**The Defence Research Committee, 1963-1972**

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What is a useful and productive focus of analysis for historians of scientific governance? Committees are the natural unit of bureaucracy, and their workings are crucial in any account of either government at large[1] or science policy decision-making in particular.[2] Since committees generate paperwork they form and organise the primary source records that are the starting point for historical research on government. However, the fact that such records are convenient is not a reason, in itself, to choose committees as a focus of analysis. Indeed, historians, in search of less powerful voices, should always be ready to question and challenge, as well as understand, the archival categories of the past. Nevertheless, there are a number of positive reasons to observe past committees at work. Committees are mid-range entities, between individual and large-scale organisation, and this feature is an advantage, since personal interventions, motivations and career paths can be weighed alongside broader, impersonal, strategic forces. Committees can be dry as dust (as anyone who has sat on one knows), but they also exist because something is at stake: the balancing of interests, the gathering of disparate energies for a common purpose, or, sometimes, the cynical desire *not* to reach a decision. Committees can be dynamic (making decisions, sharing knowledge) and they can be obstructive (blocking change, indulging in "group think"). Either way they are significant.

This chapter is on the Defence Research Committee (DRC). It was born in 1963, out of the ashes of a similar body, the Defence Research Policy Committee (DRPC). The DRC debated and reviewed defence research issues behind closed doors. Only now have many of its papers – at least, broadly, until 1972 - been declassified. It is still with us. I argue that since it kept a critical watch on defence research, greenlighting some major projects and closing others, drawing in external advice while expressing internal interests, comparing British

[1] Peter Hennessy, *Whitehall*, London: Secker & Warburg, 1989.
[2] Philip Gummett, *Scientists in Whitehall*, Manchester: Manchester University Press, 1980.

programmes with those of allies and enemies, then it forms a proper focus for the attention of historians of scientific governance.

**The Predecessor: the DRPC**

The Defence Research Policy Committee (DRPC), the highest level decision-making body wholly concerned with military R&D in Britain in the early Cold War.[3] The committee had been established in 1947, paired on the civil side with the Advisory Council for Scientific Policy, with the aim to "formulate a coherent scientific policy covering the whole range of defence research", advising on priorities and levels of effort, and reporting to the Chiefs of Staff, the Defence Committee and later the Minister of Defence. It was chaired by a succession of four prominent scientific advisers: Henry Tizard, John Cockcroft, Frederick Brundrett and Solly Zuckerman. It was dissolved in 1963, and replaced, in part, by the subject of this study: the Defence Research Committee.

Earlier commentators, probably misled by the characteristically contrarian views of Zuckerman, considered the DRPC to be a limp and inconsequential influence.[4] This early assessment was wrong. First, the DRPC was indeed an influential body. It was a key forum for the inter-service debates about research, and acted as a "gatekeeper" for British military research projects. One routine but consequential task the DRPC undertook were wide-ranging reviews of defence science. The science in turn had to be choreographed to fit with changing military strategy and economic circumstances.

Second, however, while the DRPC had a broad remit it was critically constrained in ways that shaped the decisions it took. For example, the DRPC was in practice restricted to non-atomic science, which had its own decision-making processes. In turn, the DRPC were more sympathetic to its own 'weapons of mass destruction': chemical and biological weapons. Another instance of constraints was the extraordinary asymmetry in knowledge about friendly and enemy R&D programmes. The cold, existential fact of the Cold War, that

[3] 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* (1998) 28, pp. 209-252.

[4] TNA CAB 134/4854. STO(CS)(84)33, 'Scientists bureaucrats and ministers', the text of a public lecture by Zuckerman, 24 October 1984, is strong evidence of his dismissive view of the DRPC.

devastation could be minutes away, placed an emphasis on preparation: the research and development of offensive and defensive military systems. The "present armament race", observed the DRPC's longest serving member, the Admiralty scientist (and astronomer) Sir John Carroll, "was in fact a research and development race".[5] Yet almost nothing concrete was known about Soviet research: "direct penetration of the Russian research and development program was impossible", complained an intelligence official in 1955, "We had never seen a single Russian equipment until it was in operational service or deliberately shown".[6] A looking-glass effect became evident: the DRPC had to shape the British defence science programme based on knowledge of what it - and Western allies – could do on the assumption that the East could do similar. I will argue that both of these features also describe the DRC.

**The DRC: Overview**

So what do we see? There are continuities and changes. First, the DRC, like the DRPC, conducted major reviews of the defence research programme, balancing inter-service demands, responding to new strategic guidance, and, more often than not, searching for cuts as projects overran budgets and the national economy struggled. Second, the DRC acted as a gatekeeper for specific projects, of which a partial list of the most significant would include: helicopters, satellites, fuel cells, beryllium as an aero engine material, computers, magneto-hydrodynamic power sources, radar, inertial navigation, pump jets, ram jets, micro-electronic components, sonobuoys, laser weapons, tanks, night vision, rockets, hypersonic aircraft, and chemical and biological weapons. Third, some topics received attention that they had not under the DRPC. Examples include the balance between civil and military research, the potential contribution of the human sciences, especially psychology, and what was somewhat euphemistically called "aid for civil power", in other words R&D in response to the troubles in Northern Ireland. Fourth, international relations, and the knowledge that might flow through them, remained important. It is no surprise that the relations with the two superpowers were most critical. The United States

[5] Agar and Balmer, op. cit., p. 209.
[6] Quoted in Agar and Balmer, op. cit., p. 211.

was a source of leadership, collaboration and also anxiety over dependence. Soviet research and development remained an enigma, which meant that occasional glimpses, such as the extraordinary case of the "Berlin Firebar", discussed below, were influential.

Finally, one trend was towards an increasingly influential role for a handful of "independent" academic scientists, in particular John Kendrew and Hermann Bondi, and to a lesser extent Brian Flowers and J.L.M. Morrison. They led major investigations and their voices could sometimes dominate discussion. However, this trend culminated, problematically so, in the establishment in the late 1960s of a new system for bringing outside expertise to bear on defence policy: the labyrinthine collection on bodies headed by the Defence Scientific Advisory Council (DSAC). The emerging structure, a DRC, which became a more conventional Whitehall committee, and DSAC, which channelled largely academic input, is the system for guiding defence research that has lasted up to the present. However, as I shall show, the system got off to a very rocky start.

**The DRC and Reviews of Defence R&D**

The context for the transition from DRPC to DRC was that of profound transformations in defence policy. Rearmament in the early Cold War left the UK in the late 1950s with a V-bomber nuclear force, already becoming obsolescent, retooled defence research establishments, and a hydrogen bomb programme. The success of the latter in May 1957 rebooted UK-US atomic relations and prompted the formation of CND. Duncan Sandys, the aggressive new minister of defence, forced through the decisions outlined in his 1957 white paper, often in the teeth of opposition from chiefs of staff, including the end of National Service, cutting back conventional armaments, and placing more reliance on nuclear deterrence to be delivered by missiles. When the ballistic missile Blue Streak overran budgets it was cut in 1960 in favour of an American air-to-surface missile called Skybolt launched from the V-bombers.[7] In 1962, when Skybolt was withdrawn, the submarine-

[7] Richard Moore, 'Bad Strategy and Bomber Dreams: a New View of the Blue Streak Cancellation', *Contemporary British History* (2013) 27, pp. 145-166.

launched strategic American missile Polaris was chosen, a cheaper (but not cheap) means of delivering British thermonuclear bombs.[8]

Under the Wilson administration the Ministry of Aviation became absorbed into the Ministry of Technology. Mintech had changed greatly between initial plans – a small department based around the state-owned patent-holding National Research Development Corporation - and actualisation – an enormous department absorbing NRDC, the Atomic Energy Authority, most of the broken-up Department of Scientific and Industrial Research (all in 1965), the procurement part of the Ministry of Aviation (1967) and the Industrial Reorganisation Corporation (1969). The Wilson government searched for defence cuts for reasons that went beyond a response to precarious economic circumstances. First, following the logic of the Sandys realignment of defence policy, major projects, darlings of the armed services and aviation ministry, were cancelled, including the sophisticated TSR-2 tactical strike aircraft and the P.1154 supersonic vertical take-off fighter, both in 1965.[9] Second, Mintech aimed to shift R&D spending from defence to civil areas, encourage diversification, links to industry and spin-off from defence laboratories, as well as moves 'from civil aerospace and civil nuclear power to other sectors', 'from government laboratories to the private sector', and from seeing underinvestment in research as the problem to other means of stimulating growth.[10]

Finally, to force through these changes Conservative and Labour politicians expanded the Ministry of Defence so as to be a central, powerful body, relegating the three armed service departments. The DRC, its chair and chief scientific adviser, and its secretariat, the Defence Research Staff, sat in the heart of this reformed MoD. So the DRC was part of an expanded structure to ensure control and debate about military systems. Co-created with the DRC was a Weapons Development Committee (WDC) and an Operational Requirements Committee.

The DRC's terms of reference were:

[8] For a updated view, see: Andrew Priest, 'In American Hands: Britain, the United States and the Polaris Nuclear Project, 1962–1968', *Contemporary British History* (2005) 19, pp. 353-376,

[9] Sean Straw and John W. Young, 'The Wilson government and the demise of TSR-2, October 1964-April 1965', *Journal of Strategic Studies* (1997) 20, pp. 18-44.

[10] David Edgerton, *Warfare State: Britain 1920-1970*, Cambridge: Cambridge University Press, 2006, p. 252, p. 258, as part of a rejection of the standard reading of White Heat.

(i) To advise the Minister of Defence and the Chiefs of Staff on all scientific and technical matters which may affect the formulation and direction of defence research policy.

(ii) To keep the defence research programme under review, so as to ensure that it is appropriate to defence needs, having regard to available resources, and in particular to ensure that all concerned are made aware in good time of scientific developments which may be of military interest.[11]

Members of the DRC were senior scientific advisers and controllers from MoD and the Ministry of Aviation, plus externals, including 'two or three independent scientists', and representatives, when relevant, from DSIR, the Treasury and the Joint Intelligence Board.[12] Successive chairs of DRC, illustrating a slight trough in status, were Solly Zuckerman (1963-1966), materials scientist Alan Cottrell (1965-1967), deputy CSA for MoD E.C. Cornford (1968-1969), his successor N. Coles (1969-1971), and Hermann Bondi (1971 onwards).

The challenge, recognised explicitly by Solly Zuckerman chairing the first meeting, was to steer a path between non-intervention, merely collating information for the Minister, and too much intervention, interfering with the day-to-day management of research.[13] So the approach was to conduct rolling programmes of general reviews, carefully select topics for special review (often forming working groups), while being flexible enough to respond to pressing issues. The framework for defence policy also introduced further guidance, including the Treasury's insistence to keep an eye out for 'opportunities for rationalisation and generally increased efficiency', Mintech's interest in promoting civil industry, an injunction to think through the benefits, drawbacks and consequences of 'interdependence', and work within what was known and not known about other countries' research and development.

[11] TNA DEFE 10/571, 'MoD. Draft procedures of the Defence Research Committee', 1963.
[12] Specifically, from MoD: CSA, Assistant CSA (Studies), Assistant CSA (Projects), Assistant Chief of Defence Staff (Operational Requirements), Under Secretary (R&D), Controller of the Navy, Deputy Controller (R&D), Master General of the Ordnance, Chief Scientist (Army), Deputy Chief of Air Staff, Scientific Adviser (Air); from Ministry of Aviation: Chief Scientist, Controller Aircraft, Controller Guided Weapons and Electronics; externals: two or three independent scientists, representative from DSIR, Director of Scientific Intelligence (JIB) and Under Secretary (Defence Materiel) Treasury.
[13] TNA DEFE 10/571. Zuckerman, 'Committee procedures', 12 December 1963.

The parallel WDC dealt, broadly, with the 'development' rather than the 'research' of R&D, and therefore was even more concerned with specific weapons systems. Nevertheless, there was overlap, if not, it seems turf wars. Where there was considerable shared interest, for example in the case of electronics components, still discussed under the slightly anachronistic term 'valve development', the DRC and WDC held joint meetings, chaired by Sir William Cook. Some parts of the research programme also fell under the WDC, for example nuclear propulsion for submarines.

The operation of the DRC inevitably changed over time. If you imagine a spectrum from grand strategy through calls for types of military systems, through to research, development and procurement, then problems arose as each level shifted in relation to each other. Zuckerman, for example, saw problems in tying research to specific weapons systems, which might be cancelled.[14] There was a case therefore for supporting 'component' research independently. Throughout the DRC had to deal with uncertainty about future shifts:

> It would be valueless to review the research programme until the Chiefs of Staff doctrine had been revised in the light of agreed Ministerial changes in defence policy. The Committee ought then to concentrate on the proper deployment of scientific effort and the priorities which ought to be given to the various Research fields… Unless there was a clear statement of defence policy there was danger of perpetuating the situation under which [the DRC] had to draw up their own assumptions… Furthermore, unless a clear indication of defence policy could be given to scientists … it would be impossible for them to play their proper part in formulating and implementing future research programmes. There were bound to be changes in strategic policy over the years, and judgements would have to be made on which technologies were likely to pay dividends for future weapons. Research would be influenced by the types of major projects.[15]

Indeed, the changes acted both up and down:

[14] TNA DEFE 10/570. Minutes, DRC, 15 December 1964. The specific context was aircraft equipment components.
[15] TNA DEFE 10/570. Minutes, DRC, 3 March 1965.

> Research would be influenced by the types of major projects which would continue but it ought not to be forgotten that research might well influence strategic policy as it had in the past, eg. Polaris submarines.

This recognition of complexity of relationships, how everything shapes everything else, applied *within* research too. Research 'could not be managed except in relation to the "environment of the demand", said Sir Robert Cockburn, noting that roughly 30% of R&D was "research", and of that 20% was 'applied research determined by decisions taken on projects' and 10% was 'basic or general research'.[16] But the latter 'was not in practice completely unorientated. It was inevitably influenced by the environment in which it was undertaken'. This view supports Paul Forman's analysis of the orientation of US (defence) research, and my more general 'working worlds' hypothesis on the relationship of science to arenas of problems.[17]

The regular, typically annual, reviews of the major research programmes of the armed services and aviation, are fascinating documents, but there is not room here to discuss them in detail. In general they attempted to pull together knowledge of research in order that the politicians and the chiefs of staff could make major decisions. Decisions at the next tier down were often made at DRC, although sign-off might happen elsewhere. The substantial work composing the review was carried out by the Defence Research Staff and the working groups. Models include the less regular major reviews of the DRPC, but also the so-called "von Karman" reviews conducted under NATO auspices, with the difference that the DRC had access to more secret material.[18] It is true to say that the DRC struggled with achieving overviews in the face of massive detail and constant change. Only occasionally was clarity achieved, such as in 1964 when the 'dying points' and 'growing points' were clearly identified.[19] These, after all, might be disputed, as CBW was between Aviation and Army.[20] The DRC also occasionally noted areas of expertise where research establishments struggled

[16] TNA DEFE 10/570. Minutes, DRC, 19 December 1963.
[17] Paul Forman, 'Beyond quantum electronics: national security as basis for physical research in the United States', *Historical Studies in the Physical Sciences* (1987) 18, pp. 149-229. Agar, *Science in the Twentieth Century and Beyond*, Cambridge: Polity, 2012.
[18] See Agar and Balmer for the DRPC reviews. See TNA DEFE 10/570. Minutes, DRC, 19 March 1964, for the NATO von Karman studies, which did not have access to 'secret' and 'top secret' documents.
[19] TNA DEFE 10/570. Minutes, DRC, 19 March 1964.
[20] TNA DEFE 10/624. Minutes, DRC, 22 February 1966.

to recruit, an indicator either that a research area was growing in importance or that defence research did not appeal to university students, not least for moral reasons.[21]

By 1969, the uncertainties over control encouraged a new 'management by objectives' to be adopted. There is a sense of déjà vu here, since a similar attempt to take a managerial grasp of defence systems development had emerged a decade earlier. So, for example, rather than approve specific navigation systems, the research was geared to objectives, such as 'improved reliability and life', or just 'cheaper' inertial systems.[22] In 1971, the establishment of a Procurement Executive, as well as the emergence of DSAC, discussed below, further reduced the role of the DRC.

**The DRC as Gatekeeper**

In a similar fashion to the DRPC, the DRC continued to act as a gatekeeper for defence research. Projects would come before the committee, either as part of the comprehensive service reviews or as individual items. The outcome might be expansion, confirmation, cuts or cancellation. I will give several brief examples before discussing one particular, illustrative case in more detail.

Chemical and biological weapons (CBW) had a peculiar significance for the old DRPC, the committee's interest related to its semi-permanent exclusion from shaping nuclear research. CBW continued to be reviewed under DRC, although now as one – albeit important – topic among many. CBW was considered in the defence research review of 1966, in the 'light of the increase in the Russian threat', and an increase in funds for both

[21] 'Students tended to think that defence research was confined to nuclear weapons, and there was a reluctance to become associated with it… Biological research also had a bad image', noted in TNA DEFE 10/570. Minutes, DRC, 3 March 1965. Universities not producing enough trained electro-chemists, necessary for fuel cell projects, were an issue in 1964. TNA DEFE 10/571. 'Fuel cells', 7 February 1964. The importance of retaining hypersonics experts was mentioned in 1966. DEFE 10/624. Minutes, 17 May 1966. In 1970, all departments reported problems recruiting operational researchers, while the Amy and Aviation Supply both struggled to find computer scientists, MAS also wanted more experts in electronics, technical costing and management-trained engineers, and the Army wanted some specific engineers, psychologists and biologists with biomedical expertise. DEFE 10/800. Minutes, DRC, 3 November 1970.

[22] TNA DEFE 10/793. Minutes, DRC, 1 April 1969.

Porton Down establishments agreed.[23] When the DRC devoted a whole meeting to reviewing CBW in December, there was a 'divergence of views', especially on the likelihood of full-scale BW attack, but also on other aspects.[24] W.B.H. Lord, the assistant chief scientific advisor (research) at the Ministry of Defence was bullish, calling for, in particular, high priority to be given to 'the discovery of incapacitating agents and the means of delivering them'.[25] But there 'would be no purpose in working on this potentially valuable weapon', he added, 'if our forces were to be denied it for largely emotional reasons and positive steps might need be taken to change opinion on these weapons in some quarters'. On chemical weapons he noted that 'as a deterrent it would only be credible if the enemy knew it could be used'. The DRC endorsed the incapacitating agents suggestion (leaving it to the prime minister to consider implications for the Geneva Protocol), while supporting a limited CW deterrent over objections from the Army representative.

The DRC took a special interest in computers, which were becoming smaller, cheaper and, by the 1960s, embedded in weapons and defence systems.[26] The issue was to get the whole to work together. 'The problem extended beyond the land/air battle', noted Solly Zuckerman from the chair in 1964, 'there were, for example, problems of co-operation between submarines and aircraft, and there was a close civil interest'.[27] 'A working party set up to examine online computing for the 1970s, 'with the object of considering the possibilities for standardisation and modular construction', recommended the development of a single series of machines.[28] They envisaged 1,600 computers for 33 projects, for use in 'ships, aircraft and army units'. Here we see the influence of defence on the civil industry, and the way that DRC approval could have broader consequences.

Again, like the DRPC, individuals on the DRC could act as project champions. In 1964, for example, Sir Robert Cockburn, director of the Royal Aircraft Establishment, complained that the amount of funds spent on helicopter research was 'insignificant', leading to a

[23] TNA DEF 10/624. Minutes, DRC, 22 February 1966.
[24] TNA DEF 10/624. Minutes, DRC, 17 January 1967.
[25] TNA DEF 10/624. Minutes, DRC, 20 December 1966.
[26] See, for example, TNA DEF 10/572, 'Airborne digital computers research programme', 4 March 1965.
[27] TNA DEF 10/570. Minutes, DRC, 20 February 1964.
[28] TNA DEF 10/625. 'Cabinet. Official Committee on Technology. Computers for future weapons systems', July 1966. Project Christchurch is discussed in Jon Agar, *The Government Machine*, Cambridge, MA: MIT Press, 2003, pp. 290-291.

dependence on American designs.[29] Supported by Morien Morgan, the Ministry of Aviation's controller of aircraft, he persuaded the DRC to take a 'new look'.[30] Cockburn was also influential in the call for new facilities for high altitude research at the Rocket Propulsion Establishment, Westcott.[31] At issue was an understanding of the movement of rockets, not least ballistic missiles. Sometimes, the DRC agreed, research had to be done in anticipation: 'an accumulation of experience and knowledge was essential if the right decisions were to be taken on future weapons. Research facilities could not be constructed quickly and it was not always acceptable to wait until there was a clear objective'. This linkage, between general research and specific objectives was a continual thorn.

Other examples of the phenomenon of project champion include the Navy representatives' championing of pump jets, which promised a low-noise means of replacing propellers of ships and submarines. A programme of research had started at the Admiralty Research Laboratory, prompted by a visit to the United States, as early as 1951.[32] Full-scale trials were endorsed by the DRC in December 1964.[33] Sometimes the DRC would withhold support. In 1966, for example, there was a considerable squabble about hypersonics (Mach 5 and above). The Aeronautical Research Council was pushing for expansion, while the DRC had previously suggested that work should be cut back and Britain be more dependent on research underway in Sweden, the United States and France. The DRC was the superior body so it was there that the bureaucratic fight was conducted. Again the salient points were international cooperation and dependence, and the need to invest in a stock of expertise that might be called upon decades down the line. There was also a sociology of expectations at work: there was a 'general tendency for the speed of weapons to increase'. This shaping assumption has a parallel with Moore's Law in computing.

Fuel cells provide an interesting case study of the DRC as gatekeeper. Fuel cells have their origins in nineteenth-century electrical physics. In the 1930s, Thomas Francis Bacon had developed the first hydrogen-oxygen fuel cells, adapting them for Royal Navy submarine use

[29] TNA DEF 10/570. Minutes, DRC, 20 February 1964.
[30] For Morgan as one of the 'protagonists of advanced aircraft', see: Andrew Nahum, 'The Royal Aircraft Establishment from 1945 to Concorde', in Bud and Gummett, op. cit., pp. 29-58, p. 49.
[31] TNA DEF 10/570. Minutes, DRC, 21 July 1964.
[32] Tom Wright, 'Aircraft carriers and submarines: Naval R&D in Britain in the mid-Cold War', in Bud and Gummett, op. cit., pp. 147-183, pp. 164-166.
[33] TNA DEF 10/570. Minutes, DRC, 15 December 1964.

in the Second World War.[34] Patents collected under the National Research Development Corporation were exploited through a consortium pulled together by the NRDC, Energy Conversion Ltd, in the UK, Pratt & Whitney in the United States in the 1950s, and fuel cells would later be on board the Apollo missions. Other work was underway overseas. By 1964, the Defence Research Staff produced an overview of the field.[35] The authors noted that the current British defence research contribution was 'trivial', despite Bacon's lead - £100,000 in defence research establishments and £45,000 in extra-mural contracts in the UK, compared to $50 million through NASA and ARPA in the United States. Yet, they claimed, here was a technology that promised compact and silent power, with immediate application in 'underwater beach reconnaissance units' and future potential in ships, submarines and radars. The DRC convened a working party, and soon agreed an increase in funds.

By 1968, the research had progressed, overseen by the Navy. Furthermore, the other armed services were in support. The army favoured hydrazine/air fuel cells for Cymbeline, its proposed new mortar locating radar, which, operating close to enemy lines, needed to be quiet. Air Marshal Sir Peter Wykeham stated to his fellow DRC members that the Air Force Department supported the research even when there was no immediate air application.[36] Mintech, through the DRPC, was enthusiastic on the civil side – three-quarters of fuel cell investment was non-defence. However, by the following year, the DRC became the forum for first doubts being expressed and later cancellation. At a time of cuts, the DRC wanted to see the expense being pushed on to the civil budget. In return Mintech expressed fears that if 'the Defence work on fuel cells were to be terminated the whole fuel cell techniques programme would suffer a severe set-back'.[37] Moreover, the situation was complicated by the existence of a Memorandum of Understanding having been signed with the United States, divvying up research, as well as existing contracts with industry (Energy Conversion Ltd, Shell) and universities. The Army began to explore what it might take to silence an off-the-shelf German Wankel spark ignition engine as an alternative. DRC again was the forum for debate, and eventually agreed the cancellation of the fuel cell projects. First Mintech

[34] J.M. Andújar and F. Segura, 'Fuel cells: history and updating. A walk along two centuries', *Renewable and Sustainable Energy Reviews* (2009) 13, pp. 2309–2322.
[35] TNA DEFE 10/571. 'Fuel cells', 7 February 1964.
[36] TNA DEFE 10/793. Minutes, DRC, 19 March 1968.
[37] TNA DEFE 10/793. Minutes, DRC, 1 April 1969.

pulled out of supporting fuel cells for Cymbeline, and then, in 1971, the Navy ceased all but one line of fuel cell research.[38]

**New Topics**

In this section I examine three topics that the DRC addressed either as novelties or revisited with new urgency: civil/military relations, human factors research and Northern Ireland. At its first meeting the DRC reminded itself that further 'consideration would have to be given to improving the interchange of information' since 'there was a tendency for research work in universities, in industry and in civil and military establishments, to be carried on independently'.[39] Under Wilson, acting through the expanding Mintech this 'consideration' became something more directed, urging on the identification and support for civil benefits from defence research, particularly in areas such as micro-electronics, computers, aircraft and automobiles.[40] Studies of the factors inhibiting "spin-off", prompted by a OECD inquiry, were conducted in 1964.[41] When the DRC returned, after consultation, to the matter in 1966, there was disagreement about the extent of the problem. D.N. Forbes, DS(2) at MoD, said that 'in the past Defence Establishments had not, in the main, made any conscious effort to look for aspects of their work which would have some interest to the Civil world outside and no person or cell had been responsible for such activity'.[42] If the DRC wanted dissemination then things would have to be actively changed. On the other hand, E.C. Cornford, chief scientist for the Army, replied that his own inquiries 'did not support the suggestion that Establishments gave little attention' to spin-off, the problem he thought was perhaps not one of attitude or lack of information but of 'effort put into dissemination'. The push was coming from Mintech, and the problem (and solution) seen as one of information flow, although the short-termism of industry was also mentioned. "Flash reports" (brief

[38] TNA DEFE 10/800. Minutes, DRC, 23 March 1971.
[39] TNA DEFE 10/570. Minutes, DRC, 19 December 1963.
[40] TNA DEFE 10/570. Minutes, DRC, 8 July 1965, for Mintech and micro-electronics. In the case of aircraft, the DRC had to respond to the Plowden report, which called for less government support of the industry. The DRC modelled what a 20% cut would mean. See TNA DEFE 10/625. Minutes, DRC, 18 January 1966. See also Edgerton, op. cit., p. 242. See TNA DEFE 10/793. Minutes, DRC, 22 May 1968, for automotive research, Mintech and British Leyland.
[41] TNA DEFE 10/571. 'MoD. Dissemination of information on research', 12 October 1964.
[42] TNA DEFE 10/624. Minutes, DRC, 17 May 1966.

summaries), better libraries and copying Malvern's 'Industrial Interface' were all mooted as solutions.

Human factors – which covered personnel, 'anti-personnel', and the deployment of experts including physiologists, sociologists but especially psychologists – were another topic that received more attention from the DRC than the DRPC. Nevertheless, it was, and would remain, a Cinderella branch of defence research. 'Man lay at the centre of all military activity', noted Dr Peter Krohn, academic endocrinologist and a confidant of Zuckerman's, who had chaired a working party into the topic in 1967, adding 'this tended to be forgotten'.[43] Human factors research was spread across different establishments, and was only funded to the tune of just over £1m per annum. Krohn argued for a central establishment where greater investment would be well rewarded and there were many problems that could be tackled.

The kinds of problems meant by 'personnel' were noise, protective clothing, stress, and working in confined, dangerous spaces. 'Anti-personnel' methods meant inducing these in the enemy. Krohn had found 'virtually no anti-personnel work being carried out' in the UK, because it had 'apparently been decided some time ago to rely on American work'.[44] However, just as offensive CBW work was sometimes justified so as to better develop defences, it was likewise, thought Krohn, 'important … to know more about the methods of attacking human beings so that better protection could be devised'. However, Krohn's call came just as the Defence Budget was being cut. The counter-argument was that personnel research, including psychological research, led to more effective use of weapons and therefore savings overall. In the end the DRC resisted setting up a "Human Factors Research Establishment", not least because in the present situation, it was claimed, 'psychologists were working closely with physiologists and with weapons designers and it would be a mistake to pull them out and put them in a central Establishment'.[45] Instead ways of making military psychology a more attractive career path were explored.[46] Nevertheless, the DRC

[43] TNA DEFE 10/624. Minutes, DRC, 21 March 1967. Krohn's report can be found in TNA DEFE 10/626. 'Report of the personnel and anti-personnel research working party', February 1967.
[44] Later in 1967 more information was extracted about American experience, not least in Vietnam.
[45] TNA DEFE 10/624, Minutes, DRC, 19 September 1967. TSR-2 was clearly identified in the working party report as an important example of this interplay.
[46] A Chief Scientists' Panel on Personnel Research was established under B.W. Lythall, Chief Scientist (Royal Navy), producing an interim report in 1970

recognised the 'trend [for more human factors research was]…likely to continue as equipment became more complex … [and the] lack of systematic knowledge of man's reactions and capabilities is often the main factor limiting advance'.[47]

The Troubles in Northern Ireland began in the late 1960s. British troops were deployed in August 1969. Research and development had been geared towards supporting the Army Cold War or overseas insurgencies. The sudden appearance of Northern Ireland as a battlefield therefore provoked new questions about research policy. As late as May 1969, discussion at DRC of 'improved riot control agents', principally CS gas, mentioned Hong Kong but not Northern Ireland.[48] Yet by the 1972 DRC annual review it was noted that

> The continuation of the troubles in Northern Ireland has led to an increase in demand upon the R&D resources and manpower of several of the Army-orientated establishments in support of UK Forces. Both the Internal Security problem and the increase in terrorist activity throughout the world reflects the ever increasing need for long term planning and research for defence against these types of aggression.[49]

This included work on CS for the Himsworth Committee, but also 'more fundamental work, including a programme of work covering the whole field of wound ballistics relating not only to chemical and blunt trauma weapons but to high velocity missiles and fragments'. The Chemical Defence Establishment 'on a "war-time" basis of urgency' produced 'rubber bullets, by hand, working round-the-clock'.[50] In general, however, 'aid to civil power' was an area that the struggling DSAC (discussed below) tried to contribute, in terms of offering advice on research policy, more so than the DRC.[51]

**International Relations**

[47] TNA DEFE 10/803. 'MoD. DRC. Annual review of defence research programme 1972', 6 October 1972.
[48] TNA DEFE 10/793. Minutes, DRC, 22 May 1969. CS gas is commonly called "tear gas".
[49] TNA DEFE 10/803. 'MoD. DRC. Annual review of defence research programme 1972', 6 October 1972.
[50] TNA CAB 168/244. Smith to Cottrell, 26 August 1971.
[51] See TNA DEFE 13/826, exchange of letters between William Hawthorne and Lord Carrington, 3 August 1971 and 4 November 1971.

International relations were central factors shaping defence R&D policy in several ways: as part of diplomacy towards Europe (not discussed here[52]), as restricting information flows about enemy systems, and as ties between Cold War allies expressed variously as knowledge exchange, cooperation, interdependence and competition.[53] What was implicitly a strong factor shaping the work of the DRPC, that allies' R&D programmes were taken as proxies for the Cold War enemy's state of the art, was stated explicitly at the DRC:

> One of the recurring difficulties in intelligence work is how to keep abreast of defence research … On the often justified assumption that technical developments in advanced countries remain more or less in step, one possible line of approach is to keep the scientific intelligence community as closely as possible in touch with our own forward thinking.[54]

In the absence of certain knowledge of Soviet R&D, the British defence research establishments continued, in the 1960s, to model research in response to the West's own mirror image.

This meant that rare glimpses into Soviet capabilities were doubly valuable. One such occasion was the crash, on 6 April 1966, of a Soviet twin-engined YAK 28(B) FIREBAR fighter aircraft into the Stößensee, a lake in the British sector of Berlin. The 'prolonged salvage operations afforded an opportunity for a team of officers from the Aircraft Technical Intelligence staff, assisted by specialists from the Royal Radar Establishment and the National Gas Turbine Establishment, to exploit the wreckage before it was returned to the Russians'.[55] The engines were pulled out of deep mud, while the wiring and electronics were carefully examined, all the while as the Russians watched from a nearby hill. The result was 'very valuable intelligence', immediately shared via WDC and DRC.

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[52] See Helen Parr, *Britain's Policy towards the European Community : Harold Wilson and Britain's World Role, 1964-1967*, London: Routledge 2006.

[53] For US-UK competition as a major feature of the Cold War, see: Jeffrey A. Engel, *Cold War at 30,000 Feet; the Anglo-American Fight for Supremacy*, Cambridge, MA: Harvard University Press, 2007. Edgerton, op. cit., p. 234, says that the 'key technological competitor [for the UK] was not the Soviet Union but the USA', while also noting the 'great deal of sharing' that in fact went on.

[54] TNA DEFE 10/571, 'MoD. Draft procedures of the Defence Research Committee', 1963.

[55] TNA DEFE 10/625. 'Soviet weapon technology. "Berlin Firebar"', 28 July 1966. The Soviets were judged to be behind in micro-electronics, 'at least equal' in turbine materials, and well aware of counter-electronic warfare methods.

In terms of the relations between the UK and Cold War allies, a long list could be given of topics in which particular United States interests and projects had to be discussed at DRC. The types of responses can be categorised: topics which US relations were constantly under review by DRC (space), research where American commercial interests were an issue (magnetohydrodynamics, helicopters), areas where the US might learn from the UK (night vision, "Chobham armour", fuel cells, "bottom bounce" sonar), areas where American leadership meant that collaboration or purchase was sought (electronics, airborne computers, detection of submarines, CBW detection, electronic warfare) but also came with fears of losing global competitions in new industries, and areas where collaboration was sought but noting that would entail further restrictions, since the Americans were not keen that information released to the UK was shared with European or other partners (space, satellites, missiles).

Two cases - beryllium and laser damage weapons – illustrate the unequal special bind between UK and US defence research. Beryllium, one of the lightest metals, was a new candidate as an aero engine material in the early 1960s. (The element also had atomic uses.) But it also had a peculiar significance for UK-US relations. In 1964, the DRC supported a joint evaluation study, not least because it 'represented the first practical programme of technical co-operation with the United States' (at least for some time).[56] Rights to exploit commercially any benefits had to be carefully worded and explicitly cleared at high political levels. Solly Zuckerman expressed what was at stake: 'If the United Kingdom did not participate in the Beryllium research programme there was the double risk that the Americans would gain a lead and be less cooperative on any further metallurgical research programme'. Actually there was a triple risk: beryllium as an industrial material, later, would be identified as a major chemical hazard. Nevertheless, the need to keep the superpower sweet meant that more UK money went into beryllium research than would otherwise have happened.

A similar situation can be found a year later in proposed cooperative research on 'laser damage weapons'. In this case the UK had no 'clear requirement', but this was overridden by a request to the Ministry of Aviation 'to find a suitable field of collaborative research

[56] TNA DEFE 10/570. Minutes, DRC, 13 May 1964.

with the Americans'.[57] The Ministry 'doubted whether the programme was of sufficient Defence value', yet noted 'it was probable that if this particular proposal was abandoned there would be repercussions which might prejudice collaborative development with the Americans for a long time to come'.

**'Independent' Scientists**

'If the warfare state was civilianised', writes Edgerton, 'it was through increased influence of long-standing civilian associates'.[58] True, yet the 'crucial' civilian associates on the DRC, aside from the civil servants, were indeed academics rather than the businessmen Edgerton finds. Zuckerman held on to his professorship in anatomy at Birmingham while he was chair of the DRC, chief scientific adviser to, in overlapping capacity, the MoD and the government as a whole. From the start the DRC had the aim of including 'two or three independent scientists'. In fact, the number was fewer, but with influence that was out of proportion. Cosmologist Hermann Bondi and molecular biologist John Kendrew formed the first rank. Also heard were the voices of nuclear physicist Brian Flowers and mechanical engineer John Lamb Murray Morrison. A third rank of occasional players were Zuckerman's colleague Peter Krohn, whom we met above, geophysicist Edward Crisp Bullard, and aerodynamic engineer Douglas William Holder. It would be naïve to call any of these figures 'independent' – they all had careers that stepped between academia and government.

Some of the most substantial, detailed investigations conducted by the DRC were through its working groups, chaired by these scientists, and on specific topics on which the scientists spoke loudly. Bondi led on space (1964-1965, with a major space diplomacy visit to the United States in 1966), Kendrew on anti-submarine warfare (1965), Flowers on conventional weapons (1965-1967), Morrison on armoured warfare (1965-1966), and Krohn on human factors (1967), while Bullard influenced sonar (1968) and Holder computing (1969). In committee, the scientists were less beholden to specific projects (they rarely acted as project champions), and could take a cold, hard, perhaps more disinterested look. Bondi, for example, like Zuckerman, was critical of spreading resources thinly when it seemed like a

[57] TNA DEFE 10/570. Minutes, DRC, 25 May 1965.
[58] Edgerton, op. cit., p. 146.

compromise between service interests.[59] However, the point should not be overplayed. The DRC was significant because it was a forum in which defence research was shaped in informed discussion between primarily military representatives. The 'independent' scientists were an effective part of the mix.

All the more ironic, then, that effective advice on defence research was nearly scuppered by a massive expansion in the late 1960s of the use of independent scientists. The Defence Scientific Advisory Committee (DSAC) was established on April Fool's Day, 1969. Composed 'principally of scientists and technologists from outside the Ministry of Defence', it was asked to provide advice, review 'scientific and technological aspects of the Defence Research Programme', advise on 'long-term policy' including 'where appropriate… broader aspects of Defence Policy, advise on manpower, scope and balance, bring to attention relevant developments outside defence, and advise on specific issues on request.[60] Initial plans were for a chair (W.R. Hawthorne, an ailing academic engineer and Master of Churchill College), fifteen independent members and seven official members. It soon developed into a sprawling set of committees, sub-committees, and sub-sub-committees which together mark the single biggest influx of academic scientists into the world of defence research advice.[61] This was all supplementary to the existing DRC, ORC and WDC.[62]

The DSAC clearly struggled to find its feet. While it will require further documentary research to establish its eventual influence – and indeed DSAC and DRC survive through to today – DSAC was subject to some of the most withering and sarcastic commentary I have seen from a civil servant's pen. Alan Smith was charged with summarising DSAC work for Zuckerman, Cottrell and Simpson. In November 1970 he observed that '1. DSAC has bred more boards and sub-boards than anyone can keep track of. 2. Most of these are yapping around the periphery of the MOD without coming to grips with real issues. 3. Some of them are still getting in one another's way'.[63] Another DSAC meeting was described a 'rambling

[59] See TNA DEFE 10/570. Minutes, DRC, 16 March 1965. See also Kendrew and Bondi's influence on the discussion of sonobuoys. Minutes, DRC, 18 May 1965.
[60] TNA DEFE 10/807. 'Defence Scientific Advisory Council', 2 April 1969.
[61] A Biological Research Advisory Board, Chemical Defence Advisory Board, Ships Board, Undersea Warfare Board, Vehicles Board, Weapons Board, Assessment Committee and Military Engineering Committee, all dominated by professors, each with their own sub-sub-committees.
[62] TNA DEFE 10/807. 'DSAC. Statement by Sir William Cook', 2 May 1969, sets out his vision for DSAC and its relationship with DRC.
[63] TNA CAB 168/244. Smith to Simpson, Cottrell and Zuckerman, 16 November 1970.

and inconclusive … in the course of which they raised several thorny and some potentially seditious questions, most of which concern subjects outside their terms of reference … If the Minutes are to be believed, this meeting was in the nature of a collective confessional, and about as constructive'.[64] When one of the sub-boards volunteered that it was 'quite impracticable for a part-time group of independent experts to make anything more than superficial comments or provide an automatic endorsement of official policy', Smith's wry comment was: 'This is a blunt and uncompromising statement of the general problem of advisory committees'.[65]

**Conclusion**

Committees can be problems. They can fail to work as intended, and this was certainly true of the early years of DSAC. However, committees are also places where much of the work of governance gets done. For historians, committees present opportunities, sites at which attention can be focussed productively, since they are locations of encounter of ideas, interests, parties, individuals and organisations. I've examined here the second phase of the committee for UK defence research, the DRC between 1963 and 1972. I have argued that it shaped the research agenda, reviewing, cutting and redirecting the work of research establishments in the light of changing strategic and economic circumstance. It is a contribution to the story of how we made decisions about defence in the past, but also today, since the DRC continues, largely in secret deliberation, alongside the DSAC.

[64] TNA CAB 168/244. Smith to Simpson, Cottrell and Zuckerman, 18 November 1970.
[65] TNA CAB 168/244. Smith to Cottrell, Press and Simpson, 1 July 1971.