability to attract global talent may reduce the ability of British industry and research facilities to embed their techniques in the technological patterns of foreign states, further damaging their export potential. These problems will only become exacerbated should UK higher education institutions lose their access to EU research funding, a resource from which they have historically benefited disproportionately.[48] Without a significant commitment by Whitehall to match or at least provide alternatives to EU research grants, British science will be at a permanent disadvantage and its industries will be unable to capitalise on the improved access to emerging markets which Brexit is supposed to bring about.

Conclusion

This book has dealt primarily with the problems of instigating technological collaboration in an environment which is both politically and economically volatile. Finding a 'one-size-fits-all' solution under such circumstances may prove impossible, particularly on a continent like Europe where power is concentrated in four main economies orbited by numerous smaller states. To a technologically advanced nation, cooperation with weaker partners may at first appear counter-productive, threatening the diversion of national finance, manpower and capacity into projects with little immediate value. Such engagement also portends a loss of sovereignty to international authorities and, perhaps worst of all, the sharing of expensive research with partners who will rapidly obtain technological parity at little cost. In return, there lies only the dubious promise that pooling will *eventually* allow the collective to undertake research on a scale beyond the means of the senior partner. So why share? The answer lies in the *political* realm: as Britain's experience showed, participation in international technological schemes can be advantageous if political benefits can be identified early enough. However, in these situations it is imperative to act assertively in order to gain both the credit for a progressive attitude and to maximise one's influence over the collaborative entity. This logic also applies if the aim is to neutralise the organisation by restricting it to uncontentious tasks or to redirect it away from fields earmarked for national development.

To finish, Paul Kennedy has identified that in 1950 the United States was in an 'artificially' elevated position, with its nearest competitors all exhausted by war.[49] To a degree, the same is true of British atomic energy: away from Washington, the war had left France ruined, and Japan and Germany restrained by occupation controls, effectively granting London a free decade in which to maximise its advantage. This synthetic lead was threatened, however, by a contrary trend in which Britain's economic growth trailed that of its reconstructed neighbours: by the early 1960s, as Tony Judt has shown, 'the Federal Republic was the booming, prosperous powerhouse of Europe, while Great Britain was an underperforming laggard'.[50] The task confronting post-war British ministers, in historian Alan Milward's view, was therefore to cash in Britain's many 'great but short-term advantages […] while they were still there in return for a stable international framework' which would guarantee British security and prosperity.[51] Extrapolating this concept, then, it can be argued that trying to preserve atomic energy as a national champion against this trend without engaging decisively with France and Germany in particular was exceptionally myopic. Constructing and commanding the organisations designed to develop nuclear energy internationally represented probably the best opportunity for Britain to preserve its lead, and by dictating the terms of atomic energy cooperation early enough to sabotage the sector's incorporation into the Europeanist dream, Britain would have been able to collaborate without divulging its best projects, in the same manner as the panicked AEA belatedly attempted in 1961. Although there is no guarantee that this would have forever preserved Britain's technological lead, particularly given the unknown variable of Washington's role, it would at the very least have significantly lengthened Britain's continental atomic premiership and made its political goals more achievable.

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Glossary

Aldermaston Since 1950 the main laboratory of the Atomic Weapons Research Establishment (AWRE).

Atomic Energy Authority (AEA) Public corporation created in 1954 to assume control of Britain's industrial and military nuclear research. The AEA was significant in that it afforded much greater control of research and foreign policy to scientists, as opposed to politicians.

Atoms for Peace Initiative developed in 1953 by President Eisenhower to encourage the development of civil nuclear energy internationally under US supervision. The programme relied heavily on 'Section 123' agreements, under which foreign states would be supplied with uranium and research reactors by the United States.

Combined Policy Committee (CPC) Tripartite committee established under the Quebec Agreement to oversee joint nuclear development. Joined in 1944 by a Combined Development Trust (later the Combined Development Agency), an authority tasked with cornering the world's supplies of uranium to ensure the Allied nuclear projects remained well-stocked.

Enrichment Process by which the proportion of U^{235} isotopes in uranium fuel is increased, commonly by either passing the uranium through a series of porous membranes or by spinning the uranium in a centrifuge and separating the desired layer of product. Enriched uranium can be used in nuclear bombs or to fuel more advanced civil nuclear reactors, making control and oversight of enrichment facilities a key aspect of international nuclear safety.

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European Atomic Energy Community (Euratom) Organisation formed by the six signatories to the 1957 Treaty of Rome. Euratom aims to develop civil nuclear energy in Europe and to give the continent a combined research nucleus of global stature.

European Atomic Energy Society (EAES) Society formed in 1954 as a means of giving eminent scientists from across Europe a forum in which to discuss declassified aspects of civil atomic energy without political interference. The EAES worked to ensure the exchange of literature and to promote standardisation in the nuclear field.

European Coal and Steel Community (ECSC) Organisation formed in 1950 under the supervision of French foreign minister Robert Schuman with the aim of placing the coal and steel industries of West Germany, France, Italy, the Netherlands, Belgium and Luxembourg under a common High Authority. Charged with reducing the likelihood of war by placing crucial war materials under common supervision, the ECSC was significant for starting the process of supranational integration that would eventually lead to the 1957 Treaty of Rome.

European Economic Community (EEC) Trade bloc formed after the 1957 Treaty of Rome as a means of introducing a customs union and common market between the six ECSC signatories.

European Free Trade Association (EFTA) Free Trade Area established with British help in 1960 as an alternative to the EEC. The Association comprised many of Europe's peripheral Alpine and Scandinavian economic powers, dampening its ability to compete with its main rival.

European Nuclear Energy Agency (ENEA) Organisation formed in 1958 with the goal of promoting continental nuclear cooperation under the aegis of the OEEC.

European Organization for Nuclear Research (CERN) Research organisation set up in 1954 to conduct particle physics experiments as a joint venture between European states.

Fast Reactor Reactor design which dispenses with a moderator and which can 'breed' more fuel than it consumes, greatly increasing the quantity of energy extracted from each batch of uranium.

Harwell Village in Berkshire (now Oxfordshire). From 1946 until the 1990s site of the Ministry of Supply (later the AEA's) main nuclear research laboratories at the Atomic Energy Research Establishment (AERE).

Heavy Water Also known as deuterium oxide, heavy water is a compound similar to normal water but which contains an additional neutron, making it useful as a moderator in civil nuclear reactors.

Joint Establishment for Nuclear Energy Research (JENER) Joint nuclear research enterprise undertaken by the Netherlands and Norway in 1951, marking one of the first successful collaborative ventures between European states in the field.

Magnox Britain's first model of commercial nuclear power reactors. Named for the magnesium oxide cladding using on the fuel rods. Originally known as PIPPA reactors and intended for the dual use of producing plutonium and commercially useful quantities of electricity.

McMahon Act Formally known as the 1946 US Atomic Energy Act, this legislation established the USAEC and made it an offence for any American citizen to communicate 'restricted' nuclear data to foreign states, even the United Kingdom and Canada. The Act all but terminated significant Anglo-American cooperation in nuclear energy until its amendment in 1958, when President Eisenhower signed a Mutual Defence Agreement with London.

Messina Conference Conference hosted on Sicily in 1955 which laid the foundations for the 1957 Treaty of Rome.

Ministry of Supply Ministry of the British government which until 1954 was responsible for the development of nuclear energy.

Modus Vivendi An agreement signed by British and US scientists in 1947 under which London would release its 50% entitlement to uranium procured by the CDA in exchange for limited technical information. The agreement also formalised the nuclear rights and roles of Commonwealth states.

Nuclear Fission Process by which energy is released from atoms by 'splitting' them into smaller particles. In a conventional nuclear reactor, uranium atoms are bombarded with a 'fast' neutron, causing them to split into two or more fission products while releasing energy and new neutrons to propagate the process. Around 99.3% of uranium atoms are of the isotope U^{238}, which will 'capture' fast neutrons in a reactor to form $plutonium^{239}$, a key ingredient for nuclear bombs. The remaining 0.7% of uranium atoms is of the isotope U^{235}, which will undergo fission in a reactor, releasing energy.

Nuclear Fusion Technique used to liberate vast quantities of energy by fusing two lighter atomic nuclei to form a heavier nucleus under extreme temperature. Used in both thermonuclear bombs or in modern civil fusion energy experiments like ITER.

Organisation for European Economic Cooperation (OEEC) Organisation that emerged from the Marshall Plan in 1948. The group, known since 1961 as the OECD, aims to promote economic cooperation in Europe and to encourage trade by reducing tariffs and other commercial barriers.

Polaris Replacement for the *Skybolt* ballistic missile system, sold by Washington to the British in 1963.

Power Reactor Large-scale nuclear reactor scaled to produce electricity commercially.

Pressurised Pile Producing Power and Plutonium (PIPPA) See Magnox.

Quebec Agreement Agreement signed between Britain and the United States (with Canada observing) on 19 August 1943, outlining the terms of the joint development of nuclear energy. Under the agreement, both sides promised never to use nuclear weapons without mutual consent, nor to communicate nuclear information to third parties without similar permission. Under Clause IV of the agreement, Britain also foreswore its right to develop industrial nuclear energy independently after the war without US permission.

Radioisotopes Unstable isotope of an atom, often possessing potential usefulness in medical, biological or agricultural research.

Research Reactor Small-scale reactor which can be used for material-testing experiments, agricultural or medical research, or to train engineers in nuclear safety.

Risley Location of the main laboratory of the AEA's Industrial Group, founded in 1946.

Skybolt Troubled ballistic missile system developed by the United States and cancelled in 1962, leading to great friction with the Royal Navy, who had decided to base Britain's nuclear deterrent on it.

United Nations Atomic Energy Commission (UNAEC) Short-lived body established in January 1946 with the task of restricting the development of nuclear energy internationally to peaceful uses and of providing a system of inspections to ensure the same.

United States Atomic Energy Commission (USAEC) Civilian body formed in 1946 to conduct nuclear research in the United States.

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[1] Note: Page number followed by 'n' refer to notes.

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