

Abstract

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Civil Science Policy in British Industrial Reconstruction, 1942-51

During the Second World War science came to play a large role in the British government's plans for postwar reconstruction of industry. The planners sought to improve industry's labour productivity and capacity for R&D. They drew on the consensus which had developed among scientists, industrialists and politicians favouring a great increase in state aid to universities and industrial R&D and increased government direction of research. The postwar Labour government, impressed with scientists' contributions to the war effort and faced with grave economic difficulties, was eager to enlist science in raising industrial output. By 1951, however, it had implemented few new programmes in this area. More money was being spent on the pre-existing Department of Scientific and Industrial Research and industry's co-operative Research Associations; the universities had doubled their output; the National Research and Development Corporation had begun in 1949; some publicity campaigns had raised public awareness of productivity's significance; and the economy, in the postwar boom, was performing much better than prewar. But overall the Attlee government did much less to raise industry's scientific level than it had planned. Almost every new programme was inadequately funded and staffed, and the few which survived had no realistic chance of reaching into individual factories to achieve the scientific renaissance which was necessary to return Britain to the front rank, by international standards, of innovation and industrial performance.

The thesis examines that portion of civil science policy which aimed to improve industrial R&D and productivity, from the planning stage during the Coalition through implementation by the Attlee government. After an introductory chapter, Chapter 2 covers the work of wartime ministerial and official reconstruction committees; party differences and business opposition meant that reforms favouring a greater government role in R&D and industry generally were shelved until postwar. Chapter 3 examines the Attlee government's efforts to improve industrial R&D, particularly the formation of the Advisory Council on Scientific Policy, a failed attempt to create a British MIT, and several schemes, mostly unavailing, to vitalise DSIR, the RAs and private R&D. Chapter 4 examines postwar productivity policy, particularly the work of the Board of Trade, the scientifically-orientated Committee on Industrial Productivity, various government publicity campaigns, and the Anglo-American Council on Productivity. Chapter 5 briefly sketches post-1951 developments and finds that there has been little basic change in the policies suggested for arresting British industry's technical decline relative to its competitors, despite recurrent disappointment with the results of those policies.

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This thesis traces the evolution, from the planning stage during the Second World War through implementation by the Attlee government, of that portion of British civil science policy which aimed to improve industrial productivity and R&D. The research had its origin in the discrepancy observed between Britain's remarkable technological achievements during the Second World War and the subsequent competitive decline of its science-related industries. The discrepancy seemed more paradoxical after conducting preliminary research, which revealed that harnessing science more effectively to British industry was a central goal of the ministers and officials who planned for reconstruction during the wartime Coalition, especially of the Labour ministers who were to lead the country from 1945. As Sir Stafford Cripps, one of the Attlee government's main figures, said in 1943: 'I feel, myself, that in the years which are to come the future of this country is largely to depend on how we handle this problem of research and development. . . .'¹ The postwar economy's grave problems intensified the government's desire to modernise civilian industry quickly. Increased output and exports were essential if the country was to surmount its balance of payments difficulties and afford the ambitious schemes of social reconstruction to which the government was committed. Furthermore the experience of running the war economy had shown Labour ministers many areas where industry was backward, and given them confidence that programmes of state

¹ Cripps papers, 1245, comments after J.G. Crowther's lecture to the Royal Society of Arts on 'Science in the USSR', 14 Apr. 1943.

intervention could help. Scientists, too, were largely united in endorsing a programme of greatly expanded state aid to research both fundamental and applied, coupled with some increased degree of central planning of research. Ministers, officials and scientists therefore worked hard to devise government schemes to aid and guide the application of science in civilian industry.

Some of these schemes achieved notable results. More generous government finance increased the number of university students from 50,000 in 1938-39 to 85,000 in 1949-50. The percentage of scientists and engineers among them increased, and more graduates went into industry, starting to redress the serious educational deficiencies of British management compared to German and American. Labour productivity in industry grew sharply between 1945 and 1951, in part because of massive government publicity campaigns. Existing government bodies aimed at raising the scientific level of British industry received more generous funding. The Department of Scientific and Industrial Research (DSIR), for instance, spent 58% more in real terms in 1950-1 than it had in 1945-6, a threefold increase over 1938-9. It maintained a series of laboratories which investigated many subjects relevant to civil industry, from mechanical engineering to telecommunications. The Research Associations (RAs), joint ventures between industry and government which studied the common technical problems of various industries, nearly doubled in number between 1939 and 1951. Private industry doubled the number of scientists and engineers it employed on R&D between 1938 and 1946, and again by 1961. Overall the British economy performed better after 1945 than ever before.

Given the Attlee government's many pressing problems these accomplishments in industrial civil science policy were not insignificant. Nevertheless they fell short of expectations in two respects. First, they proved inadequate to launch postwar British industry on a path of produc-

tivity growth and technical accomplishment equal to that of its trading competitors. Given the deep roots and persistence of British industry's relative decline, a complex of factors now known as the 'British disease', perhaps no set of government policies could have been strong enough medicine.¹ Second, and more significant for this thesis, the government's actual programmes to help industrial innovation were much weaker and patchier than its own plans. The most consistent theme of this thesis is feeble implementation. Few Labour programmes specifically aimed at raising industry's technical level made it out of Whitehall (usually because of business opposition or civil service dilution). Most that did were so inadequately funded and staffed that irrelevance or failure were virtually inevitable. The government had vast hopes for what an increased application of science could accomplish for industry and the country, yet took very few powers to promote such an application. By the end of its term its reforms in industrial civil science amounted to slightly greater expenditure through existing institutions. The government had apparently acquiesced in the conclusion, as one civil servant put it, that 'we cannot force people to be efficient'.²

The customary view is that the Second World War marked 'the great turning point in government-science relations in Britain as elsewhere'.³ This is true enough; the need for advanced weaponry has required postwar governments to pay much greater attention to R&D and spend more on it. Sir Alan Cottrell has thus said that postwar science policy 'was reduced to a

¹ The thesis gives examples of relative technical backwardness in many industries, and examines the explanations given for it in the 1940s and more recently, but it does not venture a new diagnosis of the 'British disease'.

² PRO, BT 195/62, minute from S.A. ff. Dakin, 2 July 1948.

³ N.J. Vig, Science and Technology in British Politics (London, 1968), pp 13-14.

naivety of simply spending money freely in all scientific directions'.¹ On the civil side, however, the strong, indeed overwhelming, theme which emerges from examining the recently declassified government records on which this thesis is based is the great continuity between Labour's postwar policy and the patterns of the more restrictive past. An extensive list of examples follows to demonstrate the extent of Labour's failure to implement significant reforms in civil science. The new body created to oversee civil science generally, the Advisory Council on Scientific Policy (ACSP) -- Herbert Morrison wrote 'I feel like a revolution here' when he appointed the committee which devised its terms of reference² -- was weak and met seldom. True to the exalted status of ministerial autonomy in the British constitution, and to civil service dislike for strong committees of uncontrollable outsiders, it had no powers to advise government departments how to spend their research funds, much less to prioritise research in universities and industry. Other committees of scientists formed to help the country through its economic crisis, in particular the Committee on Industrial Productivity, were similarly powerless, having to rely on exhortation alone for their influence. To supply the bureaucratic muscle which these advisory committees lacked, many scientists sympathetic to Labour had wanted a strong permanent secretariat in Whitehall to look out for civil science in interdepartmental battles over funding and central planning of research. They had envisaged an initial staff of 12 senior scientists and officials; the actual secretariat comprised 'an administrative assistant secretary, a

¹ Sir Alan Cottrell, 'Science policy in Britain', Proc. Roy. Inst. 52 (1980) 182.

² PRO, CAB 124/546, Morrison note on minute from Barlow to Pimlott, 'The future of the S.A.C.', 22 Nov. 1945.

physicist and an academic philosopher'.¹

The DSIR never received the funds or scientists required to diffuse technical change through the country's 50,000 workplaces. Its most imaginative postwar programme, an Intelligence Division intended to 'bridge the gap' between research labs and industry with an array of liaison officers, publications and conferences, spent only £24,000 in 1947-48 and employed at most half a dozen people, compared with a minimum of 20 envisaged in 1945. The DSIR's labs struggled similarly, unable to perform research clearly relevant to the economy's urgent needs. Austerity forced on the government by Korean War rearmament then cut DSIR's budget by 10 percent. The DSIR's impoverishment is entirely consistent with the fate of other postwar initiatives to raise the technical competence of British industry. The RAs remained miniscule and peripheral to their industries. Labour had come to power committed to instituting compulsory levies on all firms in an industry to support the RAs and other co-operative efforts, but industry balked, the government relented, and the RAs had to continue with tiny voluntary contributions (£25 to £250 per firm) and a small DSIR supplement. Many proposals were advanced to strengthen the RAs, the DSIR and the scientific staffs of individual departments; they produced scant tangible change.

When local industrialists collaborated with professors at the University of Birmingham to form a group to boost productivity and asked DSIR for a full-time liaison officer, they eventually received a junior official who came two days a week for three months. The group folded. A similar council of academics and industrialists hoping to improve R&D in Manchester-area firms also received paltry government support and accomplished much less than anticipated before disbanding. A body to promote the use of electronics in

¹ P.J. Gummett and G.L. Price, 'An approach to the central planning of British science: the formation of the Advisory Council on Scientific Policy', Minerva 15 (1977) 141.

automation was created in the National Physical Laboratory 'to do the really big thing -- to skip a whole historic phase in machine design and to proceed to devise machinery incorporating the very latest scientific knowledge'¹ -- but it was short on staff and money and dissolved. A productivity consultancy service was established in the Board of Trade to give firms free advice; despite considerable popularity in industry, senior BOT officials disliked it and it collapsed for lack of staff and money. The government's major productivity initiatives turned out to be fairly superficial publicity campaigns. The ACSP and many leading scientists and engineers campaigned strenuously for a British equivalent of the Massachusetts Institute of Technology throughout the Attlee government, but the Treasury did not want to spend the money, the existing patchwork of weak and poor technical colleges did not want the competition, and the government did nothing. Consequently the number of engineers in British industry remained lower than what industry was willing to hire, and much lower than was necessary to match German and American per capita levels.

The only substantial programmes for aiding industrial innovation to survive the Labour government were the National Research and Development Corporation, the British Institute of Management, and the Council on Industrial Design. These made some valuable contributions, but were also smaller and weaker than anticipated.

Having demonstrated that postwar industrial civil science policy amounted to much less than Labour intended, the thesis asks why the gap between ambitious goals and feeble means did not come to ministers' attention and provoke them into corrective action. Many factors contributed. The most important was that the government progressively gave up the

¹ PRO, BT 64/2334, minute from Dr. C. Gordon to W. Hughes, 30 Sept. 1947.

wartime powers it had inherited to direct industry, ultimately possessing few tools besides exhortation to affect decisions taken in individual boardrooms and factories. Some of the wartime plans for industrial reconstruction devised by a Labour-led Board of Trade had envisaged a much more active state-industry partnership: compulsory powers to amalgamate small firms into more efficient larger ones, a large government fund to develop risky inventions to commercial viability, new bodies to promote management and good design, and boards joining all firms in an industry to collect compulsory levies and use them to promote various schemes of cooperative research, export promotion and technical exchange. During the Attlee government, business opposed this degree of government interference, and the government, perhaps diverted by its overarching commitment to nationalise major industries, did not press the case. Consequently it took no powers to 'force people to be efficient'. Paul Addison emphasises how much the 'reconstruction consensus' between Labour and Conservatives accomplished in areas previously full of partisan controversy, such as social security and education.¹ This consensus did not work in civil science, where the only reforms on which the Coalition could agree, and indeed the postwar government chose to implement, were basically those proposed by the Federation of British Industries in 1943.

Other factors contributed to dull the Attlee government's awareness that its visions for civil science were not being realised. Its Cabinet was elderly, preoccupied with many crises, and focused on implementing a backlog of important reforms rather than thinking up new ones. Civil science attracted senior ministers' attention during and after the war, but was not 'political' enough to warrant a difficult fight with business and

¹ The Road to 1945 (London, 1977).

Conservatives over taking new powers to modernise private firms. And in any event Labour ideology was more attuned to central planning of large organisations than encouraging creative ferment in decentralised ones. Defence research, including atomic energy, exerted a mesmerizing hold on the government as it pursued great power status, consuming 65 percent of the government's R&D budget in 1947-48 and 80 percent in 1954-55. The effects of having little left over for civil R&D were not immediately manifest, as British industry could sell existing products easily in the postwar boom. Only towards 1950 did younger ministers like Harold Wilson and Aneurin Bevan begin to worry that industry was continuing to manifest innovative weakness. Wilson in particular proposed for a future Labour government some new and more sophisticated schemes of government assistance, seeking to harness the virtues of decentralised private enterprise to the important national goal of swift technological progress. He drew heavily on ideas already in circulation, including many schemes of government intervention which the Attlee government had abandoned after desultory attempts. Almost all of them were to find their way into the crucible of Wilson's technological revolution 15 years later, some little changed. That revolution's debt to the civil science policy of the Attlee period, and indeed to earlier reformers who during the Thirties compiled what became Labour's agenda for reconstruction, becomes evident from a detailed examination of the Attlee record.

As the British economy has continued to worsen relative to other advanced countries, politicians and others have regularly argued that a more effective civil science policy must be part of the solution. No doubt this is true. Little detailed scrutiny has however been given to past civil science policies. Thus mistakes are needlessly repeated. Indeed many current suggestions for new government programmes to help industrial R&D and productivity do not significantly differ from those attempted in the 1940s.

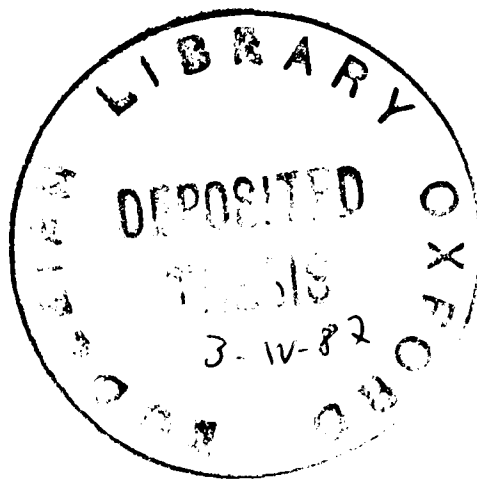
The failings, and achievements, of postwar civil science policy make clear that the British disease is deeply entrenched. It may not be curable by government intervention of any sort. It is beyond the scope of this thesis to suggest any future policies, but it is hoped that a detailed look at the record of a previous government intent on helping British industry through civil science policy could be of more than historical interest.

CIVIL SCIENCE POLICY IN BRITISH INDUSTRIAL RECONSTRUCTION

1942-51

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D.Phil. Thesis



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ABBREVIATIONS

AACP:	Anglo-American Council on Productivity
AC:	DSIR Advisory Council
ACSP:	Advisory Council on Scientific Policy
AScW:	Association of Scientific Workers
b:	billion (thousand million)
BAAS	British Association for the Advancement of Science
BIM:	British Institute of Management
BOT:	Board of Trade
CID:	Council on Industrial Design
CIP:	Committee on Industrial Productivity
CRP:	Committee on Research and Productivity (ACSP subcommittee)
DRPC	Defence Research Policy Committee
DSIR:	Department of Scientific and Industrial Research
EIU:	Economic Information Unit (Treasury)
ERP:	European Recovery Programme
FBI:	Federation of British Industries
FSP:	Committee on Future Scientific Policy (Barlow Committee)
HFP:	Human Factors Panel of the Committee on Industrial Productivity
HNC:	Higher National Certificate (in engineering)
IEP:	Official Committee on Postwar Internal Economic Problems
IGC:	DSIR Industrial Grants Committee
I.H.(O):	Cabinet designator for the Home Information (Official) Committee
IRD:	Internal Reconstruction Department, Board of Trade
L.P.:	Cabinet designator for the Lord President's Committee
L.P.(I):	Cabinet designator for the Industrial Subcommittee of the Lord President's Committee
LPC:	Lord President of the Council
m:	million
MACIP:	Midlands Advisory Council for Industrial Productivity
MGO:	Official Committee on the Machinery of Government
MJRC:	Manchester Joint Research Council
NACEIC:	National Advisory Council on Education for Industry and Commerce
NPACI:	National Production Advisory Council for Industry
NPL:	National Physical Laboratory
NRDC:	National Research and Development Corporation
NRT:	National Research Trust
OECD:	Organisation for Economic Cooperation and Development
ONC:	Ordinary National Certificate (in engineering)
O.P.:	Cabinet designator for the Official Committee on Productivity
OR:	Operational research
P.C.	Cabinet designator for the postwar Production Committee
PACT:	Panel on Automatic Control Techniques
PEP:	Political and Economic Planning
PES:	Production Efficiency Service (Board of Trade)
PRO:	Public Record Office
PSC:	Parliamentary and Scientific Committee
PWD:	DSIR Postwar Developments Committee
QSE:	Qualified Scientist or Engineer
R&D:	Research and development
RA:	Research Association
RFS:	<u>Reconstruction Fortnightly Summary</u> , Board of Trade
RS:	Royal Society
SAC:	Scientific Advisory Committee

S.P. Cabinet designator for the Advisory Council on Scientific Policy
T&ORP: Technology and Operational Research Panel of the Committee on Industrial
Productivity
TRE: Telecommunications Research Establishment
TUC: Trades Union Congress
UGC: University Grants Committee

CHAPTER ONE

Historical Background

1.1 Scope of the thesis

For Britain, victory in the Second World War had two main ingredients: membership in a powerful international alliance, and the central government's prowess in mobilising all the resources of a complex technological society towards a single purpose. One of the most important resources was scientific and engineering skill, which brought Britain radar, excellent aircraft, a substantial share in the making of the atomic bomb, higher agricultural output, new drugs and useful findings in operational research. Government ministers and officials during the war were impressed by science, and in the planning for postwar reconstruction, which in Britain was more thoughtful and sustained than in any other belligerent, science came to be a central theme. It was expected to make industry more productive and the country more prosperous, modern and just.

Reconstruction planning received major attention from both Conservative and Labour members of the wartime Coalition government. but its unifying theme of social betterment through government planning derived mainly from Labour ministers. They invoked science more frequently than their Conservative colleagues, with more faith in its ability to improve the lot of working people. But a wide spectrum of political opinion from left to right--including the Federation of British Industries (FBI) and other business groups, the Trades Union Congress (TUC), the Fabians, the Parliamentary and Scientific Committee (PSC), Freedom House, and many other groups and

individuals -- also gave the application of science an important if not precisely defined role in their plans for postwar social improvement.

To provide the precise definition, the government turned to the country's leading scientists, whom the war had elevated to positions of influence in Whitehall.¹ Some of the most articulate among them were leftists influenced by J.D. Bernal, the Marxist Professor of Physics at Birkbeck College and author of the influential 1939 book The Social Function of Science. Contrary to the stereotype of the politically naïf boffin, they were used to organising and lobbying on behalf of science and enlisted their new stature to promote the central direction and generous funding of research as part of a planned economy. Before the war, the majority of influential scientists had disdained Bernalism because it endorsed government planning of laboratory work, but the wartime triumphs of government research establishments were deeply impressive. The bulk of politically significant scientists rejected Bernalism's support of Soviet-model Marxism, but by war's end a broad consensus existed among QSEs that large amounts of public money should be channelled into science and engineering research on problems of national importance; the priorities should be determined largely by scientists themselves working in close partnership with Whitehall. Politicians of all leanings and the public agreed.

Thus by the end of the war and its reconstruction planning, Britain seemed poised for a marked increase in the organised application of science to the problems of civilian life. All agreed on two points: increasing the supply of university graduates in science and engineering and establishing permanent

¹ Engineers had less prestige than scientists and were largely ignored by government reconstruction planners, although it soon became evident that they were at least as important to advanced industrial production and were in even shorter supply. This thesis uses the abbreviation 'QSE', 'qualified scientist or engineer', to refer to both scientists and engineers.

mechanisms for giving the government scientific advice. Science policy could then address the nation's most pressing problems, which were mainly economic. The country with its economy weakened by war needed to produce and export at ambitious levels to pay for essential imports and improve living standards. Hence the chief concern of the government's high-ranking scientific committees was to improve industry's productivity and ability to develop successful new products. Much effort was focused on figuring out ways to plant 'science-mindedness' deeply and widely in industry.

Unfortunately, science policy worked no wonders on postwar British industry. During the war officials thought up some ambitious programmes to increase government's role in aiding industrial R&D and productivity, but few were implemented after 1945. Those that were suffered from tiny allocations of funds and QSEs and accomplished little. The government did not take Bernalist powers to set national priorities in civil research. In the end its policy for raising R&D and industrial productivity amounted to little more than spending slightly more in existing government departments and labs and exhorting private industry to do better. The country's economic accomplishments in the first postwar decade were impressive, especially in contrast to the depressed 1930s which figured prominently in both official and public memory. But compared to other industrialised countries, postwar Britain has demonstrated low productivity and capital investment, weak R&D and general industrial decline, despite bright spots in particular companies and industries.

It is now clear that this decline started in the late 19th century; industry's handicaps were more deeply entrenched than the governments of the 1940s recognised or wartime scientific triumphs seemed to suggest. Economic historians have speculated at length about the reasons for this long decline, the

'British disease' as it is called. This study does not advance a new diagnosis.¹ Its scope is more modest. It examines the evolution during reconstruction of that part of civil science policy which aimed to improve innovation² and productivity³ in British industry. Innovation policy and productivity policy are closely related. The former concerns programmes to aid the development of new products, the latter to aid the development and deployment of new industrial processes. A desire to speed technical change in industry and economic growth underlies both.

The broader term 'civil science policy' has been variously defined.⁴ Vig's comprehensive definition, the one used here, has three elements:

¹ The literature on the 'British disease' is briefly discussed in Chapter 5.

² The customary distinction is drawn in this thesis between 'invention', meaning a laboratory discovery whose commercial potential is not known, and 'innovation', meaning a discovery which has been successfully developed into a marketable product. The steps of 'development' which turn an invention into an innovation commonly represent 90 percent of the cost of bringing a new product to market and require much sensitivity to user needs, production engineering and marketing. Science Policy Research Unit, 'Success and failure in industrial innovation' (Sussex 1972). In this thesis, 'innovation policy' refers to government activities concerned with industrial research and development (R&D).

³ Output per person-hour is the most common definition of productivity, but since that ratio ignores the effects on output of efficiency in the use of capital, it is more precisely a measure of labour productivity. (Output can be measured in an individual factory as actual items produced or, for the entire economy, as gross domestic product.) An index known as total factor productivity takes into account how efficiently both labour and capital are deployed in generating output. It weights the various factor inputs -- labour quantity, labour quality and capital stock -- according to their contribution to output, defined as gross domestic product. R.C.O. Matthews, C.H. Feinstein and J.C. Odling-Smee, British Economic Growth 1856-1973 (Stanford 1982), 198-213. During the 1940s total factor productivity was discussed by economists seldom and politicians almost never; the overwhelming focus of policy was on raising labour productivity. Thus productivity is defined here as output per person hour.

⁴ Jean-Jacques Salomon, 'Science policy studies and the development of science policy', in I. Spiegel-Rosing and D. Price, eds., Science, Technology and Society: A Cross-Disciplinary Perspective (Beverly Hills, 1977), pp 45-6; Sir Alan Cottrell, 'Science policy in Britain', Proc. Roy. Inst. 52 (1980) 180.

1) the scale, balance, and effectiveness of government support for civil research and development in private industry, the universities, and state laboratories, particularly in relation to economic modernisation; 2) the adequacy of higher education generally and the supply of scientific and technological manpower in particular; 3) the organisation of government for support and conduct of civil research and development and for rational allocation of scientific resources.¹

Hence civil science policy is not a neatly bounded subject. Indeed, during reconstruction it comprised many economic and social issues: patent law, university expansion, depreciation allowances, capital investment levels, the removal of wartime economic controls, the funding of basic research in the universities and elsewhere, technological education, the pay and stature of scientific civil servants, the quality of industrial management. workers' resistance to new industrial processes, the small average size of British firms, restrictive practices in industry, R&D extension services to teach firms new techniques, and the government's own organisation for conducting research and giving scientific advice to ministers. There is not room in this thesis to treat these heterogeneous topics comprehensively, though each plays a role. Instead it concentrates on why and how the government aimed to improve R&D and productivity in civilian industry, and examines the related topics of educational policy, the government's own scientific organisation, and broader economic policies as required.

Many close but tangential subjects have been excluded. Reconstruction civil science policy has many parallels with prewar, but to preserve room for original material about the 1940s a minimum of prewar background is given. In concentrating on the relation of science policy to industrial performance, two important areas of civilian scientific research -- agriculture and medicine -- are omitted. Defence research, though the largest single element

¹ N.J. Vig, Science and Technology in British Politics (London 1968), p 5.

of the country's postwar scientific effort, is treated only insofar as it affected civil science.¹ Atomic energy, already chronicled, is also omitted.²

The main source of material for this thesis has been government files kept in the Public Record Office. Comprising mainly the minutes and papers of civil servants and part-time scientific advisory committees which met seldom, they exclude important elements of the story. The opinions and motivations of important ministers are often difficult to deduce from the public record. Minutes of meetings glossed over serious disputes. Oral agreements often went unrecorded. When government programmes withered, which happened frequently in postwar civil science, no epitaphs were filed to preserve the reasons. Other sources have therefore been consulted: secondary works, parliamentary debates, newspapers, scientific journals, and most importantly the papers of important scientists and politicians. These, though useful, have their limitations. Neither Herbert Morrison nor Stafford Cripps, the two Labour ministers most concerned with innovation and productivity, left a diary or other private papers available to researchers. Attlee's papers contain nothing directly useful. Sir Henry Tizard, the government's most important postwar scientific adviser, left few relevant papers besides speeches. Other important scientists, civil servants and ministers left patchy papers or none at all.

¹ A thorough examination of government policy concerned with defence research in the 1940s is already available. Philip A. Winston, 'The British Government and Defence Production 1943-50' (Cambridge Univ. D.Phil. thesis 1982).

² Margaret Gowing, Britain and Atomic Energy 1939-45 (London 1964); Independence and Deterrence vols. 1 and 2 (London 1974); Roger Williams, The Nuclear Power Decisions (London 1980), chapters 1 and 2.

To determine whether civil science policy actually influenced postwar industrial practice, materials were collected on an important science-related¹ industry, machine tools, for an in-depth case study. The idea of a case study was eventually abandoned because no records were available about relevant decisions taken in individual machine tool companies. It also became clear that the main topic, the evolution of government policy for speeding science into civilian industry, would take too much room to permit a detailed case study about any industry. While many reports since 1945 have analysed the decline of British machine tool manufacturing, they do not warrant special treatment here compared to other industries.

Science, for all its importance to reconstruction planners and the Attlee government, has been ignored by most historians of this period. Many otherwise excellent books avoid it altogether.² As a major, perhaps the major, source of economic and cultural change in this century, science and technology deserve historians' routine attention. Science policy during reconstruction is particularly ripe for study because the topic attracted

¹ The term 'science-based' is commonly used to describe industries such as chemicals, electrical equipment and machine tools which depend heavily upon systematic research by QSEs; however, it implies a quite mechanical 'research-push' conception of the relationship between science and industry. Following Christopher Freeman, the term used here is 'science-related', which captures more accurately the two-way flow of ideas between laboratory and production line. Christopher Freeman, The Economics of Industrial Innovation (Harmondsworth, 1974), p 29.

² For example, 'science', 'research', 'technology' or 'productivity' do not appear -- deservedly -- in the indexes of A.J.P. Taylor's English History 1914-45 (Oxford, 1965), Paul Addison's Road to 1945 (London, 1977), or Kenneth Morgan's Labour in Power (New York, 1984). Their discussions of cultural history concentrate on books, plays and the BBC, omitting science and technology. Arthur Marwick's Britain in the Century of Total War (London, 1968) and British Society since 1945 (Harmondsworth, 1982) give science and technology some attention, as does Angus Calder's The People's War (London, 1969).

widespread interest. This thesis has been able to draw on recently declassified records covering the whole Attlee government.

The rest of this chapter draws mainly on secondary sources to set out briefly the historical context in which reconstruction planning for civil science took place. This context has four main elements: the long-term decline in British industry's ability to innovate compared to its chief international competitors; the growth of government machinery after the First World War for making science policy and encouraging industrial innovation; the ideas circulating among scientists in the Thirties about civil science policy; and the Second World War's effects on each of these areas.

1.2 Long-term innovative decline

A large body of evidence demonstrates that an interlocking set of maladies hostile to innovation and productivity took hold of British industry in the mid-19th century and persisted through the period of this thesis. Generalising about so diverse an entity as 'British industry' is hazardous. Some firms and industries have occasionally or consistently outperformed their foreign rivals. Nevertheless, economic historians largely agree that on average the ability of British industry to develop advanced products and processes compared to other leading countries has eroded in the last century, and that this phenomenon has deep roots. As David Landes writes:

All the evidence agrees on the technological backwardness of much of British manufacturing industry--on leads lost, opportunities missed, markets relinquished that need not have been. These are themes that have recurred in every official inquiry, every report of a travelling delegation, for the last two generations.¹

For example, Britain provided 70 percent of France's machine tool imports in 1865 while Germany provided two percent and the United States none; by

¹ David Landes, The Unbound Prometheus (London, 1969), pp 331-2.

1912 the shares had become 18 percent for Britain, 55 percent for Germany and 17 percent for the US. In 1913 Britain produced 27 percent of Western Europe's total manufactures compared to 32 percent for Germany; 19 percent of its chemicals to Germany's 41 percent; 23 percent of its steel to Germany's 41 percent.¹ Overall the British economy before the First World War remained stronger and better balanced than the German, but as Landes writes:

compound interest is a remorseless arbiter. . . .the particulars of the trend were more disturbing than the general tide, [for example] the marked superiority of Germany in the newer branches of manufacture: organic chemicals from the 1880s, electrical equipment from the 1890s.²

An important reason why Britain began to lag behind the United States and Germany in science-related industries was its primitive system of education, especially in science and technology. A Royal Commission which investigated the country's poor performance at the 1867 Paris exhibition concluded that industry was suffering because of scarce science teachers, the poverty of general education, and government's failure to fund advanced research.³ Oxford and Cambridge, whose entrance requirements determined the curriculum of the 'public' schools which dominated secondary education,

¹ W.B. Walker, 'Britain's industrial performance 1850-1970: a failure to adjust', in Keith Pavitt, ed., Technical Innovation and British Economic Performance (London, 1980), pp 19-21, 35.

² Landes, op.cit., pp 328-31. For a small sample of evidence demonstrating Britain's relative decline in science-related industries, see Keith Pavitt and Luc Soete, 'Innovative activities and export shares: some comparisons between industries and countries', in Pavitt, op.cit.; S.B. Saul, Studies of British Overseas Trade 1870-1914 (Liverpool, 1960); Leslie Hannah, Electricity before Nationalisation (London, 1979); G.C. Allen, The British Disease Hobart Paper 67 (London 1976).

³ Report of the Royal Commission on Scientific Instruction and the Advancement of Science [Devonshire Commission] (London, 1872-5), 4 vols; also D.S.L. Cardwell, The Organisation of Science in England (London, 1972), chapter 5.

eschewed science in favour of classical learning and in any event educated a tiny fraction of the population. Neither science nor engineering were socially esteemed professions. 'How many young men from [the public schools and universities] would seriously have considered a career with, for example, Beyer-Peacock or Brunner-Mond?', asks Cardwell.¹ In Germany, widespread high-quality technical education preceded industrialisation, and Cardwell argues that science-related industry cannot grow vigorously until QSEs are available in abundance.² Britain started national primary education in the 1880s (Prussia's began in 1760), and a hodgepodge of science schools provided some secondary education until a nationwide secondary system was begun in 1902. There were improvements in workers' technical education and in the standard of science instruction at Oxford and especially Cambridge, where academic science began a great flowering. These achievements were modest, however, compared to Germany's, where in 1910 over one million children were receiving secondary education compared to 180,000 in Britain.³

The disdain for industry which permeated the schools was reciprocated by industrialists, who derided classroom training as preparation for the practical world of business.⁴ They esteemed knowledge gained through experience, preferring small empirical changes to systematic research.⁵ A vicious circle of undersupply and underdemand for QSEs in industry thus took

¹ op.cit., p 191.

² Ibid., pp 243-7.

³ B.R. Mitchell, European Historical Statistics 1750-1970 (London, 1976), table J.1.

⁴ Walker, op.cit. pp 19-21.

⁵ Michael Sanderson, The Universities and British Industry 1850-1970 (London, 1972), p 248.

root in Victorian Britain. Industrialists were not exposed to systematic R&D because trained personnel was unavailable; thus they did not demand any more, and their firms lost their competitive edge. The British chemical industry, for example, had a head start over Germany and abundant supplies of cheap coal, but it ultimately imported German chemists for lack of good British ones. Many British science-related firms were founded by foreigners such as Siemens, Marconi, Mond and Ford.¹ The pernicious effects of amateur management and scarce QSEs persisted into this century, as Gowing points out:

Despite weighty evidence on the need for scientific and technical education the infrastructure had not been created in Britain when the century ended. And so the management of British industry until after the Second World War, allowing for the time lag of the human lifespan, was nurtured in a tradition where such education counted for little. Technical change flowed in the blood neither of the entrepreneurs or workers.²

The First World War forced considerable change in British industry, especially greater mechanisation, mass production, and closer contact with government.³ During the Twenties and Thirties all the science-related newer industries -- light engineering, electrical and electronic goods, chemicals, pharmaceuticals -- expanded.⁴ But their successes reflected no wholesale purge of technical backwardness. A very high proportion of British manufactured exports

¹ Cardwell, op.cit., p 189.

² Margaret Gowing, 'Science, technology and education: England in 1870', Oxford Review of Education 4 (1978) 14.

³ Alan Milward, The Economic Effects of the Two World Wars on Britain (London, 1979), p 33.

⁴ C. Mowat, Britain Between the Wars (2nd edn., London, 1966), p 451; R.S. Sayers, A History of Economic Change in England (London, 1967), pp 7, 12.

consisted of goods in which total world trade had increased, between 1913 and 1929, by less than 75 per cent (in current gold values), and. . .only about one-twentieth consisted of goods in which world trade had risen by over 150 per cent. In the case of the United States, on the other hand, only 17 per cent of her manufactured exports were in the former category and nearly 29 percent in the latter.¹

More significantly, 'an exceptionally high proportion of Britain's exports of machinery, transport equipment and chemicals went to markets outside the industrial bloc -- the newer industries were even more heavily oriented towards Imperial markets than the traditional', which meant that tariffs and preferences insulated them from the toughest competition.²

Technical change still did not flow in the blood of the entrepreneurs or the workers. One Scottish steel mill rebuilt to modern standards in 1923 improved its labour productivity sixfold, showing how much room there was for improvement in other old mills, but leading steel managers still 'refus[ed] to accept the need to build hot strip mills [and maintained] the conviction that Britain remained the producer of the finest sheet steel and tinplate in the world'.³ In mechanical engineering, 'a great deal of research [was] passive', responding to the demands created by developments abroad or outside the industry.⁴ In 1913 Britain and Germany jockeyed for first place in world export share for engineering products with the US a poor third, but by 1937 Britain's share was half America's and 15 percent behind Germany's.⁵

¹ A.J. Brown, Applied Economics p 200, quoted in G.C. Allen, British Industries and their Organisation (5th edn., London, 1970), p 25.

² Walker, op.cit., pp 29, 30.

³ K. Warren, 'Iron and Steel', in Buxton and Aldcroft, pp 115-116

⁴ T.R. Gourvish, 'Mechanical engineering', in Buxton and Aldcroft, op.cit., p 147.

⁵ Allen, op.cit., p 120.

Education of QSEs and industry's use of them remained backward between the wars, despite some encouraging signs. The proportion of university students in the population increased from 1 : 1146 in 1921 to 1 : 929 in 1939, and graduates for their part were better prepared for commercial life: statistics, industrial psychology, and business administration courses found their way into higher education. Around the country engineering faculties established links with industrial firms, giving advice and performing research on commercially important subjects. These arrangements were however local and ad hoc,¹ and efforts by progressive industrialists and the Board of Education to create an Engineering Training Organisation to improve standards of instruction collapsed after receiving a favourable reply from only 30 of 246 firms. The Board of Trade rejected a 1927 Board of Education proposal to conduct a joint inquiry about technical innovation, as 'British industry was too preoccupied with its trade worries'.² Full-time students of engineering and technology numbered about a quarter of their German counterparts throughout the period; at the outbreak of the Second World War, Germany possessed about four times as many engineers (460,000) as Britain despite comparable populations.

Industrial research laboratories became more common and more generously financed. A survey of firms belonging to the FBI revealed an increase in the number conducting systematic research from 422 to 566 between 1930 and 1938, in total research expenditure from £1.7m to £5.4m, in QSEs employed on research from 1,381 to 4,382.³ Nevertheless, British

¹ Sanderson, op.cit., pp 246-75.

² Austen Albu, 'British attitudes to engineering education: a historical perspective', in Pavitt, Technical Innovation, p 70.

³ FBI, Industry and Research (London, 1943), p 7.

management still compared poorly to its foreign competitors in its regard for science and its qualifications for technical leadership. Graduate entry was largely confined to the science-related industries, and the number of graduates with industrially relevant training remained miniscule. The chemical industry faced the best supply, 4,530 graduates in relevant fields between 1925 and 1939, or one out of 37 employees; the ratio in the engineering, shipbuilding and metal trades was 1 : 428, in metal manufacture 1 : 1,411, in textiles 1 : 25,736.¹ When graduates were hired, preference was generally given to males of 'the right type' in a social sense, those with 'horizons widened through social mixing, sport, the [Officers' Training Corps] and travel', not to technical qualifications.² A 1938 survey of 900 second-year male Oxford students about their future plans showed 31 percent intending a civil service career, 47 percent the professions, and 10 percent business; an official who interviewed many students about their plans reported their belief 'that if their parents had wanted to send them into business they would have done so straight from school'.³ In sum, the culture which shaped British managers before the Second World War did not foster leadership in innovation.

The interwar relationship between government and industry impeded technological change too. The world depression forced the Conservative government to replace its commitment to laissez-faire with tariffs and other measures to prop up sick industries. There were subsidies to shipping and agriculture, a cartel and fixed prices in coal. Unfettered competition was

¹ Sanderson, op.cit., p 312; p 297, Table 26.

² Ibid., p 247.

³ Fabian Society papers, G60/3, Nuffield Conference on the education of the higher personnel of industry, 24-5 March 1945; statement by A.B. Emden from Oxford Appointments Committee.

considered the most glaring characteristic of the system which had crashed; thus planning and regulation were the antidote. Trade associations were encouraged to allocate markets, fix prices and adopt other restrictive practices among home producers to promote 'order' and 'stability', the catchwords of the day among both Labour and Conservatives.¹ This passion for order was no prescription for rapid technical change. It assumed a permanently stagnant economy in which someone's gain was another's loss. The economic adviser to the FBI, for example, argued that technical change was finished; so too was economic growth.² Others had a more expansive view, but esteemed the 'rationally planned' economy and designed machinery for government direction of industry rather than contemplating the more nebulous problem of how to encourage R&D in diverse private firms.

1.3 Government organisation for civil science

Contrary to conventional wisdom, close links between the British government and QSEs started well before the country's survival hinged upon radar and the atomic bomb. The framework of relations between science and government at the start of the Second World War was less a product of logic than of temporary improvisations made permanent. Its legacy was to shape the possibilities envisaged by those who planned the reconstruction of postwar civil science.

In 1899 a widespread fear of German superiority in the technologies of modern war spurred the creation of the National Physical Laboratory. It

¹ Nigel Harris, Competition and the Corporate Economy (London, 1972), pp 54-7.

² Roy Glenday, The Future of Economic Society: A Study in Group Organisation (London, 1944), p 3, quoted in Landes, Unbound Prometheus, p 484. Also see Addison, Road to 1945, pp 30-2.

had civilian objectives too: 'to bring scientific knowledge to bear practically upon our every day industrial and commercial life, to break down the barrier between theory and practice'.¹ Previously the government had channelled contributions to scientific research through a £4000 annual grant to the Royal Society, accepted as the authoritative voice of British science, which distributed the money to individual investigators. The Royal Society did not press for greater government funding of science and remained preeminent in setting the priorities of basic research through 1939.

The First World War divided what Cottrell has termed the 'primitive' era of science policy from the 'classical'.² So shocked was the British government at its dependence on Germany for essential high-technology materials like chemicals and optical glass that it quickly enacted reforms vainly urged for half a century. An Advisory Council on Scientific and Industrial Research was formed in 1915, supported the following year by the Department of Scientific and Industrial Research (DSIR). After immediate war requirements faded, DSIR took on three main lines of responsibility: granting scholarships to research students and faculty; administering a string of government laboratories (including the NPL after 1918) which investigated areas that were socially valuable but commercially remote, such as pest infestation and road safety; and overseeing the Research Associations (RAs), co-operative laboratories established within various industries to conduct

¹ The Prince of Wales, speaking at the NPL's opening ceremony, quoted in J.B. Poole and K. Andrews, The Government of Science in Britain (London, 1972), p 10. For good accounts of the early relations between science and government, see Ibid., pp 5-16 and the documents excerpted pp 29-158; Philip Gummett, Scientists in Whitehall (Manchester, 1980), Chapter 2; Vig, op.cit., Chapter 2; R. Moseley, 'Science, Government and Industrial Research: The Origins and Development of the National Physical Laboratory, 1900-1975' (University of Sussex, Ph.D. thesis 1976).

² 'Science policy in Britain', op.cit.

research on common problems, aimed especially at backward firms. DSIR itself was run by a full-time Secretary who reported to the Advisory Council, which itself reported to a committee of the Privy Council chaired by the Lord President, a non-departmental senior minister. Effectively this gave the Advisory Council and the Secretary a free hand. This arrangement was codified by a committee under Lord Haldane which reported in 1918,¹ and was extended to medical, agricultural, and other types of government-supported research. In combination with a central constitutional principle -- ministerial responsibility to Parliament for all departmental activities -- the autonomy of advisory committees blocked any possibility of the central control of civil science, a 'Ministry of Science'.

In the DSIR industrial innovation finally achieved an advocate in Whitehall. Its expansion, combined with the spread of the Haldane system to medical and agricultural research and the growth of the RAs in industry, meant that by 1939 the British government was spending £4m a year on civil R&D, a generous amount by international standards, up from £240,000 in 1910 and £1.3m in 1920.² This growth was certainly a sign of progress, but a look at the actual work of the DSIR, RAs and NPL shows that they faced much larger problems than their small resources could possibly handle. The

¹ Ministry of Reconstruction, 'Report of the Machinery of Government Committee', Cd. 9230, 1918; excerpted in Poole and Andrews, op.cit., pp 83-7.

² Military R&D accounted for another £6m in 1939; of the £4m for civil research, DSIR accounted for about £1m, the largest single departmental allocation; agricultural and fisheries research in various departments took £1.2m, medical research £265,000, and the ministries of fuel and power, transport, works and the post office for £330,000, with the remainder to other departments and agencies. DSIR grants to research students took only £26,000, and there was a £12,000 grant to the Royal Society to encourage research. Advisory Council in Scientific Policy, 'Government scientific organisation in the civilian field' (London, 1951), Appendix II, and Vig, op.cit., pp 3, 10-11.

DSIR's first report¹ set out the central problem of industrial civil science, one which continues to perplex policymakers: how to 'bridge the gap' between laboratory advances and the production line, especially in small firms with backward management. Its answer expressed what became the orthodoxy of the next 30 years. 'The average manufacturer is impressed with quick returns; he cannot afford to wait. . . .He wants a handy servant [in science], not a partner with ideas of her own.' Hence research programmes had to be aimed at industry's immediate needs. At the same time DSIR realised it was uniquely suited to undertake unprofitable long-term research. The two goals coexisted uneasily. The crash of 1920 cut DSIR's budget by one-quarter and intensified the short-term focus. For the rest of the decade tight finance kept DSIR struggling to survive, with 'demoralising and counterproductive' effects on staff and on its capacity to sell the innovation gospel to firms which were themselves retrenching.²

The RAs, government's principal means of 'bridging the gap' between research and commerce, also suffered from divided priorities and uncertain finance. There were 21 RAs by 1921, covering about half of British industry. The DSIR was determined that manufacturers be 'working and not sleeping partners'³ so it planned to cut off its subsidy after five years and made no contribution to capital expenditure. But the RAs had no statutory powers to compel membership or set firms' contributions, which declined as the first five years drew to a close. The goal of independence from DSIR's subsidy was not dropped until 1944, depriving staff and research programmes of

¹ Cd. 8336, 1916, excerpted in Poole and Andrews, op.cit., pp 70-1.

² Ibid., p 15.

³ DSIR, 'The Government Scheme for Industrial Research', Cd. 8718, 1917-18, quoted in P.S. Johnson, Cooperative Research in Industry (London, 1973), p 20.

security past the current DSIR grant. RA expenditure, of which the government provided about a third in the interwar period, was miniscule in any event, averaging £14,500 per RA in 1934. Aggregate RA income represented less than five percent of industry's total R&D expenditure.¹ Industry was sceptical about the RAs. Large firms found them irrelevant to their own R&D because 'what everybody knows isn't worth knowing'. Small firms had not the staff, money or inclination to absorb new discoveries. Falling between two stools, the RAs limited themselves to short-term technical service work. Cruickshank concludes that 'the basic premise of the scheme was in error, and [the RAs'] intended function [was] found to be impracticable'.² Yet DSIR did not adapt accordingly, say by strengthening the RAs' puny publicity arms to reach backward firms, or concentrating fundamental research in university labs where it could be done properly.

The weaknesses of DSIR and the RAs persisted through the 1950s. The most crucial shortcoming was lack of resources. The DSIR employed only 918 professional staff in 1939, including the NPL and all other government labs.³ The £4m spent by the government on civil R&D in 1939 represented 0.1 percent of GNP, three percent of what the country spent on tobacco, one percent of what it gambled.⁴ Even adding the £5.4m spent by private industry on R&D, British support of civil R&D per capita was about one-third

¹ Johnson, op.cit., p 29; Vig, op.cit., p 11; Centre for the Study of Industrial Innovation, Research Associations: The Changing Pattern (London, 1972), pp 7-8.

² A.D. Cruickshank, 'Government, industry and scientific research: twenty years of the Department of Scientific and Industrial Research, 1915-35' (Oxford University B.Litt. thesis 1977), p 208.

³ ACSP, 'Government scientific organisation', p 7.

⁴ J.D. Bernal, The Social Function of Science (London, 1939), p 57.

of the American level.¹

The second main problem of interwar civil science policy was the lack of any coherent strategy for fostering industrial innovation. This was a new area of government activity where strategy had to evolve by trial and error. Yet the DSIR Advisory Council, composed mostly of eminent academics whose involvement with industrial innovation was part-time and amateur, was not well poised to develop a profound understanding of its nature. Like other distinguished advisory committees it tended strongly toward incremental solutions, small 'common sense' steps that offended no one. It devoted little attention to technical publicity or other ways of diffusing research results into industrial practice. One observer summarises the DSIR's interwar work as follows:

For the most part it acted only on suggestions from external sources; its desire was to have nothing to do with postgraduate training; it tried for more than ten years to rid itself of any involvement in industrial research [through the RAs]; and it assisted a small number of individuals but in no sense organised pure research. These were not the actions and aspirations of a fountain-head of reasoned science policy. Decisions were made on the grounds of economy and expediency.²

1.4 Interwar ideas about civil science policy

Thus the interwar period saw science and technology still struggling to establish themselves in the stony soil of British industry and government. Yet the Thirties were a period of great intellectual ferment among scientists and others who sought a closer harnessing of science to social needs. The fountainhead of new ideas was mainly the scientific left, led by J.D. Bernal, J.B.S. Haldane and other Marxists who considered the advance of science and

¹ Harold Hartley, 'Industrial research: what it means to British industry' (London, 1943), p 11.

² Cruickshank, op.cit., p 207.

socialism mutually dependent. They argued that British science was hopelessly underfinanced and chaotically organised, leaving vast areas of basic and applied research untouched while overworking other areas. They argued for the central direction and generous funding of science by government along a broad and carefully planned front of human needs, invoking the Soviet Union as their model. The majority of British scientists rejected the Marxist remedy but agreed with the Bernalist diagnosis of impoverishment and haphazard direction, and wanted R&D to be better funded and planned.¹

Between the wars scientists became more politically assertive. Some banded together outside the resolutely neutral Royal Society to redress their low pay and status, especially in the civil service.² The Association of Scientific Workers (AScW) was taken over by a group of left-wing Cambridge scientists in 1932, and its General Secretary recalls:

We stood for a greater use of what science could give in improving civilisation as a whole. . . .We saw that this involved raising the status of scientists themselves. Science needed more Government support. It needed better laboratory conditions. . . .We wanted better pay and promotion possibilities.³

Events external to British science also worked to erode scientists' traditional aloofness from politics: fears about the destructiveness of technological

¹ Gary Werskey, 'British scientists and "outsider" politics', Science Studies 1 (1971) 67-83; Werskey, The Visible College (London, 1978); P.J. Gummert and G.L. Price, 'An approach to the central planning of British science: the formation of the Advisory Council on Scientific Policy', Minerva 15 (1977) 121-3.

² Evidence presented to the SAC in 1942 showed that scientific officers in their twenties earned 20 percent less than comparably qualified administrative civil servants and 37 percent less at peak salary. PRO, CAB 90/3, SAC (42) 13, 'Report on salaries of scientific officers in government service', 4 Mar. 1942, pp 4-5.

³ Reinet Fremlin, quoted in Bernal papers B.5.63, BBC broadcast 27 Sept. 1972, 'A generation for progress', p 14; Werskey, Visible College, pp 40-1.

warfare, governments' inability to solve the world depression, the rise of European fascism, and the apparent success of the Soviet Union in directing science from the centre on a large scale.¹ Some leading radical scientists were or soon became Communists. Conservative scientists also became more politically active. For example F.A. Lindemann, Professor of Experimental Philosophy at Oxford who created the modern Clarendon Laboratory, began to advise Winston Churchill regularly on scientific and other matters.²

Centrist politicians were also paying more heed to science, believing it in a vaguely defined way to offer a rational, optimistic, non-party escape from stagnation and social strife. Herbert Morrison, then serving on the London County Council, evolving his own non-doctrinaire socialism, believed electrical machinery would answer the vexing question of who would do the dirty work in his brave new world.³ A Parliamentary Science Committee was formed in 1933, designed to join the British Science Guild, the AScW, and various science and engineering institutions with sitting MPs and lords of all parties in a body which could lobby effectively for the 'scientific viewpoint' on all issues.⁴ It 'should be a worthy co-partner with our rulers at Westminster', wrote Nature editor Sir Richard Gregory at its inception.⁵ This naive scientism was too apolitical and grandiose to win the committee much influence. Nevertheless, dissatisfaction with existing institutions

¹ Werskey, op.cit., Chapter 5.

² Cherwell papers, E2, untitled typescript, c. 1925; Werskey, op.cit., p 28.

³ Bernard Donoughue and G.W. Jones, Herbert Morrison: Portrait of a Politician (London, 1973), pp 184, 111.

⁴ S.A. Walkland, 'Science and Parliament: the origins and influence of the Parliamentary and Scientific Committee', Parliamentary Affairs 17 (1964) 308-20.

⁵ Nature 132 (30 Dec. 1933) 3348.

prompted Parliament and centrist opinion generally to pay more attention to science. In 1933 Sir Frederick Hopkins, President of the British Association for the Advancement of Science (BAAS) spoke of the need to employ 'trained scientific mind[s]' in the planning of social progress, and recommended a

House recruited from the best intellects in the country. . . .devoid of politics, concerned. . .with a sustained appraisal of the progress of knowledge, and continuous concern with its bearing upon social readjustments.¹

Others in what might be termed the 'progressive centre' made similar proposals. Ritchie Calder wanted to replace the House of Lords with a senate of scientists, and Leo Amery called for a third house with scientific members. Like many others -- for example Political and Economic Planning and the Next Five Years group -- they sought a 'middle way' out of the depression through rationality and planning.²

Within the scientific community the progressive centre was behind the creation of the British Association's Division for the Social and International Relations of Science. It was carefully designed to permit discussion only, unlike the AScW, but its outlook and membership included both Bernalist and less radical elements. It formed a Scientific Advisory Committee with the TUC. Nature's editor Gregory was instrumental in forming the new BAAS Division and repeatedly wrote about the frustration of scientists under present conditions and the need to plan research rationally. The extent of Bernalist penetration should not be overstated; its committed advocates were few, and the dominant Royal Society avoided forming a section on the social

¹ Advancement of Science 1933, pp 23-4.

² Ritchie Calder, The Birth of the Future (London, 1934); Harold Macmillan, The Middle Way (London, 1939); Marwick, Total War, p 181; Addison, op.cit., pp 35-7; Nigel Harris, Competition and the Corporate Economy (London, 1972), pp 54-7.

relations of science because it 'didn't want to get mixed up with what might turn into politics'. Nevertheless, it is fair to say that by 1939 a diluted Bernalism had washed through the mainstream of scientific and political opinion.¹

1.5 The Second World War

Grim and immensely wasteful though it was, the Second World War was a 'good war' for British scientists and engineers. They made many contributions crucial to Britain's survival and then victory: radar defensive and offensive, faster airplanes, mine de-gaussers, proximity fuses, penicillin, effective camouflage for anti-aircraft guns, code-breaking mechanical computers, operational research² and the atomic bomb. Some scientists achieved high-ranking posts in the war machine not simply for their technical expertise but because the 'scientific method' was judged to have a unique value in settling profound questions of strategy and tactics. Churchill later described Britain's debt of gratitude to science as he saw it: 'Unless British science had proved superior to German, and unless its strange, sinister resources had been effectively brought to bear on the struggle for survival, we might well have been defeated, and, being defeated, destroyed'.³

The ascendancy of science was not preordained. Indeed many scientists

¹ Werskey, Visible College, pp 238-46; A.V. Hill, quoted in BBC, 'A generation for progress', pp 16-17.

² Operational research aimed to improve the organisation and deployment of fighting forces, using the standard scientific techniques of 'systematic measurement, classification, comparison, and correlation'. Sir Solly Zuckerman, Scientists and War (London 1966), p 16. By analysing data about U-boat sinkings of merchant ships, for instance, scientists improved convoy tactics.

³ Winston S. Churchill, The Second World War ii., Their Finest Hour (London, 1951), p 337.

at the beginning of the war complained bitterly of languishing in unimportant jobs due to the government's reluctance to grasp the contribution they could make. The crucial prewar body for pushing the development of radar, for example, Sir Henry Tizard's Committee for the Scientific Survey of Air Defence, had no staff, not even secretarial help; Tizard typed its letters at home in the evenings, and could only get experimental devices tested through his personal contacts with RAF officers, 'sometimes in the face of determined opposition from those resolutely preparing for the last war'.¹ Scientists' frustration with the government overflowed into a widely circulated Penguin Special Science in War² published just after the fall of France, written anonymously by members of the 'Tots and Quots' dining club, convened by Solly Zuckerman, in which younger radical and reformist scientists predominated.³ It was a passionate plea for unleashing the power of science in this moment of supreme crisis for Britain. The book reviewed the needs of war production and showed where science could help, including psychology to aid officer selection and worker morale, the distribution of a national vitamin biscuit to guard public health, better blood storage and emergency building design. The anonymous authors then reviewed it widely to generate as much pressure on the government as possible.⁴

In June 1940 the President of the Royal Society, Sir W.L. Bragg, wrote Churchill proposing a committee to coordinate the country's scientific talent chaired by a government minister and containing Royal Society

¹ R.W. Clark, Tizard (London, 1965), p 117.

² Science in War (London, 1940).

³ In 1939 it included Bernal, P.M.S. Blackett, Ritchie Calder, J.G. Crowther, Julian Huxley, C.P. Snow, C.H. Waddington and Solly Zuckerman among its 20-30 members. Solly Zuckerman, From Apes to Warlords (New York, 1978), Appendix 1.

⁴ Werskey, op.cit., p 266.

officers and the secretaries of the government's own Research Councils. Still the government showed no urgency. Sir Alan Barlow, Second Secretary to the Treasury, was charged with responding. He became the most important civil servant in the development of reconstruction civil science policy, and his attitude to this plan for the tamest sort of central direction is instructive. He wrote back asking for examples of where such a committee would have been useful had it already existed. On 31 August 1940, after much correspondence and discussion, Barlow advised ministers that a Scientific Advisory Committee (SAC) be created, more to protect the government's image than for any constructive work it might do.

Unless something is done, there will be more overt agitation, which will evoke a good deal of support. . . .The Committee ought not to be given a roving commission or be encouraged to think that it will have a voice in general Government policy.¹

Neville Chamberlain, Lord President of the Council, 'entirely approved', as did Churchill as long as the SAC was 'additional support from the outside, rather than an incursion into our interior'.²

Given this lukewarm reception, its decidedly 'establishment' membership,³ monthly meetings, and no staff except part-time secretaries,

¹ PRO, CAB 21/829, 'Royal Society', memorandum by Barlow, 31 Aug. 1940.

² PRO, CAB 21/829, letter from Barlow to Chamberlain, 23 Sept. 1940; pencilled note by Chamberlain, 23 Sept. 1940; Prime Minister's Personal Minute serial M.144, 27 Sept. 1940.

³ At first the SAC was chaired by Lord Hankey and included the President and two Secretaries of the Royal Society (Sir W.L. Bragg, A.V. Hill and Sir Alfred Egerton respectively) and the Secretaries of the DSIR, MRC and ARC (Sir Edward Appleton, Sir Edward Mellanby and Sir Edwin Butler). Hankey left the committee in 1942, replaced by R.A. Butler, then President of the Board of Education, and then by Sir John Anderson, Lord President of the Council, but Butler and Anderson chaired the committee in name only. In reality the SAC was run by Sir Henry Dale, who succeeded Bragg as President of the Royal Society in 1942. Engineers complained about being excluded from SAC, and consequently an Engineering Advisory Council was established in 1941, but it did not have the stature of SAC. CAB 21/829, SAC (40) 1, 'Composition and terms of reference', 8 Oct 1940; CAB 21/1166, minute from Anderson to the Prime Minister, 26 Mar 1941.

it is not surprising that the SAC did not become a Bernalist powerhouse directing British science. It performed some important work in atomic energy and pointed out holes in the scientific war effort, but its policy was to wait for others to refer problems rather than take any initiative.¹ Even so, criticisms of the government's laggard application of science diminished. The existence of the SAC was part of the reason, but more important was the growth of a large R&D effort effectively coordinated at the working level.² This collaboration was perhaps the most striking success of wartime British science. Strong links were forged between scientists and engineers, between labs and the plants that were to produce their inventions, between designers and the military users of the new devices. Radar research had 'Sunday Soviets': weekly gatherings at the Telecommunications Research Establishment of scientists, engineers, Air Marshals and pilots who thrashed out development problems without regard to rank or orthodoxy. A special unit made prototypes for immediate use while full-scale industrial production was being planned, and a post-design service sent scientists into operational squadrons to observe the equipment under real conditions.³ In aircraft design, 'the collaboration between the technical branches of the Ministry [of Aircraft Production] and the designing staffs of the industry was very close indeed: much closer than the relations between customer and supplier usually are'.⁴ In atomic energy, there was friction at the start as university scientists chafed at the prospect of coming under industrialists' control, but

¹ PRO, CAB 21/829, note from D.W. Rickett, Joint Secretary of SAC, to R.A. Butler, 26 Mar. 1942.

² J.D. Scott, 'British-American Scientific Collaboration', Chapter 8 in H. Duncan Hall and C.C. Wrigley, Studies of Overseas Supply (London, 1956), pp 370-1.

³ Guy Hartcup, The Challenge of War (Newton Abbott, 1970), p 25.

⁴ M.M. Postan, D. Hay and J.D. Scott, Design and Development of Weapons (London, 1964), p 63.

collaboration soon became extensive and profitable.¹

This knack for effective collaboration distinguished British wartime R&D from its Nazi counterpart. German war science was hierarchical and compartmentalised, discouraging free-wheeling interchange between scientists and soldiers. Hence while German radar was beautifully engineered, achieving signal stability 'that was better than that of the best instruments that [Britain] had available to check [it]',² the German method of displaying aircraft position was awkward for air defence controllers to use.³ In a few areas British weapons research stumbled similarly. Bomber Command was smug about its ability to hit targets by celestial navigation and scoffed at scientists' suggestions of radar bombing aids until photographic evidence demolished its case.⁴ Tank production almost ceased because gun and vehicle designers worked separately, and the Department of Tank Design in the Ministry of Supply, even when it produced a coherent critique of an existing model as with the Crusader in the fall of 1940, had no authority over production and was ignored.⁵ Nevertheless, the 'Sunday Soviet' style infected most areas of wartime technical advance: 'all government scientists tended to be more fully consulted, to be supplied with more headquarters information, to have their advice asked earlier'.⁶ This was a good omen for postwar industrial innovation.

In 1944 Herbert Morrison, Minister of Home Security and the Labour

¹ Gowing, Britain and Atomic Energy, p 110; Sanderson, Universities, p 344.

² R.V. Jones, Most Secret War, (London, 1978), p 298.

³ Crowther and Whiddington, op.cit., pp 87-9; Hartcup, op.cit., pp 11, 29.

⁴ Jones, op.cit., p 275.

⁵ J.D. Scott and R. Hughes, Administration of War Production (London, 1955), p 283.

⁶ Postan, Hay and Scott, op.cit., p 483.

figure most smitten with science as a force for social progress, summed up what the war had taught about science and its organisation. First, he said that contrary to conventional wisdom, Britain certainly had the skills necessary to develop good ideas into working products; radar had proved that. Second, 'progress in the theoretical and practical solution of specific problems can be incredibly fast when all the brakes are off', that is when private desires to preserve the status quo were subordinated to the public good. Third, the war had shown that 'science is a method which can be applied to almost any problem, however unlikely, and almost any material, however apparently intractable'.¹ This expansive statement is characteristic of how scientists' war successes raised their stature both within the government and in the esteem of politicians and the public. 'The process [was] essentially one of liberation', write Scott and Hughes.²

This liberation was reflected in bigger budgets and more responsibility for scientists all over the government. By 1944-45 DSIR's spending was at £1.43m, 53 percent higher than the 1938-9 level, and its staff numbered approximately 2,000. Aeronautical research cost the government £1.3m in 1939, £19.8m in 1945. Eight new RAs were formed during the war, the combined income of all the RAs trebled to £1.3m, and the Board of Trade was intrigued enough by their work to commission a report on it.³ Government scientists subjected the authorities to 'weighty, widespread, determined and prolonged assaults'⁴ to improve their status and pay, finally

¹ Herbert Morrison, 'Science and administration in modern government', 14th Hobhouse Memorial Lecture (London, May 1944), pp 6-7.

² op.cit., p 288.

³ DSIR, 'Annual Report 1947-8', Appendix V; Johnson, Co-operative Research, p 31; PRO, BT 64/3493, 'Note on industrial research associations', BOT Internal Reconstruction Department, 11 Aug. 1944.

⁴ Scott and Hughes, op.cit., pp 131-2.

securing an overhaul of the Scientific Civil Service despite Treasury footdragging.¹

Scientists' wartime advances were so rapid and dramatic compared to their prewar poverty and isolation that most observers have tended to consider the Second World War 'the great turning point in government-science relations in Britain as elsewhere'.² This analysis is accurate as far as it goes, but it obscures the strong elements of continuity with the more restrictive past that persisted in British civil science through the war and beyond. These inheritances were to block some of the ambitious plans for postwar R&D and industry which gained currency towards the end of the war.

Science still had no powerful voice in Whitehall. The SAC was weak and cautious. A century of educational neglect was another legacy, apparent in every segment of the technical war. In 1939 three-quarters of the population had no education past 14.³ Nature complained that the use of advanced weapons was limited by the poor backgrounds of personnel.⁴ The German Army had geologists attached to every brigade working under a central geological staff; the whole British Army, operating in many different types of terrain, had two. This meant 'the flooding of military works and of shelters, the instability of defence works on shores and along rivers'.⁵ 'The magnificent Battle of Britain [aircraft] types', say the official historians of weapons development, '[depended on] . . . the achievement of the American

¹ 'The Scientific Civil Service', Cmd. 6679, Sept. 1945.

² Vig, op.cit., pp 13-14.

³ Science in War, p 130.

⁴ 'The teaching of science', Nature 149 (7 Feb. 1942) 162.

⁵ Fabian Society papers, K30/4, Item 4, Prof. H.H. Read, 'Geology and geologists in war and peace', talk before the P&SC, Nov. 1942, and comment by Prof. N.F.M. Henry.

aircraft industry',¹ which had conducted more fundamental research before the war and had many more QSEs to put that research into practice. In the whole of the British aircraft industry there were only 3000 draftsmen, about the same as in two large American factories.² Sir Stafford Cripps had to announce in May 1943 that 'there was no considerable surplus of persons' who could design postwar civil airliners, and in 1944 Cherwell estimated that America held a four to five year lead.³

The need for radio technicians and engineers was so glaring that the government announced full bursaries in the summer of 1940 for a special short university course, and in October 1941 the scheme was expanded to 2000 places in chemistry and engineering as well as radio. This helped boost the annual output of graduate engineers from 1673 in 1938-9 to 3307 in 1947-8, of graduate scientists from 2533 to 4291.⁴ Even so Tizard argued that 'there is a large, untapped reservoir of scientific talent in this country. . . .Our technical education is inferior, taken as a whole, to that of many of the smaller countries of Europe'.⁵

The Sunday Soviet approach required QSEs to pay close attention to operational requirements and thus helped sharpen their understanding of the whole innovation chain, from invention to ultimate use. Good collaboration was however notably lacking in tank production, radio and other

¹ Postan, Hay and Scott, op.cit., p 34.

² Cripps papers, 404, Speech to Engineering Industries Assn., 4 Nov. 1944, p 15.

³ 'Cripps hopes for air pact with U.S.', Daily Mail 21 May 1943; Cherwell papers, F204, 'Civil transport aircraft', minute from Cherwell to Churchill, 4 Dec. 1944.

⁴ Hartcup, Challenge, p 25; ACSP, Eighth Annual Report (1954-55), Cmd 9537, Appendix II.

⁵ Tizard papers, HTT 580. 'Science in the war and after', Mond Lecture, 9 Nov. 1945.

lower-priority areas where the best university scientists were absent. Moreover, war production ignored monetary cost and was aimed at a simple, single goal, victory, which made it relatively simple to set research priorities. The government was the only buyer. Commercial sensitivities, never strong among the academic scientists who flooded into weapons development, atrophied further both in government and industrial labs.

The war's effect on British industry was similarly mixed. It disrupted supplies and labour, destroyed plant through bombing, ran down capital by delaying repairs and investment, and caused many non-essential industries to shrink drastically; yet 'it is the innovatory aspect of war which impresses more than its temporary restrictive aspects'.¹ Three wartime developments were most helpful to innovation and productivity.

First, a brisk wind of outside scrutiny shook up insular managements. Official schemes to improve management were extensive and effective. The 'utility goods' programme limited consumer goods to standard types, permitting economies of scale and greater productivity. Production Advisory Services eased the problems caused by the abrupt expansion of aircraft and engineering factories. Former competitors exchanged information through Mutual Aid Groups. Foremen's panels toured different factories, leading to many improvements in production details. The 800-strong Labour Supply Inspectorate advised firms on training, promotion, and production planning and offered courses for personnel managers. An interdepartmental inquiry into these schemes found that rearrangements of existing labour and machinery often led to productivity improvements of 20-25 percent and concluded: 'It has been the general experience. . .that there is great scope for improvement in all branches of management. . . . Deficiencies. . .extend

¹ Milward, Economic Effects, p 34.

throughout the whole'.¹

Second, machine tools and other new equipment were bought in great quantity to aid war production. The ensuing productivity improvements were less evenly spread than those from better management; against the gains in war industries must be set the £1b disinvestment in non-war sectors caused by a virtual halt in repairs, maintenance and new equipment purchase.² The 'Group I' industries -- munitions, chemicals, engineering and metals -- profited from £900m capital expenditure, including £100m in new machine tools, almost doubling the country's prewar stock.³ The government built more than 75m square feet of new factory space. On the other hand, non-essential industries suffered. More than 3600 establishments and 71m square feet of factory space were closed. The construction industry was so disrupted that it did not regain prewar productivity levels until the end of the 1960s.⁴

Greater labour-management cooperation was the third positive feature of wartime economic changes. Joint production councils between labour and management helped break bottlenecks and ease the way for what would have been anathema to unions before the war, the 'dilution' of skilled labour into priority jobs by introducing unskilled replacements. Union objections to motion study and other 'scientific' methods of organising work diminished. Industrial psychology was used widely in selecting and promoting personnel,

¹ PRO, BT 64/3537, 'War time measures to raise the standard of management in industry', memorandum by G.C. Allen, 5 July 1944, Appendix I, pp 2-3.

² W.K. Hancock and M.M. Gowing, British War Economy (London 1949), p 551.

³ Cherwell papers, H221, paper on postwar national income by T. Wilson, 16 Mar. 1943.

⁴ Cripps papers, 240, Notes for speech to Swiss-British Society, Zurich, Jul. 1946; Matthews, Feinstein and Odling-Smee, op.cit., p 236.

maintaining morale, designing equipment and planning optimal working conditions.¹ The government encouraged investigators to analyse the effects on productivity of lighting, heating, ventilation, hours of work, nutrition and other variables. Nature endorsed this brand of applied social science, publishing in 1942 alone two leaders and several other articles which encouraged the wider use of scientific techniques to boost production.²

Thus the war helped diffuse modern practices and equipment through high priority sectors of the economy. What was the net effect on manufacturing productivity?³ Total factor productivity in manufacturing between 1937 and 1951, years chosen to avoid the statistical abnormalities of war expansion, grew at the unimpressive average annual rate of 0.9 percent, compared to a 1.9 percent rate from 1924 to 1937 and a 2.0 percent rate between 1951 and 1964. The war industries were lavished with factor inputs (labour and capital) at a higher annual growth rate than before or since. In some -- chemicals, iron and steel and electrical engineering -- this resulted in productivity growth that was better than the 0.9 percent average for manufacturing as a whole. In others, however -- mechanical engineering and shipbuilding, vehicles, other metal industries -- productivity growth was slight or even negative. 'This suggests that the policy of pushing resources into these sectors. . . may have brought them up against diminishing returns', which is understandable since the goal of war production was speedy

¹ CAB 21/2298, 'Possible post-war applications of psychology and psychiatry in the civilian field', draft note from J. Cohen to the Lord President (Attlee), 18 Apr. 1944.

² 'Production and hours of work', 149 (14 Mar. 1942) 281-2; 'Sociological aspects of production committees', 150 (4 Jul. 1942) 1-3; Dr. May Smith, 'The human factor in production', 150 (1 Aug. 1942) 142-4.

³ Of course, the war affected productivity in all sectors of the economy, but manufacturing is the one most relevant to this thesis.

maximum output rather than the most efficient use of inputs.¹ Non-war industries showed relatively high productivity growth: though their output dropped, their labour and capital inputs dropped even faster through diversion to war uses. But this was hardly a sign of long-term strength. In sum, modern productivity data show wartime British industry succeeding at the immediate task set for it, but paying a considerable price.

This broad-brush picture is confirmed by a wealth of evidence from contemporary observers. At a 1943 meeting between the BOT and representatives of the materials handling industry, one which has important implications for productivity, manufacturers declared that they were 'definitely not up to date' in their designs and products.² The machine tool industry was not ready for great technical strides either. After three years of running the industry, its Controller, Sir Percy Mills, told a conference:

We had not got the production facilities so far as machine tools were concerned to support our own requirements. . .and what was true of machine tools was equally true of numbers of items of equipment, cutting tools and other things which went with machine tools. . . .If we left importation out of our calculations, we really had not got a Machine Tool Industry in this country at all.³

During the war Britain relied increasingly on the United States for production of technically sophisticated products, including penicillin, proximity fuzes and merchant ships. This was partly because British mobilisation of manpower was so very high but partly because it did not have the necessary industrial infrastructure. For example after the war when Britain, having 'invented' the atomic bomb and shared in the wartime U.S. project, wished to start its own nuclear programme, 'only one firm - ICI -

¹ Matthews, Feinstein and Odling-Smee, op.cit., Table 8.7, pp 240-1; p 235.

² PRO, BT 131/66, meeting with the Materials Handling Export Group, 5 Oct. 1943.

³ PRO, BT 28/334, 'Note of talk by C[ontroller] G[eneral] M[achine] T[ools]', 19 June 1944.

was capable of taking an entrepreneurial role in the construction of a single atomic plant'.¹ In sum, while some industries did improve productivity and R&D capacity during the Second World War, the gains were spotty. Even in some industries which received lavish wartime attention the gains could not make up for long-standing weaknesses in the country's management culture, educational system, and civil science organisation.

Because of the apparent wartime success of British industry -- albeit supported by the American economy -- few anticipated serious postwar difficulties in civil R&D and productivity. Indeed a wrong lesson was commonly taken from the war economy's success in innovation: that scientists, rather than scientists and engineers, were responsible. In fact the great wartime technical advances were triumphs of engineering, 'dependent on many years of patient research, culminating at that particular period because of the pressure of military need'.² But this lesson was drowned out by a chorus of hosannahs to 'pure science'. Partly this was due to the enhanced prestige of university scientists after they had proved so valuable in the war; partly to the prevailing 'research-push' model of technological advance which held that all basic research led inevitably to commercial innovations. Tizard indeed argued that the 'great lesson' of wartime technical advance was the need for close collaboration among all members of the innovation chain, but even in 1946 he thought 'this lesson, despite all our efforts, has tended to be lost. . .'.³

¹ Gowing, 'Science, technology and education', p 14.

² Sir Robert Cockburn, 'A Royal Society discussion of the effects of the two world wars on the organisation and development of science in the UK', Proc. Roy. Soc. Lond. A 342 (1975) 489.

³ 'Science and the Services', J. Roy. United Services Inst. 91 (1946) 335.

CHAPTER TWO

Wartime Planning for Industrial Civil Science

Introduction

This chapter examines the great volume of reconstruction planning which sought to raise the technical level of postwar British products and industrial processes. It focuses on the bureaucratic history of this planning, tracing the progress through Whitehall of proposals in three main areas of industrial civil science policy: first, industrial productivity; second, industrial R&D; and third, the powers the postwar government would gain to direct and stimulate scientific research. The context in which this policy evolved is outlined, dealing in particular with two factors: the opinions of business and scientific groups outside the government which set the agenda for those inside, and secondly the broader political and economic currents of reconstruction.

Of the three areas of industrial civil science policy, the most politically charged was productivity. Here, science was only one contributing element, and was inextricably bound up with arguments about the effect on productivity of extending wartime government controls over industry. Industrial R&D, which was much less political, absorbed less time in top-level Cabinet reconstruction committees, and ministers did not begin to consider government powers to direct and organise scientific research generally until the very end of the war. Despite these differences in ministerial attention, each of the three areas of industrial civil science policy followed a remarkably similar script. Any proposal which sparked controversy between Labour and

Conservatives, which rankled the Treasury or angered any important group, was scrapped, watered down, or put in hibernation until Labour's 1945 general election victory. Despite gales of rhetoric, reports and committee meetings earnestly seeking a postwar scientific renaissance for British industry, by 1945 the government had given itself very few powers to bring one about.

2.1 Themes of Reconstruction

Reconstruction planning was more serious and sustained in Britain than in any other belligerent of the Second World War. Senior ministers and officials immersed in the war effort devoted significant time and attention to it even when victory was unsure and still more as peace approached. The reasons for this and its manifestations in various economic and social policies have been thoroughly discussed in several books¹ and need not be repeated here. The tenor of public opinion was leftist and this worked in favour of the Labour Party. Morgan observes that 'the pressure for planning, equality and reform during the second world war may be linked. . .with the fortunes of the Labour Party', and that 'the radical thrust of Labour policies in the thirties should always be recalled' in seeking the roots of the Attlee government's agenda.² Addison lays more emphasis on its eclectic background, arguing that much of it emerged from the diverse pragmatic ideas of a broad progressive centre.³ Labour's commitment to parliamentary democracy meant that its socialism was in any event gradual and

¹ Addison, Road to 1945; Calder, People's War; Tom Hopkinson, Of This Our Time (London, 1982); Morgan, Labour in Power, pp 18-34; Taylor, English History 1914-1945, pp. 455, 549-50; Richard Titmuss, Problems of Social Policy (London, 1950), p 506.

² Morgan, op.cit., pp 23, 16.

³ Addison, op.cit., Chapter 4. See also PRO, PREM 4/88/4, 'Public feeling on post-war reconstruction', report by the Ministry of Information's Home Intelligence Division, Nov. 1942.

ameliorative, reforming capitalism rather than replacing it. Moreover most of the major reforms implemented by the postwar Labour government -- Keynesian fiscal management for full employment, comprehensive land use planning, wider and better secondary education, universal social security, closer collaboration between government and industry, the National Health Service -- had taken shape under the Coalition government. Labour did however exceed Conservatives in its enthusiasm for science: for the application of the scientific method generally to social problems and for the use of science in improving British industry and welfare alike. It believed in science policy.

The central theme of Labour's outlook was an endorsement of the central direction of resources so that rationality and community interest could supplant laissez-faire custom and private interest. This passion for rational planning is visible in many aspects of Labour's programme: replacing anarchic competition with central economic direction and nationalised industries; instituting national controls over the use of land; restructuring the local social services into a comprehensive and efficient system. Herbert Morrison's biographers call the 'constant objective' of his politics 'a search for tidiness'.¹ Just as the authors of Science at War criticised British science chiefly for its chaotic organisation, Labour leaders derided capitalism largely for its inefficiency. The changes they sought owed as much to 'the modernizing, technocratic motive'² as to the passions of the class struggle, and thus harmonized with the consensus in favour of more 'rational' organisation of the economy.

¹ B. Donoghue and G.W. Jones, Herbert Morrison: Portrait of a Politician (London, 1973), p 136.

² Addison, op.cit., p 183.

Science, representing rationality and modernity in their purest form, became a natural and significant element in Labour leaders' visions for postwar Britain. Morrison, for example, said in 1944: 'The general question [of] the part science can play, indeed must play, in our affairs after the war if we are to survive and progress as a community. . . . is obviously a matter of the most urgent importance'.¹ Bevin said in 1945: 'I think it is true to say that science has not merely a place in industry, but does in fact dominate it now. . . [It has] influenced not only the whole of our standard of living, but indeed our entire conception of life'.² Attlee told a Parliamentary and Scientific Committee (PSC) deputation in 1943 that he 'welcomed the[ir]. . . views as evidence of a widespread awakening of interest in [science]', and 'agreed that there should be an expansion of scientific research. . . .there must be a proper control of planning and allocation in order to avoid duplication'.³ Cripps, himself trained as a chemist and a 'love[r of] expertise of every kind: political, social, economic',⁴ said in 1943:

I feel, myself, that in the years which are to come the future of this country is largely to depend upon how we handle this problem of research and development. . . .We must develop. . . some new technique by which the various changes are better integrated and better coordinated and where the State as a whole plays a larger part. . . .⁵

¹ Morrison, 'Science and administration in modern government', pp 3-5.

² Speech to the conference on 'The Place of Science in Industry' held by the BAAS Division for the Social and International Relations of Science, 12 Jan. 1945, Advancement of Science 3 (1945) 107.

³ PRO, CAB 124/525, 'Organisation of scientific and industrial research', minutes of meeting with the P&SC, 15 Dec. 1943, p 3.

⁴ Addison, op.cit., p 191. Though Cripps had been expelled from the Labour Party before the war for advocating a Popular Front with the Communists, he remained popular and influential within Labour and rejoined it after the war.

⁵ Cripps papers, 1245, comments after J.G. Crowther's lecture to the Royal Society of Arts on 'Science in the USSR', 14 Apr. 1943.

These pragmatic reformers did not go so far as the Bernalists in actually equating science with socialism, but certainly considered them mutually interdependent.

2.2 Early Plans for Postwar Civil Science, 1940-42

Worried that Germany was winning the propaganda war with its 'New Order' for Europe, the War Cabinet established a Committee on War Aims in August 1940 charged with devising 'a post-war European and world system' and 'means of perpetuating the national unity achieved in this country during the war through a social and economic structure designed to secure equality of opportunity'.¹ Attlee chaired its first meeting on October 4, which agreed to ask Arnold Toynbee, who had worked in the Ministry of Reconstruction in the First World War, to sketch out a programme of work. Toynbee's draft proposed virtually every topic which occupied reconstruction planners for the rest of the war, from national health insurance to the distribution of industry. Science policy was among them: 'Should the state make greater provision for research in medicine and the natural and social sciences?'² Another paper before the Committee gave science a central role:

The most revolutionary part of our proposals [on production and distribution] would in fact be the one which should encounter the least opposition. The discoveries of science during recent years have created possibilities of material prosperity. . . previously scarcely visualised.³

But with German armies poised across the channel, the War Cabinet

¹ PRO, CAB 21/1582, Committee on War Aims Terms of Reference, undated note by E.E. Bridges.

² PRO, CAB 87/90, W.A. (40) 3, 'Note by the Minister of Information' reporting conversations with Toynbee, 9 Oct. 1940.

³ PRO, CAB 87/90, W.A. (40) 1, 'War aims', paper by S.M. Bruce circulated by the Lord Privy Seal (Attlee), 8 Oct. 1940.

considered the time not yet ripe for remote speculations on domestic reforms.¹ Churchill was especially unenthusiastic for a variety of reasons: he thought reconstruction plans favoured Socialist ideals, and found the issues dull compared with grand strategy.² His involvement in reconstruction was erratic: sometimes inhibiting, mostly ingoring.

Churchill and the pressures of war kept reconstruction off the agenda of top-level ministerial committees until the Beveridge Report in December 1942. Nevertheless a surprising amount of spade work was done by civil servants and outside bodies. When Arthur Greenwood, the aging Labour Minister without Portfolio, failed as chairman of the vital Production and Economic Policy Committees, Churchill made him reconstruction coordinator in December 1940. He and a small secretariat were charged with working out 'practical plans' with other government departments to be implemented up to three years after the war.³ A new but small and powerless Reconstruction Problems committee was created which met only four times until February 1942, when Greenwood was sacked. It did little of substance. Greenwood's officials and an interdepartmental committee of civil servants on Postwar Internal Economic Problems were however active on some technical and largely apolitical problems, especially for the initial 'transition' period between war and peace, for example demobilisation, reconversion of factories to civilian production, disposal of surplus goods, and the war's effects on the distribution of industry and population. Investigations were farmed out to PEP, the Nuffield Social Reconstruction Survey under G.D.H.

¹ PRO, CAB 65/10, W.M. (40) 292, 20 Nov. 1940.

² PRO, PREM 4/87/11, minute from Churchill to Home Secretary, 24 Oct. 1943; Addison, op.cit., p 126.

³ PRO, PREM 4/88/1, letter from Churchill to Greenwood, 30 Dec. 1940, p 333; Annex B, p 338.

Cole, a group under R.H. Tawney and various departments.¹

Science figured as one such apolitical topic. In February 1941 Greenwood met the SAC to seek its help in framing the government's approach to civil science. Immersed in directing the scientific war and unmoved by Bernalist schemes of central planning, the SAC came up with a disparate and rather lame group of suggestions ranging from a study of communal feeding to 'the organisation of the machine tool industry and the provision of more adequate locomotive-testing stations'.² Three days after Greenwood's meeting, Attlee cited it as the reason for rejecting an MP's request for a Select Committee to inquire into the best way of organising postwar civil science.³ In June 1941 Greenwood proposed to the SAC a large-scale survey of scientific research and education because of widespread criticisms 'that academic industrial scientists do not have enough contact with each other, that there is a good deal of duplication of work, and that the supply of scientists is too small and their rewards too uncertain'; but there is no record of the SAC ever having discussed this plan.⁴

Serious thinking was going on about the future of civil science, but in isolated pockets, and mostly outside the government. Nevertheless, ideas were percolating within individual government departments too. In February 1941, DSIR Secretary Sir Edward Appleton asked the directors of DSIR labs to send him their preliminary musings about reconstruction. His own, set down to spark their thinking, demonstrate qualities which were characteristic

¹ PRO, CAB 87/1, note from J.J. Hawkes in Reconstruction Secretariat to J.H. Peck at 10 Downing St., Feb. 1942, pp 220-37.

² CAB 90/2, SAC (41) 6th meeting, 24 Feb. 1941, pp 1-3.

³ HC Debates, Hansard vol. 369, cols. 625-6, 27 Feb. 1941.

⁴ PRO, CAB 90/2, SAC (41) 41, 'Proposed survey of scientific research and scientific education,' letter from Greenwood to Hankey, 22 June 1941.

of his leadership of DSIR: commendable imagination, but within conservative horizons which assumed that the basic mission and structure of DSIR were sound. He asked them to consider permitting RAs and DSIR labs to conduct privately supported research, along the lines of the successful Mellon Institute in Pittsburgh, USA, which undertook contract research for private firms. He sought suggestions for strengthening present ties with trade associations and government departments, and between DSIR scientists and those outside. Trying to extend what the war had taught about 'Sunday Soviets', he raised what became a central topic of science reconstruction: 'Are you satisfied that it is in the national interest that the Department's responsibility should end when the scientific solution to a problem has been found and that development should be left to industry'? Appleton advocated extra training facilities and grants to bring new graduates of accelerated wartime science courses up to full peacetime standards, yet worried that there would be a glut of researchers instead of the desperate shortage that did develop.¹

The lab directors' suggested reforms, trickling in over the next six months, wittingly and unwittingly revealed DSIR's weak spots. No one had any new ideas for improving ties with users. The Director of the Chemical Research Laboratory strongly endorsed the addition of Mellon-style contract research because 'the close and frank contact facilitates practical trials and the translation of laboratory results into practice', and would counteract the 'tendency for some of the workers to stick to their laboratories too much'. He also recommended adding a statistician to the headquarters staff, a 'business analyst possessing broad technical interests', who could analyse the commercial potential of proposed researches. It is a measure of DSIR's tiny

¹ PRO, DSIR 17/279, minute from Appleton to Research Directors, 22 Feb. 1941.

resources that no such analyst was already employed, and that one was thought enough for the future. The Director of Food Investigation agreed that DSIR research typically failed to take economics into consideration. He also complained that neither the Lord President, the DSIR Secretary or the headquarters staff 'really know, still less appreciate, what we are doing' and consequently recommended that the headquarters staff be expanded. The composite picture emerging from these questions and answers is of a DSIR too small, too fractured, too insulated from commercial life and too peripheral to the main thrust of government work to be able to inject a large dose of science into British industry.¹

Among non-government bodies, Nature, the Labour Party and the BAAS were devoting attention to postwar science before 1943. Nature ran articles advocating more science in postwar agriculture, a national food policy, and repeatedly endorsed national land-use planning along 'scientific' lines. It took a lively interest in all sorts of reconstruction topics, from the organisation of industry to slum clearance.² In June 1941 Harold Laski suggested science as one of 16 topics on which Labour's National Executive should prepare a policy and himself chaired the Scientific Research subcommittee, which also included Blackett, Emmanuel Shinwell, Lancelot Hogben and others. In May 1942 the National Executive approvingly quoted Franklin Roosevelt's 'Four Freedoms' speech, in which he foresaw 'the enjoyment of the fruits of scientific progress in a wider and constantly rising standard of living',³ but

¹ Ibid., minute from G.S. Whitby, Chemical Research Director, 13 Mar. 1941; and Eric Barnard, Director of Food Investigation, 7 Apr. 1942.

² Sir John Russell, 'Agriculture after the war', Nature 149 (3 Jan. 1942) 12-14; R.A. Gregory, 'Fighting for what?' 149 (20 June 1942) 678; 'Background to national planning' 149 (10 Jan. 1942) 31-4; 'Economic foundations of a new world order' 150 (11 July 1942) 33-6; 'Rebuilding Great Britain' 150 (3 Oct. 1942) 410-12.

³ Labour Party, The Old World and the New Society (London, Apr. 1942), p 15.

Laski's subcommittee, like the committees on all but the most politically charged reconstruction topics, produced nothing tangible until mid-1943.¹

Much greater enterprise was shown by the BAAS. Its Division for the Social and International Relations of Science held a standing-room-only conference on Science and World Order in September 1941, to which the government gave great publicity because the image of scientists planning for a better world was a powerful propaganda counter to Nazi barbarism. Pervading the proceedings were an impatience with the old ways and a sense that the scientist's hour had struck. 'The algebraic sum of our directive influence upon the world is inconsiderable', complained H.G. Wells. A young scientist, E.D. Swann, said British production would never be fully efficient 'until the application of science is planned in a scientific way', adding 'the younger working scientists in industry are in the best position to realise what changes need to be made'. Soviet science and engineering were much praised. Even A.V. Hill, the Secretary of the Royal Society and SAC member who opposed undiluted Bernalism, endorsed a vista of what science could accomplish if better organised:

It is obvious that scientific planning and the planning of our national resources can make many of our troubles unnecessary. By designing our houses properly the pipes need never get frozen up; by proper attention to nutrition, to public health and physical education, sickness can be largely avoided; by deliberate planning of public works, unemployment can be greatly reduced and the standard of living raised. . .²

This conference was an important symbol of science on the march, but it produced no specific proposals for the government. Gregory convened a committee to draw up a concrete plan deriving from the conference. Hill was

¹ Labour Party archives, Box 297, Central Committee on Reconstruction Problems, minutes and papers; memorandum by Laski, 4 June 1941; Progress Report RDR 110, July 1942; minutes of 14th meeting of committee, 19 Dec. 1942.

² 'Science and world order', Advancement of Science 2 (1941) 3-116; Wells, p 94; Swann, p 77; Hill, p 9.

sceptical because the topics to be considered were 'somewhat grandiose', such as 'the revival of international investment, the application of science to the Colonial Empire, etc.', but Hankey advised him to join.¹ There is no record that this committee was formed.

2.3 Industrial civil science policy takes shape: 1943-5

Science, like other subjects which became important in reconstruction planning, was in 'suspended animation'² through 1942. Various ideas for reform were circulating, but there was not enough political pressure to break the logjam Churchill had constructed. Paymaster-General Sir William Jowitt, Greenwood's replacement as the minister charged with reconstruction, was the most pro-Labour figure Attlee could get Churchill to appoint,³ but having 'slipp[ed] dexterously across party boundaries no fewer than four times in ten years', was not likely to forward unwelcome policies.⁴ A public statement he drafted on reconstruction emphasised that 'Reconstruction is not the framing of Utopias'.⁵

Both the high-level political, and official-level technical, debates about reconstruction were transformed by the Beveridge Report's publication on 1 December 1942.⁶ It proposed cradle-to-grave social security for all through a unified system of contributions and disbursements. Though the

¹ PRO, CAB 90/2, SAC (41) 18th meeting, 16 Oct. 1941, p 4.

² Addison, op.cit., p 171.

³ PRO, CAB 21/1586, 'Post-war reconstruction: suggestions for organisation', E.E. Bridges to Martin, 26 Feb. 1942; PREM 4/88/1, minutes from Attlee to Churchill, 26 Feb. 1942, p 151 and 28 Feb. 1942, p 148.

⁴ Hopkinson, Our Time, p 212.

⁵ PRO, CAB 66/30, W.P. (42) 507 (Revise), 'Outline of statement on reconstruction problems', memorandum by the Paymaster-General, 14 Nov. 1942.

⁶ 'Social Insurance and Allied Services', Cmd. 6404.

Ministry of Information at first refused facilities for publicising it, its propaganda value, Beveridge's own promotion skills and the public euphoria following the first victories in North Africa won the report a huge and enthusiastic following, with one poll showing an 86 percent approval.¹ Churchill was forced to create a new and more overtly political Cabinet Reconstruction Priorities committee to handle it. Bevin, Morrison, and Jowitt represented Labour, Chancellor of the Exchequer Kingsley Wood was the main figure for the Conservatives, and the Lord President, Independent M.P. Sir John Anderson, was chairman. Not surprisingly the members were divided. The government procrastinated. This grudging reception tarnished the government's image, causing by-election victories for anti-Coalition candidates who campaigned largely on 'Beveridge now'². Churchill tried to tame the groundswell of dissatisfaction in a March reconstruction broadcast, but refused to commit himself further than the Chancellor said the nation could afford. Acrimonious notes were exchanged among Attlee, Bevin, Morrison and Churchill. The Labour leaders argued that the government should make the best forecast it could of the financial and economic position of the country as a basis for making definite reconstruction commitments.³

This controversy lingered unresolved until October 1943. Wood's death in September brought to the Exchequer Sir John Anderson, who had a more open mind about reconstruction than his predecessor. Attlee replaced him as Lord President, the most powerful position on the home front. Churchill became more expansive and agreed on October 19 that 'any decisions which

¹ Addison, op.cit., pp 213-17.

² Ibid., pp 226-7; see also Quintin Hogg, 'An open letter to the Tory Party', Picture Post, 6 Mar. 1943.

³ PRO, CAB 66/38, W.P. (43) 255, 'The need for decisions', 26 June 1943. Wood tried to refute this memo in CAB 66/39, W.P. (43) 308, 14 July, which was criticised by Attlee, Morrison and Bevin in CAB 66/39, W.P. (43) 324, 20 July 1943.

are needed now for the supreme objects of FOOD and EMPLOYMENT in the years immediately after the war must be taken now, whether they involve legislation and whether they are controversial or not'.¹ In November he appointed Lord Woolton, the popular Minister of Food (non-party, but later a Conservative), as Minister of Reconstruction, and amalgamated the Reconstruction Problems and Reconstruction Priorities committees into a new Reconstruction Committee.² Postwar planning was now in high gear.

The Beveridge Report and the controversy which ensued affected the planning for postwar science in two ways. First, it 'legitimised' reconstruction, so that vastly more work both inside and outside the government was devoted to it, in science as in other fields. Second, since paying for Beveridge became a divisive issue between Labour and Conservative ministers, estimating the postwar national income took high priority. This in turn sparked deep interest in productivity, research and development and other factors contributing to industrial strength. As soon as Beveridge was published the Treasury and the Economic Section of the War Cabinet began to predict the postwar national income. This work built on an earlier study by the official committee on Postwar Internal Economic Problems (IEP), which in August 1942 had accurately forecast the major economic hurdles facing postwar Britain and considered how to combat them.³ Restoring the balance of payments, restraining inflation and ensuring the smooth transfer of resources from war to peace production were the

¹ PRO, CAB 66/42, W.P. (43) 467, 'War - Transition - Peace', memorandum by the Prime Minister, 19 Oct. 1943.

² PRO, CAB 66/43, W.P. (43) 538, 'Office of the Minister of Reconstruction', Note by the Prime Minister, 26 Nov. 1943.

³ CAB 117/4, R.P. (42) 21, 'The internal economic problems of the post-war transitional period', report by IEP, 1 July 42; CAB 66/27, W.P. (42) 347, 'Progress report by the Paymaster-General', 1 Aug. 1942; CAB 65/28, W.M. 155 (42), War Cabinet Conclusions, 19 Nov. 1942.

'three outstanding tasks' the IEP's August 1942 report had seen for the transition. If the economy could successfully readjust, the long-term prospect was encouraging, largely because of science: 'the war will in many ways have speeded up the process of technical invention and discovery, and may thus indirectly make possible a more rapid development of technique in certain civilian industries and occupations. . . .The distant vistas offer great opportunities'.¹ The IEP report influenced an estimate by the Economic Section and the Treasury of the national income, and with its emphasis on the balance of payments, prompted the Board of Trade Export Trade Committee to prepare a lengthy inquiry into the prospects for British exports.² Both the Economic Section/Treasury and Export Trade Committee reports, issued in June 1943, gave prominence to civil science as a key factor in postwar prosperity.

These two reports mark the effective beginning of an historic expansion of the British government's interest in civil science policy. Previously the government had furthered specific sorts of science to accomplish discrete goals, primarily the development of advanced weapons. DSIR began as an attempt to catch up with Germany in modern warfare, and the civilian functions it took (like road and water pollution research) aimed at fulfilling the government's own tasks more scientifically. Its more commercially orientated work, as well as the RAs, represented a more general concern about the scientific level of British industry, but both through design and skimpy funding only supplemented what industry proved unable to do for itself. As the government in 1943 broke away from

¹ Ibid; Hancock and Gowing, War Economy, pp 535-7.

² PREM 4/87/4, P.R. (43) 35, 'Influences affecting the level of the national income', 25 June 1943; PRO, CAB 87/3, R.P. (43) 25, 'Report on the recovery of export markets and the promotion of export trade', BOT Postwar Export Trade Committee, 15 June 1943.

laissez-faire tenets to accept overall responsibility for postwar prosperity, a similar concern for civil science -- considered a vital element in that prosperity -- naturally followed. As we shall see, it proved much more difficult to devise effective and politically acceptable policies for raising the technical level of industry than to set out, as these reports did, the basic problem; but it was accepted that the basic problem was to make the whole of British industry more efficient and modern.

The Export Trade Committee report, after cataloguing many international and domestic influences on levels of British exports, devoted a chapter to 'Competitive Efficiency in Production'. It said that non-technical factors, such as price rings or other restrictive practices, might affect efficiency, but the most important contributors to export sales were technical: low price through low production costs, attractive design and high quality. 'Industrial research may lead to more efficient methods of production as well as to improved design'.

The extent of our research compares unfavourably with that of the United States, which has developed a reputation for the newer types of goods. . . .

. . . .
Scientific industrial research offers long term prospects for the development of new industries, in addition to improving efficiency in existing types of products. . . . New industries must, for the United Kingdom, have a special value if only because many of the difficulties of the inter-war period arose from our excessive dependence on the industries. . . [of] the 19th century.

We compare very unfavourably with the United States in regard to the use of up-to-date machinery.

And because the war had compelled many previously safe Imperial markets to industrialise, the report earnestly recommended that Britain 'develop early every new type of product that might find a sale. . . . Sales are likely to be dependent largely upon special technical features as well as upon quality and competitive price'.¹ It saw clearly that the country's postwar prosperity

¹ 'Report on the recovery of export markets', op.cit., pp 6-7, 33-5.

would depend upon the imaginative application of science in industry.

The Treasury/Economic Section report¹ overestimated the postwar national income,² but was correct in treating science and its applications as central factors in determining it through their effect on industrial productivity. The report listed many other factors which influenced national income besides productivity; and productivity, defined conventionally as output per person-hour, itself had many determinants. They are worth quoting in full, because they showed that raising productivity -- hereafter a central topic in industrial civil science, and the primary focus of high-level scientific committees under the postwar Labour government -- required a complex array of policies in fields where government had little previous experience:

the health, skill, education and technical training of the workers; the efficiency of the management; the amount and quality of the capital equipment with which labour and management operate; the attention which is devoted to industrial research; the freedom of industry from restrictive practices; the ease with which new technical methods are spread through the industrial system; shifts from occupations of low to those of high productivity; and the sex and age composition of the labour force.³

In March 1943, as he helped prepare this report, Keynes at the Treasury contributed ideas for Churchill's reconstruction broadcast which showed him buoyantly optimistic about the war's effects on productivity.

Modern factory layouts and mass production have been introduced all over the place. . . .After the war there are numerous inventions and new methods devised for war purposes which can be adapted and exploited for peace-time uses. . . .[Thus] it is not unreasonable to expect that after the war we shall discover ourselves with a notable leap forward in productivity compared with pre-war'.⁴

¹ PRO, PREM 4/87/4, 'Factors influencing. . .national income', op.cit.

² Hancock and Gowing, op.cit., note 1, p 542.

³ 'Factors influencing. . .the national income', op.cit.

⁴ Cherwell papers, H223, notes by Keynes for Churchill broadcast, Mar. 1943.

This implied that the national income could easily support Beveridge and other ambitious reconstruction schemes. Opinion was however divided since annual productivity growth of one percent after 1938 would mean a national income of £6570m in 1948 while two percent would mean £7210m. Keynes and his camp argued that war experience, whether through more machine tools, increased standardisation or simplified distribution to new factories, 'may lead to permanent improvements in industrial and commercial technique; much of it may suggest ideas which could be continued or extended into the postwar period as a part of a consciously planned programme for the improvement of efficiency'. The pessimists argued that new techniques and machines were concentrated in relatively small pockets. 'Over the whole field of production and employment the disturbance of the war will have retarded rather than accelerated the normal processes of technical improvement', they argued.¹ They carried the committee, which concluded that £6800m was a good estimate of 1948 national income. Keynes dissented, holding out for £7400m or at least £7000m, and Kingsley Wood settled on £7000m.²

In discussing the report, ministers from both parties agreed that government should take a much more active role in promoting industrial productivity. Oliver Lyttelton, the Minister of Production, said that management training, capital equipment replacement, and machine tool purchase should be encouraged. 'Far more was done by way of scientific research and development in the United States than in this country', he argued, and the Secretary of State for Scotland, Thomas Johnston, said that 'the most difficult and important problem might be to ensure that the results

¹ 'Factors influencing. . .the national income', op.cit.

² PRO, CAB 87/12, P.R. (43) 36, 'Post-war national income and taxation', note by the Chancellor, 25 June 1943.

of scientific research were applied on a sufficient scale to the industry and commerce of the country'.¹ So by mid-1943 officials and ministers of both parties were broadly agreed that boosting the technical level of industry must be an important object of government policy.

How could this be accomplished? The rest of this chapter examines in three main divisions the various wartime suggestions and how they evolved into policy, that is in productivity, industrial R&D, and the overall organisation and direction of civil science by government.² Government policy to raise the technical level of British industry did not develop as a collection of discrete topics. They were lumped together in different combinations depending on circumstance and considered among a broad range of measures intended to promote prosperity and full employment. For clarity of exposition, however, it is necessary to impose a certain order on events.

2.4 Productivity

The last chapter showed that the acute needs of war production caused the government to take a sharp interest in all aspects of industrial efficiency, establishing advisory services and reorganising flaccid firms as required. The benefits were so pronounced that as early as 1942 the Board of Trade began to contemplate the possibilities of extending it after the war to civilian industries.³ By concentrating civilian production into the smallest number of factories and through the utility goods scheme, which arranged for long low-cost runs of standard consumer items meeting quality specifications, BOT had successfully improved productivity. It was eager to

¹ PRO, CAB 87/13, P.R. (43) 13th meeting, 13 July 1943.

² One topic peripheral to the technical level of British industry, the reorganisation of the scientific civil service, is not covered.

³ PRO, BT 131/59, 'Efficiency', note by G.C. Allen, late 1942.

apply this experience to postwar industry. Since it had charge of selling off surplus factories and capital equipment after the war, it was well placed to do so.

Productivity was never considered a purely technical topic, to be achieved solely by R&D and modern machinery. The overall structure and control of industry also had to be conducive. So productivity policy became inextricably entwined with bigger economic questions about which Labour and Conservative ministers sharply disagreed. With the Coalition divided, little government machinery for raising the long-term technical level of British industry was ready by 1945. Some agreement was reached on unambitious measures for the transition period which flowed directly from wartime industrial organisation.

2.4.1 Long-term measures

Under pressure from industry and Jowitt to form detailed reconstruction policies,¹ BOT sent a letter drafted by the economist G.C. Allen to 50 trade associations in February 1943 asking for their predictions about 'the main obstacles which are likely to confront your industry. . .the probable condition of your capital equipment. . .[and] the introduction in the post war era of new products. . .' It also wanted detailed data about production costs to determine what made certain manufacturers more efficient than others.² BOT President Hugh Dalton told reporters that the 'most important' information he hoped would emerge from this inquiry was 'what steps are to

¹ PRO, BT 131/59, 'Reconstruction - Paymaster General's Committee', note by G.L. Watkinson, 18 Dec. 1942.

² PRO, CAB 87/57, I.E.P. (43) 6, 'Industrial reconstruction', enclosing 'BOT approach to industrial problems', Annex I, 'Approach to industries on reconstruction', 30 Jan. 1943.

be taken to secure re-equipment with efficient and modern plant',¹ and the BOT's Internal Reconstruction Department was also collecting evidence about the success of foreign schemes for certifying the quality of standardised consumer goods.² The BOT's research on productivity flowed into the work of the Steering Committee on Postwar Employment, a powerful interdepartmental body of civil servants who had been studying, since Beveridge, the fiscal tools the government could use to maintain full employment.

In May 1943 the Steering Committee's first report induced Reconstruction Priorities to refer several areas for further study, including mobility of labour, location of industry, control and timing of investment and industrial productivity. Of these, this thesis is concerned with productivity. It was seen at this point as part of the larger and more controversial question of how industry should be organised: in cartels and trade associations which would divide up markets and limit output in hard times, in public ownership, or in a much more competitive free-for-all.³ Since both Conservative and Labour ministers considered industry's productivity and technical strength primarily a consequence of industrial organisation, Reconstruction Priorities found it logical to direct that further study of productivity be carried out under the heading of 'restrictive practices in industry'.

This study resulted in a major report by the Steering Committee (chaired in its final six weeks by the ubiquitous Sir Alan Barlow) for the Reconstruction Committee in January 1944⁴ which drew heavily on an

¹ PRO, BT 131/59, Note 20, 15 Feb. 1943.

² PRO, BT 131/61, BOT Reconstruction Fortnightly Summary (RFS) 2 (27 Feb. 1943), p. 17.

³ CAB 87/13, P.R. (43) 13th meeting, 13 July 1943.

⁴ PRO, CAB 87/7, R. (44) 6, 'Post-war employment', report of the Steering Committee on Post-War Employment', 11 Jan. 1944.

October 1943 BOT paper, 'General support of trade'.¹ This BOT study was a major document to which many elements of reconstruction industrial policy can be traced. Guided strongly by the interventionist proclivities of Dalton and Hugh Gaitskell, an economist and future leader of the Labour Party to whom Dalton delegated much reconstruction work,² the BOT memo's main argument was that 'the Government should have ready specific measures for the support of trade. . . measures that will not only help to achieve full employment but will also bring industry to a higher level of efficiency'. Different industries would require different combinations of remedies, which fell in three broad classes: reorganisation, primarily to amalgamate into larger units the 90 percent of British firms employing 100 people or fewer; more money in remitted taxes or direct subsidies; and encouragement of new ideas and methods. This thesis discusses only those measures directly relevant to its title, and simply records the others which accompanied them.

Reorganisation, the report advocated, should be arranged by an Industrial Commission, a powerful central body attached to the BOT. It would recommend schemes of amalgamation to the BOT, 'with industrial efficiency as the objective', backed up by the ultimate sanction of compulsory purchase. Restrictive practices would be registered with the BOT, and those found to be anti-social could be banned. There would also be Industrial Boards in industries where a majority of firms desired to have them which would have power to exact compulsory levies -- surmounting a weakness of the RAs, where contributions were voluntary and sparse -- to spend on cooperative R&D, export promotion and market research. Maximum

¹ PRO, CAB 87/63, E.C. (43) 4, 'General support of trade', memorandum by the BOT, 15 Oct. 1943.

² Philip Williams, Gaitskell (London, 1979), p. 118.

taxation stimulus should be given to 'expenditure on modernisation, re-equipment and research'.

The memo recommended a variety of measures to support industrial R&D (to which we will return) and to improve management and industrial design. An Advisory Bureau of Industrial Management funded partly by the government was to encourage management research, provide a central register of consultants and disseminate advanced techniques. A Council of Industrial Design was to establish design centres in individual industries, a central pavilion of good specimens, and oversee a new school attached to the Royal College of Arts. Finally, the British Standards Institution was to be expanded to promote standardisation of appropriate consumer products.¹ In this comprehensive plan, shaped by a Labour-led BOT, for modernising British industry, one can hear echoes of what Harold Wilson told the Labour Party Conference 20 years later:

Only if technological progress becomes part of our national planning can that progress be directed to national ends. . . .We are re-defining and we are re-stating our socialism in terms of the scientific revolution. . .the Britain that is going to be forged in the white heat of this revolution will be no place for restrictive practices or out-dated methods.²

These proposals had a rough passage through the official and ministerial committees, the detail of which must be omitted in this thesis. Apart from major differences in party attitudes to industry, civil servants and advisors were divided. The Economic Section for example feared that the BOT plans for Industrial Commissions and Boards would stifle industrial competition and expansion. Indeed it proposed more radical controls on restrictive practices. The Treasury for its part adamantly opposed measures costing money. By 1945 the Coalition Government had reached weak

¹ PRO, CAB 87/63, 'General support of trade', op.cit.

² Blackett papers E75, speech of Harold Wilson to Labour Party Conference at Scarborough, 1 Oct. 1963.

compromises on most of the proposals. A Restrictive Practices Commission was to investigate possibly harmful cases, but with no sanctions except publicity. The Industrial Commission was whittled down to the minor change of adding two small private lending institutions to the City, one of which had been recommended 15 years previously. There was a useful, albeit small, change in taxation relating to new plant, machinery and buildings, but the Board of Trade's proposals for subsidies for reequipment and new buildings were turned down. The postwar Labour government ultimately revived re-equipment subsidies in a very attenuated form; Cripps, its President of the Board of Trade, was also able to establish the British Institute of Management, the Council of Industrial Design and increase support for the British Standards Institution.

2.4.2 Productivity: measures for the transition period

The Coalition's indecisiveness about long-term productivity policy contrasts with its more impressive record in setting productivity policy for the transition. Almost all economic policymaking for the transition was relatively harmonious, since the tightly organised war economy had to be unwound carefully to avoid chaos, and all parties agreed on the economy's immediate postwar tasks. Both Labour and Conservatives agreed that the government's extensive controls over labour and materials would remain in the short term, in order simultaneously to increase exports to a level at least 50 percent above prewar, redress civilian austerity especially in housing, and 'begin the process of re-equipment required to raise British industry to the highest level of efficiency', all without causing inflation.¹ Both parties also agreed that firms engaged in war production, and surplus

¹ PRO, CAB 87/14, R.(I.)(44) 19, 'Economic controls in the transition', memorandum by the Minister of Reconstruction, 26 Oct. 1944, and discussion at R.(I.)(44) 6th meeting, 27 Oct. 1944.

factories and machine tools, should be released to give maximum aid to postwar economic expansion, rather than sold to the highest bidder.¹ Labour and Conservatives agreed too on short-term government support for certain industries whose technical level directly impinged on the national interest, either because their products were essential for defence, had 'war potential' or because home production would significantly cut imports.² The concept of 'war potential' opened the door to government support for scientific and optical instrument manufacturers, light metal producers, and for creating a domestic clock industry which could be quickly converted to making fuze timers and other precision goods.³

As we have seen, however, longer-term policies to raise the technical level of British industry overlapped with contentious questions of control where agreement was impossible. This frustrated even efforts to find a joint approach to some 'very urgent problems of industrial efficiency'⁴ in the building, coal, textile, electricity and machine tool industries in the transition period because they involved questions of reorganisation, public control and public finance.

In the 1945 election campaign the Labour Party stressed its commitment to improving industrial productivity, clearly believing its vision

¹ PRO, CAB 66/55, W.P. (44) 545, 'Release of capacity from war production', memorandum by the Minister of Production, 28 Sept. 1944, Annex, para. 8; for surplus factories, see CAB 65/43, W.M. 94 (44), War Cabinet minutes 20 July 1944; on disposing the 200,000 machine tools bought by the government worth £150m, see CAB 87/14, R.(I.)(44) 8th meeting, 20 Dec. 1944, considering R.(I.)(44) 20, 'Control and disposal of machine tools', report by the Official Sub-Committee on Industrial Problems, and R.(I.)(45) 3rd meeting, 21 Feb. 1945.

² PRO, CAB 87/14, R.(I.)(44) 21, 'Manufacture of goods formerly imported', report by the Official Sub-committee on Industrial Problems, 18 Dec. 1944; discussed in CAB 87/15, R.(I.)(45) 1st meeting, 3 Jan. 1945.

³ Winston, 'Defence Production', op.cit., pp 28-9, 161-82.

⁴ Hancock and Gowing, War Economy, p 540.

of a more modern, efficient and prosperous Britain would appeal to voters. Labour's manifesto, putting its case for the nationalisation of selected industries and the curtailment of restrictive practices, argued it in terms of

advancing industrial efficiency in the service of the Nation. By the test of war some industries have shown themselves capable of rising to new heights of efficiency and expansion. Others, including some of our older industries fundamental to our economic structure, have wholly or partly failed. . . . Britain needs an industry organised to enable it to yield the best that human knowledge and skill can provide. Only so can our people reap the full benefits of this age of discovery and Britain keep her place as a Great Power.¹

Cripps repeatedly underscored the connection between socialism and high productivity during the campaign, as for example in a broadcast speech:

One of our great complaints against Private Enterprise, emphasised by many official committees and commissions, is its failure to keep up to date with machinery, buildings and methods. . . . Industrial education, personnel management, research and development have also been neglected to swell dividends. . . . Our technicians and scientists are the best in the world; they have done a magnificent job in the war but they don't have a fair chance nor do our skilled workers.²

Consistent with the line its ministers had taken in the Reconstruction Committee, the Conservative Party's election campaign did not feature industrial productivity. Its industrial policy 'went little beyond vague acceptance of the duty of the state to intervene when the nation's interest required it. And even this conclusion was cushioned in traditional Conservative warnings about the dangers of controls. . . .'³

The postwar Labour government certainly displayed a strong desire to improve the technical level and productivity of British industry. This was to be expected, since its ministers had seen from wartime experience how much government could do to mobilize the economy and had campaigned that

¹ Labour Party, Let Us Face the Future, Apr. 1945, pp 5-6.

² Cripps papers, 301, 'What to do to win the peace', undated election broadcast.

³ J.D. Hoffman, The Conservative Party in Opposition (London, 1964), p 40.

socialist planning and technical advance were complementary. Chapters 3 and 4 chronicle how the Labour government accomplished in this area.

2.5. Industrial Research and Development, 1943-5

2.5.1 First efforts

The months following the Beveridge Report saw a great burst of planning for the future of industrial R&D, heretofore ignored by government and business. A gloomy April 1942 FBI report on postwar prospects, as well as reports by other business bodies in that year, paid scant attention to the future of science in industry.¹ But the great and fruitful wartime infusion of scientists into government and industry, especially in contrast to the widely publicised poverty of British science in the Thirties, meant that R&D was ripe for attention once reconstruction moved into the limelight. In productivity policy, the impetus for change had come essentially from Labour ministers and temporary civil servants in the BOT, and was opposed by Conservatives and industrialists because of the continuing government intervention entailed. R&D policy, having fewer implications for control of industry, did not set off the same ideological resistance among Conservatives; conversely, neither did R&D reforms excite an ideological determination to prevail among their proponents in either party. In fact business leaders originated many of the reforms eventually enacted, which had strong support from a large body of moderate opinion in Parliament and among scientists.

¹ FBI, 'Reconstruction, a report', April 1942; Fabian papers, K30/2 Item 4, Rotary Club of Norwich, 'Reports of committees appointed to consider post war reconstruction', 1942; K30/3, Association of British Chambers of Commerce, 'Report on post-war industrial commerce', May 1942; London Chamber of Commerce, 'Report on general principles of a post-war economy', May 1942.

But controversies there certainly were. Several imaginative ideas for new government bodies to support R&D were eviscerated or delayed, either through business hostility or bureaucratic infighting. In the end, the much-vaunted reconstruction consensus between Labour and Conservatives produced no reforms in R&D more radical than what the FBI was willing to back in 1943.

The theme of reconstruction in industrial R&D was to enlarge and improve existing institutions without fundamentally recasting them. Specifically this meant better tax concessions for privately conducted R&D; slightly more money for DSIR and the RAs; bigger grants to universities so that more scientists could be trained; raising the conditions of scientists in the Civil Service closer to parity with administrators; and closer contacts between industry and the universities. The Bernalist idea of directing science centrally to meet national priorities did not really enter the debate in a big way until 1945, when radical and reformist scientists emerged from war work to focus on reconstruction. Of course, Bernalism was no panacea. Increased central control of research would not necessarily have improved the innovative capacity of British industry if the controllers comprised civil servants or academic scientists with weak industrial backgrounds, as would have been likely, given the composition of all other scientific advisory committees. Since, however, as we have seen, prewar civil science was weak and fragmented, a general overhaul might have served Britain better than modest expansions and additions. As it turned out, the empirical, common sense approach to reform, developed and later administered by largely 'establishment' figures who had been satisfied with the prewar system, was not up to the task of putting British products and processes in the front world rank.

At the end of 1942 the FBI appointed a committee under Sir William Larke, Director of the British Iron and Steel Federation, to survey current industrial research and recommend changes. Its report is an excellent basic text for an analysis of reconstruction plans in industrial R&D, not only because of the reforms it advocated but those it skirted for fear of controversy. It called R&D 'perhaps the most vital industrial question of the day', and noted that 'lip service to research is often paid by firms or industries which believe that they have no problems requiring scientific investigation'. Arguing that industry's research expenditure 'certainly represent[s] an insignificant percentage of the value of industrial production', it recommended that firms should 'wherever possible. . . maintain [their] own research department', spend liberally on it and on their RA. The FBI also called for bigger DSIR grants to the RAs and a £1m annual DSIR budget, so it could expand its facilities for disseminating research results to industry. Industrial scientists needed more authority, closer contact with management and university colleagues, and more mobility within the firm so that marketing, production and other functions could profit from their expertise. Tax concessions for private R&D should be more generous. More public money should provide more scholarships for science students. In this list of recommendations can be found most of the reforms eventually enacted for industrial R&D.¹

At the end of their report the FBI committee tentatively proposed several new bodies to promote science in industry. It knew these suggestions, though quite modest, would cause controversy among FBI members and elsewhere. That in fact they were eventually quashed or much postponed shows how little reconstruction R&D policy could move beyond the consensus acceptable at the outset to a conservative business group. These new bodies

¹ FBI, 'Industry and research', Oct. 1943, pp 5-17.

were designed to address the three most vexing shortcomings thought to prevail in R&D: 1) providing centralised research facilities which, unlike the RAs, could be used for private investigations, especially by smaller firms; 2) developing laboratory discoveries into commercial innovations more effectively, one of the problems Appleton had asked his research directors about in 1941; and 3) 'bridging the gap' between discoveries already ripe for application by business and the vast numbers of firms which typically remained ignorant of them.

The FBI considered the American Mellon Institute a possible model for centralised contract research, but thought firms could manage adequately using the RAs' cooperative service. To aid the development of inventions another American body, the Research Corporation of America, seemed promising. The idea was widespread that many scientists refused to develop potentially useful discoveries for fear of enriching themselves or others. This American corporation offered an alternative. It bought patents from university scientists and others who did not want their discoveries used for private gain, contributing whatever profits derived from commercial application to the advancement of science. The third new body the FBI tentatively proposed, to 'bridge the gap', was an Industrial Research Bureau which would publish a yearbook to describe current research avenues and facilities, and perhaps advise firms about where they could go for help on particular problems. The FBI considered these new bodies useful but not urgent. The report concluded:

We are on the whole satisfied with the general scheme of organisation [of R&D]. . .and with the various types of organisation which exist. . . .we are not satisfied with the scale on which research is prosecuted and the degree to which the existing machinery is utilised.¹

While this report had been gestating, many groups had begun to urge

¹ Ibid., p 20.

reforms for industrial R&D. In February, for example, the Official Committee on the Machinery of Government, chaired by Barlow, started inquiring into the effectiveness of the government's civil science organisation.¹ Articles and letters in the Times sharply contrasted 'American foresight and energy' with 'British complacency' in R&D and called for 'scientific and technological research on a scale not yet envisaged'.² Oliver Lyttelton, Minister of Production, told an audience of industrial welfare officers in July that the 'encouragement of inventions' would be a crucial prop to economic expansion,³ and another Conservative minister, Financial Secretary to the Treasury Ralph Assheton, told the National Union of Manufacturers that 'it would be necessary to devote a good deal more money and effort to research and development'.⁴ With the Bank of England's imprimatur, Sir Harold Hartley published a widely circulated pamphlet entitled 'Are you research-minded?', extolling the returns to be derived from R&D and recommending that every firm join an RA and have at least one staff member with scientific training.⁵ Statements lauding R&D and following a similar line to the FBI came from the Internal Combustion Engine Manufacturers' Association, the Institute of Electrical Engineers, the Institution of Radio Engineers, the coal mining industry, leaders in the Times and Financial News, Lord McGowan of ICI and Samuel Courtauld of the fibre firm bearing his name, who called for expenditure on a 'revolutionary'

¹ PRO, CAB 87/71, M.G.O (43) 8th meeting, 5 Feb. 1943; CAB 87/72, M.G.O.(43) 13, written evidence by Appleton, 16 Mar. 1943.

² Sir George Schuster MP, 'Industry after the War', Times 24 June 1943; letter from Sir Lawrence Bragg, 19 June 1943.

³ PRO, BT 131/61, RFS 13, 14 Aug. 1943, p 110.

⁴ PRO, BT 131/61, RFS 20, 4 Dec. 1943, p 163.

⁵ Sir Harold Hartley, 'Are you research-minded?', Aug. 1943.

scale.¹

In July the Parliamentary and Scientific Committee instigated a House of Lords debate on R&D, an important sign that the topic had moved to the forefront among moderate opinion. The P&SC, a moribund body before the war with only 14 MPs in 1938, could claim 112 MPs, 32 lords and 35 professional and technical associations as members at the time of this debate. In June they had held the best-attended meeting in their history at which Cripps described his strategy for postwar science: 'to increase the volume of our research, both basic and applied', perhaps by a factor of 10, 'and at the same time to introduce some measure of planning so as to make the best use of our available resources'.² The debate, on a motion by the Liberal leader Lord Samuel 'to call attention to the need for the further expansion of scientific research', revealed close agreement among all parties. Samuel's basic plea, which Labour speakers echoed, was for more money to bring R&D spending up to American per capita levels, estimated to be three times Britain's; for better pay and conditions for scientists in and out of the government; and for university expansion. Cherwell, replying for the government, summarised this mutual admiration society very aptly:

My Lords, having devoted a considerable fraction of my adult life to trying to persuade Governments, industry, and indeed anyone who had any money to spend, of the importance of scientific research, it is quite a new experience (and I may say a very refreshing one) to have to answer my own arguments.³

¹ CAB 118/73, 'Post-war industrial reconstruction as viewed by the Internal Combustion Engine Manufacturers' Association', 20 Nov. 1943; Times leader 11 May 1943; PRO, CAB 117/202, letter from McGowan to Jowitt enclosing 12 Oct. 1943 speech to Institution of Chemical Engineers; for remaining items, see Fabian Society papers, G59/5, Item 7, Nuffield Conference on Scientific Research, preliminary document summarising current proposals by G.E. Fasnacht, 17 Dec. 1943.

² Cripps papers, 1239, 'Address to P&SC', 1 June 1943, pp 14, 21.

³ HL Debates, Hansard vol. 128, 15 July 1943, cols 554-83; 20 July 1943, col. 652.

He was not yet able to make specific promises about the structure and funding of postwar science, but this debate pressured the government to start formulating policy.

Within the DSIR and the BOT, first steps were already being taken. In March 1943 the DSIR's Industrial Grants Committee, responsible for funding the RAs, recommended that they no longer be expected to become self-supporting, that new RAs be formed to cover all British industry, that they publicise their work more and that compulsory levies on all relevant firms be considered as a funding mechanism.¹ That same month DSIR's overall Advisory Council began to focus on reconstruction too, sparked by a letter to its chairman, Lord Riverdale, from one of its members, Cotton Board chairman Sir Raymond Streat. He thought 'D.S.I.R. could render great service to the country if it could devise means by which. . . "esprit de research" could be consistently built up in the post-war period'.² Appleton 'welcomed [this] suggestion heartily',³ opened reconstruction for discussion at the Council's 14 April 1943 meeting, and solicited written comments. Streat proposed creating an Intelligence Division to spread the innovation gospel to small firms isolated from science, through printed publicity, conferences and regular visits from DSIR headquarters to RAs and firms. Riverdale endorsed it, sure that DSIR 'must take a big step forward, be more aggressive in our attack on this subject'.⁴ That such outreach work was being badly neglected emerges clearly from one Advisory Council member's account of conversations with staff at Glaxo, Lever Brothers and Chivers,

¹ PRO, DSIR 2/96, 'Report of the Industrial Grants Committee on the future of industrial research associations', Mar. 1943.

² PRO, DSIR 17/280, letter from Streat to Riverdale, 11 Mar. 1943.

³ Ibid., letter from Appleton to Riverdale, 15 Mar. 1943.

⁴ Ibid., letter from Streat to Appleton, 20 Apr. 1943; from Riverdale to Appleton, 30 Apr. 1943.

three important firms, about their attitudes to DSIR:

In one case it amounted to mild hostility, the phrase being "the D.S.I.R. is unacceptable to the trade". In another to suspicion on the basis of their previous relations with another Government Department, in a third remoteness. They evidently were just unimpressed.¹

Some Advisory Council members did not respond to Appleton's trawl for ideas. Others pleaded for tax concessions on research, for more attractive technical journals to publicise new developments to management, for a threefold increase in the number of science graduates, for more money to develop research results to the pilot plant stage, and for the government to support cartels to create a good environment for cooperative research.²

The upshot of these suggestions was a resolution passed at the Advisory Council's 27 October meeting:

(i) that the Headquarters organisation of the Department be so strengthened that adequate time may be devoted to the planning of policy, and the furtherance of contacts with industry and the public; (ii) that the Department be enlarged, where necessary, to enable it to carry its research work to the pilot plant stage; (iii) that, bearing in mind the need to offer all possible encouragement to industry to conduct research work for itself, representations be made in favour of the relief from taxation of all expenditure on research by industrial firms and organisations.³

Streat also prodded Appleton to have DSIR take a more public role in encouraging industrialists and university researchers to prepare for postwar R&D, which resulted in a series of public meetings between these groups in Manchester and the formation of the Manchester Joint Research Council (MJRC) to foster continued interchange.⁴ By this time the Advisory

¹ Ibid., letter from Sir Joseph Barcroft to Appleton, 4 Oct. 1943.

² Ibid., DSIR headquarters compilation of Advisory Council's letters, 13 Oct. 1943.

³ Ibid., Advisory Council minutes 27 Oct. 1943.

⁴ Ibid., note from Streat to Riverdale, 4 Nov. 1943; for accounts of MJRC work, see Nature 153 (18 Mar. 1944) 337-8; (15 Apr. 1944) 458; (29 Apr. 1944) 520.

Council's reconstruction work was so interesting to BOT that an Assessor from BOT's Internal Reconstruction Department, G.L. Watkinson, was attending its meetings, asking 'vital questions about what research might have to say about export trade possibilities' and thus 'delight[ing]. . .the progressives on that body'.¹

2.5.2 Frustrated Plans

1) Compulsory levies for RAs

The BOT devised the most ambitious ideas of any government department for postwar R&D. Its proposals then had to run the interdepartmental gauntlet. Some BOT plans which echoed the uncontroversial proposals in the FBI's report were adopted, but the more adventurous ones fared poorly. Before turning to the moderate plans which eventually bore fruit, it is useful to examine the novel ones which did not, and why.

The DSIR Industrial Grants Committee recommended in March 1943 that RAs be funded through compulsory levies on all relevant firms, which dovetailed with a similar idea in the April 1943 report of BOT's Postwar Export Trade Committee. This prompted BOT to ask firms how welcome levies would be.² Such an idea had been extant since the 1930s, but enabling legislation had been passed only for the cotton industry. To avoid controversy the FBI had purposely excluded compulsory levies from its major 1943 report on industrial research, but Larke, who had chaired the committee which drew up the report, was personally in favour and told BOT that 'there were no insuperable objections' among business, especially in

¹ BT 131/69, RFS 8, 29 May 1943, p 81; BT 64/3124, letter from Sir Raymond Streat to Sir Arnold Overton, BOT Permanent Secretary, 22 July 1943.

² PRO, BT 64/3338, minute by G.L. Watkinson, 15 July 1943, para. 3.

industries where a majority of firms desired it.¹ It seemed a propitious time for broadening the scope and resources of the RAs: their numbers and subscriptions had been growing during the war, which had helped publicise their existence and value, and in September 1943 DSIR reported 'more requests during the past six months to consider the formation of new associations than they received in the previous six years'.² Cooperative R&D also appealed to Labour, which distrusted the greed it thought implicit in private research, and squared with the dominant wartime trend towards central control of industry.

So 'General support of trade', BOT's omnibus proposal for improving industry, made compulsory levies for cooperative research the centrepiece of its programme for encouraging industrial R&D. These levies were to be assessed on all firms in any industry where a 'substantial majority' of firms desired it, and were to fund export promotion and market research as well as scientific research. 'The object is to combine, as far as possible, the virtues of private initiative. . .with co-operation [in] various pooled services'.³ The Steering Committee on Postwar Employment endorsed these recommendations,⁴ as did the Reconstruction Committee.⁵ Thus armed, in May 1944 Dalton asked the Business Members of the BOT for their views on how the Industrial Boards should work, and in September various trade associations and over 100 industries received a BOT circular to assess whether the 'substantial majority' necessary to form the Boards existed.

¹ PRO, BT 64/3415, 'Minute of meeting with the FBI to discuss the FBI report on "Industry and Research"', 22 Nov. 1943, p 2.

² BT 64/3124, note by J. Maton of BOT IRD, 1 Oct. 1943.

³ PRO, CAB 87/63, 'General support of trade', p 4.

⁴ PRO, CAB 87/7, R.(44) 6, 'Post-war employment', para. 235.

⁵ PRO, CAB 87/5, R.(44) 16th meeting, 21 Feb. 1944.

In most industries it did not. Many trade associations 'opposed compulsory membership of any industrial organisation'; there was difficulty in defining which industry some firms belonged to; and large firms with their own labs resented the prospect of having to pay a fixed percentage of their sales for research which would primarily benefit smaller competitors.¹ Only about a dozen industries had expressed interest in establishing a Board by the time the Coalition broke up in May 1945. Cripps as BOT President tried to revive interest in these Boards and secured the necessary legislative authority for industries to go ahead in a Defence Regulation,² but only four, including the pre-existing Cotton Board, took advantage. The chronicle of controversy over industrial boards after the war continues in Chapter 3, but the Coalition government's failure to secure industry's assent to large-scale cooperative research and compulsory levies for financing it meant the RAs remained poor and patchy. This left a large hole in the government's plans for boosting industrial R&D.

Frustrated Plans 2: The Development Fund

Besides the Industrial Boards, the BOT proposed another new institution in 1943 to aid innovation. This was a fund to support the development of promising laboratory discoveries into commercial products, by common consent a crucial British failing compared to its competitors. Sir Alfred Egerton, for example, who considered such a development fund one of the two essential requirements of postwar R&D (the other was better engineering education), felt the British machine tool industry had lost pre-eminence because development of new machines was 'too costly to take

¹ PRO, BT 131/61, meeting between Sir Cecil Weir and industrial representatives, RFS 39, 30 Sept. 1944, p 310.

² HC Debates, Hansard vol. 418, cols. 203-8, 23 Jan 1946.

the risk'. He repeatedly called for a large central body with 'a gambling spirit' so that 'things can be developed although [an individual] industry does not quite see the way to support experiment'.¹ An example of the work a central fund might support was the joint project between DSIR and the Ministry of Fuel and Power to develop commercially the Fischer-Tropsch process for the synthesis of oil from coal. It was generally believed that the development phase was responsible for approximately 90 percent of the cost of bringing a new invention to the market, so a development fund was recognised to be an expensive undertaking for the government.

The FBI report had raised part of this issue in its tentative proposal for a body modelled after the Research Corporation of America to develop patents generated in the course of academic research; the BOT's more comprehensive proposal in 'General support of trade' for a fund to aid the development of promising inventions from all sources, including industry, had in fact descended from it. Within Whitehall it was not the BOT but the Scientific Advisory Committee which became the most persistent advocate of reform in this area. The SAC's idea was however much less ambitious than the BOT's, seeking only a central body to hold and develop patents from academic and government research rather than a large fund to develop socially valuable inventions of all sorts. The SAC called this body the National Research Trust (NRT), differing from the Research Corporation of America very little except in having a government charter. The NRT was actually created, many bureaucratic twists later, as the National Research and Development Corporation in 1949. As we shall see, the more comprehensive proposal for a development fund never left the drawing board, despite universal approval. Its stillbirth closely parallels the fate of the Industrial Commission and the Industrial Boards with their compulsory levies

¹ Egerton papers, Box 12, copy of letter to G.D.H. Cole, Apr. 1944, p 21.

for R&D: no major departures in the structure of industrial R&D were attainable during reconstruction.

It was February 1943 when the SAC started thinking about creating a central body to which government scientists could assign the many patents being generated because of the war from which interested firms could buy. The SAC's thinking soon expanded to encompass not only government discoveries but those of all non-profit labs. Since universities and charitable foundations were not experienced with patents, many discoveries made in their labs were not patented. Consequently, said the SAC,

it is unlikely to be practicable to arrange for such development by industry as would make [these discoveries] generally available; if [they are] patented, the absence of an agreed policy not merely exposes the patentee to the temptation to use it for his own enrichment, but offers him no obvious practical alternative. Under such conditions the use of patents as such easily falls into disrepute among academic research workers.¹

Accordingly the SAC called in August 1943 for the creation of the NRT to bridge this gap between academic labs and the private firms which could develop discoveries into useful products. It would take academic and government patents, sell them to industry, and plough the royalties into further research, with occasional ex gratia payments to inventors of particularly valuable products. The public would benefit because all inventions would be exploited as cheaply and widely as possible.

Sir John Anderson, then Lord President, endorsed the SAC's report and forwarded it to Chancellor of the Exchequer Kingsley Wood, who agreed the following month and requested comments from other departments.² BOT replied on 8 October 1943, concurring in the broad outline but doubting whether NRT 'would be strong enough on the industrial side to weigh considerations of industrial efficiency in deciding whether to take over and

¹ PRO, CAB 90/4, SAC (43) 4 Final, 'Report on patents', Aug. 1943.

² PRO, CAB 90/4, SAC (43) 9th meeting, 6 Oct. 1943, p 2.

support inventions, to arrange for large scale trials or for the erection of pilot plants'.¹ In 'General support of trade', issued on 15 October, BOT thus recommended that two special funds be created under its control, one for initial development and testing of laboratory discoveries, the other to fund further development under factory conditions, both to be held by the Industrial Commission.² This was a much more ambitious conception than the SAC's essentially passive NRT, and clearly expected that government support for development would be substantial. DSIR's Advisory Council, recoiling at the prospect of having so much traditional turf carved away, recommended that the RAs, not the BOT, have charge of the first fund for developing discoveries to the pilot plant stage. But the Steering Committee on Postwar Employment followed BOT's line and assigned it the funds, 'in co-operation with D.S.I.R.', which the Reconstruction Committee did not alter.³

Thereupon ensued a classic bureaucratic infight between DSIR and BOT to control these funds, with the Treasury playing one off against the other so that the whole idea became mired in impenetrable controversy. Attlee put the government's imprimatur on the idea of a development fund in an April 1944 House of Commons statement, but gave no details.⁴ That same month BOT proposed that it and DSIR each have a development fund, DSIR's to be used mainly for inventions from the RAs and BOT's for inventions from industry, other government bodies and individuals.⁵ But by

¹ BT 64/3597, 'Progress of long-term proposals', op.cit.

² PRO, CAB 87/63, 'General support of trade', paras. 36-7.

³ PRO, CAB 87/7, R.(44) 6, 'Post-war employment', para. 248; CAB 87/5, R.(44) 16th meeting, 21 Feb. 1944.

⁴ HC Debates, Hansard vol. 399, 19 Apr. 1944, col. 309.

⁵ PRO, DSIR 17/281, letter from A. Kilroy, BOT, to O.F. Brown, DSIR, 12 Apr. 1944.

May DSIR had agreed to give BOT primary control and recommended one unified fund for the use of all departments. 'It would be fantastic, and I imagine politically impossible, to have several funds, administered by different Departments, for what is clearly one broad purpose,' Appleton wrote.¹ The Treasury upset this arrangement by allocating the fund to the yet-unborn NRT, which obviously had no industrial experience; but then it reversed itself, with Barlow deciding that DSIR should have it after all. BOT continued to stress that the development and testing were 'much closer to an industrial than to a research function', but to no avail. To complicate matters further, Appleton then reversed himself on the need for any new development fund at all, contending in August 1944 that DSIR already had all necessary powers to grant funds to outsiders for developing inventions. The BOT still sought money of its own to aid innovation, but the Chancellor of the Exchequer (now Anderson) sided with DSIR. He argued that no new financial arrangements were required to aid initial development; for industrial-scale development, any department which felt it had a promising item could fund it out of its annual budget. There matters rested when the Coalition fell.²

On the recommendation of his civil servants, Cripps as BOT President agreed that avoiding legislation was the best way to get quick tangible progress and endorsed the idea that departments aid promising inventions themselves.³ 'Fantastic' it may have been to 'have several [development] funds, administered by different Departments, for what is clearly one broad

¹ PRO, DSIR 17/281, letter from Appleton to Attlee, 15 Feb. 1944.

² BT 64/3597, 'Progress of long-term proposals', op.cit; CAB 87/15, R.I.(45)12, 'Development of inventions', memorandum by Anderson, 10 Apr. 1945.

³ PRO, BT 64/2180, untitled minute from A. Kilroy, 21 Aug. 1945, with Cripps' manuscript comments, 23 Aug. 1945.

purpose', but 'politically impossible' it apparently was not. Thus the idea of a new central body to promote the development of promising inventions -- universally agreed to be a central shortcoming of British industry -- choked in a tangle of Whitehall weeds. In so doing it joined the other 'General support of trade' proposal for encouraging R&D, compulsory levies for RAs administered by Industrial Boards, in history's dustbin.

2.5.3 Ambitious ends, feeble means: general support of R&D

What was left of the brave new world for civil science so confidently predicted in the speeches of those who planned for reconstruction? Not much that was truly novel. Denied new state institutions to firm up specific weak links in the innovation chain, R&D policy came to comprise very broad initiatives to make research more attractive to private industry: more lenient taxes, more QSEs, more money for DSIR and the RAs. This might have turned out to be the wisest approach; much modern scholarship testifies to the value of fixing responsibility for R&D with the individual firm, rather than with official bodies remote from the market.¹ As it turns out, however, the policies adopted proved inadequate to encourage a level of civilian R&D that matched Britain's postwar competitors, let alone to revamp the whole creaky system of industrial innovation.²

Why did the government fail to take greater powers to control R&D? One important factor was the normal incrementalism of politics, the press

¹ For a small sample of this work, see C.F. Carter and B.R. Williams, Industry and Technical Progress (London, 1957); Pavitt, Technical Innovation; Sir Ieuan Maddock, 'Science, technology and industry' Proc. R. Soc. Lond. A. 345 (Sept. 1975) 295-326; OECD, The Conditions for Success in Technological Innovation (Paris, 1971).

² Section 3.4.2 includes a brief attempt to measure the extent of Britain's lag in civil R&D relative to its postwar competitors; Section 4.7 does the same for postwar industrial productivity. In both areas Britain improved markedly over prewar standards but not enough to keep pace with Germany, the USA and other important competitors.

towards inoffensive 'least common denominator' solutions. Very few in government, either politicians or officials, feared that the country's backwardness in R&D was so entrenched as to demand massive intervention. They wanted to do more for industrial innovation and considered success in this area important. But it was not widely perceived to be a matter of national life or death. Throughout the 1940s few in the government had any idea how many slipping gears would prove to separate the desired output of more advanced products and processes from the general inputs of more money and personnel which were politically inoffensive.

In the absence of rich RAs or a development fund, the government had no alternative but to rest its hopes for postwar industry on research in industrial firms. Few recognised during the planning of reconstruction that this left the government with few powers to encourage R&D except the very general ones of tax remission and support of scientific and engineering education. Some saw it clearly at the time; the economist George Allen, for example, who lobbied hard to improve innovation policy while working in BOT's Internal Reconstruction Department and subsequently, remarked in 1943: 'Regarding research in industrial firms, the Government could not do very much'.¹ But few politicians, civil servants, scientists or other observers were as perceptive as Allen in acknowledging that the government could do little to turn its vast hopes for industrial R&D into reality.

In January 1944, Appleton made a speech to an important conference on postwar research sponsored by Nuffield College which shows this apparently unperceived discrepancy between ambitious ends and feeble means.² He thought it was important to encourage scientists onto company

¹ PRO, BT 64/3415, 'Minute of meeting with FBI', p 2.

² Fabian Society papers, G59/5, 'Nuffield conference on postwar organisation of scientific and industrial research', Item 4, transcript of second session, 8 Jan. 1944.

boards and the 'breaking down' of barriers between industrial and university labs, but he offered no programme to provide such encouragement. He specified three types of firms in relation to R&D: the large enlightened firm which conducted its own profitable research; the medium-sized firm which could assimilate suitably developed ideas from the RAs; and small firms unable to accept new ideas even if willing. 'Stimulus to all of these could be given by taxation relief'. In addition, more money for DSIR and the RAs would help the medium and large firms; small ones could become more 'research-minded' through propaganda or competition. But he did not envisage, as did some at the conference, a large government advisory service to bring science to insular firms as agricultural extension services brought modern techniques to farmers. Appleton endorsed some government support and coordination of large-scale development projects, but as we have seen did not fight hard to ensure the creation of a large development fund. Thus his was a plea for more of the same, for putting more resources into existing channels. And that is exactly what the Coalition government was willing to do for civil science, as we shall see in four major areas of R&D policy pursued during the war: taxation, QSE supply, the mission of DSIR and the overall organisation of government science.

2.5.3.1 Taxation

Existing R&D tax rules, which aroused much wrath among business, permitted firms to write off against taxable profits the running costs of industrial labs and RA contributions, but not capital expenditure on R&D plant and equipment. Inland Revenue often treated research on entirely new products as a capital rather than a running expense, discouraging adventurous pursuit of new discoveries, though 'deliberate administrative

lassitude' sometimes softened this regulation.¹ These provisions compared poorly to those in the US and other industrialised countries. Kingsley Wood as Chancellor set a group to work examining the problem in July 1943, but BOT was skeptical: 'the rub is that the Committee is an Inland Revenue Committee', and Wood himself was thought hostile to generous R&D provisions.² Wood's successor Anderson, however, had more sympathy. Trained as a chemist and the minister responsible for the atomic bomb project, his interest in scientific research was strong.

When Anderson set out his Budget in April 1944, he made one important concession to the business pressure for greater tax remission on R&D. In addition to some other concessions for capital expenditure generally, he announced that any capital expenditure on research could be written off over five years, a shorter period than for other capital expenditure. This was to encourage more attention to 'the pilot plant stage. . . .I believe that in this country we have been, perhaps, slow in developing this essential stage'. Allowances for R&D current expenditure were to continue.³ This speech was well-received. Of course, firms with low or no profits could not take advantage of this concession, meaning that small new firms needing to plow back earnings into growth would not find it particularly helpful in their lean years. Nevertheless, Anderson's 1944 Budget ended controversy on this subject until subsequent governments decided that still more incentive was needed to encourage R&D and speedy re-equipment.⁴

¹ PRO, BT 131/61, RFS 31, 6 May 1944, p 249.

² PRO, BT 64/3311, minute by G.L. Watkinson, 19 July 1943.

³ HC Debates, Hansard vol. 399, cols. 677-8, 25 Apr. 1944.

⁴ For an example of attitudes towards the tax legislation, see 'Research development and tax relief', Nature 155 (24 Feb. 1945) 231-2.

2.5.3.2 Numbers of QSEs

Controversy was continuing on other plans for reconstructing civil science, even those broadly approved by the moderate consensus reflected in the FBI report. In October 1943 the Parliamentary and Scientific Committee had issued a bracing report, calling for a tenfold increase in national spending on research. Its proposals for where to put the funds were unimaginative -- more for DSIR and the RAs -- but its real focus was on the need for university expansion, to produce the researchers needed.¹ 'The post-war problem will not be to find jobs for scientists but to find the scientists for the jobs', it argued. American universities in total had fifteen times the income of their British counterparts, or five times per capita, and the USA's willingness to spend more of its national income on university education had clearly paid off in 'practical application and testing'. So the P&SC recommended that the Treasury boost its grant to universities from £2.25m to £6m or £7m, with an additional capital grant of £10m in the first five postwar years.² The government accepted the report in principle but was fuzzy on specifics. Appleton, reflecting both his usual caution and a belief held by some other senior scientists that the country's reservoir of first-class talent was already being tapped fairly efficiently, wrote Attlee that

it strikes me as a sound document, whose main fault is, perhaps, a very understandable excess of enthusiasm. . . .I am sure that some expansion in facilities in Universities and Colleges for training scientific workers is necessary, [but]. . .it would certainly not enhance the status of science and scientists in industry if there were a substantial excess of trained men; and this in turn would

¹ P&SC, 'Scientific research and the universities in post war Britain', Oct. 1943.

² For more on the relative spending levels of American and British universities, see Sir Ernest Simon, 'The development of British universities', Jan. 1944, in PRO, BT 64/3388.

react unfavourably on industrial progress. . . .[DSIR] would do a great disservice. . . .if it lowered the standards of quality and attainments.¹

Barlow considered the P&SC report

a useful document, but the Government are certainly not yet in a position to say how far they can accept their recommendations. They largely ignore the great amount of research which industries themselves are doing.

DSIR, MRC and ARC were already consulting with the Treasury about larger budgets, and the whole system of university finance was being rethought.

Barlow continued:

It is clear that more time is needed. It may be desirable to let the [P&SC] deputation come and blow off steam and to assure them that the question is being taken seriously. So far as the Treasury is concerned, we are not in the least antagonistic,

which is as close as he ever came to expressing enthusiasm for greater public expenditure.²

Attlee and Anderson, then Lord President and Chancellor of the Exchequer respectively, met a large P&SC group on 15 December 1943 to discuss the report, agreeing in general terms that more money should be spent on research and universities but specifying no amounts. 'It was not', said Anderson, 'solely a question of money being made available, but also of public education and responsiveness on the part of industry'.³ Perhaps sensing that continuing pressure on the government would be necessary to secure all they sought, the P&SC then collected signatures from over 200 MPs on a motion calling for more generous funding of research 'by adjustment of taxation, by more generous financial grants and through

¹ PRO, CAB 123/165, minute from Appleton to Attlee, 13 Dec. 1943.

² PRO, CAB 123/165, minute from Barlow to Gorrell Barnes, 27 Oct. 1943.

³ PRO, CAB 124/525, Minute of meeting with P&SC deputation, 15 Dec. 1943.

adequate priorities both in demobilisation and for materials. . .and equipment'.¹

Outside bodies were also stepping up their efforts to influence policy about postwar R&D, and QSE supply -- a crucial bottleneck in the scientific war -- quickly moved to prominence as a central problem on whose solution many hopes would hang. Some extension of the state bursaries in engineering and science, an increase in public funds for universities generally plus greater subsidy of laboratory research through the research councils or the Royal Society, became the standard prescriptions for reform. At the January 1944 Nuffield conference on research several speakers stressed it, and the published statement of policy growing out of the conference signed by 96 politically diverse figures stated:

It seems necessary to stress at the outset the need for a very rapid development of all forms of scientific and technical education. . . . Hitherto a very high proportion of the potential ability in these fields has been allowed, largely owing to the defects of our educational system, to run to waste.²

Nature also repeatedly threw its weight behind more government support for the training of scientists.³ Fortunately for the agitators, P&SC member Sir Granville Gibbons secured a Supply Day in Parliament for a debate on scientific research in April 1944,⁴ just before Anderson's budget relieving tax on R&D and capital investment. His motion, 'recognising the vital part which research and science and their effective application can play in reconstruction. . .urge[d] the declaration of a bold and generous Government

¹ PRO, CAB 123/165, minute from James Stuart MP to Attlee, 21 Dec 1943.

² Nuffield College, 'Problems of scientific and industrial research - a statement', Apr. 1944.

³ 'Industry, research and education in Great Britain', Nature 152 (20 Nov. 1943) 579-81; 'Scientific personnel in industry', 153 (1 Jan. 1944) 3-5.

⁴ HC Debates, Hansard vol. 399, cols. 216-310, 19 Apr. 1944.

policy of financial assistance' for education and for research in DSIR, the RAs and private industry alike. Party differences in the debate were scarcely visible, with Labour MPs stressing the need for competitive exports¹ and Conservatives complaining about industry's reluctance to modernise plant.² The main points of the debate reiterated the moderate consensus that had formed on civil science policy: more money for scientific and technological education; more for DSIR and the RAs; more for development of inventions; more for the salaries of science teachers and government scientists; more interchange between industrial and academic scientists, between boards of directors and scientists, between civil servants and scientists. Few real innovations were proposed; mostly the debate rehashed what had become the conventional wisdom.

Attlee, replying for the government, was reassuring but vague. To demonstrate the government's seriousness before the debate, he directed Barlow to draft a white paper on civil science, but this turned out to be a catalogue of the present system rather than a blueprint for the future.³ He told the Commons:

I can assure the House that the Government are fully alive to the fact that the winning of the peace, just as the winning of the war, will largely depend on a full and a right use of the scientists and of scientific organisations. . . .The Amendment [asks] for a bold Government policy and for Government assistance. This we shall give.⁴

But Attlee — whose education had included no science whatever⁵ — also

¹ Ibid., George Benson, col. 233.

² Ibid., Sidney Shephard, col. 245.

³ 'Scientific research and development', Cmd. 6514, Apr. 1944; and criticism by BOT Permanent Secretary Sir Arnold Overton, BT 64/3124, letter from Barlow to Overton and reply, March 1944, undated.

⁴ Hansard, op.cit., cols. 304-5.

⁵ Kenneth Harris, Attlee (London, 1982), p 10.

warned that while the government could give assistance and leadership, industry and the public had to 'become more aware of the importance of science' and more willing to use the results of research. 'That is a matter of very slow growth in a nation like ours'. He promised more money for universities, better conditions for government scientists and the government fund for development of inventions, but gave no specifics. This satisfied the P&SC and its allies but left the government leeway to do almost anything it wished. By 1945 the government had increased its grants to universities to £5.5m, from £2.5m prewar, but this was just enough to keep total university income abreast of inflation -- from £6.5m to £9.5m.¹

Controversy continued for several more years over how many QSEs the nation required, whether the population possessed sufficient talent to meet this requirement, and how best to expand the universities. This will be taken up again in Section 3.3. By 1945 the one policy on which all could agree was that the government should support university education, scientists' included, more generously. This was an important change from prewar ideas, but it was a 'least common denominator' reform which did not require structural change of the education system. Other reconstruction educational reforms manifest this same fundamentally conservative ethos, despite the long-entrenched weaknesses of the state school system. R.A. Butler's 1944 Education Act, heralded at the time as a great advance, required local authorities to create secondary schools meeting national standards, eliminated fees for them, provided some national finance, and allowed for raising the school-leaving age to 16. This last provision was not implemented until 1973; another, making part-time education compulsory in working hours for all working persons up to age 18, had still not been implemented by 1986. Church schools

¹ J.D. Bernal, 'British industry and science, part II', New Statesman (16 June 1945) 336.

were strengthened and the public schools left untouched. Thus the Act 'tended to sanctify many Tory beliefs: hierarchy, the desirability of preserving educational privileges, [and] traditional religious values'.¹ Butler himself said the Act was 'a classic example of. . . our inveterate prejudice for fragmentary and gradual legislation' and that even by the late 1960s 'not all the promises of the original Act had yet been fulfilled'.²

2.5.3.3 Technological Education

Like the Education Act, the bureaucratic history of reform in technological education reveals the power of tradition and vested interests to render reconstruction reforms 'fragmentary and gradual'. The story is so byzantine and lengthy that a separate thesis would be required to do it justice, but a brief account is given to show how it fits with other aspects of reconstruction civil science.

In simplified form, the story centres on a dispute between two camps: one which sought to work a decisive improvement in the status of engineers by firmly locating their instruction within expanded engineering faculties in existing universities or in major new technological universities like the Massachusetts Institute of Technology (MIT) or Zurich Polytechnic; and the other which favoured additions and improvements to the existing patchwork of technical colleges, which were poorly funded by local authorities and mostly offered part-time courses to full-time workers leading not to academic degrees but to certificates from the engineering institutions. The first camp comprised some leading scientists (Cherwell, Francis Simon, Egerton) and industrialists (McGowan, Courtauld, Riverdale, Streat); the

¹ Addison, 1945, p 238; also see M. Argles, South Kensington to Robbins (London, 1964), pp 84-5.

² R.A. Butler, The Art of the Possible (London, 1971), p 124.

second included the existing network of technical colleges and the local businesses they served, powerful civil servants working for the Treasury and University Grants Committee (UGC), and some classically trained university administrators. Leading politicians, themselves educated in the humanities, either ignored technological education or tended to favour the piecemeal approach of the second camp. R.A. Butler, for example, though strongly exercised by other aspects of postwar education, had no background for grasping the importance of engineering, as he demonstrated in a 1942 speech at Harrow on the future of the public schools, as reported by the Times:

As the school population gradually mixed, the need for retaining Latin would be increasingly challenged. He hoped we should never underrate the importance of a lively classical education. Mr. Butler added: -- 'I have had it put to me that we should abolish Latin and introduce a compulsory study of the internal combustion engine instead. My answer to that is that if you have had a proper education in Latin you can -- so to speak -- take the internal combustion engine in your stride'.¹

The Education Act required local authorities to provide adequate facilities for technological education. To work out a proper national system Butler convened a committee chaired by Lord Eustace Percy, a former President of the Board of Education and long-time proponent of better technological training, which included representatives of industry, the universities and technical colleges. Its report argued that

the position of Great Britain as a leading industrial nation is being endangered by a failure to secure the fullest possible application of science to industry. . . .the annual intake into industries of the country of men trained by universities and technical colleges has been, and still is, insufficient in both quantity and quality.²

The wartime output of engineers -- 3000 a year, more than four times the prewar rate (but less than half the German prewar rate) -- would have to be maintained, requiring various new policies. First, technical colleges were to

¹ Cherwell papers, E67, Times 28 July 1942.

² 'Higher technological education', July 1945.

be improved so they could join universities in training future leaders of industry, offering more full-time work and including management studies in the engineering curriculum. Second, a few were to become national centres of research in specialised fields, graduating engineers of university standard and possessing the degree-granting powers of universities. Choosing the colleges to be so privileged proved too fractious for the committee, which 'decided to leave it to the Ministry [of Education] to deal with these "details"!'¹

The committee also divided about whether these chosen colleges should have the power to grant the degree of 'B.Tech.' immediately or would have to go through a probationary period during which some national certifying body would award a non-degree Diploma; the technical colleges wanted immediate degree-granting powers, Percy and the university representatives favoured a long probationary period. Third, joint academic boards were to link the technical colleges and universities regionally and nationally, so that some overall planning could finally straighten out the rococo confusion of the locally-based colleges. This was 'a weak recommendation. . . .[compared to direct] affiliation [between the colleges and nearby universities]. . . .but possibly the only one that would commend itself to the universities'.² As Henry Clay, Warden of Nuffield College, told a conference, 'he had found opposition to the suggestion that industrial technology should be regarded as a proper subject of study' at universities.³ In any event these joint boards were to have no real power; local rates were still to support the technical colleges, except for the special departments of national excellence. The

¹ PRO, ED 46/295, minute from F. Bray to Sir Robert Wood, 27 Aug. 1945.

² Ibid.

³ Fabian Society papers, Nuffield Conference on the education of higher personnel in industry, Item 4, p 24.

report also signally avoided discussing expansion of engineering faculties at universities and sidestepped the question of major new institutions along MIT lines.

The Percy Report may have been the best compromise available in the absence of a strong commitment from powerful political leaders to refurbish engineering education according to the best foreign models. But these minor additions to an already ramshackle system were incapable of producing the abundance of highly trained engineers Britain required, or of making engineering a prestigious profession. Here, as in other aspects of reconstruction civil science policy, consensus did not equate with real progress. The evisceration of the Percy Report continued during the Attlee government and will be taken up again in Section 3.3.

2.5.3.4 Mission of DSIR

The April 1944 parliamentary statements of Attlee and Anderson promising a considerable increase in state aid to R&D and more lenient taxes convinced DSIR's Advisory Council that detailed plans for DSIR's future were now required. On May 10 it appointed a seven-member Post-War Developments Committee (PWD) which included A.V. Hill, Sir Lawrence Bragg, Streat, and Ministry of Supply Chief Engineer Sir Frank Smith, to draw up proposals for DSIR's future.¹ By this point in the war DSIR's reputation had considerably improved among leading scientists and industrialists, but it still had strong critics. Watson-Watt, for instance, thought it

had not done nearly enough, being limited by both smallness of finance and also of thinking. The RA laboratories had never seemed to be able to bring the DSIR results to fruition. On the whole he was inclined to believe that well constituted RAs might with

¹ PRO, DSIR 17/281, 'Memorandum on post-war reconstruction', 10 May 1944.

advantage supplant the DSIR group altogether.¹

Cherwell believed that 'some of the research establishments under the D.S.I.R. fulfilled no useful function in that they did neither academic research. . .nor true industrial research'.² The members of PWD were less acerbic and did not feel free to draw up comprehensive reforms. They held only five meetings before presenting their findings to the Advisory Council on 5 September.

During their brief inquiry PWD encountered smugness from DSIR's permanent staff. The first draft of the PWD's report, written by O.F. Brown, the DSIR Assistant Secretary in charge of reconstruction, intoned:

We consider that in the future D.S.I.R. has a vital and most diversified part to play. In our opinion its original conception was remarkably far-seeing and needs no material alteration. . . .[The research council system] has proved an extremely flexible organisation and is, in our opinion, admirably suited to deal with the research problems of the future.³

PWD's members overcame the worst of this self-satisfaction, spurred on by the country's perilous economic future. They considered R&D crucial to economic advances which they recognised would have to be major goals of policy: high productivity, the ability to manufacture products of originality and quality, the creation of major new industries, and the full utilisation of natural resources.⁴ Unfortunately, the committee's deliberations demonstrate once again -- though not as acutely as the saga of the Industrial Boards and development fund -- the curious gap between ambitious ends and feeble means which characterised reconstruction planning for civil science. For example, one of the major problems PWD addressed was how to spread

¹ Cherwell papers, H246, 'Summary of views in course of discussions on postwar research', Dec. 1944.

² Ibid.

³ PRO, DSIR 17/210, PWD 14, July 1944.

⁴ PRO, DSIR 17/205, PWD 2, June 1944.

the innovation gospel to ignorant firms; Streat suggested that a single 'consultant general' with no executive responsibilities could do the job across the whole of British industry, as long as 'the previous standing of the man' would 'carry weight in industrial circles generally'.¹ The committee also decided to drop an investigation into the correlation between R&D spending and export performance, which might have helped point the way towards the sorts of research offering the greatest commercial payoff,² and harpooned the idea of a British Mellon Institute on the grounds that 'it appears to be generally accepted that, broadly speaking, our [RA] method has proved in principle to be admirably suited to the needs of this country'.³ Nevertheless, the committee's final report⁴ did contain some interesting and creditably ambitious proposals for the future not only of DSIR, but of British civil science generally.

The main thrust of PWD's recommendations was to give DSIR the power to forge closer links between industry and scientists. A large Intelligence Division was to publicise R&D generally and aid cross-fertilisation between universities, the RAs and industry. It was to have a press bureau, a large advertising budget, a film unit and an exhibition centre in London. To permit the Secretary more time for high-level ambassadorial work on R&D's behalf (making him Streat's 'consultant general'), he was to gain a Deputy. Taking a lesson from the wartime laboratories, PWD recommended that senior scientists and industrialists be paid for regular consultation visits with RAs and the firms they served, and

¹ PRO, DSIR 17/210, PWD 14, p 4; DSIR 17/208, PWD 4th meeting, 20 July 1944.

² PRO, DSIR 17/207, PWD 3rd meeting, 5 July 1944.

³ Ibid., PWD 7, 'Note on Mellon Institute', June 1944, p 9.

⁴ PRO, DSIR 17/210, PWD 21, 'Report of the Committee on Post-war Developments', Sept. 1944.

meet together to compare notes. RAs were to permit individual firms to finance the work of 'Industrial Fellows' on their premises, which might allow small firms to afford proprietary R&D without endangering the RAs' cooperative ethos. Exchanges of working scientists in industry, universities and RAs were to be fostered. Finally, to invigorate the loose and somewhat strained relations among DSIR, MRC and ARC, the committee argued that they should be jointly housed. These recommendations were sound and useful.

More unusual were PWD's plans for new bodies to aid research. Because NPL was 'the final Court of Appeal' in routine testing and the establishment of standards, it was felt to have developed 'a certain type of intellectual snobbishness' and to have degenerated 'into a high class testing house' which neglected fundamental work.¹ Consequently PWD called for the Advisory Council to consider creating a new Mechanical Engineering Research Laboratory out of the Engineering, Metallurgy and Metrology Divisions of NPL which would study alloys, corrosion, machine tools, engines, and other topics important to industry. NPL's Radio Division was also to be hived off into a separate telecommunications establishment. Most novel of all, the committee argued that a fourth research council should join DSIR, MRC and ARC to sponsor 'sociological research': studies of applied economics, statistics and industrial psychology which could improve industrial productivity. Taken as a whole, the PWD report was no blueprint for radical change in civil science, but Attlee's verdict -- 'progressive and practical' -- is fair.²

The DSIR Advisory Council endorsed PWD's recommendations about the Deputy Director and the new Intelligence Division. It set up committees to examine the need for a separate mechanical engineering lab, the future of

¹ PRO, DSIR 17/282, minute from O.F. Brown to Appleton, 17 June 1944.

² PRO, DSIR 17/210, letter from Attlee to Appleton, 24 Nov. 1944.

the RAs, the Industrial Fellowship scheme, and the postwar need for routine testing, and decided to seek the views of the Lord President and other bodies about the exchanges of research workers, the sociological research council and the joint housing of existing research councils.¹ But MRC Secretary Sir Edward Mellanby could barely conceal his disdain in a letter to Appleton:

I do not know how seriously you regard the [PWD] report. . . .The MRC would give little or no support to [joint housing]. . . .We should [also] have some difficulty in accepting the view that sociology had arrived at such a stage of scientific development that an Advisory Council for Sociological Research could be justified as an official Government body.²

This sort of reflexive obstructionism scuttled both these ideas in the end.

More crippling was the attitude of DSIR's staff, including Appleton, who did not have enough vision or instinct for bureaucratic empire-building to pilot the other recommendations through Whitehall. Appleton estimated the first-year cost of all the PWD's reforms at only £21,150, about two percent of DSIR's 1939 expenditure. As we shall see in Section 3.4.1.3, it proved very hard for DSIR to achieve even these tiny increases or to fill the few new posts for which it was able to obtain Treasury authorisation. Total DSIR spending in 1945-6 was £1.6m, up from just under £1m in 1938-9, but that included considerable war work.³ The new deputy directorship did not materialise; neither did the exchange programme for scientists or the regular consultations from high-level scientists at the RAs, and the Intelligence Division had nowhere near the resources it needed. By 1947-8, for instance, it was spending only £23,987, less than one percent of DSIR's total expenditure. O.F. Brown, made its Director in 1944, thought of a bevy of

¹ DSIR 17/210, 'Preliminary report from the Advisory Council to the Committee of Council on post-war developments in DSIR', Nov. 1944.

² Ibid., letter from Mellanby to Appleton, 17 Oct. 1944.

³ DSIR Annual Report 1948-9, Appendix V, Table 1.

tasks for it, but they were rather pedestrian -- like starting a newsletter for internal circulation among DSIR labs -- and focused on basic research to the exclusion of other steps in the innovation chain. Appleton's idea for remedying this bias was to appoint a single person to Brown's staff with industrial experience; 'We are, after all, pretty much of academic origin'.¹

We shall follow in the next two chapters DSIR's postwar troubles in trying to vitalise industrial R&D. But in the response to the PWD report, one can already see that DSIR would resume peacetime work with quite inadequate resources -- financial, personnel, intellectual -- to raise the technical level of British industry in the way that almost everyone active in reconstruction thought would be required. Thus DSIR's story is consistent with the rest of reconstruction planning for industrial civil science. No major structural innovations were possible. The only reforms the reconstruction consensus could support were mild, amounting to slightly greater expenditure through existing institutions.

2.6 Overall organisation of government science

A similar story of feeble means to accomplish ambitious ends is evident in the planning for the overall direction of postwar civil science, a subject finally resolved only in 1947 with the creation of the Advisory Council on Scientific Policy. Bernalism, as we saw in the last chapter, profited from the unmistakable success of the government's large-scale planning of applied research in the 'wizard war'. Its newfound legitimacy was the dominant theme of an AScW conference on 'Planning of Science in War and Peace' in January 1943, where, as Nature observed, 'for the first time those wishing to confer on the planning of science presented a substantial

¹ Ibid., 'Functions of the Intelligence Division', memorandum by O.F. Brown, 4 Dec. 1944; minute from Appleton to Brown, 5 Dec. 1944.

problem in traffic control'.¹ Increased central planning became the principle behind most ideas for reorganising civil science, though there were differences of emphasis about the importance of individual initiative, especially in fundamental research where serendipity could not be ordered. The 15,000 strong AScW took the most radical line of major bodies. In the first flush of post-Beveridge enthusiasm it called for a Central Scientific and Technical Board with executive powers to survey scientific problems, allocate priorities to their solution and assign the work and resources to relevant departments.² Cripps wanted to preserve private R&D, but believed government research should be expanded tenfold according to a 'co-ordinated plan for the productive effort of the country' and be administered by a body of scientists attached to the government, 'similar to the Academy of Sciences in the U.S.S.R. or the Academia Sinica in China'.³ The Labour Party spoke more mildly of 'integrating research work under Government auspices with the research work conducted by the separate industries and universities'⁴ rather than consolidating it through central authority. But even the London Chamber of Commerce wanted a national board processing all research proposals and distributing all government research funds,⁵ and in the April 1944 Commons debate a Conservative MP suggested a Parliament of Science with its own Prime Minister to set research priorities.⁶

¹ 'The planning of science', Nature 151 (6 Feb. 1943) 153-4.

² Ibid. This proposal was aimed primarily at the needs of war science, but AScW envisioned a postwar system along similar lines.

³ Cripps papers, 1239, Address to P&SC, 1 June 1943, pp 3, 18.

⁴ Labour Party Archives, Research Department Report 223, July 1943.

⁵ London Chamber of Commerce, 'Scientific industrial research', 11 Jan. 1944.

⁶ HC Debates, Hansard vol. 399, col. 275, J.H. Wooton-Davies.

Yet planning had its detractors, spearheaded by the Society for Freedom in Science started in 1941 by Michael Polanyi, a refugee Hungarian who was Professor of Physical Chemistry at Manchester, and John R. Baker, an Oxford cytologist. They disliked the groundswell of opinion among their colleagues favouring retention of wartime mechanisms for steering science towards socially desirable ends. They tended to caricature the leftist approach, saying that Bernalists deprecated science except as a source of technology and wanted to block researchers from 'following their noses' in favour of detailed orders from remote bureaucrats or politicians. Baker went so far as to say:

I do know what [Bernal] is after: he's going to tell me that I dare not ever again use gentian violet as a stain for my section, but from now on I shall have to restrict myself to methylene blue.¹

Baker was also unsettled about the prospect of university expansion, believing the new entrants would not be sufficiently intelligent 'to have. . . the instincts of a scientist. . . the feelings of a scientist', though they might have value in 'directed work'.²

Bernal believed that scientists themselves, not remote officials, should determine scientific priorities as they largely had during the war, and that science was part of 'general culture just like music and art and so forth and is a valuable thing in itself'.³ It is difficult to find any radical scientists -- let alone the much greater body of reformists -- who espoused as rigid a

¹ quoted in Hilary Rose and Steven Rose, 'The two Bernals', in Science at the Crossroads (British Society for Social Responsibility in Science, 1982). See also Werskey, Visible College, pp 261-85; J.R. Baker, Science and the Planned State (London, 1945); Blackett papers H12, Michael Polanyi BBC broadcast, 'Science and the decline of freedom', 26 May 1944.

² Bernal papers, B.5.23, 'Science and the future', BBC broadcast in Freedom Forum series, no. 190, 20 Mar. 1946.

³ Ibid; also see AScW, 'Science in the Universities', Mar. 1944, emphasising 'the cultural value of science as a discipline in itself' as well as its benefits in application, p 4.

system as Baker and his colleagues feared. P.M.S. Blackett, for example, agreed that a system of controlling science 'unintelligently from the top. . . might be disastrous'¹ and strongly opposed 'fanciful schemes of the grandiose reorganisation of applied research'.² In retrospect the bitter conflict which grew up between the Bernalists and the Society for Freedom in Science had less to do with differences in their prescriptions for British science than with their underlying political orientations. As the Cold War intensified, Bernal's ringing endorsements of Stalin³ and Stalin's henchman Lysenko seemed to confirm every Bakerian nightmare that Bernal's secret agenda all along had been a crushing dictatorship of science. But even before this -- during the war when the Soviet Union's reputation was high among moderates and the only issue at contest was the organisation of British science -- the debate between the two camps was surprisingly virulent. Zuckerman thinks that the right-wing scientists 'genuinely. . . misunderstood'⁴ the Bernalist position. Certainly on one of the few occasions when Bernal and Baker actually debated face-to-face, there was almost no specific point on which they disagreed, though Baker found this so astounding that he kept reverting to stock denunciations.⁵

Between these two extremes, the general drift of opinion among scientists was leftwards, but this did not translate into a specific programme for British science. Egerton, for example, SAC member and vigorous

¹ Blackett papers, E7, 'Some immediate problems of the post-war period', speech to AScW conference Jan. 1943, p 6.

² Blackett papers, E8, untitled article on postwar science, Sept. 1943.

³ When Stalin died, for example, Bernal wrote a fulsome eulogy for this 'champion and guide', who was 'incontestably the greatest figure of his age'. Bernal papers, B.4.65, 'On the death of Joseph Stalin', Mar. 1953.

⁴ BBC, 'A generation for progress', p 21.

⁵ 'Science and the future', op.cit.

proponent of giving researchers maximum freedom, nevertheless imbibed of reformist wartime political currents. He joined with Picture Post editor Tom Hopkinson, Economist editor Geoffrey Crowther, Sir George Schuster, Sam Courtauld, and an eclectic group of non-party progressives to start a dining club known as 'Freedom House', which investigated how 'planning -- economic and social, national and international'¹ might be 'combined with personal liberty of speech and writing and the right of association and religious tolerance'.² Cripps, joining reformist zeal with respect for science and technology, was a Freedom House favourite. Egerton's politics retained a certain naiveté -- he believed that party divisions did not really need to enter reconstruction planning -- combined with 'top-down' progressivism of the Beveridge or Reith school, which valued the 'dignity, the culture, the taste, the high-mindedness of the best in an older world'³.

Egerton's opinions were not uncharacteristic of moderate scientists generally. Blackett told a Fabian conference in March 1944 that while a leftward trend was visible among junior scientific workers, 'there is no alignment to party; the Labour Party fails to inspire any faith. . . .scientists are generally rather naive about politics and tend to think complacently that science is a panacea for all evils'.⁴ A union official underscored Blackett, observing that 'scientists too had no link with the Trade Union world and had made very little impression on Trade Union thought about technical or political matters',⁵ despite the TUC's liaison committee with the BAAS. A

¹ Cripps papers, folder 634, untitled document describing aims of Freedom House, Nov. 1943.

² Ruth Egerton, Sir Alfred Egerton F.R.S., p 48.

³ Ibid., letter from Egerton to son Capt. F.L. Egerton, 28 Nov. 1943, p 98.

⁴ Cripps papers, folder 629, 'Dartington Hall' conference, 3-5 Mar. 1944, p 3.

⁵ Ibid., comments by Symonds.

good example of a scientist whose yearnings for a better world remained non-partisan was A.P. Rowe, the immensely successful TRE director. He felt Britain had something to learn from Nazi Germany and the Soviet Union in the zeal for sacrifice they had inspired in their citizens even in peace. Requesting volunteers from TRE to speak and be heckled on reconstruction, he suggested that the 'Great Problem' of postwar Britain was

how best, in peace-time, we can attain, for the betterment of of mankind as a whole, the same spirit of self-sacrifice and living for a cause that we have in war? . . . Party politics are absolutely barred in the proposed debate; in any case the issues are far above party politics.¹

Blackett, believing that the better world for which people would sacrifice was the raison d'etre of party politics, treated the TRE workers to an impassioned plea for socialism.²

The political centre of gravity among scientists did shift leftwards during the war. But this did not translate into concrete proposals for reorganising civil science. The gulf separating the radicals and the Society for Freedom in Science, the high science tradition of not meddling in politics, and the absence of detailed party platforms until just before the 1945 election, meant that no specific set of proposals emerged about the postwar structure of science to which this leftward drift could anchor itself. Scientists were not organised to express their opinions as a body on this complex and controversial topic.

In the absence of strong political pressure, it is not surprising to find that the civil servants and scientists who planned for postwar civil science did not envisage any great change to the existing system. Within Whitehall the debate centred on whether the Scientific Advisory Committee would

¹ Blackett papers, H10, 'Chief Superintendent's Letter No. 5', 15 Sept. 1944.

² Ibid., 'Speech to TRE workers', Dec. 1944.

become a more powerful body, or even a Ministry of Science with directive powers over the whole government scientific effort. The Official Committee on the Machinery of Government (MGO), a body of senior civil servants chaired by Barlow, considered this at the instigation of SAC Chairman Sir Henry Dale. Dale argued that the SAC, formed 'after prolonged discussions and negotiations. . . may be said to represent an acceptable residuum, rather than a theoretical ideal'.¹ He believed that since the three Research Council secretaries comprised half the committee the SAC could not give impartial scientific advice as the Royal Society had once done; it became a site for bureaucratic battles between the Research Councils without having the strength to resolve them. Dale questioned whether the Research Council secretaries should be members at all, since they already had direct access to the Lord President, and the government 'had come to depend too exclusively' on them for scientific advice. He recommended adding four or five distinguished outsiders as a 'practicable if not entirely logical' step to ensure that the SAC would have the knowledge and esteem to offer 'independent advice' to the government on the organisation of research, major appointments and other topics which it was too weak and 'official' to handle now.

This memo trod on many sensitive toes. The secretaries of the MRC and ARC flatly opposed any dilution of their strength on the SAC, while Appleton saw no harm in adding two outsiders but would not accept any more. Dale's view that 50 percent official membership was excessive 'was not generally accepted' by the SAC's other members, particularly that 50 percent; they

suggested that the Committee should not in any event regard it as part of its function to inquire into the domestic affairs of the

¹ PRO, CAB 81/72, MGO (43) 27, 'The place of science in the machinery of government', memorandum by Sir Henry Dale, 18 Sept. 1943.

three Research Councils; and that, if the activities of one of the Councils were under consideration, the Secretaries of the other two could be counted on to give an unprejudiced opinion.¹

Nor would ministers necessarily welcome a powerful independent committee telling the government how it should organise research; as one civil servant observed, 'window dressing was not absent from the mind of the Government in setting up the [SAC]'.²

In 1943 MGO took evidence from the MRC, ARC and DSIR secretaries as well as Dale and Hankey about the future organisation of government science, but did not cast its net any wider. The recommendations collected in this evidence were not radical, but some were useful. There was a strong consensus against a Ministry of Science because it would 'isolate science from the real life of departments'; the principle of ministerial authority would not permit external direction of a department's own scientific activities. The same criticism was levelled at any other prospective body outside existing departments (like a revamped SAC) whose

implicit function is to co-ordinate the scientific work of different departments, to review or criticise their scientific activities, or to thrust science on them from the outside. Normal human beings do not react favourably to stimuli applied in this way.³

The most intriguing idea came from the Secretary of the Agricultural Research Council (ARC), W.W.C. Topley, who thought some variation on the Agricultural Improvement Council (AIC) -- a new body which had done excellent work applying the results of the ARC to real farming -- be created for industry in the relevant government departments. The AIC, a body in close touch with extension workers and farmers which sought to disseminate

¹ PRO, CAB 90/4, SAC (43) 9th meeting, 6 Oct. 1943.

² PRO, CAB 21/1166, note by M.T. Flett for Lord President Woolton, 20 June 1945.

³ PRO, CAB 87/71, MGO 37th meeting, testimony of ARC Secretary W.W.C. Topley, 17 Dec. 1943.

usable new techniques to them, was located firmly within the Agriculture Ministry and could commission research as needed from the more theoretical ARC. The AIC became an important force in shaping the ARC's research programme, thus anticipating Lord Rothschild's 'customer-contractor principle' by 30 years. MGO had difficulty envisaging how a similar body would function across British industry; it concluded that 'there should be some appropriate mechanism for linking Government administration with applied research even if it took the form of only one man',¹ a "mechanism" whose tiny scale would have rendered it ridiculous.

MGO waited a year before forming recommendations out of the testimony it had collected; meanwhile Attlee had told the Commons that he thought a separate Science Ministry 'would be a great mistake' because science had to be widely diffused through the government to be effective.² MGO's final recommendations in October 1944 agreed that there should be no Ministry, but did not provide any machinery to ensure effective diffusion. In fact MGO sidestepped or blocked every innovative idea for civil science it had encountered. On Topley's plan for Industrial Improvement Councils in the relevant departments it had 'no comment'. Appleton had suggested that each government department have at least one scientist; MGO advocated distributing 'a suitable pamphlet describing the Government organisation for scientific research'. While agreeing that the SAC should have four or five new outside members and that ministers might appreciate its advice on overall scientific organisation and senior appointments, it said SAC should have no 'right to express their views' unless asked; this directly countered Dale's concept of a senior, informed and independent source of scientific

¹ PRO, CAB 87/72, MGO 56, 'Government organisation for scientific research', Appendices C-J summarising suggestions of all witnesses, Oct. 1944; CAB 87/71, MGO 37th meeting, 17 Dec. 1943.

² HC Debates, Hansard vol. 399, col. 309, 19 Apr. 1944.

advice. To improve overall coordination of the government's scientific effort, MGO recommended that a single official 'of rank not higher than Principal Assistant Secretary' be assigned to the Lord President's staff. Tidy administration, not central planning, would be this person's brief: 'not only did Ministers come and go, but matters were dealt with on files sent up from the separate departments, and the Lord President's Office had no proper system of records'.¹ It is difficult to see any relation between these insipid ideas and the huge task which every witness before MGO agreed lay ahead for British science. They reflected the civil service's values -- smooth administration, continuity, and minimum public expenditure -- rather than a serious attempt to fit the machinery of government to its task.

Yet these decisions were watered down still further. Lest any controversy remain in its plans for civil science, MGO sought the imprimatur of W.L. Gorell Barnes, an official from the Lord President's office who was also SAC secretary. He thought the Lord President's scientific officer should be an Assistant Secretary, not a Principal Assistant Secretary. He considered the booklet describing government research 'a welcome innovation', far superior to Dale's recommendation that Administrative Class officers be required to know some science, which would produce only 'a smattering of scientific knowledge'. (He seemingly could not conceive that the science requirement would be rigorous.) He agreed that the Scientific Advisory Committee should be expanded, renamed the Scientific Advisory Council, and prohibited from giving advice on major subjects unless asked. MGO's secretaries were instructed to follow Gorell Barnes's opinions in preparing a report for submission to the Ministerial Committee on the Machinery of Government.² By the time the Coalition fell nothing had happened.

¹ PRO, CAB 87/71, MGO (44) 60th meeting, 12 Oct. 1944, pp 3-5.

² PRO, CAB 87/71, MGO (44) 72nd meeting.

Nonetheless MGO's work has historical significance, reflecting the caution, even small-mindedness, of the Research Council secretaries and the senior civil servants involved with science policy. And it shows the basic attitude of MGO's chairman Barlow, who was to lead the major postwar Committee on Future Scientific Policy.

The public record contains no direct evidence to explain why MGO's modest recommendations for improving the organisation of civil science at the centre did not attract ministers' attention before the 1945 election. Possibly other war and postwar questions were more pressing. In addition, MGO's conclusions were out of step with the consensus about future scientific organisation then developing among politically important scientists and groups. The P&SC, the first and most powerful, issued a memorandum in December 1944 which said that despite the tremendous attention R&D had been receiving, industry and agriculture still failed to recognise the huge change in attitude required. 'Nor are we aware', wrote the P&SC, 'that the Government has yet any comprehensive plans for fulfilling its own special functions in this field and for getting suitable assistance and direction'.¹ The P&SC made two proposals with a Bernalist tinge: first, that the government review the existing position of R&D and plan a five-year programme aimed at remedying the most important defects; second, to survey the country's economy and natural resources so that 'adequate permanent arrangements for financing, stimulating and organising research. . .and the effective utilisation of results' could be worked out. The P&SC worried that during the postwar boom industry would forget the need shown in the war for basic reorganisation, productivity improvement, and R&D growth. Only a

¹ PRO, CAB 124/525, P&SC Subcommittee on the future scope and organisation of science in Great Britain, 'Interim memorandum', 12 Dec. 1944.

comprehensive government enquiry could produce 'a plan of action. . .to recover and maintain [our] industrial strength'.¹

Whitehall recoiled at the idea. 'An enquiry of the kind suggested would be redundant, embarrassing, protracted and in any case based on a possibly inaccurate estimate of the progress made by British industry and agriculture in adapting itself to modern conditions', wrote A.N. Coleridge in the Lord President's office.² Appleton thought existing machinery could perform such an investigation more effectively than the sort of Royal Commission the P&SC desired: the new Intelligence Division, working closely with the economic ministries, could report gaps in the national research programme to the DSIR Advisory Council which would suggest to the Lord President ways of filling them.³ Again there was the gap between ambitious ends and feeble means. A tiny Intelligence Division, boasting one member with industrial experience, and a part-time Advisory Council could not possibly survey the whole economy and devise workable plans for modernising it. A DSIR official offered a more sensible if less soothing rebuttal to the P&SC's enquiry: 'without direction of industry of a character which Parliament would not be likely to accept, H.M. Government can only encourage industry to embark on industrial research'.⁴

Ministers agreed that such a comprehensive inquiry would be either useless or troublesome. When a P&SC deputation finally discussed the memorandum with Anderson and Appleton in May, the Chancellor said that 'a mere factual survey would be difficult enough, but one that would attempt

¹ Ibid.

² PRO, CAB 124/525, letter from Coleridge to J.P.R. Maud, 7 Feb. 1945.

³ PRO, CAB 124/525, minute from Appleton to Attlee, 18 Jan. 1945.

⁴ PRO, CAB 124/525, enclosure, 'Comments on the Interim Memorandum of the P&SC', anonymous author.

to assess priorities among different branches would be impossible'. Nevertheless, he agreed that 'there might be something lacking in the Government organisation at the top', and said that some way of equipping the Lord President better to coordinate research was under consideration -- without revealing that it was the MGO's meagre plan for giving the Lord President's office another assistant secretary.¹

All sorts of bodies expressed views similar to those of the P&SC. Indeed there was striking convergence between the Bernalists and previously more traditional groups. Virtually everyone agreed that research needed to have more effective central direction; most wanted the government to conduct some sort of survey to devise its exact form. The BAAS sponsored a conference on 'The place of science in industry' in January 1945, where many distinguished scientists, industrialists and politicians spoke about ways to improve R&D. Bernal suggested an inquiry be commissioned to codify existing knowledge about the best way to organise R&D.² Nature editor Gregory wrote, asking him to explain what sort of body he had in mind; Bernal replied:

Things have been moving so rapidly in the field of science organisation that my ideas on what is desirable are continually enlarging. In its present form, what I should suggest is the setting up of a special committee, representing in about equal numbers official government science and independent science, to report on the present use of research by industry and to recommend possible improvements. The committee would have to have a permanent staff. . . [and] an official standing to secure the necessary information.³

Egerton, while sceptical about permanent directive machinery, agreed with Bernal's and Blackett's speeches to the BAAS conference favouring more

¹ PRO, CAB 124/525, minutes of meeting between Anderson, Appleton and the P&SC, 16 May 1945.

² 'The place of science in industry', Advancement of Science 3 (1945) 116.

³ Bernal papers, H.2.1., letter to R.A. Gregory from Bernal, 29 May 1945.

money and tighter organisation for civil science. 'There was. . .much truth in what [Blackett] said that nobody in this country looked after the needs for stressing certain activities or economising on other activities[;] there was no body coordinating the work of the Universities'.¹

A broadcast by John Lennard-Jones -- Professor of Theoretical Chemistry at Cambridge, DSIR Advisory Council member and Director-General of Scientific Research (Defence) at the Ministry of Supply -- showed that central planning had become much more acceptable to senior scientists. 'I think everyone in Britain is agreed on the necessity for rationing. . .our natural resources. This means in turn some form of planning', he said. The army was an example of a wholly planned organisation, but success required a balance between implicit obedience and personal resourcefulness. To encourage 'independence and resourcefulness within defined limits', the commando had been created. 'The scientist', he said,

must be a Commando in spirit and enterprise, capturing and exploiting the secrets of Nature for the enlightenment of the few and the good of the many. . . [thus] society can be blessed by the controlled use of new knowledge.²

The basic idea was to find a balance between central direction and individual freedom which would optimize the progress of science and technology.

Conclusive proof that the timid plans of MGO, Anderson and Appleton were out of tune with the scientific mainstream comes from a remarkable broadcast by Dale, A.V. Hill -- two pillars of conservative high science -- and Bernal,³ in which all three were in agreement. Differences still existed,

¹ Egerton papers, Box 12, diary vol. 3, p 33, Jan. 1945.

² Lennard-Jones papers, 'Science and the state', BBC broadcast, undated, probably late 1945.

³ Bernal papers B.5.14, 'For and against: science in the post-war world', BBC broadcast 3 Sept. 1945.

but they had much in common. '[The Royal Society]', said Dale, 'have pointed out that, whereas big plans have been made for recruiting one particular branch of science -- that is, the medical profession -- there's been no such organised planning for the equipment of science in general'. Dale also said that the war 'has provided for scientists convincing evidence of what can be done by team work', with which Hill concurred:

it can be very advantageous, given the right guidance. I have only one political principle, and that's a very simple one: it is that the right balance has somehow to be secured between the activities of the State and the activities of the private individual. . . .I am sure it is very far from either extreme. . . .There are. . .certain scientific activities which might with advantage be regulated by the State.

Bernal endorsed Hill's view that teamwork was not appropriate for every kind of research. After agreeing that government-sponsored R&D might resolve several agricultural and industrial problems, Dale summed up the discussion: 'we are all agreed that a great future awaits [science], provided it obtains the necessary support, and provided it is properly organised. Is it too optimistic to assert that at long last the value of science to human peoples is being recognised'?¹

No doubt the convergence of views among radical, reformist and conservative scientists favouring greater central direction of R&D was encouraged by the heady triumph and optimism that prevailed at war's end, when the contributions of scientists to victory could be revealed to an admiring public.² The vagueness of most statements on postwar science also helped traditional opponents to bask in their similarities. The Coalition had promised more money and status for science, but its future structure was

¹ Ibid.

² One of the main projects of the SAC in 1944-5 was an official popular history of the scientific war effort; the heroic past seemed to inspire the committee much more than the uncertain future. See PRO, CAB 90/5, SAC minutes and papers 1944-5; particularly SAC (44) 15th meeting, 23 Aug. 1944.

still a fog of half-formed ideas in which everyone could find something agreeable. It fell to the postwar Labour government to formulate a tangible programme.

During the election campaign, Labour's civil science policy was overtly Bernalist. The 'basic principles' it advanced stressed heavily the advantages of collective, non-profit, government-directed research:

Long-term work whose results are problematical but which may turn out very valuable can in general only be sponsored by the State, since private industry will not, and cannot be expected to, take the risk. . . It should be the responsibility of the State to sponsor research on problems which affect large sections of industry or the consuming public. . . It is only the State which has the means to survey the field of industrial development and consumer demand and thus determine the necessary fields of research.¹

This statement did not describe the particular mechanisms by which Labour would implement its policy, but it was an unambiguous call for a greatly expanded government role in R&D. It did not embody the flaw we have seen in many other attempts to plan the reconstruction of civil science: the unwillingness to contemplate big departures from previous practice in order to achieve the complex industrial renaissance which Britain required. Herbert Morrison, leader of the Labour campaign and its most important formulator of science policy,² probably shaped this statement, and he was shortly to take responsibility for civil science policy as Lord President. We shall see in subsequent chapters how little of this bold plan Morrison and his colleagues accomplished. The role for government it envisaged was greater than industry, the civil service, most scientists, and Labour ministers themselves ultimately would accept, despite the apparent quasi-Bernalist harmony of 1945.

¹ Labour Party, Speaker's Handbook (London, June 1945), p 54.

² Donoughue and Jones, Morrison, pp 331-46.

2.7 Conclusion: why the gap between ambitious ends and feeble means?

The reconstruction consensus between Labour and Conservative was weak in R&D and productivity policy as in other areas, permitting only least common denominator solutions which could not accomplish the thorough modernisation of British industry universally sought. By the end of the war, R&D policy comprised little of substance, very little compared to the gales of rhetoric it had unleashed: no industrial boards, no development fund, no system for setting research priorities, only moderate tax breaks on industrial research, a modest commitment to university expansion, and minute adjustments to DSIR, the RAs and the technical education system. As the anonymous DSIR official observed on page 105, the government's lack of powers to direct industry left it no alternative but a policy of 'encouraging' research in private industry; yet as George Allen observed, the government 'could not do very much' to provide such encouragement. Hence the huge incongruity between the vast goals of reconstruction R&D policy and its meagre accomplishments.

Why did so few at the time recognise this ends-means gap? Several factors contributed. First was a widespread sense that British science was fundamentally sound. Though most leaders of science, government and industry — Anderson, Appleton, Blackett, Cherwell, Cripps, Hartley, Lyttelton, McGowan, Riverdale, and Streat to name a representative cross-section — acknowledged innovative weakness in British industry, it seemed a temporary aberration. Britain had led the world in manufactures within their lifetimes; it still did in Nobel prizes. If any doubt lingered, the success of scientists in the 'wizard war' banished it.¹ Give the scientists

¹ Pride in Britain's wartime scientific achievements was widespread, as shown by the attempt of one baking firm to bask in some incongruous reflected glory: 'In talking of flying one shouldn't forget / that Radar was British and so was the Jet. / In crispbread, of course, it's exactly the same, / with Vita-Weat quite the most eminent name'. Listener 38 (6 Nov. 1947) 1.

more money, went the feeling, let them get on with the job, and things will soon be right. This was reinforced by the prevailing 'research-push' view of innovation, which held that virtually any investment in pure science would eventually result in profitable new technology for the investing country. As peace approached there was considerable clamour among scientists, those skilled in applied work included, for concentrating even more heavily on fundamental research. Appleton, for example, said that 'fundamental research is scientific capital, and as happens in all fields during wars, we have been living on our capital. There is nearly six years of progress to be made up'.¹ Blackett, though a socialist and strongly influenced by Bernal, repeatedly warned of the 'dangers of academic scientists going too industrial', telling his colleagues, as one popular newspaper put it, 'not to sell their brains for high figures to industrial firms'.² He played a major role on an important Royal Society committee on postwar fundamental research whose premise was a fear that the war had made 'the pendulum swing too far and that we shall plan to devote too large a proportion of our first-class resources in brain power to technology and starve fundamental scientific research. [This] . . . shall kill the goose that lays the golden egg'.³ Few perceived at the time how many ingredients besides pure research went into that egg.

Finally, the dominant ideology in favour of planning and large-scale business organisation meant that the best ways of organising and supporting private R&D was an intellectual desert. Still a perplexing topic today, it was

¹ Sir Edward Appleton, 'The scientific method', International Industry (May 1946) 190.

² Blackett papers, E1, 'Dangers of academic scientists going too industrial', handwritten notes, undated; 'Duds at top hold back our industries declares scientist', Daily Mirror 13 Jan. 1945.

³ Papers of the Royal Society, committee on the needs of research in fundamental science after the war, undated memorandum from Sir Ralph Fowler (late 1943).

entirely neglected then, a neglect reinforced by the evident disdain of high scientists for profit-making research. When British innovation seemed wanting, the common instinct was to turn to cooperative solutions, mainly DSIR and the RAs. C.E.K. Mees, a British chemist who had directed research for Kodak in the United States brilliantly since 1912, criticised this prevalent bias in a report which the BOT received in July 1943. He estimated that British R&D 'on the whole. . . was some twenty years behind that of the United States', attributing this mostly to the RAs. The American oil companies had started R&D with a cooperative lab 20 years ago, but only when they built their own did research really flourish, 'transforming the petroleum industry from an engineering to a chemical undertaking'. Recent articles in Nature, he said, showed

that the most active and progressive minds in British science are those of university professors, many of whom are actively opposed to the prosperity of private business because of their political convictions. . . . They are not thinking in terms of great companies making discoveries and exploiting them, inventing new products, and making large profits, much of which can be plowed back. . . . They are thinking of 'co-operation' between industries, so that all together can continue on a low level of efficiency. . . .¹

Mees overstated both the inhibitions on firms' private research caused by the existence of RAs and the Bernalists' predominance in setting science policy. But he captured an important truth, which the records of every relevant wartime government body confirm: that private R&D did not excite the creativity and drive of many leading figures, scientists, civil servants, industrial managers and politicians included. 'There was a general realisation that mutual cooperation would be essential to success' in postwar R&D, concluded business and labour leaders in 1943.² Labour politicians especially tended to

¹ PRO, BT 64/3388, letter from Mees, 5 Jul 1943.

² PRO, CAB 87/19, Reconstruction Joint Advisory Council 5th meeting, 9 Nov. 1943.

gravitate towards large-scale, centralised solutions like development funds or refurbishing the RAs. However, R&D was not 'political' enough to warrant pushing through solutions over business and Tory opposition. When Labour could not achieve compulsory levies or the development fund, its centralist bias did not conduce to subtle thinking about how to energize private R&D. This problem bedevilled Labour policy throughout the postwar government.

CHAPTER THREE

Postwar Industrial Innovation Policy

3.1 The economic and political background

By 1945 the remarkable contributions of science to Britain's survival had earned it admiration inside and outside the government. The atomic bombs which brought the war to a sudden end were a sobering reminder that discovery could be destructive; one young person spent most of August 'chalking up all over London the slogan: "SHOOT ALL SCIENTISTS"'.¹ Nevertheless, public statements continued to stress the benefits science had conferred on material life, and the even more promising vistas opened up by wartime discoveries.² Could science ensure postwar economic survival as it had ensured military victory?

When President Truman announced on August 17 that lend-lease would end in two weeks, Britain faced what Keynes called 'without exaggeration. . .a financial Dunkirk'.³ Without massive American aid Britain could not afford even essential imports. To pay for the war Britain had sold off £4.6lb in foreign assets⁴, increased its sterling liabilities by £2.5b to £3.7b, and depleted its

¹ Mass-Observation, Peace and the Public (London, 1947), p 8.

² See Bernal papers, B.5.14, BBC Broadcast 'For and against', with Dale, Hill and Bernal, 3 Sept. 1945; B.5.16, BBC Broadcast 'Science magazine No. 5', 30 Sept. 1945; Sir James Marchant, ed., Postwar Britain (London, 1945); and Dale's Presidential Address to a BAAS conference on 'Swords into ploughshares', Advancement of Science 4 (Sept. 1947) 153-6.

³ CP (45) 112, para. 27, 14 Aug. 1945, quoted in Hancock and Gowing, War Economy, p 546.

⁴ Matthews, Feinstein and Odling-Smee, Economic Growth, pp 129-30.

gold and dollar reserves to only £453m. The merchant shipping fleet was one-third smaller in 1945 than in 1938. Exports were down 60 percent, enough to pay for only one-fifth of imports. Yet military commitments abroad, the German occupation and the Lend-Lease settlement meant that large foreign bills still had to be paid. The government was looking at a first-year balance of payments deficit of £750m, and a five-year cumulative deficit of £1.25b, 'even with a very austere import programme'.¹ To bridge this gap additional American finance was needed; but instead of the \$6b grant² hoped for, three months of complex and acrimonious talks produced a \$3.75b loan at two percent interest, which even with Canada's additional \$1.25b was insufficient. Nor would Britain's other creditors write off their sterling balances.³

Furthermore the United States attached conditions to its loan -- notably convertibility by July 1947 -- which made financial equilibrium more difficult. Other countries rushed to change their pounds for dollars, depleting Britain's dollar and gold reserves by one-quarter. Convertibility had to be terminated in five weeks.⁴ The loan itself was exhausted by 1947 instead of 1949 as originally planned. Britain would have been unable to pay for vital dollar imports had the United States not introduced Marshall Aid, which provided Britain with £681m net between 1948 and 1951. But the balance of

¹ Hancock and Gowing, op.cit., p 549; also see Milward, Economic Effects, pp 46-8; T. Balogh, 'The international aspect', in G.D.N. Worswick and P.H. Ady, eds., The British Economy 1945-50 (London, 1952), p 489 and Table 3, p 481; Peter Calvocoressi, The British Experience 1945-75 (London, 1978), pp 10-14.

² £1 = \$4.03 was the prevailing exchange rate.

³ Hugh Dalton, High Tide and After (London, 1962), pp 72-3.

⁴ Cairncross emphasises that convertibility was not solely to blame for the balance of payments crisis in the summer of 1947. Years of Recovery (London, 1985), pp 162-3. See also J.C.R. Dow, The Management of the British Economy 1945-60 (Cambridge, 1965), pp 24-6; G.D.N. Worswick, 'The British Economy 1945-50', in Worswick and Ady, eds., op.cit., pp 30-1; Sidney Pollard, The Wasting of the British Economy (London, 1982), p 32.

payments remained precarious. The Korean War which began in June 1950 provoked a new financial crisis, chiefly through raising the prices of many world commodities, machine tools and other goods purchased abroad for rearmament.¹

Throughout this period, boosting production was the most important element of the government's domestic economic strategy. It believed that through increased output would come full employment, exports essential to the balance of payments, capital goods necessary to long-term competitive strength, and domestic consumption to rectify war damage and pay for ambitious schemes of reconstruction. Among the many contributors to increased production, increased productivity had great appeal. It depended largely upon more modern capital equipment, or in the words of Herbert Morrison 'more electrical horses and mechanical robots; more scientific and efficient machinery; better tools'.² This held out the prospect of more output for less toil, which would serve the working class and the balance of payments simultaneously. Cripps, as President of the Board of Trade, Minister for Economic Affairs and finally Chancellor of the Exchequer, was a ceaseless advocate of raising productivity to put the economy right. 'The fundamental need is, of course, the highest degree of efficiency in our production', he said.³ What would that require?

First we must be up-to-date with our machinery and methods of production. Second we must improve the status and standards of our managements. Third we must bring the workers of all grades more and more into the planning and organising of production. Fourth, we must recognise the need for proper and up-to-date buildings and

¹ Dow, op.cit., pp 54-6; Joan Mitchell, Crisis in Britain 1951 (London, 1963), pp 11-15; Cairncross, op.cit., pp 216-25.

² Labour Party, 'Report of the 46th annual conference', May 1947; keynote address by Morrison in 'Labour for higher production' debate, p 135.

³ Cripps papers, 219, speech to Manchester Chamber of Commerce, 16 Nov. 1945.

layout and all those services of the Welfare type which are now recognised as essential to efficient production. . . .

. . . .

Morale in industry can be studied as scientifically as was the morale of the troops in time of war. . .I stress the word 'scientific'.¹

Except for greater labour-management cooperation, each of these prescriptions for higher productivity relied upon an increased application of science.

The government considered not only productivity but also industrial R&D as keys to economic renaissance. Research would create new products and thus new industries, exports and jobs; it would also devise ingenious substitutes for expensive imports. 'Research is the life-blood of our industrial progress, and industrial progress is the basis for our continuing prosperity as a great exporting nation', said Cripps.² One Labour MP whose private member's motion prompted the first postwar Commons debate on science considered R&D the paramount factor in economic growth. Britain could solve its trade problems 'by the production of the highest quality goods for export. . .lowering the cost of production wherever possible by the latest and most scientific methods and technical improvements. . .and develop[ing] home-grown food and raw materials'.³ Conservatives shared this emphasis on science. 'All of us, indeed, not only agree [with it] but find very wide agreement outside this Chamber', said one Tory MP.⁴

Thus civil science maintained after 1945 its wartime political status. All parties agreed that it deserved more government support, but Labour

¹ Cripps papers, 309, speech at Kingswood to engineering industry representatives, 29 Apr. 1945; 265, speech to National Institute of Industrial Psychology, 8 Oct. 1946.

² Cripps papers 270, speech to Physical Society, 1 Jan. 1946, p 9.

³ HC Debates, Hansard vol. 474, col. 2062, 5 May 1950, statement by M. Philips Price.

⁴ Mr. Fort of Clitheroe, Ibid., col. 2099.

considered itself science's special ally. The Labour government showed more interest in harnessing science to its economic goals than any of its predecessors. It established an Advisory Council on Scientific Policy in 1947, which devoted much of its effort to improving the scientific level of British industry. Another major Committee on Industrial Productivity was formed in 1948, composed mainly of scientists. There was more money for university expansion, for DSIR and the RAs. Cripps in particular strove constantly to sell innovation to business. Methods of persuasion included: joint labour-management-academic Working Parties which surveyed various industries in 1945-6 and recommended almost unanimously that more attention be paid to R&D and productivity;¹ a Production Efficiency Service established in the BOT to provide firms with free consultancy; cooperative research through government-sanctioned Development Councils in various industries (the descendants of the Industrial Boards recommended in 'General support of trade'); a series of sophisticated publicity drives to boost productivity; the Anglo-American Council on Productivity, which produced more than 70 extensive reports based on inspection trips to the US; and constant exhortation.

The results were in no way to match the hopes Labour placed on science for permanently transforming the economy. Partly this was because the machinery the government employed to encourage and direct civil science, like its machinery for directing the economy, was weaker than it seemed. Partly it was because the economy's creditable performance during the early postwar years masked the persistence of underlying innovative weakness. For despite the recurrent foreign exchange crises, the Labour Government was successful in bending the domestic economy to its priorities:

¹ BOT, Reports of the various working parties, 1946-7; see for example Carpets, Clay, Cotton, Furniture, Jewellery, Lace, Linoleum, Pottery, Silverware, and Wool.

exports first, capital investment in industry second, and personal consumption last.¹ Between 1946 and 1950, industrial production never rose less than five percent annually. The volume of exports increased by three-quarters -- to a level two-thirds higher than in 1938 -- while imports were held to a one-quarter increase. Of the growth in national output, consumption took scarcely more than a third, about the same as fixed investment.² Meanwhile the National Health Service, the Beveridge pension scheme, and other social reforms were implemented. The frequency and severity of the crises in external finance, as well as the government's evident success in boosting production, meant there was little time or incentive for ministers or officials to examine the roots of the country's long-term decline in industrial innovation.

What administrative approach did Labour employ to accomplish its economic goals? '[T]he government's relations with private, non-nationalised industry. . .were not marked by anything that could coherently be described as planning'.³ The government promptly gave up its most potent wartime economic controls -- those over employment -- and refused calls for an economic general staff on the grounds that existing arrangements were adequate. Neither the Treasury nor the Lord President's Committee, which until the 1947 coal crisis was supposed to be the principal instrument of economic coordination, were 'dedicated to the planned expansion of industrial production'.⁴ An Economic Planning Staff was set up under Cripps after the coal crisis shut down large sections of industry. But

¹ See Cripps speech at Workington, Jan. 1949, quoted in Dow, op.cit., pp 34-5.

² Chapter 4, Table 4.2 below; Worswick, op.cit., Table I, p 3; Dow, op.cit., Table 2.1, p 15, Table 2.2, p 39, and p 53.

³ Morgan, Labour in Power, p 130.

⁴ Ibid., p 134.

it never employed more than 30 people; and in government service as a whole 'the number of economists employed. . .during this period was much lower than during the war'.¹ The government's plans also became less precise. 'It quite early came to be appreciated that the Government had little or no means to bring about some of the changes involved in its forecasts'.² Wartime labour controls were reauthorised in 1947 but never used. Controls over building, imports and some raw materials were retained until 1950,³ but practical wartime experience had diluted Labour's belief in the need for a totally planned economy. Instead, necessary interventions could be made 'piecemeal'.⁴ The decrease in central direction was consistent with a return to peace, when the purpose of the economy became the satisfaction of diverse consumer preferences, replacing the wartime regime when victory was the sole object and only government could set the required priorities.⁵

It would be fair to term Labour's basic approach to directing the economy pragmatic, not ideological.⁶ Its philosophy in industrial civil science policy was similar, seeking small common sense improvements, not major overhaul. The Bernalist conception of an activist government surveying the country's economic and social needs and directing R&D resources accordingly was never pursued. Since the government quickly dropped many

¹ D.N. Chester, 'Machinery of government and planning', in Worswick and Ady, op.cit., p 353.

² Ibid., p 359; Cairncross, op.cit., p 343.

³ Worswick, 'Direct controls', in Worswick and Ady, op.cit., pp 278-84.

⁴ Dow, op.cit., p 12.

⁵ Cairncross, op.cit., pp 310-11.

⁶ Marwick, Total War, p 334. Morrison's biographers say that his approach to the postwar economy was that of a 'pragmatist, operating the government planning machine to maintain an ordered economy during the major transition from war to peace. . . .' Donoughue and Jones, op.cit., p 352.

of its inherited coercive powers over industry and spent relatively little money on civil R&D in its own labs, it had little choice but to rely on industry to raise its own technical level.

In the postwar boom, industry could sell virtually anything it made and had little incentive for investing heavily in technical change. Labour ministers might have an expansive vision of the results of a more intensive application of science in industry -- new products, more efficient processes, and general prosperity -- but had no power to direct the decisions in individual boardrooms and factories required to realise this vision. As we shall see, the government's new advisory committees concerned with industrial R&D and productivity were more energetic than say, the DSIR Advisory Council, but they were still part-time, outside the administrative machine, without power to direct R&D spending to the civilian objectives they thought most pressing, and essentially powerless on any matter of controversy. The Cripps productivity initiatives were useful but superficial, exhorting managements to adopt new techniques without offering much help in implementation.

Towards 1950 some of Labour's younger ministers began to worry that the government's powers for encouraging R&D and productivity were much too weak. That the government did not wake up earlier to the gap between the ambitious goals it set for science and the paltry powers it possessed to catalyze them can be attributed to several factors. It was a period of great strain on a 'distinctly elderly Cabinet';¹ of the two ministers chiefly responsible for civil science policy, Morrison was repeatedly sick in office and Cripps had to resign in October 1950 for ill health. A series of pressing crises demanded their immediate attention, on top of enduring troubles including 'austerity and rationing at home, wars and surrenders overseas, a

¹ Morgan, op.cit., p 55.

mood of general gloom and of almost unbearable burdens'.¹ Neither focused on ways of improving R&D or government's relationship with industry. Furthermore, civil science policy sparked no significant partisan controversy that might have sharpened their thinking and drawn attention to the gap between ambitious ends and feeble means. Indeed, postwar political discourse about science policy was so uncontentious that it tended to be nebulous. One MP compared it to

those admirable exhortations to uphold the Ten Commandments or eschew sin, on which everyone is agreed. The whole danger is that the subject. . .is so self-evident that people are complacent and do not take enough thought about how to carry out in detail the general terms and good intentions.²

3.2. 'I feel like a revolution here':³ The Barlow Committee and the formation of the Advisory Council on Scientific Policy

The previous chapter described how efforts of Sir Henry Dale and others to redesign the SAC into a more powerful and representative body had stalled in the latter stages of the Coalition. The new Labour government, and especially its minister responsible for science, Lord President Herbert Morrison, wanted to enlist science in their plans for remaking Britain. Within several months of taking office Morrison appointed the Committee on Future Scientific Policy (FSP) to predict the country's future need for scientists and recommend machinery for getting scientific advice into Whitehall. Morrison seemed to take a heroic view of what it

¹ Ibid., p 46.

² Mr. Fort of Clitheroe, HC Debates, Hansard vol. 474, cols. 2099-2100, 5 May 1950.

³ PRO, CAB 124/546, Herbert Morrison's marginal note on minute from Barlow to Morrison's private secretary J.A.R. Pimlott, 'The future of the S.A.C.', 22 Nov. 1945.

should and could accomplish: 'I feel like a revolution here', he wrote.¹ He told the Commons the day after announcing FSP's creation:

We recognise the contribution which science made to the prosecution of the war and the achievement of victory, and we are no less desirous that science shall play its part in the constructive tasks of peace and of economic advancement and progress.²

He appointed several members of FSP who had Bernalist leanings, such as P.M.S. Blackett, Zuckerman and C.P. Snow.³ Closer examination of FSP's work and Morrison's role in it, however, reveals that either he did not share their desire for an overhaul of the government's central scientific apparatus or was unwilling to overrule civil servants and others who did not wish science to deviate from time-honoured patterns of Whitehall administration. To chair it he first wanted Sir John Anderson, and when Anderson was not available agreed to let the interim chairman, Sir Alan Barlow, fill the role permanently. Neither could fairly be described as Lenins of British science. Barlow, joint Second Secretary to the Treasury, was a powerful and skilled civil servant who exerted a strong restraining hand on the committee's work. The revamped SAC which emerged from FSP's work, called the Advisory Council on Scientific Policy (ACSP), was given no control over research expenditure or facilities. While it did some useful work it bore no relation to the Bernalist powerhouse some radicals and reformers had envisaged, and did not even attempt to plan or rationalise British science. In Barlow's words, FSP's work was 'more. . .a delicate operation of grafting than. . .an engineering operation of designing a new machine and scrapping the old';⁴

¹ Ibid.

² HC Debates, Hansard vol. 416, col. 1857, 30 Nov. 1945.

³ Other members of FSP included DSIR Secretary Appleton, SAC member Egerton, Economist editor Geoffrey Crowther, and English Electric Chairman Sir George Nelson.

⁴ PRO, CAB 132/52, 'The Central Machinery for Science - Note by the Chairman', 31 Jan. 1946.

and the graft gave forth a limp flower.

Gummett and Price have admirably described the origins and work of FSP, which need not therefore be analysed here in detail.¹ However, because FSP was an important and interesting body, its course is briefly charted.

The committee had its origin in one of the crucial problems of postwar scientific policy, the pressing shortage of QSEs. Scientists agreed almost unanimously that university places for science students had to be dramatically expanded to meet the needs of the country and use the available pool of talent. Dale, Blackett, Tizard, Egerton, Sir Charles Darwin and Barlow met at the Royal Society on 8 August 1945 to urge Barlow that a committee be created to investigate the possible expansion of the universities. Barlow counselled caution, saying that the UGC could do the job without a new committee, but promised nevertheless to consult with Morrison and Dalton, Chancellor of the Exchequer.² Ministers did indeed agree to a comprehensive survey of the supply and demand for scientists, and FSP was originally formed for this purpose alone. As it took shape in October and November 1945, its provisional terms of reference focused entirely on scientific manpower. Reorganising the scientific advisory apparatus was almost an afterthought, added only a week before the committee started work.³

It is difficult to see why Morrison did not pay attention to the organisational aspects earlier. Already in August 1945 Dale had pressed to

¹ P.J. Gummett and G.L. Price, 'An approach to the central planning of British science: the formation of the Advisory Council on Scientific Policy', Minerva 15 (1977) 119-43.

² Egerton papers, Diary vol. 5, p 20.

³ Gummett and Price, op.cit., p 129.

meet him to renew his criticisms of the SAC.¹ Cripps, President of the BOT, inspired by Vannevar Bush's report on the future organisation of American science,² gave a copy to Attlee and arranged for Blackett, as President of the AScW, to write to Morrison in August advocating a 'small investigatory commission to study the best form of organisation, and to outline its main functions'.³ Morrison met Blackett and some other scientists in September to discuss this idea and afterwards received a long description of what a central scientific secretariat might do.⁴ Tizard, too, made recommendations in September for revamping the SAC, advocating that two separate but overlapping advisory committees be created for defence and civil science, both chaired by the government's chief scientific advisor and served by a strong secretariat. The civil committee would be similar to the SAC with the addition of engineers and more outside scientists.⁵ Prime Minister Attlee also commended the organisation of R&D to Morrison's attention in a September letter. Nevertheless, Morrison's reply to the Prime Minister and FSP's evolving terms of reference continued to emphasise manpower alone, leaving to the future any inquiries about 'the establishment of permanent machinery for continuous reviews' of the country's scientific resources.⁶

¹ Gummett and Price, op.cit., p 126, 128.

² Office of Scientific Research and Development, Science: The Endless Frontier (Washington, 1945).

³ Blackett papers, F11, letter from Reinet Fremlin to Blackett, 21 Aug. 1945; letter from Blackett to Morrison, 22 Aug. 1945.

⁴ Blackett papers, F11, 'Need for a science secretariat', 16 Sept. 1945.

⁵ PRO, CAB 79/39, C.O.S. (45) 611 (O), 'Central direction of the scientific effort', confidential annex to 279th meeting; also see Gummett and Price, op.cit., p 129.

⁶ PRO, CAB 124/532, letter from Attlee to Morrison, 29 Sept. 1945; letter from Morrison to Attlee, Annex A, 9 Oct. 1945.

Meanwhile the P&SC, now with over 100 members, had renewed the call of its December 1944 memorandum for a comprehensive survey of the country's research needs, a five-year expansion programme, and a new central body to plan and coordinate it all.¹ As leader of the House of Commons, Morrison was sensitive to the lively interest the P&SC was showing and sought to have a considered response to their proposal by the end of November 1945, when a debate was scheduled on the overall organisation of science.² Captain Blackburn, sponsor of the debate, called for a 'central scientific planning body to direct and co-ordinate scientific manpower and resources on a national basis' in conjunction with the 'proposed National Investment Board'.³ Morrison, however, seemed unconcerned about reforming the SAC and indeed told the Commons that 'things on the coordination side are pretty good', especially in industrial R&D where government money was already helping 28 RAs and a conference of RA directors had been formed. 'It seems. . .that the organisation is not bad'.⁴ Announcing the FSP's formation, Morrison gave the Commons no firm indication that he intended it to overhaul the government's civil science organisation; instead he said that he himself would from time to time review the constitution of the SAC, which 'may be capable of improvement'.⁵

Nevertheless FSP's remit did contain a provision, recently added, which conferred a somewhat ambiguous authority to examine the central scientific machinery, asking for recommendations on 'the establishment of permanent machinery for carrying out surveys as to the best use of our

¹ PRO, CAB 124/525, 'Interim memorandum', 12 Dec. 1944.

² HC Debates, Hansard vol. 416, col. 1863, 30 Nov. 1945.

³ Ibid., cols. 1837-8.

⁴ Ibid., col. 1856.

⁵ Ibid.

scientific resources in the national interest'.¹ It seems that the imminence of this P&SC-inspired debate is one reason why Morrison finally agreed to terms of reference for FSP beyond manpower, even if the language was vague. Afterwards the P&SC wrote to Morrison that it was 'particularly gratified that [you] should have now taken a step so closely in accord with [our] recommendations'.²

Another reason for Morrison's last-minute assent to extending FSP's remit beyond manpower is that his civil servant advisors had recently shifted to that position. Morrison's biographers claim that he was unusually dependent on advisors in science policy because of his own lack of education in this area.³ Here Barlow was the principal advisor, and he approved the expanded (but ambiguous) terms of reference for FSP at the end of November 1945, a few days before Morrison did.

The apparent trigger for Barlow's shift was Dale's continuing campaign to reform the SAC. In preparation for a meeting with Morrison scheduled for November 26, Dale proposed that FSP recommend alterations to the SAC. M.T. Flett, in Morrison's office, followed by Barlow and Cabinet Secretary Sir Edward Bridges, approved and forwarded this recommendation to Morrison, who concurred.

Gummett and Price call Barlow the 'active ally' of Dale in this campaign to recast the SAC.⁴ That seems unlikely, since Dale and Barlow continued to disagree on two central questions and several subsidiary ones. Barlow believed that 'the work done by the S.A.C. makes a good showing',⁵ which Dale obviously did not. Dale argued that the chair of the SAC's

¹ PRO, CAB 132/52, F.S.P. (46) 56, 'The central government machinery for civil science' [FSP final report], 16 Oct. 1946.

² Blackett papers, F10, letter from P&SC to Morrison, 17 Dec. 1945.

³ Donoughue and Jones, Morrison, p 360.

⁴ Gummett and Price, op.cit., p 130.

⁵ PRO, CAB 124/546, note from Barlow to Bridges, 21 Nov. 1945.

successor should be designated the government's 'Chief Science Advisor',¹ which Barlow strongly opposed. Barlow also watered down the more expansive terms of reference for FSP which came out of Flett's consultations with Dale,² and unlike Dale who openly sought to rid SAC of the MRC, ARC and DSIR secretaries, Barlow felt that even the idea of moving them to 'a kind of panel attached to the S.A.C.' would be a matter of extreme delicacy.³

A likelier explanation for Barlow's last-minute assent to expanded terms of reference for FSP was his desire to head off pressure for a single scientific advisor, which had been building since Tizard made such a proposal to the Chiefs of Staff in September and forwarded a copy to Morrison. Such a person might make inroads upon ministerial autonomy and Treasury control of government spending. Remembering their experience of Lord Cherwell, many departmental government scientists (and Barlow's mentor Anderson) vigorously disliked this idea. Barlow agreed that 'a single scientific adviser would not be adequate',⁴ and while the record is not explicit about why he changed his mind at the end of November to favour FSP review of the government's scientific machinery, opposition to a powerful chief science advisor seems a likelier motivation than any wholesale conversion to Dale's beliefs. In any event, his assent paved the way for Morrison to do the same.

After FSP finished its manpower report (discussed in the following section) and turned to the organisation of civil science, its work divided into

¹ Blackett papers F9, F.S.P. (46) 14th meeting, evidence of Sir Henry Dale, 7 May 1946.

² PRO, CAB 21/830, 'Future of the Scientific Advisory Committee', minute from Flett to Barlow, 21 Nov. 1945.

³ PRO, CAB 124/546, minute from Barlow to J.A.R. Pimlott, 'The future of the S.A.C.', 22 Nov. 1945.

⁴ PRO, CAB 124/546, note from Barlow to Bridges, 21 Nov. 1945; Gummett and Price, op.cit., p 135.

two stages. The first concerned the form and functions of the body which would replace the SAC; the second, more contentious, sought to define the size and powers of the permanent secretariat which would serve that coordinating body and, more importantly, look after the interests of science in daily Whitehall battles. Three major divisions of opinion appeared on the committee as it discussed these issues. There was a left-wing camp comprising Blackett, Zuckerman, Snow (FSP's scientific assessor) and on some issues Geoffrey Crowther, editor of the Economist and a very effective wartime civil servant. Gummett and Price call them "radicals", and the label is retained here though it seems to overstate their proximity to Bernal. A group favouring moderate reform included Barlow, Appleton and Nelson. Egerton, the most consistent and vocal conservative, opposed almost every plan for giving the government new powers to coordinate science policy.

The radicals were the most sympathetic to central planning and adding some younger QSEs to the machinery for directing science: the SAC's average age was 61.¹ They eschewed a Ministry of Science, an idea which was doomed to failure in any event because of Attlee's previously expressed opposition² and the nearly universal Whitehall conviction that removing science to a single ministry would deprive individual departments of control over their own affairs as well as the means to put science to work effectively. The radicals were also sceptical that any part-time advisory committee, no matter how energetic and pro-planning, would have the muscle to direct British science. As Blackett said, 'the general view is that [the SAC] has been a complete flop'.³ Blackett and other radicals did not want

¹ Gummett and Price, op.cit., p 133.

² HC Debates, Hansard vol. 399, col. 309, 19 Apr. 1944.

³ Blackett papers, F14, marginal note on F.S.P (46) 2, 'The British central government machinery for science', Annex I [probably Dec. 1945], p 4.

the government to 'direct' scientists into 'work they don't like', but did want it to be able to exhort, spend, and build labs in 'those fields which it is in the interest of society that scientists should go'.¹ Of the three approaches FSP entertained for reforming government science -- a ministry of science, a national research council under the Lord President to advise ministers about setting R&D priorities among departments, or grafting additional high-level coordination and staff to the present decentralised system loosely managed by the Lord President -- Blackett and his radical colleagues

strongly believe[d] we should go for [the last one]. This leaves the valuable ministerial responsibility for their own science untouched. The drastic decentralisation of powers to Ministers is a valuable part of our Government system.

This endorsement of significant departmental autonomy gave Blackett and the radicals some common ground with FSP's moderates. Where they disagreed was over the radicals' plan to enlarge departmental science staffs and create a powerful full-time secretariat under the Lord President (but located in the Cabinet Office) to plan and coordinate the departments' work. This secretariat would be analogous to the joint planning staff of the military services, headed by the government's Science Advisor holding Permanent Secretary rank. Some large, UN-style body might be created to replace the SAC for channelling outside scientific advice to the government, but Blackett thought 'the essential point on which to concentrate and on which most of the opposition will turn is the necessity for a "thinking" scientific staff on Cabinet Office levels'.² As FSP was drafting its final report, this was the radicals' central plank.

The moderates on the committee, most powerfully represented by

¹ Blackett papers, H17, 'How planning might be organised', BBC broadcast 17 Jan. 1946.

² Blackett papers, F11, 'Notes on the central scientific organisation of the government', 18 Mar. 1946.

Barlow himself, followed the line of Sir John Anderson, whose experience directing the British atomic bomb effort and service as high civil servant, Home Secretary, Lord President and Chancellor of the Exchequer gave his opinions great weight. He opposed any reform in civil science which would dilute ministerial authority or alter existing arrangements in any significant way. He wrote to Morrison, and testified before FSP in person, that a small part-time committee of perhaps seven non-government scientists should succeed SAC in advising the Lord President on scientific matters; apart from the President of the Royal Society, members should be appointed for their personal qualities alone. Their terms of reference should cover the scientific work of the government only; 'it would be for the responsible Ministers to decide how far [this committee] or other government scientific organisations should concern themselves with outside industry and the Universities'. The Lord President should have a 'small permanent staff of administrators competent to understand scientific matters and put them in ordinary language', headed by a deputy or under secretary. A few might be scientists, 'but they should become administrative staff on transfer'. He underscored his dislike of a full-time scientific advisor or a strong secretariat which could rival the scientific expertise of the departments.¹ Nor could Anderson 'accept. . .the claim which was sometimes advanced by scientists to a right to advise the Government on every major issue of the day', to which Blackett silently replied: 'Who does'?² The Anderson-Barlow axis thus emphasised ministerial responsibility, administrative economy, and historical continuity.

¹ PRO, CAB 132/51, F.S.P. (46) 13th meeting, 16 Apr. 1946, with attached letter from Anderson to Morrison, 19 Feb. 1946. Also see Gummett and Price, op.cit., p 133.

² Blackett papers, F9, marginal note on F.S.P. (46) 13th meeting.

Egerton represented the view of conservative high science most cogently on FSP. He tried to block Zuckerman's appointment to the committee¹ and fought all dilution of Royal Society authority. He liked the idea of Sir Oliver Franks, permanent secretary in the Ministry of Supply, that the SAC should be replaced with one or two administrator-scientists in the Cabinet Office who could convene ad hoc official committees to deal with problems as they arose.² 'I have been anxious', Egerton wrote, 'lest an authoritarian body were set up which would call the tune in regard to science -- particularly fundamental science -- which if there is any such body, it should be the R[oyal] S[ociety] and science should keep free of Government Control'.³ Thus Egerton was alarmed by the radicals' vision of a strong central secretariat, and appears to have disliked even Dale's proposal for substantially strengthening the SAC. However, since FSP's moderates also sought to retain the essential features of the existing science policy machinery -- ministerial autonomy coupled with necessarily weak central coordination -- Egerton was content to go along with them on major issues and for simplicity can be termed a moderate.

When the conflict between the radicals and moderates on FSP over the powers and size of the central scientific secretariat was argued out in June and July 1946, they had already reached tentative agreement on what was to replace SAC: a committee of ten, half government scientists and half outside members including scientists, industrialists and someone who could speak for the Royal Society. Named the Advisory Council on Scientific Policy (ACSP), it would report to the Lord President through its chairman, who would be

¹ Egerton papers, Box 12, Diary vol. 6, p 12, 9 Jan. 1946.

² PRO, CAB 132/51, F.S.P. (46) 15th meeting, 14 May 1946; Egerton papers, Box 13, Diary vol. 7, p 63, 14 May 1946.

³ Ibid., unnumbered page at the end of vol. 7, June 1946.

chosen more for administrative than scientific eminence; to designate 'any one man as Chief Scientific Adviser. . .is neither necessary nor desirable'. An overlapping secretariat and membership would provide coordination with the new Ministry of Defence's scientific committee. Its draft terms of reference were quite broad: to advise the Lord President 'on the formulation and execution of scientific policy in the civil field'; to gather information on research manpower, equipment, accommodation and finance; to recommend how they should be allocated; to foster the application of scientific knowledge at all points where it might be 'of service to the community'; and to oversee information services and international scientific relations.¹ The terms of reference were however artfully vague about how, or whether, the ACSP was to enforce the priorities it set for research. There was no grant of manpower controls to direct the employment of scientists, no powers to prevent departments and private research laboratories from ignoring the committee's priorities for the allocation of research funds. Departments' retention of complete budgetary authority was exactly what Anderson and Barlow sought.

Thus the radicals recognised that their ambitions for greater coordination of science policy would hinge upon the central secretariat. They laboured to make it an effective counterweight to departmental independence, strong enough to win the daily bureaucratic battles over spending and programmes through which any grander science policy would take shape.² They thought the secretariat should employ

about a dozen scientists (including a few technical experts), together

¹ Blackett papers, F9, F.S.P. (46) 18th meeting, 18 June 1946; Gummett and Price, op.cit., p 136.

² The AScW's 'Science and government', Jan. 1946, p 28 gives a very explicit demonstration of how left-wing scientists tried to apply the knowledge of Whitehall they gained during the war towards devising ways of overcoming departmental barriers to peacetime planning.

with two or three experienced administrative officials. . . .Status might be equivalent to 2 Under Secretaries, 4 Assistant Secretaries and 6 Principals' plus one administrative official at each level.

This was a big staff, but one warranted by the 'great variety of functions' envisaged for it, 'many of them intrinsically technical and complex': allocating scientists, money and facilities according to a priority list; coordinating long-term research with the economic plan; surveying public and private R&D 'in order to suggest changes and extensions and dovetailing'; overseeing patent law and innovation policy; encouraging operational research in government and industry; and 'advising Government on scientific/technical aspects of general economic/social/military/administrative policy'.¹ Of course the moderates disliked this whole conception. Flett, FSP's civil servant secretary, had in mind a permanent staff of one assistant secretary and a few very junior scientists. Barlow '[was] shocked' by the radicals' proposal, 'which he regard[ed] as a waste of scientific manpower'.²

Aided by confidential advice from Edmund Dixon, FSP's assistant secretary, who wanted a large secretariat, the radicals tried to devise tactics and arguments which might convince their colleagues. Lunch meetings of various radicals, consultations with Bernal, and further confidential notes from Dixon³ culminated in a paper which Blackett presented to FSP on 20 July 1946.⁴ Its purpose was to identify so many important and reasonable tasks for the secretariat that no one could disagree with making it large and powerful. In addition to setting priorities for R&D spending and staffing,

¹ Blackett papers, F12, memorandum by C. Secord, 'Government machinery for science', 15 June 1946.

² Blackett papers, F12, confidential letter from E. Dixon to Blackett, 21 June 1946.

³ Ibid., letter from Dixon to Blackett, 8 July 1946.

⁴ Blackett papers, F10, F.S.P. (46) 53, 'Draft programme for proposed scientific secretariat'.

Blackett's secretariat would study the supply of engineers, analyse how science might be used to remedy industrial shortcomings identified by BOT's Working Parties, promote industrial microbiology, survey the Empire's raw materials and perform more than 50 other jobs. The moderates remained sceptical. Dixon reported that 'Appleton was greatly disturbed by the list of projects and attacked [some of them] as overlapping Departmental responsibilities'.¹ Zuckerman said that the discussion of this paper

was rather sticky, as Appleton, aided and abetted by Flett, tried to reverse our understanding about the strength necessary for the Secretariat. I blocked pretty thoroughly. . . .Whatever lip-service may have been paid to the idea that some central direction is necessary there are one or two who would undoubtedly like to see an edentulous organisation emerging from our deliberations.²

FSP's final report made only a ritual bow towards the radical position. It 'attach[ed] very great importance' to the secretariat's role and noted that the ACSP 'may well perish for lack of roots' unless the secretariat could 'initiate and stimulate scientific activity'.³ Stronger language in earlier drafts had however been deleted,⁴ and the report stated unequivocally that 'we do not. . . suggest that the Secretariat should have any power of direction over the work of individual departments',⁵ to say nothing of academic or industrial research. The report envisaged that the secretariat would serve both defence and civil science from the Cabinet Office, but when the Ministry of Defence insisted upon having its own staff, a separate

¹ Blackett papers, F10, confidential note from Dixon to Blackett, 25 July 1946.

² Ibid, letter from Zuckerman to Blackett, 24 July 1946.

³ PRO, CAB 132/52, F.S.P. (46) 56, 'The central government machinery for civil science', 16 Oct. 1946, p 5. From the start this final report was planned as a confidential document to encourage forthright criticism of the existing setup.

⁴ Blackett papers, F12, FSP Report second draft, 25 July 1946, pp 11-13.

⁵ F.S.P. (46) 56, op.cit.

civil science secretariat in the Cabinet Office seemed redundant on top of the staff which the Lord President's scientific responsibilities would require him to retain. The civil secretariat thus came under his control, though it was located in the Cabinet Office across the hall from its defence counterpart. Its size was puny compared to the radicals' hopes: led by Dr. Alexander King, the former head of the British Commonwealth Scientific Office in Washington who was widely known and respected by moderate scientists, the staff eventually comprised 'an administrative assistant secretary, a physicist and an academic philosopher'.¹ Gummett and Price argue that this small size resulted from splitting the defence and civil staffs in two, citing early plans by Tizard and Zuckerman for a joint secretariat of about a dozen.² But this argument does not seem to take account of the radicals' final conception of the secretariat, which looked to a staff of a dozen for civil tasks alone,³ or of the dogged opposition mounted by Flett, Barlow, Appleton and Anderson to any kind of powerful full-time body outside departmental control.

Despite the radicals' numerical strength on the committee, their ties to Morrison and Labour and the widespread belief in the importance of increased planning of science, they were routed on FSP. Morrison later wrote that the committee's report 'followed closely' Anderson's views.⁴ The terms of reference of the ACSP and its secretariat offered little prospect

¹ Gummett and Price, op.cit., pp 139-41.

² Ibid., p 141; also see Gummett's more recent Scientists in Whitehall, p 220, where he reiterates that the small secretariat 'was not, as has been suggested, because of Treasury opposition', but because of splitting the two staffs.

³ F.S.P. (46) 53, op.cit.; PRO, CAB 124/534, 'The scientific advisory committee', undated chart showing Zuckerman's views among others.

⁴ Herbert Morrison, Government and Parliament: A Survey from the Inside (London, 1959), p 330.

that they would impinge on the autonomy of the research councils and outside laboratories. '[The ACSP's] lack of responsibility for advice on finance also denied to [it] the supreme weapon of a coordinating body',¹ and Vig thinks that it did not significantly alter the fairly chaotic structure of civil science inherited from prewar.²

This account of the ACSP's formation is based partly on documents to which Gummett and Price did not have access, primarily the Blackett and Egerton papers. The analysis here differs from theirs; it concludes that the constitution and functions of the ACSP and the central science secretariat actually represented a very small departure from past practice, and in ascribing responsibility for the limp reform to civil service mentality, personified most strikingly by Barlow but also exhibited by Anderson, Appleton, Flett and others. The radicals were bureaucratically knowledgeable and optimistic about planned science at war's end, but they faced two formidable opponents. First was the exalted status of ministerial autonomy in the British constitution. Gummett observes:

[I]n Britain the traditions of government have made it seem natural not to seek to co-ordinate science policy (or any other kind of policy) interdepartmentally at other than a minimal or low level. . . [The radicals' plans] failed because they [went] across the grain of the traditions of functional organisation and relative decentralisation of decision-making.³

Second was day-to-day control by classically trained administrators who sought to prevent scientists from developing an independent power base in Whitehall which might come to make trouble for them and for ministers. Anderson, Barlow, Appleton and others imbued with civil service culture carried an unspoken but powerful image of government as essentially static,

¹ Gummett, Scientists in Whitehall, p 221.

² Vig, Science and Technology, p 16.

³ Gummett, op.cit., p 223.

responding to events thrust upon it rather than actively seeking to mold society into a new shape. Their common metaphor was 'the administrative machine', implying that a few drops of oil here, a new control lever there, would restore some mythic equilibrium of smooth functioning. That passive conception was blatant in the work of Barlow's wartime Official Committee on the Machinery of Government, where civil servants talked only to each other and thus devised trivial reforms for the central scientific structure. It was present in Barlow's 'shock' at the large and activist secretariat the radicals envisioned, and in Appleton's baffled question about it: 'What would it do'?¹ A statement by Crowther, who occasionally weighed in on the side of FSP's radicals, shows how powerful was the cult of the administrator. He opposed giving departmental science advisers large staffs and automatic access to their ministers because that would 'complicat[e] the process of administration. . . .administration is itself a special skill which may be as much diluted by the incursion of non-specialists as science itself'.²

Another reason why the radicals failed was that they thought they had won. The secretariat's tiny size was not settled until after FSP had disbanded, and the radicals had every reason to believe Morrison would resolve in their favour any ambiguities in the report -- 'as ambitious as it is vague', in the words of one BOT official.³ Yet another factor which may have given the radicals a false sense of security about letting the loose ends go was the knowledge that Tizard was to chair the ACSP as well as the Defence Research Policy Committee and thus become the government's chief science advisor in fact if not in name. During the 1946 summer recess which

¹ Letter from Dixon to Blackett, 21 June 1946.

² Blackett papers F14, unsigned note with Blackett's notation 'Crowther' on the first page, undated [probably June 1946].

³ PRO, BT 64/2264, R.M. Nowell, 'Central government machinery for civil science', 2 Dec. 1946.

separated FSP's debates on the secretariat from its final report, submitted to Morrison in October, Barlow had conducted complex negotiations with Tizard to get him to chair both committees. 'My Committee's report was drafted with you in mind', wrote Barlow in August. 'If you cannot undertake it, we shall have to think of separate Chairmen'.¹ Tizard resisted for personal and financial reasons.

Barlow kept pressing, and so did some radicals. Secord wrote to him from the Lord President's office in late October 1946, just as Tizard was deciding to accept the joint appointment after all:

I have no doubt you will have surmised the conflict of views which any proposals for 'central direction' of civil science provoke -- by comparison you were preaching to the converted in the Services. It is precisely this entrenched resistance to all attempts at integration which makes me feel you are needed even more on the civil than on the defence side. . . .I do want to add a personal plea, and say with the utmost emphasis that we can ill do without you. Nobody else could persuade the diverse and in some ways potentially recalcitrant parts to work constructively and imaginatively together.²

Hardly a Bernalist, Tizard was nevertheless known to have an independent mind and no fear of civil servants, with whom he worked effectively. The written record dries up at this point, so it is probably fair to surmise that once he was designated chief of civil science, debates about its future shifted for radicals and moderates alike from formal committees to conversations with him. Both sides may have read into him what they wished to see: his original proposal to the Chiefs of Staff fell between the Blackett and Anderson approaches and he had avoided the subsequent divisive arguments.

Neither a socialist nor a bureaucratic empire-builder, Tizard frequently came to irritate the moderates but never seriously jeopardized their

¹ Tizard papers, HTT 485, letter from Barlow to Tizard, 29 Aug. 1946.

² Ibid., letter from Secord to Tizard, 21 Oct. 1946.

ascendancy. A note he wrote Barlow when he first took the job illustrates his basic attitude: 'I saw Appleton the other day, and hope I persuaded him, if he needed persuasion, that the new Chairman is not going to interfere with departmental responsibilities'.¹ Tizard's biographer says he believed that as ACSP's head 'he would be less worried by the political intrigue which he detested, and which he must have felt would always bedevil matters of defense' -- an unaccountably naive view given the deep controversy which surrounded the central direction of civil science.²

In fairness to Tizard, however, no head of the ACSP could have transplanted Bernalism into the postwar government. The sense of urgency and common cause which had forced the overruling of departmental prerogatives in war disappeared with peace. As Morrison told the BAAS:

Being a member of a war cabinet. . . is a simpler business than being a member of a government faced with the big tasks of adaptation, of reversion, of getting society going in the right way. . . . The Government cannot order people about as they did. . . . The spirit of freedom comes up as it ought, and I do not complain. . . . Nevertheless. . . circumstances [are] more difficult than they were before.³

Perhaps someone with real political authority like Morrison could have imposed greater central direction in civil science, but he did not. His attention to scientific matters seems to have slackened in this period; while he made fairly extensive marginal notes on FSP's manpower report in April 1946,⁴ no record survives of his reaction to the October report on scientific organisation save a rather routine endorsement before ministerial

¹ Ibid., letter from Tizard to Barlow, 22 Oct. 1946.

² Clark, Tizard, p 374.

³ 'Planned research', speech to the BAAS 7 Dec. 1945, Advancement of Science 2-3 (1945-6) 299.

⁴ PRO, CAB 124/535, notes on the bottom of memo from Flett to Morrison, 'Report on scientific manpower', 18 Apr. 1946.

colleagues in January 1947.¹ Nicholson advised Morrison that FSP's report was 'excellent' and the ACSP a 'first-rate instrument for exercising your responsibilities in this field',² so Morrison is not likely to have mistrusted its recommendations. Moreover, the economic forecasts of this period were depressing, the winter was extremely harsh and the Production and Prosperity Drives launched in late 1946 'added to the claims on his time. . . .In fact his life was an endless treadmill of work and official business'. He became seriously ill as the ACSP got under way, and after the fuel crisis overwhelmed the government in February all his efforts had to be devoted simply to keeping afloat.³

There was no longer time for abstruse speculation on the ideal structure for science, by Morrison or any responsible official. Science had to get to work and help the country out of its immediate economic crisis. The need to concentrate on the task at hand was perhaps the most immediate reason for the failure of FSP's radicals to secure a strong central body for the orchestration of British science.

3.3 QSE supply and technological education

As the war ended, the main need of British science was to produce more scientists and engineers, and the main goal of government science policy was to produce them. As discussed in Section 1.5, the shortage of qualified personnel in radio, chemistry and engineering had spurred the government to provide 2000 bursaries each year during the war. Coalition

¹ PRO, CAB 134/504, Ministerial Committee on the Machinery of Government, M.G. (47) 1st meeting, 8 Jan. 1947. At this meeting Cripps expressed disappointment that 'the position envisaged in the Report for the new [ACSP] was not sufficiently authoritative. . . .'

² PRO, CAB 124/1112, Nicholson to Morrison 24 Apr. 1947, p 3.

³ Donoughue and Jones, op.cit., pp 389-90.

ministers were acutely aware that the QSE shortage threatened not only war production but transition to a peacetime economy. The War Cabinet, especially conscious of the United States lead in civil aircraft design which was made possible by its abundance of university-trained engineers, paid close attention to schemes for releasing skilled personnel for civil design work as soon as they could be spared from the war.¹ The Royal Society's January 1945 report on postwar research looked to a big increase in numbers of QSEs and government funds for training them and equipping their laboratories,² and the Percy Report had recommended that the wartime output of graduate engineers be maintained, quadrupling the prewar rate.

The Labour government heartily shared this sentiment favouring extended university education. The marked success of the wartime bursaries confirmed that many capable of excelling at higher education had been denied it solely for financial reasons. But the government needed to know how much the universities should grow, which required an estimate of how many QSEs the economy could usefully absorb. That was Morrison's original reason for appointing FSP. The committee certainly recognised the importance of its recommendations for Britain's future, as the beginning of its first report, on 'Scientific Man-power', makes clear:

Never before has the importance of science been more widely recognised or so many hopes of future progress and welfare founded upon the scientist. . . .Least of all nations can Great Britain afford to neglect whatever benefits the scientists can confer upon her. If we are to maintain our position in the world and restore and improve our standard of living, we have no alternative but to strive for. . .scientific achievement.³

¹ PRO, CAB 65/43, W.M. (44) 114th Conclusions, 1 Sept. 1944, p 7; CAB 66/57, W.P. (44) 649, 'Design development and production of civil aircraft', 16 Nov. 1944; CAB 66/60, W.P. (45) 29, 'Priorities for research and development', note by the Prime Minister, 15 Jan. 1945.

² Royal Society, 'Report on the needs of research in fundamental science after the war', Jan. 1945.

³ 'Scientific man-power', Cmd 6824, May 1946, para. 2.

FSP's efforts to estimate QSE demand were not so contentious or interesting as the second half of their work discussed above and they merit only brief treatment. There was a mild dispute about whether there really were enough bright people to justify expanding the universities; some vice-chancellors thought they were already tapping the pool of talent efficiently,¹ and Egerton 'was very definite [in committee meetings] that intelligence tests did not necessarily mean that they measured academic ability'.² But other members recognised that the facts did not support this complacency. Britain was sending less than two percent of its population to university compared with 20 percent for the United States, and tests showed that 'only one in five of the boys and girls, who have intelligence equal to that of the best half of the University students, actually reach the Universities'.³ Some universities feared that shortages of money and staff would prevent any rapid and dramatic expansion and dragged their feet; Oxford and Cambridge saw no reason to alter their traditional size.⁴ But the government's obviously sincere promise of generous and steady funding relieved the vice-chancellors' anxieties, and thus FSP had a reasonable basis for believing the universities could produce the QSEs they thought a growing economy would require. Their report estimated that the country would need some 90,000 scientists by 1955 compared with the existing 55,000; the prewar output had to be doubled to '5,000 newly qualified scientists per

¹ Blackett papers, F9, F.S.P. (46) 4th meeting, 29 Jan. 1946, p 3.

² Egerton papers, Box 12, Diary vol 6, p 130, 15 Mar. 1946.

³ 'Scientific man-power', para. 26.

⁴ Blackett papers, F9, F.S.P. (46) 3rd meeting, 22 Jan. 1946, p 3; F12, letter from J.P.R. Maud, Ministry of Education, to Sir Walter Moberley, UGC, 2 Apr. 1946.

annum at the earliest possible moment'.¹ This prediction was admittedly rough, and the committee recognised that there was 'reason to believe that it represents an under-estimate (perhaps a serious under-estimate) of the number of scientists whom the nation could usefully employ once peace-time industry gets into full production. . . .We hope, indeed, that this is so'.² The report was well received and the government swiftly endorsed the expansion of university science FSP called for as part of its generally increased support to universities.³

The universities rose admirably to the challenge of dramatic growth. Despite a desperate shortage of facilities and supplies for new buildings, teaching staffs accomodated the bulge of students returning from military service. R.V. Jones, the new Professor of Natural Philosophy at Aberdeen, found himself instructing 400 students with eight assistants.⁴ The target of 5,000 new scientists each year took five years to achieve instead of ten, and science students became a higher proportion of the expanded university population, as illustrated in the following tables:

¹ 'Scientific man-power', para. 23.

² Ibid., para 14.

³ PRO, CAB 124/535, C.M. (46) 50th Conclusions, 20 May 1946.

⁴ Jones, Most Secret War, p 653.

Table 3.1 **First degrees and diplomas (Universities in Great Britain)**

	1938-9	1947-8	1951-2	1953-4
In pure science	2,533	4,291	5,821	5,482
In technology	1,673	3,307	3,785	3,500

Source: ACSP, Eighth Annual Report (1954-55), Cmd 9537, Appendix II.

Table 3.2 **Full-time students (undergraduate and advanced) (% of total)¹**

	1938-9	1949-50	1953-4	1956-7	1961-2
Arts & social science	44.7	43.6	43.0	43.1	43.0
Pure science	15.3	19.8	21.1	22.2	25.4
Technology	10.6	12.8	12.4	13.9	15.2
Total students	50,002	85,421	80,602	89,866	113,153

Source: Argles, South Kensington to Robbins, p 100; Sanderson, Universities, p 352; British Political Facts 1900-1975, p 279.

That FSP had the courage to think so expansively, and that the government and universities managed to fulfil its vision, reflects credit on all three.

Even so the supply of university graduates, both QSEs and others, did not match employers' demand for them until the recession of the late 1950s.² FSP's report was thus the first in what became a long series of faulty postwar estimates of QSE demand, based on statistics that were speculative and complex.³ Underestimating industry's demand for graduates

¹ Medicine and dentistry, not shown here, lost the most students. Sanderson, Universities and British Industry, p 352.

² Ibid.

³ Poole and Andrews, Government of Science, pp 258-61.

had especially grave consequences because industry was already starting from a position of serious long-term inferiority in its use of graduates compared to other advanced countries, as discussed in Chapter 1. A strategy of lavish QSE supply might have served, as Cardwell argues it did for 19th century Germany, to spread QSEs from the laboratory into the whole production process and top management.¹ In simply collating industry's forecasts of its needs rather than giving a bold lead, FSP missed a crucial opportunity to help the application of science to industry. The resulting handicap to the British economy is demonstrated in the following table:

Table 3.3 **Numbers of degrees in science and technology, 1954**
(rounded to nearest hundred)

	Science	per million population	Technology	per million population	Ph.D.s both subjects	per million pop.
UK	5,500	105	3,500	57	900	15
US	23,500	144	22,500	137	3,500	22
USSR	12,000	56	60,000	280	4,500	21
FRG	3,450	67	4,450	86	--	--
France	1,760	41	2,988	70	--	--
Italy	2,436	51	2,200	45	--	--

Source: P.M.S. Blackett, 'New minds for the new world', New Statesman and Nation 8 Sep. 1956, pp 280-1.

FSP's vision was in fact bolder than most, but its low estimate of QSE demand is symptomatic of the handicap which the past imposed on postwar plans for industrial growth. A second shortcoming of FSP's report was its relative neglect of the supply of engineers. This too reflected deeply rooted attitudes and practice. The following two sections examine how these

¹ Cardwell, op.cit., pp 175, 241-2.

problems continued to manifest themselves throughout the Labour government and beyond: first, the continuing underemployment of QSEs in industry relative to Britain's competitors; second, the unavailing struggle to create new institutions for training engineers.

3.3.1 QSEs in industry

The infiltration of graduates of all sorts into British industry increased markedly after 1945. Wartime diffusion of advanced techniques and the postwar need for maximum output from restricted input combined to make highly trained personnel attractive, both QSEs and others. By 1950 industry had become the biggest single employer of university graduates, taking 38 percent of the total. Some 300 firms were arranging vacation internships for more than 2000 students in that year to draw them to long-term careers. Salaries for graduates increased with the demand, and employers found that arts graduates and mathematicians were adaptable if QSEs were scarce or too expensive. Unlike Austin Motors of the 1930s where graduates performed mind-numbing clerical tasks for lack of any better idea about what to do with them, the FBI found management training schemes for new graduates at 24 of 43 firms surveyed in 1949, most of which had been introduced or revised since the war.¹

This general improvement was not distributed evenly over the economy, however, leaving many firms and some whole industries largely untouched. Nor with certain small exceptions was it strong enough to raise British industries to the level of their foreign competition. Here a few examples of continued weakness must suffice to represent the range of industries in which management's low educational attainments persisted as a

¹ Sanderson, *op.cit.*, pp 353-4; Blackett papers, H44, 'Introduction to the FBI Conference on Industry and the Universities', July 1949. Only two more of the 43 firms surveyed in 1949 added training schemes by 1954.

serious malady. These examples are not all derived from hindsight. From the the BOT Working Parties which scrutinised more than two dozen industries, regular FBI surveys and the joint labour-management investigative teams of the Anglo-American Council on Productivity, the backward industries of the postwar period knew who they were and that inadequate employment of QSEs held them back. This widespread awareness serves as an ironic but depressing backdrop for the unavailing campaign, described in the next section, to improve engineering education in the wake of the Percy Report.

The attitude of British firms to QSEs was not uniform. Some like ICI or Marconi built their organisations around them, while others deprecated their value. Some firms willing to hire graduates nevertheless preferred those with arts degrees, for the breadth of background and social polish which the more studious QSEs were alleged to lack. A 1949 FBI survey of 43 firms employing 529,000 people of which only 8,139 (1.6 percent) were graduates showed wide variations of approach. One firm reported a dawning awareness that QSEs contributed 'a freshness of thought and ability to think for themselves' which apprentices promoted from the shop floor usually did not; another complained that 'the man who had absorbed only scientific and technical knowledge during his university career has a strictly limited scope in industry'. One firm employing over 1000 people said its six divisions 'could not carry a university graduate beyond a qualified engineer and a [technician] each', and a linen textile manufacturer said that a degree 'can be a definite handicap. . .in business'. More than a third of the graduates in the 43 firms surveyed had been hired since the war, and only 12 percent of them were managers¹. Willingness to employ graduates as managers correlated strongly with success in innovation: three-quarters of firms which

¹ 'Introduction to the F.B.I. Conference', op.cit., and attached 'Analysis of replies to questionnaire' Nov. 1949.

had QSEs both as directors and employees pursued innovation vigorously, compared to one-half of firms which had QSEs as either but not both and one-fiftieth of firms employing no QSEs at all.¹

In general, industries that were backward between the wars remained so afterwards. British shipyards, for instance, originated a decreasing share of major innovations in their industry, and even when they secured a lead often failed to maintain it. Regular surveys 'pointed to a low ratio of qualified staff, both in the design department and in production, compared with that in Japanese and other European yards'. In 1960 the industry employed only 80 graduates, half in the Admiralty Research Department, out of approximately 251,000 workers; in 1966, the Japanese ratio of naval architect to worker was more than five times the British ratio.² One observer of machine tool manufacturers noted in 1946 that they 'have been more inclined to copy foreign ideas, with or without modification, than to think for themselves',³ and a 1960 inquiry found that only 1.3 percent of the industry's employees were QSEs compared to seven percent in oil refining and 2.2 percent in electrical engineering. Ninety machine tool firms employing 30,000 people in that year employed only 25 graduates, a ratio less than half of the German and Swiss competition's.⁴

One of the most tenacious problems of British industry was the number of small firms which stubbornly resisted modern techniques and QSE

¹ PRO, DSIR 17/422, letter from O.F. Brown to J. Ainsley, Manchester Joint Research Council, 22 May 1952.

² Albu, 'Shipbuilding', in Pavitt, Technical Innovation, p 179; FBI, 'Industrial research in manufacturing industry 1959-60', Table 1A, p 64.

³ Sir Frank Heath and A.L. Hetherington, Industrial Research and Development in the United Kingdom: A Survey (London, 1946), p 146.

⁴ BOT, 'The machine tool industry', report of a subcommittee of the Machine Tool Advisory Council, London 1960, p 12; Albu, 'British attitudes to engineering education', in Pavitt, op.cit., p 74.

employment; this was particularly serious because small firms comprised a larger portion of the British economy than the American. A survey conducted by the Manchester Joint Research Council of 225 area firms in 1948-9 revealed that just under half employed no QSE, and that the average businessman was not convinced of the value of science.¹ A comprehensive FBI inquiry in 1961 found that nearly half of British firms employed no QSEs on R&D. The willingness to employ QSEs correlated closely with firm size: more than 80 percent of firms employing fewer than 300 people had no QSEs, compared with 45 percent of firms employing between 300 and 1,999 people and 10 percent of firms employing 2,000 or more.² Such figures help to explain why postwar governments have frequently been impressed by the idea of compulsory consolidation of small firms into larger ones able to conduct ample research.

The reports of the BOT Working Parties and the 72 AACP labour-management missions to the United States abound with evidence of low management qualifications. The Jewelry and Silverware Working Party noted 'an attitude in the industry of reserve amounting on occasion to hostility, toward scientific and technical research. . . .very few manufacturers today really feel a commercial need for a properly trained designer at all'.³ The Wool Report noted that 'true appreciation of the spirit, meaning and implications of research is still disappointingly low' among top management.⁴ The Economist summed up the verdict of the Working Parties: 'The painful truth is that far too many British business men

¹ S.A.J. Parsons, The Framework of Technical Innovation (London, 1968), pp 9-10.

² FBI, op.cit., p 13.

³ BOT, 'Report of the Jewelry and Silverware Working Party', 1946, p 44.

⁴ BOT, 'Report of the Wool Working Party', 1946, p 107.

are out of their depth in their own technologies'.¹ The AACCP teams found scant improvement later in the decade. A special team on management education summed up the AACCP consensus:

The reports of more than 25 British Productivity Teams. . . were almost unanimous in attributing much of the [American] drive for higher productivity. . . to the attitude of the executives. Further, a number of these teams traced a connection between this attitude and a combination in the U.S. of facilities for higher education and strict adherence to merit.²

Even thoughtful observers of this evidence of industrial decline failed to grasp fully the the backwardness of British management or perceive some of the solutions, like undergraduate and postgraduate management education, which have since been successfully transplanted from abroad. A distinguished physicist attending the 1949 FBI Conference noted that 'it was generally felt that. . . direct training for management. . . was not the task of the university'.³ Blackett called it 'wrongheaded' to think that universities could prepare science and engineering students for future management responsibilities. 'It cannot be done!' he wrote.⁴ Cultural bias against industrial careers and the training to excel in them remained strong. 'It is a prevailing opinion [in the U.S.]', observed one AACCP team, 'that business attracts the best talent from educational institutions, whereas in Britain there is a strong tendency for the best students to find their way into the

¹ 'A policy for wealth', Economist (26 Apr. 1947) 36.

² AACCP, 'Education for management', 1951, p 1.

³ Blackett papers, H44, notes of Nevill Mott on FBI Conference on Industry and the Universities, Nov. 1949.

⁴ 'Training for the professions', Listener (6 Apr. 1950) 604.

Civil Service and the professions generally'.¹ Some oblique confirmation of this belief comes from a survey taken in the 1960s. It showed that 74 percent of American QSEs worked in industry, compared to 52 percent in France and 42 percent in Britain.²

¹ 'Education for management', p 8. A recent investigator has found that 'the major and significant differences between British managers and their rivals in most other countries are in their professionalism, in the number of engineers amongst them, and in their social class. . . .with consequences for the quality of industrial entrants, for their competence and for their status'. Nuala Swords-Isherwood, 'British management compared', in Pavitt, op.cit., pp 93-5.

² Peck, 'Science and technology', p 451.

3.3.2 Technological education

According to many observers, Britain's greatest educational deficiency compared to the U.S., Germany and other competitors was its relative paucity of university-trained engineers. Cherwell called it a 'grave lacuna';¹ the Advisory Council on Scientific Policy observed that 'there was a deeply rooted feeling in this country, especially in the schools, that, as a career, engineering was not on the same level as pure science. This . . . must be resisted'.² The unattractiveness of engineering as a profession may partly have stemmed from the common practice of blurring the terms 'technician', 'technologist' and 'engineer'. This perhaps reflected an underlying confusion between a technician -- someone possessing an Ordinary National Certificate (ONC) granted by one of the engineering institutions, usually obtained after a few years' part-time study at a locally financed and often inadequate technical college -- and graduate engineers whose training included considerable fundamental as well as applied science.³ The technical colleges performed important work, educating more than 2m evening students and 264,000 day release students in 1951, but many were 'vocational forcing-houses' not suited to advanced training in a wide range of fundamental subjects.⁴

Hostility from employers imposed another barrier to the diffusion of highly trained engineers through British industry. 'There was still an exceedingly large amount of suspicion' of technologists who had not started

¹ Cherwell papers, E68, letter to the Times 30 Aug. 1946.

² PRO, CAB 132/65, S.P. (48) 3rd meeting, 28 Apr. 1948, p 5.

³ 'Technologist' and 'engineer' are used here synonymously to mean a university graduate in applied science or the holder of a Higher National Certificate, and 'technician' to describe the typical product of a technical college holding an ONC.

⁴ Argles, op.cit., pp 92, 94, 97.

on the shop floor, whereas in the U.S. 60 percent of industrial executives were themselves graduate engineers.¹ Few in Britain comprehended the high status, lavish finance and exacting academic standards which foreign engineering schools like the Zurich Polytechnic maintained. For many years after the war MIT 'disposed of greater resources for its research programme than all the English universities put together'.² Cherwell frequently despaired of trying to make English politicians and officials understand that an engineer was not just

an expert garage mechanic. They do not understand. . .the scope and range of fundamental knowledge required. . . .Hence they think all we need is slightly bigger and better technical colleges. It is as though it were claimed that since there are quite a lot of Secretarial colleges, some of which even teach accountancy and administration, there is no need for a London School of Economics.³

Despite the centrist consensus reflected in the Percy Report that engineering education deserved urgent attention, and initial sympathetic noises from the Labour government, nothing really changed until the late 1950s. The reformer's vision of MIT-style technological universities faded in a blizzard of memos, reports and committees thrown up by existing technical colleges and arts-orientated university administrators. This failure to remove a crucial and obvious bottleneck exemplifies a recurrent theme of civil science reconstruction. Reforms which required the government or private

¹ Ibid., pp 99, 91. The prejudice against graduate engineers is certainly consistent with previously presented evidence of retrograde attitudes among industrialists, but it may have had some factual basis. A study of engineering instruction at Cambridge by an F.R.S. engineer working at the Cavendish revealed that tuition hours there were only half those of the shortest comparable course at three leading foreign universities. In addition, fundamental science comprised about 20 percent of the Cambridge curriculum, compared with a range of 31.5 percent to 50 percent at the others. Cherwell papers, E69, letter from Dr. Egon Orowan to Cherwell, 3 Sept. 1946.

² Sir Harrie Massey, 'Atomic energy and the development of large teams and organisations', Proc. R. Soc. Lond. A 342 (1975) 501.

³ Cherwell papers, E72, letter to R.A. Butler, 28 Apr. 1950.

institutions to expand what they were already doing, such as increasing the number of university science graduates, proved relatively simple. Those that required the creation of wholly new institutions threatened too many existing ones to break through the fetters of tradition.

That technologists would continue to suffer from second class status and facilities was evident as early as 1946. In January FSP agreed that it was more important to estimate the demand for scientists than for engineers.¹ Indeed its manpower report made no effort to predict how many engineers the economy would require, merely noting that the historic ratio of engineers to scientists at universities was 40 percent, and devoted its six paragraphs on the education of engineers (there were 28 on scientists) to a rehash of the Percy Report.² Dixon then wrote to Blackett enclosing a compilation of every reference in FSP's minutes to engineers, and complained that the committee, following Barlow's advice, had sloughed off its responsibility to forecast engineering demand onto a wholly inadequate interdepartmental committee run by the Ministry of Education, UGC and Ministry of Labour. 'I should have little objection to this if I saw any sign of scientific thinking in [the Ministry of] Labour or even if their present figures stood up to elementary analysis', he wrote.³ FSP's report acknowledged the 'vital importance' of highly trained engineers to the country's economy, but so mesmerizing was the appeal of scientists in those days that support for engineers was more rhetorical than tangible. Tizard noted a fixation on scientists in FSP's second report on scientific organisation as well, asking in a draft note to Barlow:

¹ Blackett papers, F10, F.S.P. (46) 3rd meeting, 22 Jan. 1946.

² 'Scientific man-power', paras. 30-35 on engineers; 10-29 and 56-63 on scientists.

³ Blackett papers, F12, letter from Dixon to Blackett, 18 May 1946.

What are the engineers going to say? All the stress is on science and scientists. But the [ACSP] is going to be concerned, I hope, with big questions of policy of the application of science, and the advice of experienced engineers will be often essential. . . .We scientists are inclined to overplay our hand nowadays.¹

Even though FSP's manpower report merely reiterated Percy's proposals on the education of technologists, these did comprise quite an ambitious programme. Selected technical colleges were to develop 'full-time technological courses of university degree standard' and the best of them were to expand into 'major university institutions'. Universities were to train 'a high proportion of the nation's first-class technologists' and provide the courses and research facilities which would 'attract into technology a greatly increased number of students of outstanding ability' both graduate and post-graduate.² Morrison's note to the Cabinet endorsing FSP's report supported a 'considerable expansion in the facilities for higher technological education'.³ In the following three years reports from the P&SC, FBI, Institute of Physics, and Nuffield College called for a dramatic improvement in technological education along lines similar to those of Percy and FSP. Some were quite radical, such as the physicists' call for 20 new university-level colleges of technology granting their own degrees and handsomely financed by the government.⁴

Yet the government procrastinated. The result was that temporary compromises ossified by increments into a permanent arrangement which

¹ Tizard papers, HTT 485, letter from Tizard to Barlow 31 Aug. 1946. For reasons not relevant here this letter was not sent.

² Paras. 31-35.

³ PRO, CAB 124/535, C.P. (46) 185, 'Report on scientific manpower', 3 May 1946.

⁴ P&SC, 'Colleges of technology and technical manpower', 1947; FBI, 'Industrial research in technical colleges', 1947, and 'The education and training of technologists', 1949; Institute of Physics, 'Education and training of technologists', Mar. 1948; Nuffield College, 'The problems facing British universities', 1948.

satisfied no one. In 1947 the regional advisory councils which the Percy Report had recommended to link the technical colleges with industry began work. In 1948 the national coordinating body known as the National Advisory Council on Education for Industry and Commerce (NACEIC) got under way, with 72 representatives from industry, trade unions, technical colleges, local authorities and others. This was hardly a breakneck pace -- Percy had reported in April 1945 -- and the universities continued to resist being stitched into this structure. Moreover, the Ministry of Education did not implement the Percy plan for upgrading selected technical colleges to university standard. This was supposedly too costly, and ran contrary to the British tradition of unspecialised universities. Instead the Ministry concentrated on creating specialised 'national colleges' within major technical colleges for advanced training in particular industries such as rubber, clocks, foundries and aeronautics.¹

Frustrated by the lack of progress, the ACSP discussed technological education in November 1947. No member was satisfied with how things were evolving. Sir Ewart Smith, former chief engineer of ICI, emphasised that thoroughly trained engineers were scarce, 'urgently required', and not emerging from the technical colleges. Appleton observed that Imperial College was the only place in the country where science graduates could obtain postgraduate instruction in engineering. The committee leaned towards Smith's idea for expanding some technical colleges into major institutions like MIT, cutting away, in Tizard's words, the 'arts and crafts' courses which created such a gulf between them and the universities. But as the Ministry of Education representative remarked, 'this would involve a radical departure from the traditional functions of technical colleges in this country', and the

¹ Argles, *op.cit.*, p 88; PRO, CAB 132/65, S.P. (48) 35, ACSP report 'Higher technological education', 22 July 1948.

Ministry was already having difficulty in implementing a shrunken version of the Percy Report's more modest programme.¹

The ACSP was extremely perturbed by the engineer shortage. 'We have been impressed', wrote the Council in its first annual report, 'by the evidence from several sources that the effective application of the results of scientific research by suitably qualified technologists and engineers is an even more urgent need than the furtherance of research itself and would bring much quicker results'.² Fearing continued timidity from the Ministry of Education, NACEIC and others, it decided to investigate engineering education for itself.³ In July 1948 it issued a report 'fundamentally disagree[ing]' with the current strategy for expanding engineering education, which it felt was being awkwardly forced into the cracks of the present ramshackle structure of technical colleges and small university departments.

The 'crying need' for high-quality technologists could not be met, the ACSP report argued, 'either by putting a "top-storey" on certain existing technical colleges or by limiting some of them to advanced training in technology'. The technical colleges were already stretched in providing lower level courses which were valuable in their own right; but even if they could manage to expand, 'we still do not believe that the type of [engineer] we need can receive the right kind of education in a technical college. For that, we are convinced, we must rely on the Universities'. Simply giving more money to existing university faculties of applied science was no answer because it would disperse resources too broadly, and the large numbers of new engineers required would swamp other faculties. Thus 'the right

¹ PRO, CAB 132/64, S.P. (47) 10th meeting, 19 Nov. 1947, pp 4-5.

² PRO, CAB 132/65, S.P. (48) 25, 'First Annual Report' (1947-48), 28 May 1948, p 12. [Same as Cmd. 7465, 15 July 1948.]

³ PRO, CAB 132/65, S.P. (48) 35, 'Higher technological education', 22 July 1948, para. 1.

long-term policy would be the creation of new institutions in which a course of education in the fundamental sciences was followed by a further course in an applied science'; they would be similar to Imperial College except that they should be integrated more intimately into the life of their parent or adjacent universities. The ACSP recognised a short-term need to strengthen existing departments and endorsed sending 100 graduates a year to the US for advanced engineering instruction.¹

The UGC had recently established a joint subcommittee with the NACIEC on technological education, but neither body warmed to the ACSP's criticism. UGC Deputy Chairman Arthur Trueman, a geologist, emphasised before the report's release that 'we had to take the position as we found it, which in view of economic difficulties was a position which was likely to persist for at least ten years'. Barlow agreed with Tizard that educating technicians and technologists at the same school 'might be undesirable if one were building up an educational system from the beginning and could do as one liked, but with the situation as it was at present it was surely better than nothing'.²

On the Lord President's Committee Morrison put his considerable weight behind the ACSP report, doubting 'whether the Universities or the education authorities or other bodies concerned were yet devoting enough thought and effort to the training of scientists for industrial activities'. But George Tomlinson, Minister of Education, supported the part-time approach of technical colleges; British employers, he said, were not as willing as American ones to hire QSEs without industrial experience. He thought the new national colleges in specific technologies offered a promising road towards higher quality, though Tizard said they were too expensive 'and did

¹ ACSP, 'Higher technological education', op.cit.

² PRO, CAB 132/65, S.P. (48) 3rd meeting, 28 Apr. 1948, pp 2-3.

not justify the title "college" by the quality of their work'. The Committee 'resolved' this controversy by appointing a panel to study the ACSP report drawn from its persistent foes, the UGC and the NACEIC.¹

The panel's report, ready in January 1949, made ritual bows towards the ACSP position but gave no ground. It touted the national colleges of which Tizard thought so little. Otherwise it wanted only more of the same: expanding the universities' engineering faculties. New institutions like MIT or Imperial College were desirable but impractical. 'We believe', it said, 'that the short-term programme [of expanding existing faculties], which it is vitally necessary to complete with the minimum of delay, will in fact provide the necessary basis for settling the long-term problem'; certain ones could be hived off in the unspecified future into technological universities, a very nebulous concession to the ACSP viewpoint.² Nevertheless the ACSP endorsed the report on Tizard's advice 'rather than delay a decision by further discussion'.³ The ACSP probably realised that as a part-time advisory committee meeting monthly it stood little chance of prevailing against the determined opposition of the Ministry of Education, the UGC and the NACEIC. Tizard also seemed to lack the stomach for prolonged bureaucratic infighting. It is noteworthy that Tizard let Trueman water down the engineering education section of that year's ACSP annual report to bring it much closer in line with UGC/NACEIC orthodoxy.⁴

However support for the ACSP view arrived from an unlikely rescuer, Tizard's arch-detractor Cherwell. In March 1949 Churchill, speaking at MIT,

¹ PRO, CAB 132/9, L.P. (48) 12th meeting, 9 July 1948.

² PRO, CAB 132/66, S.P. (49) 1, 'Higher technological education', 18 Jan. 1949.

³ PRO, CAB 132/66, S.P. (49) 1st meeting, 2 Feb. 1949.

⁴ PRO, CAB 132/66, S.P. (49) 3rd meeting, 4 May 1949.

uttered a Cherwell-inspired endorsement of the American system:

We have suffered in Great Britain by the lack of colleges of university rank in which engineering and the allied subjects are taught. Industrial production depends on technology and it is because the Americans, like the pre-war Germans, have realised this and created institutions for the advanced training of large numbers of high-grade engineers. . .that their output per head and consequent standard of life are so high.¹

Other Conservatives disagreed. Sir John Anderson, in a speech to London University on 27 November 1949, worried that universities were losing their balance and freedom to pursue knowledge untrammelled by utilitarian goals. The Times said the following day that it was a 'disturbing tendency for the universities to be more and more considered the proper places for higher technological education', which was a specialised professional training 'out of tune with the university spirit. . . .It is doubtful whether applied science can best flourish in an academic environment'. Thus it argued that a few technical colleges should be 'slowly raised' to the standards of continental technological institutes. A heated correspondence in the Times followed in which the majority, including the Rector of Imperial College and some distinguished scientists, seemed to prefer the existing system for fear that technological institutes would insulate their students from the humanities and for other reasons.² Since most of them displayed little knowledge of foreign technological institutes, their differences with the Cherwell camp were probably less than they appeared. Both sides agreed on the need to distinguish technological from technical education and to link technological studies wherever conducted with the liberal arts.³

Cherwell and some others seized upon the Times leader to press their

¹ Cherwell papers, E82, Churchill speech 31 Mar. 1949.

² PRO, CAB 132/68, S.P. (50) 8, 'An analysis of some recent letters in the Times regarding higher technological education', 28 Jan. 1950.

³ Ibid., p 4.

case for a British MIT. Appleton and Sir Lawrence Bragg endorsed the idea of a technological university.¹ J.D. Cockcroft, director of the Atomic Energy Research Establishment, wrote after an ACSP-sponsored symposium that British industry showed a 'great shortage of "creative technologists"'. While standard-quality technologists could come from expanded university departments and the best technical colleges, he felt 'very doubtful' about developing 'the atmosphere of "creative technology" in post-graduate work' at such places. So 'there is a case for a new pilot institution based on the California Institute of Technology. . .'.² A laudatory series appeared in the Times Educational Supplement which prominently featured Cherwell's viewpoint. It would be 'grotesque', he argued, to try to graft a dramatic expansion of engineering education -- perhaps 4000 new students -- onto existing universities.³ If spread evenly through all of them the quality and status of the engineering faculties would not rise sufficiently; if lumped in one place the existing school would be completely distorted.⁴ Public meetings, articles in Nature and other agitation were crowned by a House of Lords debate in March 1950.⁵

However, by December 1949 the UGC had endorsed a quite different view advanced by the Ministry of Labour's Technical Personnel Committee (the committee whose competence Dixon had disparaged in 1946): that

¹ Ibid., p 5.

² Cherwell papers, E75, copy of letter from Cockcroft to Tizard, 28 Mar. 1950.

³ Lord Percy was propounding such a graft, fearing for some reason that successful technological universities would lead to the expulsion of science from existing ones. Cherwell papers, E75, letter from Cherwell to TES, 29 Oct. 1950.

⁴ Cherwell papers, E72, 'Demands of modern engineering', second article in collected TES series The Case for the Technical University, Jan.-Mar. 1950.

⁵ 'Technological education in Britain', Nature 165 (20 Jan. 1950) 125-7; HL Debates, Hansard vol. 166, cols. 203-40, 14 Mar. 1950.

current numbers of university engineering students would satisfy all foreseeable demand.¹ This estimate was based on surveys of industrial firms, universities and government laboratories. The report argued that not only engineers but scientists were graduating in adequate numbers. Trueman, fearing a glut of unemployable QSEs, told the ACSP that 'certainly [there was] insufficient evidence on which the Universities could safely be urged to increase their output further'.² The ACSP disputed this conclusion, which seemed to reflect too much the fears of the Thirties. Sir Ewart Smith argued that 'the present demand of industry for scientific graduates did not measure up to the urgent need for applying scientific knowledge and methods to our economic problems. . . the demand would increase only when the supply became more plentiful'.³ The ACSP also doubted the validity of the primitive statistics on which the Ministry of Labour/UGC position was based, so it established its own permanent subcommittee on manpower under Zuckerman to collect data more systematically.⁴

Meanwhile the Ministry of Labour's report seemed to demolish the argument of those who sought expensive new ventures in technological education. Instead of creating new self-governing technological institutes within existing universities as the ACSP had advised, the UGC's December 1949 report simply wanted to add 250 postgraduate places around the country. It believed this would produce quicker results since a new technical university might take ten years to produce graduates, and 'it is more in

¹ UGC, 'A note on technology in universities' (HMSO 1950) [15 Dec. 1949].

² PRO, CAB 132/66, S.P. (49) 12, 'Reports of the Committee of Enquiry set up by the Technical Personnel Committee', 24 Mar. 1949.

³ PRO, CAB 132/66, S.P. (49) 8th meeting, 2 Nov. 1949.

⁴ CAB 132/68, S.P. (50) 6th meeting, 5 July 1950.

accordance with our traditions to build on what is there'.¹ The NACEIC issued its first report in January, restating Percy's proposal for creating a Royal College of Technology to set standards and grant awards to graduates of both technical colleges and universities.² But neither the universities nor the professional engineering institutions which currently granted ONCs and HNCs wanted to lose their autonomy to the Royal College.

In light of this unresolved controversy, the best the ACSP could manage was to recommend yet another review of engineering education, hoping that it would favour the British MIT.³ The government was undecided. It was unwilling to offend vested interests or spend the £5m-£8m necessary to create a major new institution (though Sir Francis Simon believed that 'from recent utterances by American politicians and technologists, it is clear that they would welcome the use of Marshall money for such purposes').⁴ But it did not like the alternatives. The Minister of Education was aware of some 'very disquieting examples of the bad conditions under which technical education still has to be conducted', but felt improvement was 'bound to be a fairly lengthy process'.⁵ Higher-ranking ministers who might have been able to break this logjam do not seem to have taken much interest in technological education in this period.

Not surprisingly therefore the March 1950 House of Lords debate on technological education was inconclusive. Viscount Caldecote, a Conservative

¹ UGC, 'A note on technology in universities'.

² Ministry of Education, NACEIC, 'The future development of higher technological education', HMSO 1950.

³ PRO, CAB 132/68, S.P. (50) 2nd meeting, 1 Feb. 1950.

⁴ Sir Francis Simon, 'A scientist looks at America', Financial Times 5 Jan. 1950.

⁵ Labour Party, Speakers' Handbook 1949-50 (London: Oct. 1949), p 32.

former Lord Chancellor and vice-president of the Classical Association, agreed that the Ministry of Education should study this subject further but opposed what he construed as a 'plea for the granting of indiscriminate degrees'. British industry was successful, the present system of ONC and HNC awards by engineering institutions was adequate, and keeping engineering faculties small and within existing universities was correct. Training at places like MIT was 'too technical', he argued. Lord Darwen, a Labour cotton manufacturer from Manchester, argued that only the 'select minority' of engineers destined for the 'highest posts in industry' required the kind of high quality training which the ACSP, Cherwell and their allies had been pushing. Most contributions to this hastily organised debate showed complacency, contempt for engineering as an academic subject, confusion about the differences between technologists and technicians, and most of all ignorance about the existing setup in Britain and abroad as well as the various proposals for reform.¹

Technological education remained unresolved during Labour's last year in office. Still more reports were issued by various bodies, including PEP, the Association of University Teachers and the NACEIC, but none of their solutions managed to satisfy all disputants. Furthermore the rearmament programme which followed the Korean War made any costly innovations in technological education virtually impossible. After a Nature editorial backed new separate technological universities,² Tizard decided to take up the cudgels once again, this time privately with the scientists on the UGC rather than in yet another report. He and Zuckerman realised that the Treasury was unlikely to fund a new technological university, but hoped that it might be induced to let the arts side of an existing university atrophy, or concentrate

¹ HL Debates, Hansard vol. 166, cols. 203-40, 14 Mar. 1950.

² 'Technical and technological education', Nature 167 (20 Jan. 1951) 87-9.

major resources on a few technical colleges.¹ The government rejected this idea in July 1951, when it settled its technological education policy at the last meeting of the Lord President's Committee before the Conservatives came to power.² It was a least common denominator compromise. University faculties of technology were to continue boosting their graduate and postgraduate programmes, though no numbers were attached. The committee decided that the simplest path to raising the quantity and quality of both technicians and technologists lay in improving the technical colleges whose quality was mostly poor. It thus endorsed the NACEIC's plan for a College of Technology (though not a "Royal" one) to approve degree-level courses at technical colleges which could then award such degrees themselves. These advanced courses would receive a 75 percent Exchequer grant instead of the customary 60 percent.³ A White Paper was quickly issued to head off further agitation.⁴

The new Conservative government, prodded by its Paymaster-General Lord Cherwell and some influential Financial Times articles from his Oxford colleague Sir Francis Simon,⁵ promptly decided to set aside the White Paper's limp compromise and devise a better policy. But faced with the same warring constituencies and budgetary constraints as its predecessor, it could come up with nothing better. Delay and tortured inaction prevailed in the face of entrenched opposition from those running the inherited structure of

¹ Cherwell papers, E76, letter from Zuckerman to Cherwell, 3 Feb. 1951.

² PRO, CAB 132/17 & 18, L.P. (51) 49, 'Higher technological education', discussed at L.P. (51) 18th meeting, 27 July 1951.

³ L.P. (51) 18th meeting, op.cit.

⁴ 'Higher technological education: statement of government policy', Cmd 8537, 1951.

⁵ Cherwell papers, E77, letter from Cherwell to Florence Horsbrugh, Minister of Education, 6 Nov. 1951; F.E. Simon, 'Scientific Manpower I & II', Financial Times 29-30 Nov. 1951.

inadequate institutions. Still more committees were appointed to study the problem. The Royal College of Technology which formed the centrepiece of the White Paper was rejected without any alternative proposed. More debates in the Lords demonstrated continuing ignorance, confusion and disdain for engineers.¹ Finally the Cabinet agreed that the technical colleges at Glasgow and Manchester as well as Imperial College should be expanded into major technological centres.² However the Chancellor of the Exchequer, R.A. Butler, then undercut that decision by siding with the UGC's persistent fight against engineering instruction outside existing universities. Many angry letters and meetings followed, but Butler and the UGC had their way. 'I think it will be found at the end of the day', Butler wrote, 'that we have been moving forward as fast as is wise and healthy'.³ It is a telling commentary on the government's priorities that the development which finally spurred it to pay serious attention to technological education in the mid-1950s was not advice from the ACSP or yet another study repeating the obvious about British industry's handicaps, but fear of losing industrial and thus military superiority to the Soviet Union.⁴

During the Labour government, the annual crop of university-trained engineers doubled and the number of student hours spent at technical colleges rose by three-quarters.⁵ These were noteworthy accomplishments. They were not imaginative ones. They required only a freer hand at the

¹ HL Debates, Hansard vol. 177, cols. 35-114, 120-92, 11-12 June 1952.

² Cherwell papers, E78, letter from Butler to Cherwell, 28 Nov. 1952.

³ Cherwell papers, E84, letter from Butler to Cherwell, 26 Mar. 1954.

⁴ Gummett thesis, p 87; Argles, op.cit., p 92; Vig, p 15; Sir Francis Simon, 'The "atomic" rivals', Financial Times 6 Aug. 1954.

⁵ Argles, op.cit., p 94.

Exchequer. Existing institutions, slightly revamped, spent the money doing more of what they had been doing. They proved unwilling to raise their horizons beyond parochial self-interest, and the government proved insufficiently bold to lead them there. This was a failure not just of finance but of vision. A government which could find £20m to develop the Brabazon civil airliners was not without choices or resources for technological education. Despite strong conviction by distinguished scientific advisors that new centres for technological education were the economy's 'crying need', nothing happened. Blackett, a decade later, saw quite accurately why it proved beyond the government's grasp to vitalize technological education as British industry required. 'We are in fact in the middle of one of those crises that are hardest of all to cope with', he wrote.

This is an invisible crisis: nothing dramatic is going to happen for years: all we shall hear are warnings from Sir Francis Simon mixed with bland reassurances from others that things are not quite what they seem. Then we shall wake up and find, like Venetians in the 17th century, that all that makes our living has slipped away. . . .

. . . .
The ablest Venetians could see with unpleasant clarity what was coming. . . . They wrote memoranda about new kinds of trade: those plans would have meant upheaval and discomfort for the society, but they might have worked. They did not work, of course. They were never so much as tried.¹

Unwilling to finance a technological institute over which it would have control, the government had to fall back on exhorting private and semi-private bodies to behave in accordance with the national interest -- which of course was variously perceived.

¹ 'New minds for the old world', New Statesman and Nation (8 Sept. 1956) 279.

3.4 Industrial R&D

3.4.1 Government assistance programmes

We saw in the last chapter that Labour came to power convinced that R&D should play a bigger role in British industry. We also saw that its ideological heritage from the Thirties, and the experience of its leading ministers in running the war economy, had shaped its innovation policy in an anti-competitive, collectivist mold. It agreed on certain reforms with the FBI and leading Conservatives, such as giving tax breaks for R&D and spending more on the government's own research establishments. In addition Labour's agenda stressed cooperative research funded by compulsory levies, government powers to reorganize small firms into larger units better able to afford R&D, and a government development fund to aid the commercialization of promising inventions. Since Dalton, who had grown frustrated as wartime President of the Board of Trade when Conservatives successfully blocked these ideas, was now Chancellor of the Exchequer and Stafford Cripps was his energetic successor at the BOT, R&D reform had powerful backing.

However, apart from increased expenditure on DSIR and the RAs, civil R&D altered very little as a result of Labour's term in office. Cripps did not seek wider government powers to compel reorganization or to resurrect the BOT's wartime proposal for an Industrial Commission to oversee such efforts because he believed these subjects would arise only at a later stage of the government's work -- a stage which never came.¹ Anderson had arranged for the Bank of England to create two new private companies, partly government-funded, to provide loans and equity to socially valuable but risky new ventures: the Industrial and Commercial Finance Corporation for long-term needs, and the Finance Corporation for Industry for short and

¹ PRO, BT 64/2180, Cripps' notations at the end of an untitled memorandum by A. Kilroy, 21 Aug. 1945.

medium term ones. They were prudent rather than adventurous investors, however, and by 1949 ICFC had advanced about £15m and FCI about £11m, not enough to be a major force in helping industry modernize. Nor did they aim at consolidating firms into units better able to finance research.¹ The proposal for a central fund to aid the development of inventions through the pilot plant stage was upstaged by, and then melded into, the evolving plans for a National Research Trust (NRT) to encourage the commercialization of academic and other patents. These eventually took life as the National Research and Development Corporation (NRDC), discussed below, but the NRDC did not begin work until 1949 and did much less than had been hoped.

3.4.1.1 The Development Councils

The BOT's wartime plan for Industrial Boards to administer compulsory levies for aiding R&D, market research, export promotion and other socially useful purposes met a similar fate. Lord Barnby had proposed a bill in 1944 enabling trade associations to collect a compulsory R&D levy when 75 percent of their members approved, and as the Coalition was drawing to a close the BOT surveyed about 90 industries to assess their enthusiasm for such a scheme. Though none expressed hostility, only a dozen thought they might avail themselves and only two considered it urgent.² Cripps thought this response quite inadequate. 'Our general financial and economic position is such', he wrote,

that a high degree of industrial efficiency. . . is a national interest of the first importance. It will therefore be the business of the Government, and especially of the Board of Trade, to play a positive part in securing that British industry operated under

¹ Labour Party, Speaker's Handbook 1949-50, p 138.

² PRO, BT 64/2190, 'Industrial research bill: brief for second reading', 19 Nov. 1945; CAB 71/22, L.P. (45) 258, 'Statutory levies for industrial research associations and industrial development boards', memorandum by Cripps, 3 Dec. 1945.

private enterprise quickly reaches, and thereafter maintains, full efficiency.¹

He set up Working Parties of labour, management and outside experts to survey the needs of various industries, especially consumer industries which had suffered during the war, hoping that they would see for themselves the need for dramatic improvement and recommend a plan of action which the government could assist.²

It was clear to him in early December 1945 that many of the Working Party reports would endorse collective research as an inexpensive path towards modernisation, especially for small companies. Barnby's bill was still pending. But Cripps did not want to add another bill to Parliament's already crowded schedule, and his idea of how the levies should be used and administered was considerably more ambitious than Barnby's. So Cripps turned to the government's emergency economic powers and hastily secured the approval of the Lord President's Committee and then Parliament to a new Defence Regulation. It gave the government powers to collect a levy from all the members of an industry to finance collective R&D, export promotion and market research after 'consultation' with the industry. Cripps thought this would serve as a trial run for permanent legislation to be passed in 1947.³ A permanent Industrial Organisation Bill was introduced in January 1947 and passed in June, though no levies had been collected meanwhile under the Defence Regulation. It permitted any of eight ministers to set up a Development Council for an industry after consultations with it. Employers, workers and outside persons would be members of the Councils, which could

¹ PRO, CAB 129/1, C.P. (45) 142, 'The government plan for encouraging industrial organisation and efficiency', 1 Sept. 1945.

² Ibid.

³ HC Debates, Hansard vol. 418, col. 203-9, 23 Jan. 1946; L.P. (45) 258, op.cit.

impose a levy to promote scientific and market research, the study of industrial psychology, standardisation, exports, and the improvement of management, design, technical education and recruitment. Another section of the bill permitted the government to collect a levy for R&D or export promotion in industries where a full Development Council was not necessary.¹

Industry did not rush to take advantage of this bill. Only four Development Councils were established, one of which had been operating under special legislation since 1940 as the Cotton Board and two of which were dissolved by 1953. Only two industries without Development Councils instituted the specialised levies for research. Employers seemed to prefer disorganisation to a statutory body which gave workers and outsiders a majority in setting priorities, would compete against existing trade associations, might release trade secrets to competitors, and could prove the thin edge of the nationalisation wedge. Harold Wilson, who succeeded Cripps at the BOT in September 1947, created a Council for the important clothing industry despite substantial objection from the employers because poor cooperation between textile producers and machinery manufacturers was retarding technical progress,² and because the whole industry was plagued with seasonal unemployment, low-quality products and inefficiency. The employers resisted so stubbornly, however, that the Council 'was doomed to failure from the start',³ and the government decided to launch no more councils without employers' agreement.⁴ Though often the larger and more

¹ PRO, BT 64/2258, 'Industrial organisation bill', 27 Jan. 1947; Cripps papers, 222, 'Industrial organisation bill': brief for second reading', June 1947.

² PRO, BT 64/2353, 'Provision for development', 8 July 1948.

³ PRO, BT 64/2258, draft of H.A. [Home Affairs Committee] (53) 76, 'Industrial Organisation and Development Bill 1947', 29 July 1953.

⁴ PRO, CAB 134/644, P.C. 13th meeting, 12 July 1950.

research-conscious firms were willing to go along with a Development Council, especially in the industries where Working Parties had generated enthusiasm for compulsory levies, many smaller employers were suspicious. The postwar sellers' market made R&D seem less urgent than in 1945. And in the absence of sweeping economic controls, the government had no choice but to accept industry's verdict which rejected an expanded and institutionalised provision for cooperative research.

3.4.1.2 The RAs

Thus with a few exceptions the RAs remained small, poor and peripheral to their industries. This was so even though their numbers and wealth improved on prewar levels: 18 new RAs were formed between 1938 and 1948, bringing their total number to 37, and three more began by 1953.¹ The Industrial Grants Committee's wartime decision to drop the fiction that RAs should become self-supporting paved the way for a healthy growth in their resources, from approximately £1.2m in 1945 to £3.1m in 1950 (of which the DSIR grant comprised approximately one-third). Industry contributed the majority of the increase.² A conference of RA directors began meeting in 1945 to work out common problems, and the reports of the Working Parties identified the need for systematic inquiry into the properties of the staple materials of many consumer industries, to which cooperative investigation was well suited.

Yet serious problems remained: the scale of RAs' work, still tiny despite increased funds; poor facilities; and persistent confusion about the purposes and clients the RAs were intended to serve. In the 1940s the

¹ DSIR, Annual Report 1947-8, Cmd. 7761, p 62; Johnson, Co-operative Research, p 38.

² ACSP, Sixth Annual Report 1952-3, Cmd. 8874, para. 21; DSIR, Annual Report 1950-51, Cmd. 8773, pp 14-17, 51; Johnson, op.cit., p 43.

largest companies contributed no more than £250 annually to their RAs, small companies £25 or less.¹ In 1960 the RAs accounted for only four percent of British industry's total expenditure on research. (A higher percentage applied in the more backward industries, reflecting their paltry provision for internal R&D.)² A 1952 DSIR probe of the Leather RA, which served an industry with £87m annual sales, illustrates how RAs had to spread their resources 'too thinly over too many objectives'.³ Only half of the relevant firms were members. Their annual contributions of £30,000, added to the DSIR grant of £20,000, meant that the RA could spend only £50,000, or approximately 0.06 percent of sales, even though the annual savings accruing to the industry from the RA's work exceeded £300,000.⁴

The idea that the RAs would prove a ready vehicle for spreading the innovation gospel to small firms proved illusory. Two-thirds of small firms did not belong to one. (The same was true of only one-tenth of large firms.)⁵ Translating the RAs' findings into useful innovations almost always required the mediation of an in-house QSE; it was no use to small firms receiving RA bulletins in the post unless they made a considerable investment in internal R&D. The RAs' own extension services were almost always miniscule and ineffective. The DSIR Advisory Council did indeed make frequent pronouncements about the need to diffuse research results into industry, especially into small firms.⁶ It recognised that 'adequate liaison

¹ Appleton, 'The organisation and work of the DSIR', J. Inst. Metals 75 (1949) 988.

² FBI, 'Industrial research 1959-60', p 15; Johnson, op.cit., pp 59, 63.

³ ACSP, Sixth Annual Report, para. 22.

⁴ DSIR, Annual Report 1952-3, Cmd 9083, p 16.

⁵ FBI, op.cit., p 15.

⁶ See for example its Annual Report 1947-8, pp 22, 46.

departments' and frequent interchange of staff between the RAs and industry were essential, and even recommended an expanded programme of consulting work by RAs which would link science, engineering, economics and operational research to devise explicitly commercial solutions to industry's technical challenges.¹ But the Advisory Council never supplied the staff and money to make these bright ideas reality. By 1950, the furthest it would go in the direction of industrial relevance was a pious hope -- obviously unfulfilled in many RAs -- that 'ideally [the RA] staff should be sufficiently conversant with the technology of the industry to be able to show, on the plant, how research results could be used'.² Remedying this admitted inability of the RAs to get research results into industry was never an urgent priority. In addition, the infrequent flow of staff between RAs and firms harmed both since the hiring of knowledgeable outsiders turns out to be one of the most effective ways of transferring technology between organisations.³

A perpetual tension between short and long term objectives accentuated the shortage of resources. Smaller companies preferred the RAs to concentrate on R&D with a quick payoff, while larger firms liked them to tackle the fundamental studies which were too remote to be profitable. The compromise tended to be a least common denominator programme which was, in the words of an industrial R&D director, 'not of enormous value to anybody'⁴ and did not attract staff of the highest quality. RA directors felt

¹ DSIR, Annual Report 1948-49, Cmd. 8045, p 13.

² PRO, DSIR 17/422, minutes of special AC meeting 22 Mar. 1950.

³ Johnson, op.cit., p 52; W.H. Gruber and D.G. Marquis, 'Research on the human factor in the transfer of technology', in Gruber and Marquis, eds., Factors in the Transfer of Technology (London, 1969), p 261.

⁴ Johnson, op.cit., p 156.

that DSIR considered them 'scientific poor relations'.¹ The pressure to let short-term work elbow out basic research was accentuated by the country's economic plight, the additional economies required by rearmament after 1950, and progressively stiffer grant terms after 1950 to encourage the RAs to secure more industrial income.² This stiffening succeeded in reducing the share of RA funds coming from DSIR from 33 percent in 1950 to 23 percent in 1960,³ which may have pushed the RAs closer to industry — but at the cost of important long-term investigations.

Deprived of the Development Councils' bureaucratic backing and compulsory levies, the RAs never surmounted their status as Whitehall orphans suspended somewhere between industry and government. The RAs' own advisory councils met quarterly, and some did not even examine their own RA's grant application to DSIR's Industrial Grants Committee (IGC) for fear of 'offending someone' at DSIR.⁴ The IGC could not possibly follow the research programmes of individual RAs in detail, nor could the DSIR Advisory Council. When periodically the IGC or Advisory Council reviewed the RA scheme, their approach was resolutely incremental, recommending a few minor amendments here and there. They had neither political clout to insist that the RAs receive enough resources to catalyze industrial R&D effectively, nor sustained enough involvement with R&D to sense where promising alternatives might lie. In 1950, for example, Morrison asked the DSIR Advisory Council to study whether the RAs were making the greatest possible contribution to the national economy. He set out a fairly ambitious

¹ PRO, DSIR 17/277, report from H. Wooldridge, 21 Oct. 1946.

² Centre for the Study of Industrial Innovation, Research Associations; DSIR Annual Report 1951-2, pp 16-19.

³ Johnson, op.cit., p 42.

⁴ Ibid., p 96.

inquiry. But the Council reduced it to a harmless bit of bureaucratic tidying up. Its head Sir Ian Heilbron dampened the tone of Morrison's request in a way entirely characteristic of the part-time advisory committees which guided the RAs and DSIR in this period. In opening discussion, he assured the Advisory Council

that the Lord President was not suggesting any revolutionary changes, but his request required the Council to make certain that there was sufficiently close contact between the Department and the Research Associations to ensure that they were being given effective aid in serving their industries. . .¹

And the committee agreed that

care must be taken not to underestimate what Councils and Directors of RAs had already done. It might be that, being themselves part of the industry they served, they were best able to judge what was needed.²

Through this period routine approvals and reports take up almost all of the Advisory Council's minutes. The impression given is of a well-meaning but blandly conventional body decreasingly able to see beyond the bounds of the existing RA network to the needs of industrial innovation not yet being served.

It is not possible in this thesis to pronounce a verdict on whether the aid the RAs gave to British industry was 'enough' in some absolute sense. This would require a detailed examination of their work and its diffusion into individual industries and firms in relation to the cost of providing it. Certainly the annual reports of the DSIR contain examples of valuable contributions by RAs in diverse fields,³ and some industrialists spoke

¹ PRO, DSIR 17/422, minutes of special AC meeting, 22 Mar. 1950.

² PRO, DSIR 1/11, DSIR AC, 'Memorandum of a discussion on scientific research and the manufacturing industries', 22 Mar. 1950, p 3.

³ For example, see 1948-9, Cmd. 8045, pp 44-50; 1950-1, Cmd. 8773, pp 16-19; 1949-50, Cmd. 8169, pp 18-19.

warmly of them.¹ Retrospective analyses have been less kind. Johnson found that a majority of industrial research directors surveyed considered 'the RAs' non-research activities or their research into commercially non-significant areas as their main value', and concluded that the 'RAs have not been responsible for many important technological breakthroughs'.² Some contemporary observers shared the view that the RAs were overrated. A January 1947 Nature leading article criticized some Working Party reports for believing that cooperative research could obviate the need to build up internal R&D departments. It argued:

Any vigorous industry with private research establishments moves rapidly ahead of its co-operative research association in knowledge of the application of scientific work. . . .A research association cannot justify itself until an adequate body of research workers is employed privately by manufacturers to form a bridge between the association and the industry.³

Sir Ewart Smith told the ACSP in 1950 that 'there is widespread agreement that [the RAs] are not, in general, as effective as it was originally expected that they would be'.⁴ The DSIR's own probing review of three sample RAs in 1952 (of which the Leather RA study was mentioned above) revealed that confused priorities and -- most importantly -- lack of money and QSEs seriously burdened the work of all of them. Recurrent fiddling with the terms of the DSIR grant and frequent reorganizations of the RAs through the 1950s also point to unease about their activities. The weight of the evidence points to the RAs having more in common with their poor, weak interwar predecessors than those who presided over their postwar growth perceived.

¹ FBI, Industry and Research (London, 1946), pp 11-12.

² Johnson, op.cit., pp 156-7.

³ 'Research Associations in Great Britain', Nature 159 (18 Jan. 1947) 75-6.

⁴ PRO, CAB 132/68, S.P. (50) 4, Sir Ewart Smith, 'Comments on report on D.S.I.R.', 2 Jan. 1950.

3.4.1.3 DSIR

The DSIR's postwar development followed a pattern very similar to that of the RAs. Expenditure increased, but not nearly enough to carry out its plans for reconstruction, let alone implant innovation in the backward sectors of industry. Moreover, a serious shortage of QSEs and facilities continually prevented DSIR even from spending the money it was allocated. Its laboratories, underfunded and understaffed, came under heavy pressure to relieve the country's short-term economic crisis through 'band-aid' investigations for industry, then to help rearmament, while still struggling to pursue long-term fundamental studies. DSIR's headquarters and its Intelligence Division, in which so many hopes were placed for spreading 'research-mindedness' through industry, remained scrawny. Unable to surmount this crippling austerity, DSIR's leaders tried to make the best of the status quo, repeatedly suggesting 'better liaison' with the RAs and other existing bodies as their big hope for industrial innovation. DSIR was never given the resources to implement the creditable reconstruction plans of its Post War Developments committee (PWD) discussed in Chapter 2, let alone launch still newer programmes.

DSIR's budget grew from £654,000 in 1938-9 to £2.7m in 1947-8 and £5.9m in 1953-4, a ninefold increase (a fivefold increase if adjusted for inflation). In the same years its scientific staff multiplied by 2.5, from 918 to 1,626 to 2,297.¹ Its annual reports abound with accounts of useful work. The Radio Research Board, for instance, pioneered studies of how meteorological and electrical conditions of the atmosphere affected broadcasting and other electronic communications.² A special research trawler of the Food Investigation Organization conducted experiments aimed

¹ ACSP, Eighth Annual Report 1954-55, Cmd 9537, Appendix III, p 12.

² DSIR, Annual Report 1951-52, pp 13-14.

at preserving fish better on long sea voyages, important in a country facing food shortages.¹ The Fuel Research Station conducted studies in conservation, more efficient burning and the synthesis of oil from coal some of which helped the country avoid a repeat of the 1947 fuel crisis even as energy demand continued to rise.² A new Mechanical Engineering Research Laboratory was hived off from the NPL to give more attention to the science underlying manufacturing processes, and NPL's mathematics division gave attention to operational research, computers and the application of statistics to industry.³

Nevertheless, DSIR's public reports and internal documents are saturated with evidence of continuing poverty. The budget increases over the 1930s still did not represent very much money. In 1950 the Advisory Council determined that implementing the PWD's postwar plans would have required a budget of £4.6m each year from 1946, corresponding to £7.5m at 1950 prices, and about £10m worth of new buildings; staff would have had to double, to about 4000.⁴ Though at Morrison's instigation the Lord President's Committee approved a DSIR programme of that size in 1946,⁵ neither the money, the people nor the buildings materialized.⁶ In 1950-1 DSIR spent

¹ DSIR, Annual Report 1954-55, Cmd. 9690, p 12.

² DSIR, Annual Report 1949-50, p 13.

³ Moseley, 'NPL', pp 268-72.

⁴ DSIR, Annual Report 1950-51, pp 10, 12.

⁵ PRO, CAB 132/1, L.P. (46) 68, 'Research programme of the DSIR', 20 Mar. 1946; CAB 132/2, discussion at L.P. (46) 11th meeting, pp 5-7.

⁶ It is not clear from the record why this decision by the Lord President's Committee was not enforced. Morgan and Cairncross both point to its weakness as a coordinating body. Morgan, op.cit., p 49; Cairncross, op.cit., pp 50-1. One can only surmise that the Treasury, which gradually reasserted its authority over Whitehall after wartime weakness, exercised actual control over how much DSIR received, and that Morrison did not contest the reduction.

£4.9m, 65 percent of what its plans called for. Its QSE and administrative staff numbered 3000, 75 percent of its requirements.¹ In 1947-8 it was allowed to spend only £50,000 on new buildings,² and when in 1950 it finally seemed that yearly capital expenditure might reach the £1m agreed upon with the Treasury, Korean War economies slashed the level by more than half.³

The Advisory Council issued progressively sterner warnings about the havoc this parsimony was causing. 'Progress has been slower than we had hoped on account of the difficulties. . . of getting the necessary staff and new laboratories', it said in its first postwar report.⁴ In 1951 it drew repeated attention to DSIR's stunted postwar growth, especially the 'extremely disappointing' progress in building, and concluded ominously:

If this country is again to be prosperous, British industry must make science a real and living force in its daily life. There is no need to learn this lesson, as we have learnt so many in the past, through bankruptcy and unemployment, but time is getting short.⁵

The following year it reported 'anxiety' and 'deepening concern' about the 'relation between our scientific needs and our scientific resources', and said it remained 'firmly of the view that there is no alternative to the planned expansion of D.S.I.R. that our predecessors recommended six years ago'.⁶ Yet in the following four months the Treasury cut DSIR's existing staff by 25 and eliminated 217 unfilled positions, an overall reduction of seven percent. And this came on top of a thorough 'recasting of DSIR's research

¹ DSIR, Annual Report 1950-51, pp 10, 12.

² ACSP, Eighth Annual Report, Appendix III, p 12.

³ DSIR, Annual Report 1950-1, p 10.

⁴ DSIR, Annual Report 1947-8, p 3.

⁵ DSIR, Annual Report 1950-51, pp 10, 23.

⁶ DSIR, Annual Report 1951-52, pp 13, 15.

programme in the interests of defence' in the wake of the Korean War.¹ In 1953 DSIR's Secretary Sir Ben Lockspeiser concluded a depressing tour of its privations with an account of his struggles to wrest from the Treasury an 11 percent funding increase over five years:

This seems to me a very modest increase, but even so I fear it will not prove acceptable to the Treasury unless there is a change of heart there and they recognise that D.S.I.R. does not fit neatly into the category of a spending department, but is in fact an inescapable national investment.²

The cost to industrial innovation of shackling DSIR's postwar programme comes out most vividly in examining the effects on individual labs and the new Intelligence Division. In 1952 the Mechanical Engineering Research Laboratory was still scarcely one-quarter built, yet suffered another cut in its building programme. Its German counterpart, also begun after the war, was more than two-thirds completed and was operating. The Fuel Research Lab's industrial site was so polluted by combustion products that it could operate only at two-thirds capacity. The Water Pollution Research Lab had unsuccessfully sought new facilities since 1927.³ The Geological Survey was so inundated with short-term work that it had to drop the detailed mapping of 33,000 square miles on which important decisions about mining, civil engineering projects and water supplies depended.⁴ The NPL too was swamped with routine testing and had difficulty, due to meagre resources, in striking an effective balance between short and long term work; a difficulty sharply accentuated by the Korean War, which halted all expansion and diverted most civil research and

¹ PRO, DSIR 17/278, memorandum from DSIR Secretary Sir Ben Lockspeiser to Lord President Woolton, 27 Mar. 1953.

² Ibid.

³ HL Debates, Hansard vol. 177, col. 86, 11 June 1952, statement by the Earl of Halsbury.

⁴ DSIR, Annual Report 1952-53, p 15.

industrial liaison into defence work.¹ Lockspeiser's 1953 memo to Woolton gave several examples of important programmes which DSIR establishments had recently eviscerated because of lack of funds and excessive attention to defence: extracting valuable materials from low-grade ores and wastes; producing scarce substances with micro-organisms; and most important from industry's viewpoint, NPL's research into factory automation which 'had to be reduced to a "man and a boy" basis'.²

The Intelligence Division was perhaps the most imaginative of DSIR's postwar creations, aimed at bridging the gap between lab and shop floor with an array of liaison officers, libraries, publications, films and conferences. Its first director, W.L. Francis, estimated that a staff of 20 would be needed by 1948, which was endorsed by O.F. Brown, the DSIR official in charge of reconstruction programmes. The Treasury saw things differently. A staff of four was authorized for 1946, but two of them were not appointed.³ Francis, appointed in September 1945, spent most of his first year arranging the British Commonwealth Scientific Conference and could not get anyone to be hired for the intelligence work 'which is generally agreed to be urgent'.⁴ DSIR documents reveal extremely poor communications within the organization itself, let alone with businesses outside; the report of a headquarters official who interviewed many of the RA and DSIR lab directors in 1946 said that 'one point which [they] all made without any conscious prompting was that they did not know what each other was doing'.⁵ In 1947-48 the Intelligence Division spent only £24,000. It had

¹ Moseley, op.cit., pp 285 7.

² DSIR 17/278, Lockspeiser memo. op.cit., Appendix.

³ PRO, DSIR 17/291, minute from O.F. Brown, 13 May 1946.

⁴ PRO, DSIR 17/291, memorandum from W.L. Francis, 11 May 1946.

⁵ PRO, DSIR 17/277, report by H. Wooldridge, 21 Oct. 1946.

neither the QSEs nor the money to create a staff which could mediate between industry and the DSIR; instead it had to rely on pamphlets (100 published in 1948-49), occasional articles by contract journalists, press releases, radio programmes at unpopular hours, monthly abstracts of important scientific discoveries, and exhibitions. The DSIR and the RAs combined fielded more than 100,000 requests for information each year.¹

The idea of providing a full-fledged extension service to act as a conduit between manufacturers and laboratories, demonstrating new techniques locally just as the agricultural extension service did for farmers, provoked occasional curiosity.² The conviction was widespread that good liaison work depended upon robust personal contacts for which printed materials substituted feebly. But an effective R&D extension service would have required so much government finance and so many scarce QSEs that no plans for one were ever seriously considered. In 1945 a BOT official sketched out an extension service in embryo, where R&D officers in each BOT region would help individual firms innovate. Norman Kipping, BOT under secretary, replied that research 'raises questions of general policy rather than day to day detail and is not comparable with the case for Export Officers. Accordingly I doubt whether special officers would be kept occupied'.³

The next grope towards an R&D extension service came from industrialists in Manchester and won DSIR support, but its scale was so puny that little came of it. This was the Manchester Joint Research Council

¹ DSIR, Annual Report 1947-48, p 96, Table I; PRO, DSIR 17/295, A.C. (47-8) 89, 'D.S.I.R. publicity activities', 14 July 1948; CAB 134/591, OP (48) 13, 'Dissemination of results of D.S.I.R. work', 10 Dec. 1948.

² Labour Party, 'A new deal for science', May 1949, p 9; Tizard papers. HTT 597, 'Bridging the gap between science and industry', 1949, p 2.

³ PRO, BT 64/2134, letter from R.F. Kahn to Kipping, 22 Nov. 1945; reply 5 Dec. 1945. [Kipping soon became FBI Director-General.]

(MJRC). A collaborative effort of Manchester University and area businesses, it was formed after a 1944 speech by Appleton to the Manchester Chamber of Commerce about the value of research. Sir Raymond Streat, a committed booster of DSIR's Intelligence Division who served on the DSIR Advisory Council as well as PWD, was one of MJRC's driving forces. At an October 1946 MJRC conference on 'research and the smaller firm' which attracted representatives of 200 firms, many of the comments from the floor dealt not with fundamental research but information services, the problem of absorbing and applying what was already known. The conference endorsed the then popular notion of designating a Development Officer in every firm, responsible for identifying relevant research and adapting it to the firm's needs.¹ To give some practical support to firms tempted to embark on R&D, the MJRC also appointed an Executive Liaison Officer attached to the Chamber of Commerce. He became a one-person fire brigade, telling various firms about subjects ranging from flax drying to the use of internal combustion engines in mines.² MJRC published a well-received book on the application of OR to industry and started a survey of the research practices and needs of firms in the northwest to which DSIR contributed £10,000.

But again the scale was inadequate. The survey, employing two full-time and one part-time investigator, took more than four years to complete, years when its hard data about research practices, costs and benefits would have been extremely valuable to firms and Whitehall. To expect one liaison officer to serve thousands of diverse firms was ludicrous, a curious throwback to Streat's 1943 idea of a single 'consultant-general' to advise industry from DSIR. Streat himself uneasily recognized the mismatch between MJRC's size and task in his final speech as its chairman in 1951;

¹ MJRC, 'Research and the smaller firm', Oct. 1946.

² MJRC, 'Annual Report for 1949', Manchester 1950.

from his defensiveness one can infer much criticism. 'The great difficulty which faced the Council' at its inception, he said,

was the vastness and the vagueness of the problem. I think we were all conscious that what was required was that the thinking and practices of literally thousands of separate organisms in our economic structure should be so influenced as to lead to a new trend or tide. . . .The part played by any one person or single institution need not be comprehensive or conclusive in itself. . . . Viewed in this way I think our action in establishing the MJRC eight years ago was well-conceived. . . .We certainly have no cause to be ashamed of our activities. Our liaison work has been, I think, much more useful than some members of the Council realise.

He accurately concluded: 'Communications and liaison work have to be developed to a degree far and away beyond anything we have yet visualised if scientific knowledge is to fertilise industrial efficiency to the utmost extent'.¹

That the MJRC's puny scale had crippled it, however, was lost on the DSIR Advisory Council, always forced to work on the cheap. It found the MJRC liaison service a promising model and told the Lord President it wanted to 'explore the possibility of establishing local technical information services, based on Chambers of Commerce and other suitable local organisations'. This would save 'the expense of setting up regional D.S.I.R. offices'. The Council agreed that 'some government encouragement might be desirable', but was none too direct in offering it. 'We should hope', it wrote passively, 'that any well-founded application for financial assistance for such a scheme would be sympathetically considered'.²

DSIR was not oblivious to its weaknesses. Its officers knew that money and staff were chronically short. It conducted occasional self-examinations, and sometimes faced outside scrutiny. But there is a cloistered feel to most

¹ MJRC, 'Annual Report for 1951', Manchester 1952.

² PRO, DSIR 17/422, 'Report by the Advisory Council for Scientific and Industrial Research to the Lord President on the objectives of D.S.I.R.', July 1950.

of these documents. The existing structure of DSIR and the RAs was taken as given, something which might be tidied but never fundamentally questioned. In 1946, for instance, DSIR's review of how well it was serving other departments 'discovered [no]thing startlingly new'. The DSIR and RA labs were 'giving other Departments all the assistance that their staff and facilities permit, but. . .given greater facilities, they could with advantage give more assistance'. Liaison between DSIR and the RAs and between both of them and industry could be improved, but it was 'all a question of personal arrangements'.¹ In 1948 the Department told an official committee surveying the contributions of various departments to the productivity drive that it was 'tak[ing] all possible steps to make known the results of its work and the services it can render', betraying either a lack of imagination about other publicity methods or depressed ambition due to relentless austerity. The committee's view of how DSIR might improve itself sounded familiar themes: better liaison among DSIR, the RAs and government departments; better publicity; encouraging the RAs to conduct more OR.²

Lockspeiser replaced Appleton as DSIR Secretary in May 1949. Unencumbered by memories of past defeats, he quickly advanced a fresh conception of DSIR's responsibilities which would justify sharp growth. His central idea was to stitch DSIR much more closely into the making and execution of the national economic plan. He wanted DSIR to encourage economic, sociological and operational research in industry and in response to new technical developments from government labs. Thus it would need more resources. Most significantly, DSIR was to direct the RAs (which would also expand vigorously) rather than guide them informally, to make sure that

¹ PRO, DSIR 17/277, summary of Wooldridge report by Eric Barnard, 7 Nov. 1946.

² PRO, CAB 134/591, O.P. (48) 4th meeting, 15 Nov. 1948.

research results really did get into industry with the urgency that Britain's plight demanded. Its headquarters would work closely with the departments which oversaw particular industries, like the BOT and Ministry of Supply, and with nationalized firms. The headquarters staff would be 'strengthened very considerably' and given executive authority instead of having to rule through countless committees. Lockspeiser, who had previously directed R&D in the Ministry of Aircraft Production and the Ministry of Supply, thought the economic crisis warranted powers for DSIR akin to those the wartime economic ministries possessed: 'D.S.I.R. . . seems to have reached a stage where it must either be given new life and brought up-to-date with the realities of our economic situation, or it will almost certainly continue to drift further and further from the centre of Government activity. . . .'¹ This memo, with its robust call for a strong government hand on the R&D tiller, seems to have as ideological parents the FSP radicals' plan for a strong scientific secretariat, and the BOT-Cripps plan for Development Councils that would make industry more responsive to national priorities.

Like them, it had a brief and futile life. For the Bernalist impetus was by now completely spent. Government planning was beginning to lose its political magic, Labour was fatigued and Conservative criticisms of austerity and controls were hitting home. Now people like C.E.K. Mees, far from crying in the wilderness, held the initiative in R&D policy, arguing that innovation policy should decentralize responsibility as much as possible into the individual firm. He testified to the ACSP in June 1947 that

the prevailing attitude towards research in Britain was too disinterested, and that there was a widespread tendency to forget that scientific knowledge would be useful to industry only if it could be, and was, applied by technologists [in industry itself]. . . . [R]esearch associations in Britain were inclined to overlook this,

¹ PRO, CAB 132/67, S.P. (49) 63, 'Report on the D.S.I.R.', 2 Dec. 1949, pp 4, 10.

and to concentrate too exclusively on fundamental research for its own sake.¹

On the ACSP, which considered Lockspeiser's memo, this view's most thoughtful proponent was Sir Ewart Smith, ICI's former chief engineer. To suggest that the DSIR or any other central group 'should play an effective part in analysing research problems, directing the work and "seeing that its results are applied" for the whole field of industry', he said, would be 'attempting what is manifestly impossible'. Observing that the most successful RAs served industries already advanced, he argued that 'effective improvement can only come by getting the scientific attitude into the "user" organisations'. Thus he wanted the RAs to employ for a few years the greatest possible number of good QSEs and then 'sell' them to appropriate firms. 'In my view, there is no better way of spreading knowledge than to move [those] who possess it to the points where its uses will be beneficial'. Instead of building up DSIR, he thought it would be best to hive off appropriate labs into the relevant government departments whence they could infiltrate daily decisionmaking. As support he cited the impressive scientific progress of the Ministry of Fuel and Power, which had its own research unit, compared to the backward Ministry of Works whose mandarins had refused one. DSIR would help industry most if its attitude was 'to serve and educate. . .not to control'.²

One might expect that a clash of views between such able and experienced disputants, reflecting much deeper thought than the predictably rote in-house reviews of DSIR by civil servants, would lead to some real sharpening of its role. On the contrary: the end product of this debate was another mass of inconsequential pabulum. The ACSP agreed with Lockspeiser

¹ PRO, CAB 132/64, S.P. (47) 6th meeting, 12 June 1947.

² PRO, CAB 132/68, S.P. (50) 4, Sir Ewart Smith, 'Comments on report on D.S.I.R.', 2 Jan. 1950.

that DSIR should try to do more to relieve the economic crisis. It implied, but did not directly state, support for strengthening the DSIR headquarters staff. On the main issue of whether DSIR should direct the RAs or instead devise novel ways of improving their capacity 'to educate and serve', however, the ACSP told the Lord President that 'it [did] not feel competent to advise on the[se] administrative changes'.¹ So once again the status quo prevailed by default.

The DSIR thus muddled onward, unsure of its role. One frustrated member of its Advisory Council, the Earl of Halsbury, complained to Tizard in 1952 that the directors of RAs and DSIR labs were 'themselves products of the industrial system. . .and tend to perpetuate rather than correct. . .its faults'. The Advisory Council spent 'the greater part of [its] time. . .hearing about Directors' difficulties in getting money out of the members and [its] difficulty in getting the Government contribution out of the Treasury'. He concluded that it was a 'conscientious but essentially passive critic of propositions brought to it for assent, comment or authority. . . .What else can you ask of part time voluntary unpaid workers meeting once a month'? Tizard replied: 'If this is true the Council is of very little use in these times of emergency'.² In 1955 a highly critical report tried to remedy the Advisory Council's passivity, recommending its dissolution in favor of an Executive Council empowered to control the actual research programmes of DSIR and RA labs instead of giving their directors autonomy within broad budgetary limits.³ Parliament passed the necessary legislation but it did not reverse DSIR's lackluster reputation as Britain's technological decline

¹ PRO, CAB 132/68, minute from Tizard to Morrison, 12 Jan. 1950.

² Tizard papers, HTT 508, letter from the Earl of Halsbury to Tizard, 29 Oct. 1952; reply from Tizard, 26 Nov. 1952.

³ DSIR, 'Report of a committee of enquiry' [Jephcott committee], Cmd. 9734, 6 Oct. 1955.

became more glaring in the late 1950s. When Harold Wilson's Labour government created a Ministry of Technology, DSIR's functions were folded into it.

3.4.1.4 The NRDC and other BOT initiatives

The only government institution aimed at aiding civil R&D born under Labour was the National Research and Development Corporation (NRDC), which began work in 1949. It originated in wartime debates over patents, which were then suffering a period of poor reputation. The belief that big companies bought up promising inventions and shelved them to protect existing products and processes was common in the Labour Party; so was a faith that during reconstruction secrecy and selfishness in industry should be subordinated, as in wartime, to the public good. At the 1944 Nuffield conference on postwar R&D, even industrialists like Samuel Courtauld thought blocking patents 'a real evil',¹ a belief bolstered by the unsavory prewar dealings of the international chemical cartel of which ICI had been a member. In March 1944 Dalton wrote Woolton, then Minister of Reconstruction, proposing a patent inquiry. 'I wonder', he wrote, 'whether the present patent system is consistent with the new expansive economy we hope to develop. . . .I think there is a strong case for saying that the facilities for obtaining licenses should be greatly extended'.² Woolton agreed and a committee was set up under Kenneth Swan, a patent lawyer, which issued its first report in April 1945. Despite Dalton's expansive hopes, the committee first took up the technical issues arising from patent rights lost because of

¹ Fabian Society papers, G59/5, 'Nuffield conference', Jan. 1944, item 4, p 20.

² PRO, CAB 124/586, letter from Dalton to Woolton, 7 Mar. 1944.

the war.¹ Subsequent recommendations simplified the system for obtaining and litigating about patents, but did not challenge its basic assumptions.²

On the larger issues defenders of the existing system began to mount their case publicly in 1944.³ They pointed out that profit was likely to remain the most effective incentive for individuals and companies to risk the heavy development costs of bringing an invention to market. The law already permitted the patent comptroller to reassign patents which were dormant or had been taken out mischievously. In the absence of a consensus among QSEs and industrialists, neither the Coalition nor Labour felt confident about adopting the radicals' preferred system of letting any competent manufacturer obtain a license for any patent on the promise of paying a suitable royalty. But the anti-patent impulse continued to operate, and attached itself to the proposals for a National Research Trust (NRT) which, as we have seen, had emerged from the wartime SAC.

Despite the BOT's strong desire, expressed in 'General support of trade', for a large fund to help commercialise promising new inventions, Dalton as Chancellor of the Exchequer endorsed in November 1945 the weak compromise of his predecessor Anderson that departments should fund development out of their existing budgets⁴. Why he took this decision is not apparent from the record. Nevertheless it seems that he had not entirely given up on some kind of separate fund, for which many important scientists

¹ 'Patents and Designs Acts, First Interim Report of the Departmental Committee', Cmd. 6618, Apr. 1945.

² PRO, CAB 129/27, C.P. (48) 122, 'Patent law reform', memorandum by BOT President Harold Wilson, 7 May 1948.

³ Francis Hughes, 'Notes on the prospect confronting post-war British patent property', Agenda 3 (1944) 48. Other endorsements of the existing system can be found in 'Scientific and industrial research in Great Britain', Nature 153 (11 Mar. 1944) 293-6; PRO, BT 131/61, RFS (26 Feb. 1944) 206-7.

⁴ PRO, CAB 71/27, L.P. (I) (45) 5th meeting, 26 Nov. 1945, discussion on 'Patents and testing of new processes', p 3.

including Tizard were continuing to press. Dalton, Cripps and Morrison began to concentrate on making the NRT the vehicle for this fund, despite its original conception as a colourless body for accepting patents from government scientists and academics. In November 1946 they agreed to establish a committee to examine how such an expanded NRT, 'which ought to be given a wide financial discretion', might operate.¹

The committee reported in July 1947 after extensive interdepartmental debate. The report can be viewed as a BOT return salvo against the Treasury and DSIR opposition which had scuttled its development fund proposals in 1944-45. Indeed it seems a remarkable feat of bureaucratic resurrection. The committee agreed that the growing number of patents arising from government, university, and charitably funded research justified a central repository to promote their commercial exploitation. This body, to be called the National Research and Development Corporation, would need powers to seek out valuable patents as well as accept those offered, and perhaps even powers of compulsory acquisition. Departing from Anderson's view that government departments already possessed adequate powers to secure the development of promising inventions, the committee wanted the NRDC to 'itself have full and direct responsibility. . .for ensuring that the products of patents of national value held by it are both manufactured and made available to the public "as widely and as cheaply as possible"'. That implied powers to provide finance to private companies and even to create new ones. A full-time managing director would run the corporation.² Treasury officials had tried to deny the NRDC all authority beyond acting 'in a purely passive manner' to accept academic and government patents, but

¹ Ibid.

² PRO, BT 64/2194, 'Report of the National Research Trust Committee to the President of the Board of Trade', 17 July 1947.

Cripps and Dalton ensured that the BOT view prevailed -- at least in the committee's report.¹

A bill creating the NRDC won Parliament's approval in July 1948. Harold Wilson, then President of the BOT, recognised that the NRDC would have to secure the cooperation of industry to succeed and toned down the report's recommendations to mollify Conservatives. The most important safeguard he inserted allowed the corporation to take up private patents only if they were not being otherwise exploited, thus preventing it from using public money to compete with private enterprise. In practice this meant that the NRDC had to 'wait till an invention [was] brought to [its] notice and then say Yes or No'.² Powers of compulsory acquisition were also eliminated. Although the Corporation was given powers to create subsidiaries for the development of particular inventions, the expectation was that normally it would contract with government bodies or private firms. And the corporation was expected to repay the government's £5m loan.³

Sobered, perhaps, by the struggles of the industries which BOT oversaw in turning good ideas into properly engineered and marketed products, Wilson doubted that the NRDC would liberate a host of useful innovations from dusty laboratory shelves. He believed that 'on the whole' private firms were already 'extremely successful in developing. . . inventions' and told the Commons that he did not 'pretend that [this bill] will do anything spectacular to improve. . . research'.⁴ Conservatives were even more sceptical, fearing that the NRDC would get stuck with inventions which private firms had

¹ PRO, BT 64/2190, minute from R.F. Kahn to Nowell, 25 July 1946.

² Tizard papers, HTT 508, letter from NRDC Managing Director Halsbury to Tizard, 29 Oct. 1952.

³ HC Debates, Hansard vol. 451, cols. 2692-2703, 11 June 1948.

⁴ Ibid., col. 2703.

already rejected as commercially useless, but did not oppose the bill. This was not much of a welcome for the only new organisation for civil R&D during reconstruction.

Like the RAs and DSIR, the NRDC did some good work. It aided computers, the Hovercraft, cephalosporin, fuel cells and many less famous technological developments. It certainly eased the administrative work of university, government and charitably funded labs which uncovered promising ideas but had no interest in developing them. But its original premise -- that academics and garage tinkerers were failing to bring inventions to market because of ignorance or rapacious private companies -- was wrong. The barriers to successful innovation were much more complex than the NRDC could remedy: a shortage of scientists and especially engineers in industry, backward management, poor connections between labs and potential end users, and the low status of applied work, to name a few. Assuming that academic scientists would step forward with a bagful of ideas if freed from the taint of personal gain was in itself a symptom of 'pure science' snobbery, and revealed the continuing power of the 'research-push' model of innovation. The NRDC spent only one-third of its £5m in its first five years. It noted that 'our . . . experience has failed to confirm that a multitude of meritorious private inventors stand in need of public assistance';¹ by 1967, having sifted 6000 private inventions, it found that only one percent deserved help.²

Nor did government support guarantee commercial success, as computers and fuel cells demonstrate. Perhaps the cautious scale of investment and passive terms of reference prevented the NRDC from backing new ideas as forcefully as success required. Even if the NRDC had been

¹ NRDC, Annual Report 1953-4.

² 'Bridging the gap for inventors - the NRDC', Times 28 Apr. 1967.

much more active, however, its function still would have been peripheral to the development of civil science, filling gaps rather than altering the whole enterprise. As its first director observed, 'there is [still] no body within our present constitutional and administrative structure which can actively initiate specific research directed towards strategic [economic] targets'.¹ The 'strategy of science' was still a patchwork quilt, not a planned tapestry.

During the Labour government the BOT put forward other proposals for improving R&D in the industries over which it had charge. None showed imagination. They came from civil servants, who seemed not to conceive of any solution beyond better liaison with the DSIR and RAs. They got nowhere. DSIR resisted BOT intrusion on its turf, and the Board could not afford to establish separate research labs to aid its industries. Starting in 1944 the BOT sought to place its officials on the councils of the relevant RAs, but DSIR considered this a threat to the RAs' autonomy. Protracted negotiations produced nothing.²

Tizard almost succeeded in enabling the BOT and other departments to create strong, independent science units, but was foiled by opposition from DSIR and Barlow. In a position remarkably similar to what later became famous as the Rothschild 'customer-contractor' principle, Tizard argued in 1947 that individual departments should designate a chief science adviser backed up by an advisory council, empowered to set out research programmes and pay for their execution by DSIR or outside labs as they saw fit. Tizard believed that this system, modeled after the one used in aeronautical research, would promote the swift and effective application of research

¹ Tizard papers, HTT 580, letter from Halsbury to Tizard 29 Oct 1952.

² PRO, BT 64/3779, O.S.R. 4, 'History of discussions with D.S.I.R.', Nov. 1947.

results.¹ Appleton, however, wanted to ensure that DSIR remained the sole provider of civil research to the departments, and Barlow was again averse to institutionalising within Whitehall a series of powerful advocates for science who might stir up trouble for ministers and their senior civil servants.² Despite support from other scientists on ACSP, Tizard capitulated on the essential points. Ministers remained free to establish whatever form of scientific organisation they pleased, and DSIR by default retained its powers to execute civil research.³ In the year which followed these ACSP recommendations, only two civil ministries -- Food and the Home Office -- joined the four which already had science advisers. The BOT was not among them.⁴

But the ACSP's report on departmental science organisation still made a ritual bow to departments' control over research in their exclusive areas of responsibility, and BOT seized upon it to make a bid for greater powers in industrial R&D. It promptly set up a working party which recommended that the BOT have extensive contacts with RAs in the industries which it oversaw, send observers to their council meetings, and create its own scientific unit to encourage appropriate research in government laboratories and disseminate results to industry.⁵ This would be on top of the BOT's already active Special Research Unit, whose six social scientists conducted

¹ PRO, CAB 132/64, S.P. (47) 12, 'Government organisation for scientific research', 1 Apr. 1947.

² PRO, CAB 132/64, S.P. (47) 2nd meeting, 10 Apr. 1947; 3rd meeting, 1 May 1947.

³ PRO, CAB 132/64, S.P. (47) 25, 'Government organisation for scientific research', report to the Lord President, 12 May 1947.

⁴ ACSP, Annual Report, Cmd. 7465, July 1948, para. 12.

⁵ PRO, BT 64/3779, O.S.R. 1, 14 Oct. 1947; BT 64/2438, O.S.R. 13, May 1948.

economic and operational research for industry's benefit.¹ By 1949, however, no BOT scientific unit had been established due to difficulties with funding, staffing, DSIR, the unusually broad range of industries BOT oversaw, and Treasury opposition.² Moreover by 1949 the Special Research Unit had declined to two people, one of whom had tuberculosis, and it was folded up pending the creation of the scientific unit, which in the end was not created.³

So the BOT, hotbed of civil science reform during reconstruction planning, could hardly point with pride to its accomplishments under Labour. No Industrial Commission, few Development Councils, bad contacts with the RAs, no internal scientific staff, an NRDC with passive terms of reference -- hardly the brave new world for science Labour had intended. This stemmed from business opposition to compulsory levies and the government's role in collecting them, the Board's tangled internal communications and high staff turnover, austerity, and the lack of any defined role within the government for the BOT in civil science. In addition, Cripps and Wilson paid more attention to productivity than to R&D, as we shall see. If the plans for R&D they inherited from the war failed or were sidetracked, they had no ready stock of new ideas to fall back on, nor the time to develop any.

3.4.2 R&D in private industry

By the end of reconstruction the government had managed to construct very little of its original blueprint for R&D policy. Mostly it had tacked

¹ It examined, for example, which types of products made the best exports on the basis of net value added per person-hour, and where the greatest opportunities for standardisation lay. PRO, BT 64/2293, 'Annex to OM/62', Mar. 1947.

² PRO, BT 195/28, minute 50, Pankhurst to Blaker, 2 Nov. 1948.

³ PRO, BT 64/2438, minute from S.A. ff. Dakin to Nowell, 30 Mar. 1949; brief for Wilson by Dakin, July 1949.

additions onto existing structures on a scale smaller than required, and the resulting complex had a ramshackle appearance. Of course, this would not have mattered much had industry's own commitment to innovation been independently robust. Was British civil R&D thriving heedless of all the Whitehall battles about it? Was there enough of it? Were its priorities correct?

Before we can address these questions directly, another area of government policy which forms an essential background to them must first be considered. The most important government influence on R&D within industry was the heavy priority it gave to military research. Much has been written asserting that Britain's postwar capacity for successful civilian innovation was choked by the mammoth claims of defence upon research funds and personnel.¹ An authoritative conclusion on this subject would require lengthy and complex statistical analysis beyond the scope of this thesis. Since national survival must be any government's first responsibility, there is no way to be sure that the heavy defence bias of R&D spending was wrong even if civil industry suffered as a result. It is only possible to point to the consequences.

The weight of the evidence suggests that Britain's pattern of R&D spending after 1945 was a mistake, squeezing civil innovation, capital investment, productivity and ultimately prosperity in an interlocking cycle of decline. There is no doubt that in absolute terms civil R&D fared considerably better than before the war; in 1946 the FBI estimated that industry was spending approximately £20m on it (wholly apart from defence contracts), about four times the 1938 level, and employing about 10,000

¹ For a small sample of this literature, see Maddock, 'Science technology and industry'; Merton J. Peck, 'Science and technology', in Caves, Britain's Economic Prospects, pp 448-484; Mary Kaldor, 'Technological change in the defence industry' in Pavitt, ed., Technical Innovation; ACSP, 10th Report, p 8; and Pollard, Wasting of the British Economy, p 40.

QSEs, double the 1938 level. QSE employment doubled again by 1960.¹ In 1951 Tizard put industry's annual self-generated R&D expenditure at £30m, which, added to the government's spending, meant at least £40m was going to civil research.²

What of defence research? Cold war tensions, the increasing sophistication of weapons³ and the widespread assumption that Britain should and could remain a great power meant that civil R&D always took a back seat to defence work, even before the Korean War. Of the government's £76.5m R&D expenditure in 1946-7, at least 65 percent went to defence.⁴ This occurred despite FSP's strong recommendation that military research should be the country's third priority for scarce QSEs, with teaching and basic science first and civil R&D second.⁵ The share of government R&D expenditure devoted to military investigations rose steadily during the Attlee government, and was given a stiff upwards jolt by the big rearmament programme following the Korean War. Staff and facilities of DSIR and other civil departments were pressed into defence pursuits.

¹ FBI, 'Industry and research', 1943, p 7; Industry and Research (London, 1946), speech of Sir William Larke, p 11; 'Industrial research in manufacturing industry 1959-60' (London 1961), p 79.

² PRO, CAB 132/69, S.P. (51) 12, 'Industrial research', 29 Mar. 1951.

³ See Winston, 'Defence production', p 13.

⁴ Another 21 percent went to industrial research; ten percent to general support of science through grants to universities and individual investigators; and agricultural, medical and colonial research absorbed the remaining four percent. Parl. Papers 1946-7, Select Committee on Estimates, Third Report, 'Expenditure on Research and Development', July 1947, p 26. Tizard told the ACSP that the estimate of 65 percent to defence research was 'quite inaccurate' but did not specify an alternate figure, possibly for security reasons. Judging from how much went to defence R&D in the early Fifties, when statistics were first systematically collected on the subject, and from Tizard's repeated overestimates in this period of the QSEs and funds being devoted to civil R&D [see page 206], the 65 percent estimate seems reasonable. PRO, CAB 132/64, S.P. (47) 8th meeting, 20 Aug. 1947.

⁵ 'Scientific man-power', para. 59

Between 1950-1 and 1952-3, DSIR suffered a 10½ percent real decline in funds; the funds that remained were also steered more heavily towards defence work.¹ By 1955-6 defence claimed 80 percent of the government's £300m research outlay. Since the government was responsible for 76 percent of total national research expenditure, 60 percent of Britain's total allocation for research was going to military investigations. And because the cost of military research per QSE was greater than for civil R&D, this spending level meant that about 80 percent of the country's QSEs were engaged in defence work.²

Civil R&D and productivity were important, but could not stand that kind of competition. For example, Morrison was extremely proud of being civil science's patron, but when the new Chancellor, Hugh Gaitskell, asked for spending cuts to finance rearmament, Morrison instructed his staff: 'We must help all we can in every field, inc[luding] science. Pls look around'.³ Britain then took upon itself a heavier rearmament burden in proportion to its economy than any other country including the United States, even though the economy had not yet fully convalesced and the Korean War was overwhelmingly an American one. Unwilling to finance the £700m defence increase in the 1951 budget solely from new taxes, Gaitskell lanced investment; one casualty was the initial allowances on new plant, buildings and machinery introduced to general acclaim by Anderson in 1944 and increased by Cripps in 1949, one of the few potent inducements to

¹ HC Debates, Hansard vol. 518, col. 120, statement by Austen Albu.

² Ibid., pp 19-20; Gummett, Government of Science, Table 2.1, p 39, and p 37; ACSP, Tenth Annual Report, Oct. 1957 (Cmd 278), Table I, p 2; B.R. Williams, Technology, Investment and Growth (London, 1967), p 5.

³ PRO, CAB 124/1112, marginal note by Morrison on 24 Nov. 1950 letter from Gaitskell, 28 Nov. 1950.

modernisation the government possessed, for an annual savings of £170m.¹

The plans for rearmament approved by the Cabinet in January 1951 required

that at least one-third of the motor-car industry would be engaged in defence work. The output of military aircraft would come to exceed the output of all aircraft in 1950. The building work to be done would require a work force more than half as large as that employed on the housing programme.²

'An imperial tradition coupled with a victorious war. . . tempt[ed] successive governments into politico-military adventures beyond the capacity of the economy', observes Pollard. 'While we built tanks and planes, [Germany and Japan] built the machinery with which to achieve their later successes'.³

Gowing notes that the decision to build atomic bombs flowed not only from a desire to deter the Soviet Union but also

a fundamentalist and almost instinctive. . . feeling that Britain as a great power must acquire all major new weapons [and] a feeling that atomic weapons were a manifestation of the scientific and technological superiority on which Britain's strength, so deficient if measured in sheer numbers of men, must depend.⁴

The Cabinet may have been correct in figuring that membership in the great power club demanded heavy investment in prestigious technologies, but like heavy defence spending, this choice subordinated prosperity to politics.⁵

Weapons specifications were often technically ambitious and helped diffuse advanced techniques quickly into contracting firms. Paradoxically, however, those who performed abundant defence work did not necessarily learn better civil innovation skills. In 1960 two-thirds of the country's total R&D spending was in aircraft and electronics, the most important defence

¹ Dow, op.cit., p 59; Pollard, op.cit., p 37; Marwick, Total War, pp 446-50.

² Cairncross, op.cit., pp 222-3.

³ Pollard, op.cit., p 37.

⁴ Gowing, Independence and Deterrence vol. 1, p 184.

⁵ Interview with Sir Ieuan Maddock, 21 Feb. 1980.

industries. Three-quarters of aircraft R&D came from the government.¹ Many placed great hopes in the commercial spinoffs defence R&D would produce, but in aircraft as in other industries such hopes were sorely disappointed. The sheer size of the military effort dulled firms' commercial sensitivities. In 1954-55, for instance, domestic sales of military aircraft, engines and spares were £210.5m, exports (including military) were £66m, and home civil sales were only £14m.² Despite British leads in many technical areas, of 35 commercial airliners launched between 1945 and 1970, fewer than five were profitable, and only the Viscount was a big success.³ Electrical engineering took three-quarters of the government's non-aircraft R&D funds in 1960;⁴ in 1980 one observer noted that electronics firms had a 'custom-device orientation' caused by the predominance of state and military purchasers, and despite considerable 'technical virtuosity' could not develop their products into commercial successes.⁵ Defence R&D in the US gave rise to computers, transistors, integrated circuits, and other profitable innovations. In Britain, however, inefficiencies in defence procurement, poor management, a smaller market and the QSE shortage conspired to reduce civilian spinoffs. A detailed study of defence procurement under the Labour government concludes:

The desire to maintain a comprehensive armaments industry was something for which Britain no longer possessed the resources. . . . [Defence] made demands within. . . the aerospace, atomic energy

¹ FBI, 'Industrial research 1959-60', p 14; Winston, op.cit., p 5.

² Ely Devons, 'The aircraft industry', in Burn, ed., The Structure of British Industry, p 46. The aircraft industry has been so bound up with detailed and changing government policies that it cannot be considered typical, but its size makes it important in itself.

³ Arthur Reed, Britain's Aircraft Industry (London, 1973), p 21.

⁴ FBI, op.cit.

⁵ E. Scriberras, 'The UK semiconductor industry', in Pavitt, Technical Innovation, p 289. Also see Winston, op.cit., pp 248-50.

and electronics [industries] which were not found in the normal sphere of their commercial activity, both in terms of product and priorities. To attempt to operate in both spheres was not a happy marriage for defence firms.¹

Not only did the government's R&D allocation tend to mummify the industries which profited from it, but left the others scrounging for the R&D resources which remained, scarce QSEs especially. Corporate R&D departments, for example, had an average 13 percent vacancy rate in 1960.² In Peck's pithy description, 'the situation [became] the familiar British one of doing too much with too little, which leaves no room for revolutions'.³ In 1960 aircraft and electrical engineering took 56 percent of all R&D monies spent in industry; three-quarters of the remainder was spent in only one-quarter of the other 26 industries.⁴ Gowing points out how much the atomic energy programme, a major government priority, accomplished on remarkably small resources, taking only 0.44 percent of current government expenditure between 1946 and 1953. Nevertheless, it employed approximately 1600 scientists in 1952, which though only two percent of the country's total stock represented between ten and 15 percent of those working in industry. She notes that 'at a time of great strain on the economy the opportunity cost of the resources devoted to the project was high and at some points the demands it made, though marginal, were critical'.⁵

Heavy defence R&D spending was not, of course, the only reason why industry did not build up its innovative capacity to internationally

¹ Winston, op.cit., p 320.

² FBI, op.cit., p 7.

³ Peck, op.cit., p 448.

⁴ FBI, op.cit., p 65.

⁵ Gowing, Independence and Deterrence vol. 2, pp 37-8.

competitive levels. We saw in section 3.2 that long-standing cultural patterns worked to keep industry poorly endowed with QSEs. It also is clear that defence R&D sometimes aided civil R&D. Nevertheless, the tremendous unevenness with which British industry reaped the benefits of postwar R&D growth must have owed a good deal to the consistent and heavy diversion of R&D resources into advanced weaponry.

Whatever the causes, British industry did not invest enough in civil R&D. A few examples of backwardness must substitute for a detailed treatment. By 1955 shipbuilding employed 200,000 people, had sales of £120m a year and accumulated the largest order book in world history, 7m tons. This was 'a British industry with all the cards stacked in its favour'. But the foundations for continued leadership had been long neglected. In 1950 the industry employed a total of 37 people in R&D, probably fewer than half of whom were QSEs. Between 1951 and 1954, when German and Japanese yards were investing heavily in modernisation, their British counterparts spent less than £4m on their fixed assets annually when normal replacement alone would have cost £6m. Germany's shipbuilding exports overtook Britain's for the first time in 1954, Japan's in 1955, and by 1979 Britain's ship output had fallen to 11th place, behind Yugoslavia.¹

Textile machinery was another industry where British firms once had led the world. As early as 1946, however, industry representatives were aware that for the past decade foreign manufacturers '[had] been spending money on research and development on a scale immensely greater than anything attempted in this country'.² It proved impossible to recreate the Sunday Soviet ethos in this industry despite assiduous BOT efforts, as the machinery manufacturers and their customers stubbornly resisted closer

¹ Pollard, op.cit., pp 78-80; FBI, op.cit., p 78.

² BOT, Cotton Industry Working Party report, HMSO 1946.

liaison.¹ One reason was the three year backlog of orders for existing machines which the manufacturers could fill without the bother and expense of R&D. The results were depressingly predictable. Most important innovations after 1945 originated abroad. Capital investment per worker, productivity, technical quality and attentiveness to customer needs all failed to meet competitive standards, but the industry kept afloat on its empire and Commonwealth sales of outmoded types. In a survey of 50 postwar innovations in 20 British textile machinery manufacturers, the factor which correlated most closely with success was possessing a formal R&D section; the companies likeliest to have one were those without a history of imperial markets.² From pottery to machine tools, from cars to coal mining, the postwar weaknesses of British industry compared to its foreign competitors were remarkably uniform: low spending on R&D, low employment of QSEs, and low investment in new technology. Despite increasing industrial interest in R&D and improved innovative performance compared to prewar, other countries were improving faster. Unfortunately 'compound interest is a remorseless arbiter'.³

Of course, this cycle of innovative decline is much clearer in retrospect than it was in 1950. The statistical indicators of R&D effort available then were scanty and primitive compared with today's. In 1947, for instance, Tizard tried to estimate the distribution of QSEs between civil and defence work and concluded that civil R&D was doing extremely well, with 13,700 QSEs to defence's 6000. He mistakenly assumed, however, that the 10,000 QSEs estimated by the FBI to be working in industry should all be

¹ PRO, BT 64/2353, 'Provision for development', note by J. Frost, 12 July 1948.

² Rothwell, 'Textile machinery', in Pavitt, op.cit., pp 133-7.

³ Landes, Unbound Prometheus, p 328.

counted as engaged in civil work, whereas probably half were employed on defence projects. Moreover, the sets of figures which Tizard amalgamated into his estimate used varying QSE definitions. Zuckerman concluded that 'the information at present available was insufficient to enable the [ACSP] to form any opinion regarding the distribution of scientific manpower',¹ and the ACSP established a subcommittee under Zuckerman which strove to penetrate the statistical fog surrounding this subject. In 1952 the ACSP's annual report was devoted to the subcommittee's initial findings, which stressed that demand for scientists was growing much faster than Barlow's FSP committee had predicted in 1946, certainly much faster than the Ministry of Labour had predicted in 1949, and forecast continuing large-scale shortages in virtually all subcategories of QSEs.²

Though lacking exact figures, the ACSP and other influential observers of Britain's R&D effort sensed strongly that its civil side was inadequate. We have already seen evidence of this in the ACSP's struggle to improve technological education, in the Working Party and AACP reports, in the plaintive cries of the DSIR and RAs for more resources, and in the formation of the NRDC. Zuckerman told the ACSP in 1952, invoking the favourite country of comparison:

In spite of the deficiencies of the data, it is clear that American industry spends relatively and absolutely very much more than does British industry on Research and Development. This . . . is reflected in the very great diversity of American industry and its innumerable growing points.³

But the ACSP and other influential scientists were not willing to press the claims of civil R&D against those of defence. They agreed with senior

¹ PRO, CAB 132/64, S.P. (47) 59, 'Distribution of scientific manpower', note by Tizard, 15 Nov. 1947; S.P. (47) 60, supplementary note, 17 Nov. 1947; S.P. (47) 10th meeting, 19 Nov. 1947.

² ACSP, Annual Report 1951-2, Cmd 8561.

³ Tizard Papers, HT 471, S.P. (52) 22, 22 Sept. 1952

politicians that civil R&D could not be fueled at defence's expense, only from whatever growth resulted from long-term policies like increasing the pool of QSEs. In October 1948, for example, the Production Committee agreed to accord the development of prototypes needed for defence the highest priority. Impressive results prompted the committee three months later to extend highest priority to improving the plant and equipment used in producing those prototypes.¹ The public record contains no evidence that similar priority was ever accorded civil R&D of any sort, even during the crises of 1947-48.

As the strains of Korean rearmament intensified the focus on defence priorities became even more mesmerizing. DSIR brought many defence R&D projects into its own laboratories. In 1951 the Treasury's representative on the ACSP suggested a review to identify areas of civil research that were 'not so essential. . .in the present conditions of financial stringency'.² ACSP then established a special committee to squeeze the maximum number of QSEs and lab facilities out of the government's civil projects into defence research. Lockspeiser chaired it and did his work well despite the havoc the disruption caused his already struggling department.³ Between 1951 and 1953 DSIR's budget declined in real terms by 10½ percent.⁴ Lockspeiser and virtually everyone else officially appointed to give advice on exactly this sort of question could see that 'effective rearmament and our whole economic future depend alike upon a highly efficient industry', which the

¹ PRO, CAB 134/640, P.C. (49) 1st meeting, 14 Jan. 1949.

² PRO, CAB 132/69, S.P. (51) 1st meeting, statement by E.W. Playfair, 7 Feb. 1951.

³ PRO, CAB 132/72, S.P. C.R.P. [Civil Research Programme] (51) 1, 'Terms of reference and composition', 11 Aug. 1951.

⁴ HC Debates, Hansard vol. 518, col. 120, statement of Austen Albu, 20 July 1953.

government's heavy defence priority was retarding.¹ But as is the way of governments, immediate pressures elbowed aside speculations about future prosperity. 'Peace is more indulgent [than war],' Lockspeiser wrote. 'The penalties of neglect take longer to show'.² Tizard concluded, from an intriguing but economically crude line of reasoning, that industry was investing so little money in new capital equipment that recent research results were not having much effect on production. Therefore he argued that industrial R&D could 'be contracted without any great harm being done' to economic progress.³

By the 1951 general election, then, the combined effects of austerity, rearmament, opposition from business and Conservatives to extended government powers, and Labour's intellectual exhaustion left the government with no civil R&D policy to speak of. Industry, the DSIR and RAs were spending more on civil research than previously, more QSEs were graduating and the NRDC was beginning to develop some inventions. Even so neither human nor financial resources for civil innovation were adequate. The government had given up tax remissions to encourage investment and R&D as a war economy measure, killing one of the few reforms to have emerged from the Coalition. Its spending steered scarce QSEs heavily to defence work, and the DSIR and RAs complained consistently of starvation. Technological education still limped along badly in need of the overhaul ordered in 1945. Industry, especially smaller firms in traditional fields, failed to employ the QSEs needed to keep up with foreign competition. There was no R&D extension service despite wide frustration at industry's

¹ DSIR, Annual Report 1950-51, p 9.

² Sir Ben Lockspeiser, 'Manufactures', J. Roy. Soc. Arts (16 Apr. 1954) 420.

³ PRO, CAB 132/69, S.P. (51) 12, 'Industrial research', note by Tizard, 29 Mar. 1951; criticised at S.P. (51) 3rd meeting, 4 Apr. 1951.

backwardness. Nor had development contracts, used often and successfully in defence procurement, made any inroads in civil innovation despite regular recommendations to this effect.¹ Essentially powerless advisory committees meeting infrequently could not energize or direct the government's civil science work, let alone industry's. Not even the socialised industries, over which the government had complete authority and Morrison a special sense of stewardship, conducted nearly enough R&D. In 1950 they spent less than £1m on it, 0.12 percent of their £800m revenues, compared to the one percent target for progressive firms.² In sum, by the end of reconstruction a wide gulf separated Labour's great expectations for R&D from what R&D had actually done to help the economy. And in view of the miniscule powers the government had managed to secure to encourage and direct civil innovation, scant improvement was likely.

3.5 Conclusion: disillusion and renewed expectations

The end of the Labour government nevertheless marks an important watershed in the history of British civil science. The reconstruction consensus on innovation policy had finally shattered beyond repair. Itself the descendant of debates among the progressive centre during the 1930s, this consensus had never inspired universal allegiance. But during the 1940s the Labour Party's blend of domesticated Bernalism and corporatist socialism at least had held the intellectual initiative. Sharing important features with the Conservatives' brand of corporatism, it had framed the terms of every debate on future reforms, even if implementation was repeatedly blocked by

¹ See, for example, PRO, CAB 132/106, S.P. (52) 38, 'Research, development and investment', draft ACSP report, 30 Dec. 1952, p 5.

² PRO, CAB 124/202, minute from Tizard to Morrison, 22 Aug. 1950.

business, civil servants, fiscal austerity and a certain impractical grandiosity in some of the reforms themselves. Its essential belief was that planning was superior to unfettered competition, better at serving key national priorities as well as inherently more efficient. Just as the solution to the structural problems of a depression economy was thought to be more government planning and direction, the remedy for sluggish innovation was cooperative research funded by the government and conducted in DSIR or RA labs. Innovative backwardness was considered simply one more casualty of an economic system which, by emphasising short-term private gain, necessarily inhibited costly long-term R&D; if the economy were organised more rationally, new products and processes would naturally arise.

By 1950 it was evident that this approach to innovation policy had been mined out. The exhaustion of the old approach was widely apparent: in the essential irrelevance of the RAs to their industries, in the aimless drifting which followed the Lockspeiser-Smith debate on DSIR's future, in Wilson's low expectations of NRDC, in the poor R&D performance of nationalised industries, and in the BOT's failure to discover an effective way of promoting innovation in its industries.

New answers would not be forthcoming from the existing government, which had run out of fresh ideas. Nicholson concluded after a review of government scientific organisation in the summer of 1950 'that progress on the whole has been fairly satisfactory' and that 'the need [was] for plugging along on fairly familiar lines'.¹ Morrison also lacked imagination, as shown by his defence of the government's civil science record before the Commons in May 1950. 'I think we have done all that we could in [making resources available to science], both in equipment and materials, and that science has

¹ PRO, CAB 124/1112, minute from Nicholson to Morrison, 29 Aug. 1950.

had a chance to throw itself about in recent years. . . .'¹ Cripps, who resigned for health reasons in October 1950, did not generate any new ideas either.

Many were beginning to realise uncomfortably that Britain's R&D backwardness was less tractable than had been assumed in 1945. Yet the government was essentially rudderless. No initiatives could be launched until a new paradigm of innovation policy, one which took account of the failures of the old approach, won widespread assent among the scientists, politicians and others in the 'progressive centre' on whom the government had relied since at least the Thirties for new ideas in this area. Meanwhile DSIR and RAs continued their ineffectual drifting.

Among the ruins of reconstruction policies for industrial innovation so confidently asserted only five years previously, one can see the blocks from which the next great paradigm in innovation policy was built, the one which Harold Wilson's government tried to implement from 1964. Wholesale nationalisation and corporatist central planning having lost its appeal, the new blueprint was to push, pull and cajole private industry to innovate by every means the government could command while preserving private ownership and decentralised control. As Blackett wrote, 'the lesson of the last decade is that industry as a whole cannot be relied on to modernise itself quickly enough: unless it is aided or prodded by the Government'.² As will be discussed in detail in Section 4.8 and Chapter 5, Wilson's government owed a major intellectual debt to the discarded civil science initiatives of the Attlee government. In fact their unifying principle was a more active partnership between government and industry to encourage innovation and

¹ HC Debates, Hansard vol. 474, col. 2131, 5 May 1950.

² Blackett Papers, E49, 'The case for a ministry of technology', Sept. 1964.

productivity, exactly what Wilson's government was to attempt. Neither business nor government was prepared to embark on this sort of partnership in 1945 when both were accustomed to heavy government direction. Nor did either side have an opportunity for creative reappraisal in the face of the economy's many crises between 1945 and 1951, the long backlog of reforms which occupied the government's attention, its corporatist philosophy, and industry's struggles to convert to peacetime production, overcome scarcities of raw materials and boost exports and productivity. As the next chapter discusses, however, many of the failed initiatives of the Attlee era were resurrected under Wilson, some hardly altered. The Production Efficiency Service, the Development Councils with their compulsory levies for R&D, the stillborn Industrial Commission intended to amalgamate small inefficient firms into larger ones better able to conduct research, the FSP radicals' call for a large science secretariat in Whitehall and the ACSP's ideas for improving technological education, all found their way into the crucible of Wilson's white-hot technological revolution.

Thus the struggles of reconstruction were not entirely in vain. Just as confusion during the Thirties about how to eradicate the depression fermented into the reconstruction paradigm for innovation policy, the confusion following its collapse eventually spawned productive ideas which a later government energetically seized upon. Unfortunately, inertia ruled for another fifteen years.

CHAPTER FOUR

Postwar Productivity Policy

4.1 'P.M.H.: an admirable slogan for our time'¹

Britain was in dire economic straits at the end of the war. At the same time the Attlee government had in mind an ambitious programme of social reconstruction. Higher output was essential to satisfy the many competing claims on the nation's resources, yet people and plant were already fully employed. The government tried to increase the labour supply by encouraging more housewives into paid work, increasing work hours in selected industries, importing foreign miners, cutting the armed forces and asking everyone to work harder. But as Cripps stressed repeatedly, without 'a really marked advance in production efficiency there is not the least hope of raising the standards of our people above prewar levels and it is very doubtful. . .whether we can even maintain that prewar standard'.² Boosting productivity was crucial. 'P.M.H', the acronym then in vogue for 'production per man hour', was suggested as 'an admirable slogan for our times'.³

The Attlee government pursued productivity by encouraging small firms to amalgamate, attacking restrictive practices and union resistance to

¹ B. Hollowood, D.L. Burn and M. Stewart, 'Production per man hour', Contact (June 1946) 75.

² Cripps papers, 264, speech 'Fuel and the future', 10 Oct. 1946.

³ 'Production per man hour', op.cit.

automation and dilution, but, most of all, through science and technology. More capital equipment, electrical machinery, and modern processes in factories would not only help the GNP but ease workers' physical toil and raise their pay. To the Labour Party, socialism, science and prosperity were mutually dependent, and higher productivity was a key to their simultaneous advance. By 'being political', productivity policy engaged the sustained attention of senior ministers, unlike R&D policy, which after the Development Councils failed was essentially left to the DSIR, RAs and ACSP to work out.

Morrison and Cripps were productivity's special champions. Morrison's approach matched his status as a non-departmental coordinating minister. He charged the ACSP and other scientific committees with studying the sources of low productivity in the economy generally and proposing rapid solutions. But part-time advisory committees of eminent industrialists and scientists had no means to implement their ideas in Whitehall, let alone in private industry. The ACSP, its Committee on Research and Productivity (CRP), and the major Committee on Industrial Productivity (CIP) which succeeded CRP prescribed sound medicine for sluggish productivity but had no way to see that thousands of firms around the country took it. These committees met monthly or less often. They lacked the permanent large base in Whitehall which a 'scientific general staff' could have provided. And they were directed by Tizard, who excelled at 'putting the cat among the pigeons'¹ but had no instinct for bureaucratic empire-building and tried repeatedly to resign from a task which both overtaxed and frustrated him. In the end these committees accomplished less than had been hoped. Even the nationalised

¹ Hartley papers, box 6, Lockspeiser's obituary comments about Tizard in the Times, undated.

industries, theoretically under government control, proved remarkably resistant to modernising their techniques.

Cripps commanded greater bureaucratic resources than Morrison both as President of the BOT and as Chancellor of the Exchequer, had experience in orchestrating productivity improvements as wartime Minister of Aircraft Production, and attacked with his concentrated zeal the central problem: diffusing advanced techniques throughout the country's businesses. 'His concern was with industrial and commercial efficiency rather than with socialist transformation';¹ his basic technique was to admonish and cajole private enterprise rather than threaten existing patterns of ownership and control. As President of the BOT he created a free corps of consultants, the Production Efficiency Service; sponsored the British Institute of Management to promote the study and dissemination of more effective management techniques and the Council for Industrial Design to improve the appearance and marketability of British products; devised the Working Parties, which focused on the productivity problems of traditional industries; and became a powerful advocate for applying psychology in the workplace. As Chancellor of the Exchequer from November 1947, he was instrumental in creating the Committee on Industrial Productivity as well as the Anglo-American Council on Productivity which attempted to diffuse the techniques of the best American factories widely through British industry. He also directed the Treasury's Economic Information Unit, which used sophisticated campaigns to publicise the need for productivity growth and ways of achieving it. In enlisting all the support which powerful, activist ministers like Morrison and especially Cripps could offer, productivity policy differed markedly from its R&D counterpart.

¹ Morgan, Labour in Power, p 360.

However, the similarities between these two spheres of the government's postwar civil science work -- R&D and productivity -- were as striking as the differences. A desire to speed industrial change underlay both. Both required complex and costly shifts in industrial practice that included educating and employing more QSEs, professionalising management, investing in new equipment and buildings, and revamping existing patterns of design, marketing and manufacture. Despite the visibility and effectiveness which the patronage of Morrison and especially Cripps gave the productivity drive, it too was blunted by austerity and the absence of workable bureaucratic mechanisms to bridge the gap between the government's goals and industrial practice. It too suffered from Labour's intellectual exhaustion as large-scale central planning, corporatist and anti-competitive, proved decreasingly effective.

The major economic controls inherited from the war -- over raw material allocation, building, consumer rationing, prices, imports, investment and labour -- might have been welded into an effective instrument for aiding productivity. Scarce commodities like coal, steel and timber could have been preferentially directed to more efficient plants, or to improvement projects at less efficient ones; workers could have been incrementally removed from overstaffed firms; building licenses could have been refused to factories which did not embody the latest knowledge about materials handling, proper working conditions, joint consultation and other contributors to high productivity. Such a system would have been expensive, complex, and contrary to the government's postwar strategy of encouraging private firms (besides those nationalised) to resume normal functioning as quickly as possible for the sake of higher output and exports. Morgan writes: 'Clearly this was a government which thought at best in terms of partnership with industry, somewhat in the form of Roosevelt's NRA of 1933, and had no

intention of harassing private industrialists in their vital concerns'.¹ In any event, physical controls were progressively dismantled and no new instruments of government command took their place. The Development Councils stalled. No Industrial Commission was created to reorganise inefficiently structured industries. The National Investment Board promised in Let Us Face the Future amounted to little and was terminated by Cripps.² The Monopolies Commission started in 1948 was toothless, empowered only to study the extent of restrictive practices, and 'by the end of the nineteen-forties the area covered by monopoly and restrictive practices was larger than before the war'.³ The CID, BIM and EIU were useful beginnings but proved too general and remote to catalyze an overhaul of manufacturing practice. Public relations work, exhorting managers and workers with practical tips to think flexibly and work hard, was no substitute for the full-scale extension service which PES never became. It can be argued that private industry should have modernised itself without government help. This did not happen fast enough, so the government understandably stepped in. It worked hard and accomplished much, but not enough. In productivity as in R&D, postwar policy was not sufficiently discerning, adventurous or well-financed to keep British industry equal to its competitors.

4.2 First efforts: Cripps at the BOT

By the time FSP had finally reported and the ACSP got under way in March 1947, the data identifying low productivity as a crucial hindrance to

¹ Morgan, op.cit., p 130. See also G.D.N. Worswick, 'Direct controls', in Worswick and Ady, The British Economy 1945-50, pp 280-4; Cairncross, Years of Recovery, p 343.

² Morgan, op.cit. , p 367.

³ G.C. Allen, The Structure of British Industry (London, 1966), p 68. See also Margaret Hall, 'Monopoly policy', in Worswick and Ady, op.cit., pp 399-423.

the economy had made a deep impression upon the government and those who advised it about civil science. Rostas' 1943 article estimating that American productivity was twice as high as Britain's in virtually every industrial sector¹ had been repeatedly confirmed by more detailed studies. The Platt Report on cotton textiles revealed an industry whose capital equipment was aging and obsolete, leading to an output per person-hour advantage for the United States in spinning of 65 percent and in weaving of at least 160 percent.² Automatic looms produced no more than five percent of the British output, 95 percent of the American, and the British system of warp preparation was 'completely out of date'.³ The Reid Report described a similar tale of woe in coal mining, with British labour productivity 65 percent of the Dutch level and 27 percent of the American. Mechanical coal handling was so primitive that fully one-quarter of all miners were engaged in underground haulage.⁴ The Lace Working Party found that one section of the industry had installed no new machines since 1923; the Pottery Working Party contrasted the abundant mechanical handling devices in American plants with the 'peculiar looking contraption which rests on the head of the worker' for carrying ware to the ovens in British plants.⁵

The Working Parties did not cover a representative sample of British industry. They often invoked anecdotes to back up their claims of higher American productivity rather than sophisticated statistics that could link

¹ L. Rostas, 'Industrial production, productivity and distribution in Britain, Germany and the U.S.', Eco. J. 53 (Apr. 1943) 44.

² L. Rostas, 'Productivity of labour in the cotton industry', Eco. J. 55 (June-Sept. 1945) 195.

³ Platt Report, p 27.

⁴ Reid Report, pp 29, 72.

⁵ BOT, 'Report of the Lace Working Party', 1946, p 38; 'Report of the Pottery Working Party', 1946, p 11.

specific differences between American and British plants to their effects on output. Even so, the weight and quality of the Working Party and other government reports were impressive. Newspapers and trade journals gave them extensive coverage, and by 1946 a wide range of British industries had evidence that a large productivity gap separated them from their American competitors.¹

Cripps knew this already. As soon as Labour came to power he began to draw industry's attention to its backwardness and offer it government aid. In August 1945 he set out to BOT staff the themes which prevailed during his tenure: '[I]t will be our job to stimulate [industry] to produce by the most efficient means possible the greatest possible volume of high quality goods - well manufactured and well designed - having regard to the labour force which we can spare them'.² Cripps immediately set the BOT to work in various directions, most of which sought to apply science to industry in some way.³

The Working Parties, and the Development Council legislation which grew out of them, were designed to give the government some influence over the direction and pace of industrial development. The 'public' members Cripps appointed to the Working Parties included professional designers, OR experts and QSEs who could shake labour and management out of complacent habits. He hoped to use the Development Councils in the same way. He exhorted business groups and the TUC to encourage their members to

¹ PRO, BT 64/2313, 'The working party reports and productivity', undated 1946.

² Cripps papers, 70, speech to BOT staff, 29 Aug. 1945.

³ Cripps' main non-scientific answer to low productivity was joint labour-management councils to encourage cooperation in plant decision-making. This would tap workers' knowledge and imagination, and because it represented 'true democracy', raise morale and elevate the tone of industrial and national life. Cripps papers, 240, notes for speech to Swiss-British Society, Zurich, July 1946.

welcome more scientific methods even if they upset comfortable customs.¹ He also endorsed 'the application of scientific methods to the study of human movements', which had tripled output in some aircraft plants. The difficulty was that unions feared management would use it to cut piece work rates and speed production, a practice Cripps deplored; the real purpose of motion study should be to 'find out how the job can be done with the greatest convenience and least fatigue. . . .arriving at the right use of the human moving parts'.² Slowly he overcame the 'almost pathological prejudice' of union leaders against motion study.³

Psychologists had proved extremely useful to the Services and to large factories during the war; at Cripps' instigation they wrote a report about how they could help the peace. The principal contributions they envisaged were matching people to jobs, selecting promising managers and maintaining morale. Cripps repeatedly commended the use of psychology in industry.⁴ 'The only thing that could arrest its growth is. . .a failure to study and understand the science that lies within it', he said.⁵ He also endorsed the efforts of the British Colour Council, a body which sought to create through careful research the optimal visual surroundings for production.⁶ Social science also had to be applied to winning markets for British products. Now that the government was no longer industry's sole or main purchaser, firms

¹ 'Management congress revival', Sunday Observer 29 June 1947.

² Cripps papers, 243, speech at motion study exhibition, 2 Oct. 1945.

³ 'Management congress', op.cit.

⁴ Cripps papers, 265, speech to the National Institute of Industrial Psychology, 8 Oct. 1946; 29, speech at Roffey Park rehabilitation centre, 12 June 1948.

⁵ Cripps papers, 136, speech to personnel officers' course at Nottingham, 6 Apr. 1945.

⁶ 'Value of colours in output drive', Glasgow Herald, 2 May 1947.

had to find customers, discover their needs and design new products to satisfy them, especially in the crucial export market. 'We really must approach this great undertaking of winning markets upon a scientific basis'.¹ He also gave extensive publicity to the work of the British Intelligence Objectives Subcommittee, which sent 10,000 investigators to Germany after the war to ferret out 'the latest manufacturing methods and processes' and wrote 1400 reports available for free. 'Here is an opportunity . . .to take full advantage of all the intensive research in Germany throughout the war years'.²

How did the BOT attempt to diffuse these various scientific aids to productivity into industry? Cripps was acutely aware that exhortation alone would not dissolve old behaviour patterns; tangible help was needed too. Exhortation was nevertheless the main feature of his productivity initiatives. Practical and philosophical reasons lay behind this approach. First, since industrial production was conducted at 51,000 workplaces, the most visionary productivity policy at the centre would be useless unless managers and workers understood it and tried to implement it themselves. Second, Cripps placed great faith in the ability of the British people to overcome difficulties if the government explained clearly their underlying causes and gave a clear lead. 'When [the people] understand the national purpose', he said, 'they will join together in helping to achieve it'.³ Productivity merited special attention as a topic of public education. He told a cotton industry conference:

¹ Cripps papers, 261, speech to British Export Trade Advertising Council, 6 Mar. 1946.

² Cripps papers, 248, press conference, 9 Dec. 1946.

³ Cripps papers, 1067, press conference on economic publicity, 18 Apr. 1947, pp 26-7.

We have not yet got into our older industries, of which cotton was one of the earliest, that spirit of scientific enquiry and appreciation which is so marked a characteristic of the newer engineering industries and indeed of all industry in countries like America. . . . I am pretty confident that the resistance which we find to improvements and changes amongst both employers and employees is largely due to neither side appreciating fully the problem which they themselves, their industry and their country is up against.¹

Thus a hallmark of the Cripps-BOT productivity programmes was their focus on reaching into industry to convince unions and management that productivity would help the nation as well as their pockets.

The BOT effort which looked farthest ahead was the BIM, proposed by the Weir Committee in 1944 and redesigned with a smaller, stronger executive council by a committee under FBI president Sir Clive Baillieu which reported in 1946.² 'The country was suffering from a serious lack of knowledge and experience in modern industrial management', Cripps believed, attaching 'great importance to the proposed institute as a means of remedying it'.³ Despite Treasury scepticism he secured for the BIM a five-year £150,000 government grant and named as its director L.O. Russell, a BOT Assistant Secretary sympathetic to Labour who had previously held management posts in a newspaper chain. Concerned to raise management standards and prestige, BIM first stressed the academic side of its work as if to demonstrate by example that management was a learned profession. It started a journal, a central library and a series of abstracts and handbooks on management subjects. Only slowly did it build up regional satellites to bring educational programmes to managers. Its long-term goal was to make itself the recognised representative of the 'third industrial estate',

¹ Cripps papers, 223, speech to Buxton Conference, 10 Oct. 1947, pp 26-8.

² PRO, CAB 71/27, L.P.(I) (46) 18, 'British Institute of Management', note by Cripps, 8 Mar. 1946.

³ PRO, CAB 71/27, L.P.(I) (46) 4th meeting, 12 Mar. 1946.

management, as opposed to ownership and labour already represented in the FBI and TUC. But it proved impossible to mix the BIM's basic mission of education, financed by the government, with the highly political one of establishing management as a separate force in national politics.¹

Another BOT programme was the Council on Industrial Design, characteristically Crippsian in its conviction that exports and the esthetic environment of the working class could simultaneously be improved by making industrial products more attractive. Its long-term objectives were to encourage various industries to establish cooperative design centres with government aid, publicise good design, and raise designers' educational standards. Planning along these lines had begun during the Coalition. The gifted advertiser who became the CID's first Director, S.C. Leslie, a Morrison protégé, decided its first effort should be a large exhibition in London which would both raise public awareness of good design and commemorate the end of the war. Opening in September 1946 under the title 'Britain Can Make It', it proved a huge success. It drew more than 1.4m paying visitors, four times the initial estimate. Perhaps £50m worth of orders were placed by 43,000 trade buyers from Britain and 7000 from 67 overseas countries.² Cripps enthused that 'there has never been anything to compare with it. . . .It gives you the impression, not of post-war tiredness and frustration, but of youth and vigour and freshness'.³ He called the exhibition 'a well-calculated act of National policy, of first-class importance'.⁴ Unfortunately, however, all of the CID's 104 employees,

¹ PRO, CAB 134/591, O.P. (48) 3rd meeting, p 4; BT 64/2360, minute 10 from Dakin, 26 Feb. 1948.

² PRO, BT 64/2300, CID, Annual Report 1946-7, Sept. 1947.

³ Cripps papers, 267, BBC broadcast, 27 Sept. 1946.

⁴ Cripps papers, 296, speech to CID lunch, Nov. 1945.

including its Industrial Liaison Officers, had to devote themselves fully to the exhibition, and negotiations to establish design centres lapsed until January 1947. By 1948, with a £145,000 BOT grant, design centres had been started for silk and rayon, the CID was advising many nationalised and private firms and regional exhibitions were continuing to draw appreciative audiences.¹ The Council began a design journal and a reference library which rapidly developed the world's largest collection of photos relating to industrial design. It had a large hand in planning the widely acclaimed 1951 Festival of Britain, which at Morrison's behest stressed science.²

Another Cripps brainchild was the Production Efficiency Service (PES), a close copy of the MAP's Production Efficiency Board. Many firms could not afford private consultants, yet experience had shown that quite simple changes in factory layout, production planning, material supply, mechanical handling and inspection could result in dramatic productivity gains -- gains which were now considered the nation's concern as well as shareholders'. So Cripps envisaged an initial staff of about 20 BOT consultants, available at no cost to any firm which asked, reporting confidentially on delicate questions of firm organisation and management competence as well as technical matters. His Cabinet colleagues approved,³ and to head the PES Cripps appointed Frank Chappell, who had chaired the MAP analogue. But the MAP board had possessed powers to compel aircraft firms to accept its recommendations, while the PES could only advise. The PES had almost the whole of civilian manufacturing as a possible client instead of a single industry. And some firms suspected that its inspectors would leak sensitive

¹ PRO, BT 64/2387, CID, Annual Report 1947-8, Oct. 1948.

² Gordon Russell, 'The Council of Industrial Design and the Festival of Britain', Research 4 (May 1951) 207-11.

³ PRO, CAB 71/27, L.P.(I) (45) 2nd meeting, 30 Oct. 1945.

information to the unions or other parts of the government in pursuit of eventual nationalisation.¹

The PES made some valuable contributions to productivity. Like other postwar initiatives for bringing science to industry, however, its scale was minute compared to its task, and it quickly triggered opposition from older parts of the civil service. On the day he received his seals as BOT President in July 1945 Cripps told Chappell to proceed, but nine months were required to work out PES's relations with other BOT sections and it started work in March 1946 with 36 applications for help already pending. The BOT's joint labour-management advisory board, the National Production Advisory Council on Industry, then became nervous about the functions of the new body and tried to rein it in. Business representatives did not want PES investigators talking to workers without managers present, and did not relish the idea of criticism beyond technical matters. Labour representatives worried that the investigators would help management set piece work rates and wages.² Chappell managed to mollify both sides by promising PES would avoid these subjects and consult regularly with management and unions. Initial demand for PES assistance was heavy: 237 companies applied between March and August 1946, when the last of the 20 technical officers authorised had been recruited.³ Typical clients included a company switching production from rubber dinghies to inflatable chairs, which PES helped with advice on layout, design and construction; a manufacturing chemist seeking help with lighting and seating which was also shown how its layout produced 'a great deal of wasted effort' generally; and a firm seeking alternatives to scarce ceramic

¹ PRO, BT 64/2192, note from H.J.B. Lintott to R.F. Kahn, 15 Dec. 1945.

² PRO, BT 64/2192, note from L.O. Russell to Chappell, 16 Mar. 1946.

³ PRO, BT 64/2192, NPACI (46) 30, 'Production efficiency service', 2 Aug. 1946.

insulators.¹ One client firm complimented PES on its unusual aversion to red tape and its 'zest for getting things done'.²

As its experience increased, PES moved away from 'band-aid' advice to more intensive written reports, almost 200 of which had been submitted and discussed with management by the end of 1948.³ A representative sample of 83 clients showed that management accepted the validity of the PES findings in 98 percent of the cases. Half of them fully implemented the advice given and one-third did so partly. The resulting productivity gains ranged from ten to 750 percent for individual operations. All this was done on an annual budget of £35,000.⁴

Staffing and jurisdictional problems mounted. Chappell initially intended to divide the staff into industrial specialties but to save traveling he divided them instead into four regions. Each region had only one senior officer capable of making initial contact with firms and supervising junior staff, many of whom had little training. Four officers had to be detached to two experimental cotton mills; promised replacements did not arrive for seven months, and the remaining officers had to be switched around frequently. Publicity was explicitly avoided to prevent overload. Another 20 officers were authorised in March 1947, but by December 1948 only 12 were in place. Turnover was high because the Treasury would not authorise the establishment of any of the staff; denied civil service security and pensions,

¹ PRO, note from Russell to Chappell, op.cit.

² PRO, BT 64/2192, letter from John S. Corby to Chappell, 20 July 1946.

³ PRO, BT 64/2403, NPACI (48) 188, 'Production efficiency service', 24 Nov. 1948.

⁴ PRO, BT 64/2434, minute 22, 'Statistical abstract of PES activities', Jan. 1948, and Ibid.

many left for higher salaries in industry.¹ Much worse from Chappell's perspective, the PES was 'fully regionalised' in October 1947. Staff was dispersed to the 12 BOT regions and came under the direction of the regional controllers. Chappell thereupon resigned in frustration and charged BOT officials with seeking to 'throttle' the PES. He claimed that regionalisation had cut the number of successful cases per year from 72 in 1947 to 14 in 1948, and that BOT red tape and disorganisation meant frequent missed opportunities.²

BOT officials contested Chappell's arithmetic and presented evidence that he was a poor manager, failing to train subordinates or arrange meetings where they could exchange successful methods. Nevertheless it is evident that the postwar BOT could not easily coexist with the bureaucratic anomaly of the PES. The unit had to be fast and flexible to serve industry, but the imperatives of war production no longer dissolved industrialists' worries about confidentiality and government intrusion³ or Whitehall's ideas of tidy administration. The senior BOT official most concerned with productivity, S.A. ff. Dakin, frankly admitted that 'we are not satisfied [whether] the Service should remain permanently under Government or. . . be taken over eventually by some outside body'.⁴ This lukewarm attitude also

¹ PRO, BT 64/2403, minute 22, 'Brief for NPACI meeting on December 3rd', note by S.A. ff. Dakin, Nov. 1948. One BOT official wrote on this paper that high PES turnover was 'not altogether without benefits in spreading the gospel, tho[ugh] very inconvenient to us'. Marginal note by A.R.C.H., p 1.

² 'All pleasant people', News Review, 11 Nov. 1948, p 10.

³ L.A. Ferney, the Air Ministry's assistant scientific advisor, told an interdepartmental productivity working group discussing the PES that 'there was considerable resistance from both the F.B.I. and industry as a whole to any large scale attempt on the part of the Government to make industry more productive', presumably for political reasons. PRO, CAB 132/50, C.I.P. (W.P.) [Committee on Industrial Productivity Working Party] (49) 3rd meeting, 31 Jan. 1949.

⁴ S.A. ff. Dakin, 'Brief for NPACI meeting on December 3rd' [1948], op.cit.

reflected new leadership at BOT. Harold Wilson, President from September 1947, did not take Cripps' interest in PES, an interesting contrast with his devotion from 1964 to spreading the technological revolution. The PES's previous official champion, L.O. Russell, had left to head the BIM. After several more months of stumbling along, the PES folded in 1949, according to Wilson because of personality conflicts and the need to cut government expenditure after the pound was devalued in September.¹ An intriguing experiment, the closest the postwar government came to providing a comprehensive extension service for spreading science into industry, the PES jarred with civil servants' perceptions of the proper role of government. Even if Chappell had adjusted smoothly to BOT folkways, prevailing dictates of economical administration would have kept the PES from becoming as large as the problems of British industry required.

Another part of the BOT's drive to foster productivity was hammering home productivity's importance via the government's general publicity campaigns, which used all the propaganda techniques developed during the war. There is no sound way to measure any specific effects this -- or indeed any of the other programmes discussed in this chapter -- may have had on industrial performance. However, the publicity campaigns certainly succeeded in turning productivity from a technical concept in economics into a household word. Newspaper articles, conferences, broadcasts, parliamentary debates, exhibitions, and factory posters all followed in the wake of official public relations drives. The government was sufficiently convinced of these campaigns' value to spend freely on them, for example £250,000 in 1946 to encourage exports and at least as much from 1946 to

¹ PRO, CAB 124/1200, 'The state and private industry', memorandum by Wilson, 14 May 1950.

1947 to promote output generally.¹ Both the export and production campaigns contained productivity themes. The BOT alone employed 88 people in public relations work in the last quarter of 1946, at an annual cost of £36,000.² All this effort made some impression. A December 1946 poll revealed that 92 percent of the population considered increased production a 'necessity'.³

The government strengthened its publicity apparatus as the need to secure public cooperation mounted with the gravity of the country's economic problems. An official committee under Attlee's press agent Francis Williams started meeting weekly in February 1946 to coordinate the interdepartmental machinery for getting concise and accurate information about the economy into the public mind with a consistent theme. Its first test was the Prosperity Campaign, begun in March with 26 regional conferences at which ministers addressed 28,000 representatives of labour and management. The second phase used 90,000 posters, 2000 talks to factory workers, films and hoardings to press the theme 'Extra Effort Now Means Better Living Sooner'.⁴

The prosperity campaign was judged a success, but BOT officials, no doubt influenced by Cripps (as well as Rostas and other productivity experts who were working for the department) wanted economic publicity to feature productivity more prominently. In July 1946 Sir John Woods, BOT Permanent Secretary, asked the main official committee concerned with the economy, then reviewing the annual Economic Survey, to prepare material 'bringing out

1 PRO, CAB 134/354, I.H. (46) 2nd meeting [Committee on Home Information Services], 28 June 1946.

2 Cripps papers, A7, Daily Express clipping, 24 Jan. 1947.

3 PRO, CAB 134/356, I.H.(O) (47) 22 [Home Information (Official) Committee], 'Report on the production drive', 31 Mar. 1947.

4 Ibid.

the vital contribution which an improvement in efficiency and productivity had to make to the national economy'.¹ In January 1947 Woods presented the committee with a quantitative survey of the country's productivity problems. He said the paper 'drew attention to the urgent need to increase productivity, and the practical morals seemed to be (a) that the public must be educated to realise the importance of this, and (b) that everything possible should be done to increase incentives to greater productivity'.² The desperate fuel crisis in February and March 1947 riveted public attention on unpleasant economic facts and prompted the government to invigorate its means of guiding interpretation of them. Morrison had already agreed to create a small unit of full-time officials to direct economic publicity, and during his illness it was assigned to the BOT. Cripps also took over Morrison's fortnightly press briefings, which received extensive coverage. In the Cabinet shakeup which followed the fuel débacle and then the convertibility crisis of August 1947, Cripps became Minister of Economic Affairs and supplanted Morrison as the minister responsible for overall planning, matching resources to priorities, and economic publicity. Two powerful new bodies supported these tasks, the Economic Planning Office headed by Sir Edwin Plowden, an MAP veteran, and the Economic Information Unit under Leslie. But as Attlee told the Commons, 'planning is in itself no substitute for the increased effort and efficiency which are essential to our national prosperity'.³

To encourage that effort and efficiency, the EIU instigated a propaganda programme in the spring of 1947 'for enlightening the public

¹ PRO, CAB 134/187, E.D. [Official Committee on Economic Development] (46) 5th meeting, 11 July 1946.

² PRO, CAB 134/190, E.D. (47) 2, 'Changes in productivity in British industry', 12 Jan. 1947; E.D. (47) 1st meeting, 17 Jan. 1947.

³ HC Debates, Hansard vol. 435, col. 1413, 27 Mar. 1947.

about the unfamiliar problem that faced the country, and for indicating the new attitudes and actions that were demanded by the times'.¹ Its theme was more ominous, warning the country that 'We're Up Against It -- We Work - Or Want'.² Cripps championed the tough message of the new campaign, offering productivity gains as the way out. To reach the ten percent gain in output which the government sought, 'more brain than muscle is required. . . .if all the production units in each industry brought themselves up to the standards of the best units then we should at once get more than the ten percent increase'.³ When Cripps became Chancellor of the Exchequer in November 1947 after Dalton's budget indiscretion, productivity policy was assured of a knowledgeable and extremely powerful advocate. There was a drawback, in that he relinquished control over the BOT which had direct responsibility for many industries and specific programmes to aid their productivity. At the Treasury his influence on productivity had to be indirect, through publicity and general economic policies such as the level of taxation and investment.

4.3 The ACSP and its productivity offspring

The ACSP's first meeting took place in March 1947 at the time of the fuel crisis.⁴ Morrison had supplemented the committee's vague terms of reference -- 'to advise the Lord President of the Council in the exercise of

¹ PRO, T 245/6, Report on the EIU by Leslie, Oct. 1948, p 1.

² Cripps papers, 1067, press conference on economic publicity, 18 Apr. 1947.

³ Cripps papers, 223, speech to Buxton Conference; 1299, speech to Production Drive Conference, 15 Oct. 1947.

⁴ The Council's members were: Tizard, Appleton, Barlow, Zuckerman, Sir Ewart Smith, MRC secretary Sir Edward Salisbury, UGC vice-chair A.E. Trueman, Ministry of Works scientific adviser Sir Reginald Stradling, ARC secretary Sir John Fryer, Sir Howard Florey, and Professor A.R. Todd.

his responsibility for the formulation and execution of Government scientific policy'¹ -- with a letter asking for help in specific areas, one of which was 'the most appropriate form of research effort to assist the maximum increase in the national productivity during, say, the next ten years, including research in natural and social sciences'.²

The ACSP quickly showed the weaknesses inherent in its structure and resources. The council met 13 times in 1947, eight times in 1948 and at about that rate thereafter. Its endorsement helped ideas which had support elsewhere, but without a large secretariat it could not stray too far from conventional wisdom. Ian Mikardo observed that it could operate 'only through the painful process of one-sided negotiations with vested interests',³ as for example in its unavailing advocacy of a British MIT described in section 3.3.2. Most committees tend towards least common denominator compromises, and the ACSP was additionally inhibited from heterodoxy by the presence of Appleton, Trueman, Salisbury and Barlow, all officials with departmental interests to protect. We have already seen how Appleton and Barlow in particular blocked Tizard's recommendation that each department should have a scientific adviser backed by an independent advisory council able to commission research from whatever source they saw fit.⁴ Tizard himself produced fresh, incisive ideas, but paid more attention to his heavy defence responsibilities and, in any event, seemed to lack a

¹ PRO, CAB 132/64, S.P. (47) 1, 'Terms of reference and composition', 18 Feb. 1947.

² Others were the organisation of government civil science, QSE supply, fuel policy, research in the socialised industries and oceanography. PRO, CAB 132/64, S.P. (47) 2, Remit by the Lord President of the Council, 18 Feb. 1947.

³ quoted in Clark, Tizard, p 397.

⁴ Page 197.

certain instinct for political maneuvering.¹ Lockspeiser noted: 'There was a streak of the rebel in him. . . .For this reason he may not have enjoyed a great popularity among the top people'.²

Certainly the ACSP's productivity work bore Tizard's strong imprint. His views on what science could do for industry and how fast it could do it had been largely fixed for at least a decade. In 1938 he said:

If we consider the progress of industry as a whole and forget for a moment the spectacular discoveries which may lead at long last to the establishment of new industries, we must surely realise that the chief fruits of industrial research are to be found in the improvement of known processes in detail.³

In 1940 he wrote: 'I, myself, feel quite confident that there are not half a dozen new things that we can hope to introduce during the war which would have material effect on winning it. Can we not try to make up our minds what these are'?⁴ His postwar work showed similar themes: a stress on development and engineering rather than fundamental research as the only route which would bear industrial fruit within a reasonable period; the need to set priorities based on what was likely to succeed and spend generously and consistently on them; eschewing glamorous projects for practical ones. A corollary of these views was that Britain should concentrate on educating many more scientists and especially engineers who could turn unexploited discoveries into usable innovations. This advice was sound but difficult to implement.

¹ Ibid., pp 397-99; Crowther, Statesmen of Science, 303-5.

² Tizard obituary, Times, op.cit.

³ Tizard papers, HTT 566, 'Industrial research - present and future', Tata lecture, Jan 1938.

⁴ Memorandum to the Advisory Council on Scientific Research and Technical Development of the Air Ministry, May 1940, quoted in Clark, op.cit., p 198.

In June 1947 Tizard proposed a separate ACSP subcommittee to give more attention to productivity than the full council had so far been able to, and a Committee on Research and Productivity (CRP) was established led by Sir Claude Gibb, managing director of C.A. Parsons.¹ Its terms of reference altered in a small but significant way the wording of Morrison's remit: instead of advising about how 'scientific research' could promote productivity gains, the CRP thought a broader outlook was required and changed the phrase to 'a scientific approach'. The whole manufacturing process, not just the lab, would have to contribute to higher productivity.² The CRP's first steps revealed a sensible humility about the possibility of producing a dramatic leap in productivity. A BOT paper for the committee pointed out that the existing 'rate of work, labour saving devices, etc. [are] now an integral part of a cultural pattern and will, therefore, be difficult to eradicate'. Shortages of materials and labour and the work-slowness fear of a slump would also persist. Mechanisation on a large scale, an important goal, would obviously take intelligent management, investment and new building, all of which were scarce. Restrictive practices which insulated many inefficient firms from concern about productivity were deeply entrenched. And even if these long-term dampers could be reduced, the country's economic crisis demanded something more immediate.³ So the CRP set up a working party of departmental officials to initiate research in areas which could have rapid payoffs, and itself started scrutinising industrial psychology,

¹ Other members included Smith, Appleton, Todd, Sir Thomas Merton from the BOT, Plowden, Nicholson and Dr S. Wyatt from the Industrial Health Research Board. PRO, CAB 132/64, S.P. (47) 37, 'Research and productivity', note by Tizard, 29 June 1947; 7th meeting, 3 July 1947.

² PRO, CAB 132/83, S.P. (R.P.) (47) 1st meeting, 25 Jul. 1947.

³ PRO, CAB 132/83, S.P. (R.P.) (47) 3, 'Productivity', paper by Dr. Gordon, 22 July 1947.

operational research and other techniques of 'social engineering' which could be implemented quickly and cheaply.

Productivity was a new field, virtually unexplored, and during July and August 1947 the working party set out multiple lines of attack, mostly in the social sciences. They consulted nutritionists and doctors to conclude, in answer to an inquiry from Morrison, that current rations would have to rise if workers were to produce appreciably more. They looked at the effects on output of low coal quality, pay incentives, management skills and interior decoration and lighting (40 percent of factories were improperly lighted).¹ The working party also investigated standardisation of products and recommended the CRP to consider whether some central body should be established to make sure that its recommendations on productivity, 'if accepted, are effectively carried out'.²

The CRP adopted the working party's line on employing the social sciences to secure the quickest productivity gains. In September 1947 the CRP submitted a one-page report to Morrison outlining a basic approach for the government. Current fundamental research, it said, while 'undoubtedly important in the long run', would not 'have any material short term effect on increasing productivity'. Application of existing knowledge should instead be stressed, which would require more QSEs; therefore it was 'indefensible' for the armed forces to be calling them up 'indiscriminate[ly]'.³ Operational research held the greatest immediate promise, but even more important was making management and workers grasp 'the magnitude and real causes of the

1 PRO, CAB 132/85, S.P.(R.P.W.) (47) 8, 'Summary of suggestions made by the directors of establishments in D.S.I.R.', 24 Sept. 1947, p 6.

2 PRO, CAB 132/83, S.P.(R.P.) (47) 2nd meeting, 29 Aug. 1947.

3 Agitation by Tizard, Zuckerman and other leading scientists to secure deferments from military service for scientists persisted throughout the Attlee government but does not appear to have produced results.

crisis facing the country' to spur them on. 'The blunt fact then is that the problem is essentially psychological in the short term', the CRP concluded.¹ This was an interesting line for a committee on which physical scientists and industrialists were heavily represented. Morrison found it interesting too but wanted guidance about what the government should actually do.²

No answer was immediately forthcoming. The CRP and its working party continued research into incentives, nutrition, standardisation and workers' attitudes, but mostly these revealed how much more study was required before coherent recommendations could be placed before ministers.³ Morrison, however, needed sound advice quickly, and he worried that the CRP and working party could not handle the diverse array of complex topics they had identified as important. Leftist scientists, especially the AScW, had indeed been criticising the government throughout the summer for lethargy and lack of imagination in harnessing science to the economy, especially after the convertibility crisis.⁴ Nor was Cripps, as Minister of Economic Affairs, satisfied with the government's science machinery. On 20 October 1947, Morrison invited him to participate in 'revising the composition or subject-matter of the [productivity] enquiry. . . .I am anxious to accelerate the measures which I had set in hand earlier in the year for mobilising science to assist in coping with the economic crisis'.⁵ Meeting in

1 PRO, CAB 132/64, S.P. (47) 53, 'First interim report of the CRP', 25 Oct. 1947. [While the ACSP considered it in October, the report itself is dated 17 Sept. 1947].

2 PRO, CAB 132/83, S.P.(R.P.) (47) 4th meeting, statement by Nicholson.

3 See, for example, PRO, CAB 132/83, S.P.(R.P.) (47) 14, 'Specification, standardisation and the reduction of variety', memorandum by C. Gordon and T.E. Easterfield, 8 Sept. 1947, p 1.

4 AScW, 'Science and the economic crisis', Aug. 1947; Bernal papers, B3.126, letter to the Times 23 Aug. 1947.

5 PRO, CAB 124/1093, letter from Morrison to Cripps, 20 Oct. 1947.

November 1947, Morrison, Cripps, and Minister of Labour George Isaacs agreed that an overhaul was necessary; Cripps said there were 'a lot of bodies which needed thinking up and a good steering body was necessary'.¹

4.4 The Committee on Industrial Productivity

4.4.1 Origins

The staffs of the three ministers worked out the details. Nicholson, very much Morrison's alter ego in this area, prepared a survey of what the ACSP and CRP had learned so far and with Cripps' aides sketched out a reinforced committee structure to pursue further inquiries. A preliminary document stressed the need to increase the pool of first-rate researchers in the social sciences, now numbering fewer than 50, and to deploy them in inter-disciplinary teams to study all factors relevant to productivity in sample factories. 'Administrative and scientific thought is converging on the problem of worker/management relations and on the study of the total situation in. . .factories and mines as the most urgent job'.²

How could the government disseminate the results of these new studies into workplaces all over the country? Nicholson mentioned the central publicity units and a chain of implementing agencies, starting with the NPACI in London, leading to the Regional Boards for Industry and then to the joint Production Committees which were as yet patchy but would soon extend, he hoped, to every firm. The BIM, the Ministry of Labour scheme through which 100,000 low-level supervisors had already been trained, the PES and the Factory Inspectorate would also contribute. 'All of them are

¹ Ibid., 'Note for record' by Nicholson, 3 Nov. 1947.

² Ibid., minute from Nicholson to Morrison, 31 Oct. 1947, p 2. See also PRO, CAB 132/83, S.P.(R.P.) (47) 37, 'The human factor in production', report by the Working Party on Research and Productivity, 15 Dec. 1947, p 13.

much too small for present needs', Nicholson wrote, 'and any tidying up of the structure must not be allowed to interfere with its intensive development. . . . Meanwhile there is no alternative to continued improvisation'.¹

Cripps' officials suggested how the government should set the productivity policy which this chain of committees would encourage industry to implement. Their focus was on the prior need to commission and oversee research in the diverse areas relevant to productivity. During the war the Forces had themselves generated abundant problems requiring laboratory and operational research; in peace, however, 'most of the production units do not do so'. Thus G.B. Blaker, Cripps' chief aide in this area, believed that 'identification of the problems is really the major task with peace-time industry'.² He therefore proposed what became, after some negotiating with Nicholson and others, the Committee on Industrial Productivity. Chaired by Tizard, it was to contain 'a wide variety of [natural and social science] disciplines welded together in an effective group and suitably influenced at the formative stage by those who will have to apply or disseminate the results, e.g. administrators, managers, information officers, etc'. Four subsidiary panels would break down the subject matter into manageable chunks. The Technology and Operational Research panel would examine promising new technologies and how machines and workers could be better organised. The Human Factors in Industry panel would take over the studies of incentives, industrial psychology and morale. Imports Substitution would examine how home-produced raw materials might replace expensive imports, and Technical Information Services would study how to speed and simplify the distribution of scientific and engineering literature to those who were

¹ Nicholson minute, 31 Oct. 1947, pp 4-5.

² PRO, CAB 124/1093, letter from Blaker to Nicholson, 1 Nov. 1947.

trying to apply it.¹ Tizard had little criticism of this plan but emphasised the unlikelihood of quick practical results. 'What you are suggesting is a long term policy'.² Cripps, Morrison and Attlee agreed to the plan by November 12. Cripps and his officials were the dominant force in shaping the CIP, and Nicholson's concern about mechanisms for disseminating results into industrial practice fell by the wayside in the way it was structured.

Setting up the CIP was politically delicate. Sir George Schuster, a barrister and director of Westminster Bank who had been a Liberal MP during the war, was made head of the Human Factors panel and took on negotiating the cooperation of the TUC and FBI. The TUC was concerned lest it appear 'that the workers were to be psychoanalyzed'³ and the FBI was 'cautious' for reasons of its internal politics.⁴ Both agreed to participate, however, and Morrison announced the CIP's creation to the Commons on 18 December 1947.⁵ Besides TUC and FBI representatives, the CIP also contained Appleton and Gibb from the ACSP, Nicholson and Blaker to represent their ministers' interests, the head of the Cabinet's Economic Section, and the member of Plowden's planning staff who oversaw future investment. The heads of the four panels were also members: Schuster, Zuckerman for Imports Substitution, King for Technical Information Services, and Sir William Stanier, a distinguished mechanical engineer, for Technology and Operational Research. Deliberately excluded from the CIP for reasons of

1 PRO, CAB 124/1093, 'Problems affecting industrial morale and productivity and the organisation for handling them', memorandum by Nicholson, 5 Nov. 1947.

2 PRO, CAB 124/1093, comments by Tizard on 'Draft outline for report to ministers', memorandum by Nicholson, 3 Nov. 1947.

3 PRO, CAB 124/1094, 'Note for the record' by Nicholson, 9 Dec. 1947.

4 'Note for the record', op.cit.

5 HC Debates, Hansard vol. 445, cols. 1869-70, 18 Dec. 1947.

size and speedy operation were representatives of the relevant government departments: BOT, Supply, Labour and the financial side of the Treasury, though their officials were to serve on some of the panels.¹ The BOT, weaker now that Cripps had left, was particularly angry about not being consulted; 'it is really rather monstrous', wrote under secretary R.M. Nowell, and the Permanent Secretary, Sir John Woods, 'let off. . .unofficial curses' about it. Both worried that Nicholson and Blaker might use the CIP as a vehicle for poaching on BOT responsibilities, but resignedly concluded that the Council could do 'a useful job if it stays within its announced terms of reference'.²

4.4.2 The CIP Panels

The CIP first met in February 1948 but most of its panels had already met and instigated a blizzard of studies. The Economic Planning Board had composed a list for the CIP of areas where the national interest required the greatest attention to productivity: industries which were short of workers, had low productivity compared to prewar, showed great divergence between best and worst firms, or were producing key items for export or in short supply. Specific industries meeting these criteria included textiles, tinsplate, foundries, pottery, cutlery, coal mining and docks.³ Two panels, Imports Substitution and Technical Information Services, speedily produced some practical results. Imports Substitution wrote a report on steel economy showing that large savings could come from educating engineers to depart from wasteful traditional practices in construction. It recommended erecting

¹ PRO, CAB 124/1094, minute from Blaker to King, 22 Dec. 1947.

² PRO, BT 64/2360, minute 1 by Dakin, 31 Dec. 1947; minute 4 by Nowell, 12 Jan. 1948; minute 7 by Woods, 19 Jan. 1948.

³ PRO, CAB 132/28, C.I.P. (48) 7, 'Report from the Economic Planning Board', 31 Jan. 1948.

a plant for pulping straw to make paper, which would cost £12m but save £8m in the first year off a £50m hard currency bill for wood and paper imports. The BOT then approved the construction of several straw mills. Imports Substitution also pointed out how quick and easy it would be to expand grass production for livestock by 20 percent for a net savings on imported foodstuffs of about £50m, and recommended publicity and readjusted subsidies to bring this about. The Ministry of Agriculture consequently sped up and expanded its grasslands programme, and the BOT approved plans for building the plant necessary to produce 100,000 additional tons of nitrogenous fertiliser.¹

The Technical Information Services panel quickly agreed that the government possessed much unused technical data. It considered a central lending library too expensive and cumbersome a remedy. Instead it preferred to encourage the development of specialised collections attached to labs, universities or other facilities where they would be intensively used, and to provide a central referral service to make them accessible to others. Morrison agreed to expand DSIR's technical information unit to provide this service. The panel also undertook more detailed studies about standard classification systems, microfilming and the dissemination of wartime technical reports. Like Imports Substitution, the Technical Information Services panel produced practical results quickly and did not offend vested interests.

By contrast, the work of the Human Factors Panel (HFP) in labour-management relations under maladroit leadership embroiled it in controversy which the CIP, basically a committee of scientists, was not

¹ PRO, CAB 132/28, C.I.P. (48) 18, 'Interim progress report', 7 May 1948, p 4; C.I.P. (48) 16, 'Report by chairman of imports substitution panel', 11 May 1948; Annual Report 1948-49, Cmd. 7665, paras. 69, 61; CAB 132/29, C.I.P. (49) 16, 'Note by the deputy chairman of the panel on imports substitution', 23 May 1949.

equipped to resolve. A major report by the CRP's Working Party in December 1947 was the HFP's point of departure.¹ The report distinguished between 'primary' human factors affecting productivity -- national phenomena like restrictive practices, taxation levels, fear of unemployment and labour mobility, which were important but scarcely understood -- and 'secondary' ones operating in individual firms. Experts on the latter almost unanimously agreed that

the key to higher productivity. . .lies. . .in raising the general morale of the workers by improving their relations with their managements and by substituting an attitude of purposive co-operation for one of indifference, suspicion, or hostility.²

Specific ways of inducing collaboration included well-run joint production committees, fair grievance procedures, training schemes for low-level supervisors, more modern management organisation, incentive payments and bringing in a team of experts like those from the Tavistock Institute who specialised in fostering harmony in companies. The report called for the government to fund research into all these areas, and into ways of easing its application by industry. A central board to coordinate the research and more investigators was also needed. 'We are convinced', concluded the Working Party,

that research by field investigators in industrial relations can be profitable if undertaken in an impartial and scientific manner, and that it is capable of yielding results immediately applicable to industry. . .of great significance in raising productivity levels. . . . Those derived from the sociological approach could exert significant influence on productivity in a short time and often without any capital expenditure.³

The research programme begun under the aegis of the Human Factors panel shows the influence of this Working Party report. It included studies of

¹ PRO, CAB 132/83, S.P.(R.P.) (47) 37, 'The human factor in production', 15 Dec. 1947.

² Ibid., p 6.

³ Ibid., p 13.

joint consultation in the Glacier Co., an engineering firm with 1500 employees and an iron foundry, of the status, selection and training of low-level supervisors; of methods of disseminating existing knowledge in factories; and four other projects, mostly in motion study. The Treasury agreed to finance them at an estimated cost of £45,000 in the next year, and the MRC agreed to administer them.¹ The CIP and HFP themselves were thought to comprise the necessary oversight mechanism.

Doubts were soon expressed about the relevance and practicality of the HFP programme. Zuckerman thought it was thin compared to the economy's problems.² Foundries were the only priority industry on this first list of projects, and that was by coincidence. The academics on the panel sometimes gave the appearance of trying to pursue long-postponed pet projects on government finance, rather than devising the most practical programme for a straitened economy.³ Some panel members wanted to devote more attention to the 'primary factors' affecting productivity such as status of jobs and fear of unemployment.⁴ Given the already expressed worries of the FBI and TUC to HFP's whole programme, this was unrealistic. Indeed HFP's Ministry of Labour representative opposed the joint consultation study merely because it might lead to some improvements in working relationships at the plant not initiated by unions or management.⁵

The BOT also worried that HFP was aiming to trespass into sensitive

¹ PRO, CAB 132/28, C.I.P. (48) 18, 'Interim progress report', 7 May 1948.

² PRO, CAB 132/28, C.I.P. (48) 2nd meeting, 24 Mar. 1948.

³ See, for example, the statement of Dr. Wilson, in PRO, CAB 132/31, C.I.P. (H.F.) (48) 7th meeting, 12 Oct. 1948.

⁴ PRO, CAB 132/31, C.I.P. (H.F.) (48) 47, 'Implementation of the Working Party's recommendations', paper by R.G. Stansfield, 28 Oct. 1948.

⁵ PRO, CAB 132/31, C.I.P. (H.F.) (48) 2nd meeting, comments by M.D. Tennant, 4 Mar. 1948.

topics beyond its competence, such as the introduction of incentive payment schemes which most unions opposed. BOT officials considered Schuster an 'exceedingly vague and woolly' thinker. Apparently he was hoping to make his job 'a major executive position' by using HFP as a platform to propound his views on thorny political questions of union-management relations.¹ Dakin wrote that Schuster was 'prone to empire building even in cloud-cuckoo land',² and Tizard seems to have partly shared these views.³ In any event, it was clear that all the studies instigated by HFP would take many months to complete and their conclusions many more to implement. While Schuster and his panel had attracted valuable publicity to the issue of how management and labour could organise work and cooperate more effectively, Tizard became convinced that many reforms were a matter of 'commonsense' and depended more on 'good leadership by the trade unions rather than. . .work by the Panel'.⁴

The panel on Technology and Operational Research (T&ORP) also provoked criticism from Tizard and others, largely because other bodies with greater executive responsibility were engaged in the same kind of study.⁵ One of the panel's reports provoked fury in the machine tool industry. Written by L.A. Ferney, assistant scientific adviser in the Air Ministry, it

1 PRO, BT 64/2360, minute 11 by R.M. Nowell, 16 Apr. 1948; minute 14 by Nowell, 6 May 1948.

2 PRO, BT 64/2360, minute 10 by Dakin, 26 Feb. 1948.

3 A letter Tizard wrote to all CIP members criticised unnamed persons for 'arguments about the relative culpability of what are commonly, but wrongly, called the two "sides" of industry', which Schuster was known to conduct. PRO, CAB 124/1096, letter by Tizard, 14 May 1948.

4 PRO, CAB 132/28, C.I.P. (48) 27, 'Memorandum by the chairman', 20 Sept. 1948.

5 Ibid., p 2.

sharply criticised the industry for technical backwardness.¹ It overlapped and contradicted a study being undertaken by the Ministry of Supply's Machine Tool Advisory Council (MTAC), controlled by leading manufacturers, which found nothing fundamentally wrong. The head of the machine tool trade association wanted Ferney's report withdrawn and destroyed; the chair of MTAC called it 'misleading and mischievous', but Ferney ably refuted all specific criticisms.² Nevertheless the FBI Director-General used Ferney's report as an example of unsound work by the CIP 'prepared by [people] in government departments who have not had the necessary industrial experience'.³ Whether or not Ferney was correct, antagonising those in industry who alone had the power to make needed changes was not necessarily productive. Nor did it coincide with Tizard's sense of how an advisory committee had to operate.⁴

T&ORP concentrated most of its energies on the cotton industry, a major target of government aid and the only industry to receive a re-equipment subsidy of 25 percent. The Shirley Institute (the industry's RA) had recently allowed efficiency experts a free hand at the Musgrave Mill in Bolton to make any improvements they thought desirable that did not require significant new capital equipment -- something Sir Raymond Streat had been trying to arrange since before the war. Bitter opposition from employers and

1 PRO, CAB 132/47, C.I.P. (T.R.) (48) 16, 'A report on British machine tools', 23 Jul. 1948. [The report was first circulated in May.]

2 PRO, BT 195/76, note from L.H. Robinson to Blaker, 21 Aug. 1948; letter from Sir Harold Brown to Blaker, 15 Nov. 1948; letter from Sir William T. Griffiths to Tizard, 12 Aug. 1948; letter from Ferney to King, 24 Aug. 1948.

3 The others were Zuckerman's memo advocating more straw in papermaking and a report [see p 251 below] by Dr. Gordon of the BOT for a new government body to frame new ideas for civilian machinery innovations, especially in textile machinery, as the services had done for weapons during the war. In fact Ferney's industrial experience was considerable. PRO, CAB 124/1096, minute from Tizard to King, 17 Aug. 1948.

4 C.I.P. (48) 27, op.cit., p 3.

unions had frustrated it until the dismal conclusions of the Platt Report made continued refusal too embarrassing.¹ This mill was already one of the best of its kind, but simple reorganisation measures produced an output per person-hour increase of 40 percent that was passed on in lower costs and higher wages.² The T&ORP decided to set up a study panel to investigate how these techniques could be widely diffused. While wholesale reorganisation of mills might take more than a year, the panel found ample scope for simple 'tuning up' measures. Since however management and especially unions continued to resist them, the panel recommended adding social scientists to Shirley Institute teams who could study and help overcome the sources of resistance.³ Stronger measures were needed to transform this hidebound and insular industry, but they were beyond the scope of a scientific subcommittee.

A longer-term need for replacing the aging stock of textile machines was also apparent to T&ORP. Based on the Evershed Report,⁴ the Ministry of Supply was sharply expanding production of Northrop looms even though it acknowledged them to be significantly inferior to current American models. Because the mills resisted re-equipment, machinery manufacturers feared they would not be able to sell enough novel designs to recover development costs. So the panel commissioned a large study by its Working Party of the textile machinery industry.⁵ This report took more than a year to finish, and not surprisingly criticised the low level of textile machinery research

¹ PRO, BT 64/2192, note by W. Hughes, 23 Jan. 1946.

² Labour Party, Speakers' Handbook 1949-50, p 31.

³ PRO, CAB 132/28, C.I.P. (48) 18, 'Interim progress report', 7 May 1948.

⁴ Committee of Investigation into the Cotton Textile Industry, Report (HMSO 1947).

⁵ PRO, CAB 132/47, C.I.P. (T.R.) (48) 5, 'Future programme', note by Stanier, 23 Feb. 1948; 2nd meeting, 27 Feb. 1948.

and feeble liaison between producers and users. After considering it, T&ORP concluded that textile machinery firms should expand their own research departments, as opposed to starting a new RA for them or new machinery research units at existing RAs. This was hardly an earth-shattering recommendation, especially after such a delay. Nevertheless it crossed lines with a working party with greater executive powers recently established by ministers to consider yet again the problems of textile machinery R&D.¹

4.4.2.1 The Panel on Automatic Control Techniques

For a period in 1947 and 1948 the government moved toward taking responsibility for directing the development of a whole range of new devices to automate industrial processes. With T&ORP's approval, a Panel on Automatic Control Techniques (PACT) was established in February 1948. PACT was given unusually large authority to work directly with industry. It was supposed to educate potential users about the vast productivity improvements available through electronic and electromechanical automation, to bring users and potential producers of new equipment together, to identify promising applications for automation and to place development contracts for prototypes through the Ministry of Supply.² The concept of an activist central body to promote automation had emerged from the BOT in October 1947. Earlier that year the first fully automated transatlantic flight had gathered wide publicity, and the BOT Journal had carried an article by Dr. H.A. Thomas of the NPL, in charge of the government's small research programme in this area, pointing to the 'innumerable industrial purposes' to

¹ PRO, CAB 132/48, C.I.P. (T.R.) (49) 1st meeting, 18 July 1949.

² PRO, BT 64/2334, DSIR Advisory Council paper A.C. (47-8) 97, 'Automatic control techniques', 14 July 1948, p 2; CAB 132/47, C.I.P. (T.R.) (48) 2nd meeting, 27 Feb. 1948.

which standard electronic devices like valves, photocells and gas rectifiers could be applied.¹

The immediate spur to the work which resulted in PACT's creation was DSIR's lackadaisical attitude towards automation. When asked in September 1947 whether it was pursuing automation as part of its effort to aid productivity, the DSIR responded lamely that it had advised Thomas to alert electronics firms to the market potential through lectures but had received no report from him.² Dr. Cecil Gordon from the BOT, believing a much more comprehensive automation strategy was required, enlisted support from the CRP's Working Party. Every member of that body, including the DSIR representative, 'agreed with [him] that what was lacking was (a) a real policy requirement that electronics in industry shall be developed, and (b) the making available of research teams from defense research'. Since Britain was widely acknowledged to be 'extremely backward' in machine research and design, Gordon believed that electronic automation offered 'an opportunity to do the really big thing - to skip a whole historic phase in machine design and to proceed to devise machinery incorporating the very latest scientific knowledge'.³

Gordon's enthusiasm persuaded Dakin at the BOT, who wrote his superiors that electronic devices 'open up an almost limitless vista of the automatic control of the more repetitive processes of industry'.⁴ During the war Britain had developed highly successful electronic gunlaying devices, but since 1945 civilian advances had come mostly from the United States, which

¹ PRO, BT 64/2334, 'Electronics as an aid to production', BOT Journal (26 July 1947) 1266.

² PRO, BT 64/2334, minute from Gordon to W. Hughes, 30 Sept. 1947.

³ Ibid.

⁴ PRO, BT 64/2334, minute by Dakin, 13 Oct. 1947.

had three monthly periodicals devoted exclusively to industrial applications of electronics and several hundred specialty manufacturers. Dakin wrote that British firms were finding research in this area too expensive to be repaid by sales in the 'ones and twos which industry [was] prepared at present to order'. A few people were working at the NPL on servo mechanisms, a few others on digital computers,¹ but this did not compare to the hundred people working on electronic automation at the U.S. Bureau of Standards and the many more employed by American companies. In Britain 'no one is even trying to cover the main fields of industry', wrote Dakin, 'and it is no one's job to try to bring the different researches together'. So after some prodding from the BOT and King, Appleton convened a meeting in November 1947.² It established a small survey team under NPL Director Sir Charles Darwin, which met manufacturers, users and RAs in the relevant industries. It found 'a willingness to make the earliest and fullest use of automatic devices' but also widespread 'ignorance of the potentialities of these techniques'. Other impediments to quick progress included: the expense of new devices because of high development costs; a seller's market for familiar electromechanical devices which made their manufacturers loth to risk new lines; fear of another slump; poor contacts among development workers and between suppliers and users; insufficient trained personnel for demonstration and service; poor engineering design; and shortages of components.³

To remove these impediments PACT was created, along with subordinate working groups at NPL and TRE which in combination were

¹ In retrospect it is interesting that Dakin considered the computer research 'mainly of purely academic interest'. Ibid.

² PRO, BT 64/2334, letter from Sir John Woods to Appleton, 5 Nov. 1947; from Dakin to King, 11 Nov. 1947.

³ PRO, CAB 132/47, C.I.P. (T.R.) (48) 6, 'Automatic control and instrumentation', 23 Feb. 1948, containing 'Interim report of the Industrial Electronics Panel', 31 Jan. 1948.

authorised to employ nine scientists and spend about £13,000 annually.¹ Darwin chaired PACT, whose members came from DSIR, the Ministry of Supply and BOT.² Its assigned tasks were to aid all of British industry in the solution of known automation problems, to identify and solve new ones, and to facilitate the placing of development contracts for risky new devices.³ By July 1948 its staff had visited most important manufacturers of electronic controls and was collaborating with them on many valuable projects. These included viscosity meters, strain gauges which could weigh aircraft and other heavy loads quickly and accurately, a non-destructive ultrasonic method for wire testing, devices to detect dirt in glass bottles and extraneous matter in flour, and electronic simulators of entire oil refineries.⁴

Here was an intriguing attempt to replicate in civil industry the extraordinary wartime fruitfulness of Sunday Soviet style collaboration, stimulating exchange between producers and users in a fast-moving technology clearly important to the national interest. Indeed some PACT participants were Sunday Soviet veterans, and many automation devices were direct descendants of radar. However not even this strong start was enough to ensure success. The panel folded in 1949, after Dr. Thomas, who had directed its NPL working group, left NPL in March. It is not recorded why PACT stalled, but it is clear that inadequate staffing and finance once more

1 DSIR, A.C. (47-8) 97, 'Automatic control techniques', p 'b'.

2 Dakin had written his superiors: 'It is doubtful whether the N.P.L. or for that matter D.S.I.R. is sufficiently impressed with a sense of urgency or accustomed to handling problems of immediate development in close contact with industry to be left in sole independent charge. . . .production departments should be represented'. Dakin minute, op.cit.

3 DSIR, A.C. (47-8) 97, 'Automatic control techniques', p 'b'.

4 PRO, BT 64/2334, PACT minutes [dated 25 Oct. 1948] from 4th meeting, 28 July 1948, Appendix 5.

played a role. Some of PACT's authorised positions were not filled, a problem accentuated by the vast range of uses for automation equipment. Unlike the Sunday Soviets, where the user group and its needs were well defined, PACT had all British industry as a potential client. It was not feasible for such a small body to specify the needs of diverse industries for electronic controls, educate backward firms about their potential, and conduct path-breaking research as well. Post-devaluation economies in government expenditure, intensified by the Korean War, further reduced the government's automation work to what Lockspeiser called a 'man and a boy' basis.¹ Perhaps PACT could have been effective as one component of a full-fledged government R&D extension service, but standing alone it was inadequate to its task.

4.4.2.2 'Provision for development': A proposal for civilian Sunday Soviets

Meanwhile Dr. Gordon had been so impressed by PACT's fast start that he believed its central feature -- a government body empowered to look ahead and formulate challenging but attainable technical specifications for the next generation of devices -- might be extended to capital goods generally, particularly in textiles and other staple industries where machinery was clearly backward. This impinged directly on the textile machinery investigations of the CIP's panel on Technology and Operational Research, and it was to the panel's working party that he presented his ideas, in a long and thoughtful July 1948 paper entitled 'Provision for development'.² 'Two important things present in [military procurement]', he wrote, 'and absent in the traditional industries, are institutions for

¹ PRO, DSIR 17/278, memo from Lockspeiser to Woolton, 27 Mar. 1953, Appendix.

² PRO, CAB 132/47, C.I.P. (T.R.) (48) 18, July 1948.

formulating the operational requirements for new equipment, and a supply of sufficient resources for new development.' The Services possessed sizeable units whose job it was to specify the operational requirements of the next generation of weapons, aided by operational research groups and in-house R&D teams. These units maintained close liaison, at all phases of drawing up specifications, between field officers who would have to use the new equipment in combat and the laboratory QSEs who sought to enhance its capabilities by the time it reached production. 'To sum it up, the Defence development procedure presumes that you can't really get the best until you know what it is you want; you can't want the best until you know what it is that you can get'.

Certainly technical excellence had to be the overriding attribute of new weapons, whereas textile machinery had to compete on cost too; many argued that the service model of procuring advanced devices was therefore irrelevant to the civilian economy. But Gordon took pains to show how 'the purely economic factor', always present to some extent in decisions about what would constitute the optimal weapon, had become 'the major consideration' during the war, when the services had to be concerned about 'the practicability and cheapness of making new weapons on the necessary scale'. Increasingly the Services had to frame their weapons requirements in terms of 'achieving an objective, say, an area of destruction, at the lowest cost' -- a problem very similar to a textile machinery firm balancing attributes against expense in designing its next generation of products. Thus the Services' procurement model was not irrelevant to civilian needs, especially when laissez-faire was failing, as in textile machinery, to break a 'vicious circle of a refusal to re-equip and little demand because the machinery offered is not sufficiently novel, and a failure to develop new machinery because there is not enough demand'.

Gordon hoped that the Development Councils would eventually prove the right place for locating PACT-like development teams able to mediate between producers and users of advanced machinery and stimulate them both. In the meantime the RAs would have to be strengthened to do the job. For most of them 'economic evaluation of processes and plant would. . . be a new responsibility'. They would consequently need staff, money, authority to place development contracts with private firms, and a broader vision. DSIR, as the direct arm of the government, should take responsibility for directing the RAs' development work in accordance with national priorities. 'This would be a logical development of the existing objectives of the D.S.I.R.', wrote Gordon, 'and would bring industry into line with agriculture, where almost all R&D of improved farming practise is Government-financed and Government-run and yet is compatible with the maintenance of private enterprise on the farms'.¹

'Provision for development' was one of the more sophisticated efforts during reconstruction to adapt what was fruitful about the organisation of wartime development work to the civilian economy.² It went nowhere. Making textile machinery his exemplar of present failures guaranteed him the attention of T&ORP, which was charged with suggesting improvements in that industry. But it also meant plunging into the centre of several controversies: between textile machinery manufacturers and their critics

¹ Ibid.

² The postwar inefficiencies of British military procurement have been well documented, but these were not appreciated in 1948. See, for example, Winston, 'The British government and defence production, 1943-50'; M.J. Peck, 'Science and Technology', in Caves, ed., Britain's Economic Prospects; Mary Kaldor, The Baroque Arsenal (London 1982).

over whether the industry really was backward;¹ between textile manufacturers and the government over how much the government was entitled to intervene; between the DSIR and RAs over their prerogatives; and between the BOT and DSIR over which was better suited to stimulate R&D. Since T&ORP was a technical advisory body it is hardly surprising that it declined Gordon's implied invitation to suggest major revisions in the structure of DSIR, the RAs and British R&D generally. Its only response to 'Provision for development' was to ask the FBI for a survey of existing laboratories capable of taking on development work.² It simply ignored the provocative structural questions; and as we have seen, another year went by before T&ORP felt ready to venture the bland recommendation in July 1949 that textile machinery firms should expand their own research departments rather than start a new RA or new machinery research sections at existing RAs. Gordon's paper was one of the items the FBI Director-General cited as evidence that the CIP was being led astray by academics bereft of industrial experience.³

In retrospect it appears that 'Provision for development', despite its thoughtful argument, was a document both after and before its time. Development Councils, direct economic controls, a strong science secretariat,

¹ Despite the evidence of the Platt and Evershed reports and of Streat's Musgrave Mill experiment, many textile machinery manufacturers insisted that their industry was healthy, citing their full order books and especially foreign demand. Some BOT officials responsible for textile manufacturing reflected these views, telling Gordon that he was 'unfair' to British machinery and that 'the failure of the machinery makers to co-operate with cotton manufacturers had been exaggerated'. PRO, BT 64/2353, 'Provision for development - note of a meeting. . .', 8 July 1948, para. 4. Indeed one BOT official in the textile industry section so faithfully reflected the industry viewpoint that he argued that 'electronics technique cannot be applied to the textile industries', prompting a colleague to scribble 'Hell!' in the margin. PRO, BT 64/2334, note 71 by J. Norris, 8 Apr. 1948; marginalia by B.G. Lane.

² PRO, CAB 132/47, C.I.P. (T.R.) (48) 6th meeting, 9 Aug. 1948.

³ PRO, CAB 124/1096, minute from Tizard to King, 17 Aug. 1948.

a government body to formulate advanced machinery specifications and other centralised solutions to the problems of low innovation and productivity were all being rejected in this period, despite their obvious analogy with successful wartime measures. Many factors were responsible for this aversion to government direction: the government's support for the mixed economy, which implied at least some respect for industry's ability to get on with its job; the inertia behind existing institutions, both in government (such as the DSIR and RAs) and business; active opposition from business leaders, Conservatives and some civil servants and scientists; and a shortage of QSEs and government finance which guaranteed that many experiments in government aid to R&D and productivity, such as PACT, DSIR's Intelligence Division and the Midlands Advisory Council on Productivity, were mere shells of the bodies they needed to be to succeed. It was another twenty years, under the Wilson government, before ideas like Gordon's found themselves in synchrony with broader political currents.¹

Meanwhile, in 1948, the chilly response to Gordon's memo and the broader problems of T&ORP and HFP prompted Tizard to dissuade CIP and its panels from further excursions into high policy. Frustrated himself at the difficulty of securing the application in factories of existing sound ideas for boosting productivity, however, he was soon to propose a major overhaul of

¹ In 1952 the ACSP considered a scheme remarkably like Gordon's to 'establish. . .in Departments concerned with private civilian industry, specialist technical and scientific organisations (of the kind that already exist in such departments as the Ministries of Supply, Agriculture and Fuel and Power) with the broad function of revitalising industries which are technically backward'. These bodies were to identify areas ripe for technical progress and issue development contracts for new devices considered too risky by individual firms. The ACSP dropped the idea, 'partly because of its potential expense', and partly because they believed it could be performed adequately by the NRDC and RAs. As already noted, however, the NRDC only took ideas presented to it rather than surveying whole industries to identify gaps; and the public record does not reveal the RAs making much use of development contracts in the 1950s. ACSP, Sixth Annual Report, May 1953 (Cmd 8874), pp 7-8.

the RAs' powers to stimulate development work which was quite in harmony with Gordon's robust view of what government coordination could accomplish.

We now return to the main subject of this section, the CIP. To recapitulate the conclusions drawn so far about the four panels, Human Factors and Technology and Operational Research had trouble carving out a worthwhile niche, while Imports Substitution and Technical Information Services proved successful largely because they did not stray far from fairly narrow technical studies.

4.4.3 The decline of the CIP

4.4.3.1 Tizard's initiative to strengthen the RAs and CIP

How was the parent body of the four panels, the CIP itself, faring? When it was appointed one headline exulted 'At last -- they've called in the boffins again',¹ and the Labour Party was moved to describe the combination of the ACSP, CIP and DRPC all under Tizard and served by an overlapping secretariat as a "'Scientific General Staff'".² Yet only three months after the CIP's first meeting Tizard had to report that he was 'not altogether happy' with the work of this much-heralded body. Members were sending deputies to meetings who dredged up arguments settled previously. The discussions were becoming too political on the one hand, too theoretical on the other. Neither suited the narrow territory which Whitehall conceded to part-time advisory committees -- to make practical, unthreatening suggestions for reform. 'We are not an executive body', Tizard admonished his colleagues;

¹ Chapman Pincher, Daily Express, 19 Dec. 1947.

² Labour Party, A New Deal for Science, May 1949.

our responsibility is to say what ought to be done to improve productivity, not to do it. . . .We are, and are intended to be, in the main, a scientific group. . . .We must not, for instance, waste our time in semi-political discussions.¹

HFP and T&ORP had devoted substantial effort to the problems of the cotton industry, for example; yet were these not already clear enough, requiring not further study but action? Thus Tizard decided that CIP, and the government's scientific advisory apparatus generally, should shift their scrutiny to that recurrent and crucial problem of civil science policy, the one which Tizard had considered central for more than a decade: devising better ways of getting research results into industrial practice.

He took these concerns to Morrison and Cripps. Nicholson agreed with Tizard that the CIP should be considered temporary and that some mechanism had to be found for locating productivity extension work within the responsible government departments, which alone had the resources for a sustained campaign. Probably influenced by the Labour Party's recent policy statement A New Deal for Science, he suggested a substantial strengthening of the RAs' OR capabilities, a batch of regional productivity advisory councils for publicity and technical liaison work, and a much larger central staff for preparing digestible technical news for backward firms.² Tizard ruminated on Nicholson's ideas and, 'believ[ing] firmly in devolution of responsibility' in the application of research results, expanded upon those which would make the RAs the field agents of the productivity drive. He then presented to Cripps and Morrison a plan for making the RAs the front line of all research, 'Scientific, Economic and Human that is of importance to maintain the health and productivity of the staple industries'.³

¹ PRO, CAB 124/1096, letter by Tizard, 14 May 1948.

² PRO, CAB 124/1096, letter from Nicholson to Tizard, 20 May 1948.

³ PRO, CAB 124/1096, letter from Tizard to Nicholson, 24 May 1948.

Frustrated at the longevity of old restrictive habits among managers and workers, especially in the glaringly backward cotton industry, Cripps and Morrison were disposed to be receptive to this plan.¹ In particular, Tizard proposed that RAs devote their chief attention to improving industrial processes which would lead to cheaper products made with less labour, 'and that this should be made a condition of Government grant'; that they submit progress reports to the CIP every six months, which would focus the work of that body; and that staff be added and RA directors changed as required. This new sort of investigation into production processes he termed 'quantity research', as opposed to 'quality research' aimed at producing wholly new products. Quantity research was being conducted on a 'scale ridiculously small compared to the United States', and so far the RAs had 'been of little value to industry'.²

Appleton was outraged at this implied criticism of his DSIR stewardship. Seizing upon Tizard's novel and somewhat forced distinction between quantity and quality research, he tried to discredit the plan for making the RAs more accountable to the CIP, which he thought would 'have a catastrophic result', destroying the autonomy on which the RAs' reputation rested. RAs were now 'dominating influences in their industries' and the leading force in the country for advancing OR and productivity. To Appleton no change was needed. It is an interesting commentary on his priorities that he chose to fight what might have proved an excellent chance to expand the

¹ PRO, CAB 134/220, E.P.C. [Economic Policy Committee] (48) 27th meeting, 6 July 1948.

² PRO, CAB 124/1096, minute from Tizard to Morrison and Cripps, 26 May 1948. This minute also contained some specific suggestions about the cotton industry, including the publication of productivity figures by firm as in football league tables, and increasing the number of workers or at least redistributing them from less to more productive mills.

RAs' budgets and usefulness rather than face any possible dilution of DSIR's control over them.¹

Few however shared his rosy assessment of the RAs' current value. The BOT, still eager to build some sort of direct bridge to R&D and productivity policy in its industries across the DSIR's Maginot Line, welcomed Tizard's basic approach but knew that the minor Whitehall revolution involved in recasting the RAs would be difficult:

DSIR as it is at present staffed and with its present philosophy could not possibly do it. Even if there were a revival of faith there and if its staff was strengthened sufficiently to enable it to do the liaison, administration and finance work which would be involved in the new policy, DSIR could not and should not be expected to give guidance to RAs on the policies and economic needs of their industries. This proposal, therefore, raises once again the question of the relationship between production departments, who alone could give this guidance, and the RAs.²

King wrote Tizard that in contrast to Appleton's 'completely misleading' account of RAs eagerly and knowledgably promoting productivity and OR, 'they have only just begun to nibble at the problem'.³ Blaker and Nicholson agreed with King, and told their ministers so: though some RAs had done good work, wrote Nicholson, 'in the completely new economic and technical conditions which now face us something very much more comprehensive and full-blooded is called for'.⁴

The ministers' solution was to ask the Official Committee on the Machinery of Government, chaired by Sir Edward Bridges, Secretary of the Cabinet, to review government facilities for aiding productivity.⁵ This was

¹ PRO, CAB 124/1096, letter from Appleton to Morrison, 3 June 1948.

² PRO, BT 195/36, letter from Dakin to Blaker, 4 June 1948.

³ PRO, BT 195/36, letter from King to Tizard, 7 June 1948.

⁴ PRO, BT 195/36, minute from Blaker to Cripps, 25 June 1948; minute from Nicholson to Morrison, 26 June 1948.

⁵ E.P.C. (48) 27th meeting, op.cit.

a sensible if unimaginative move. Ministers probably felt that raising the 'productivity consciousness' of civil servants and shifting the focus in this area from a gadfly advisory committee to the departments, which alone could devote people and funds to actual programmes, was the only way of making productivity a permanent feature of government policy. As we have seen, however, official committees such as the Machinery of Government Committee have characteristic drawbacks: a tendency to accept the existing constellation of departments as immutable and to finesse disagreements rather than solve them. In this case, few of the committee's members knew about Tizard's struggle with the RAs, and it was not really in a position to recommend quickly the major overhaul of DSIR's responsibilities he sought. Furthermore Bridges had 'strong views on streamlining the machinery of government' which brought him into frequent conflict with Morrison¹ and could not have predisposed him to expanding the role of the RAs or CIP, both unorthodox and awkward bodies from a civil service point of view. The Bridges committee's response to Tizard was to recommend the creation of a Productivity (Official) Committee (OP) which could review systematically the government's productivity activities and identify gaps. There was no mention of the RAs.² The officials who proposed this new committee may have been right in observing that 'attempts by Government Departments to teach industry its job would be foredoomed to failure. . . . detailed measures for increasing an industry's productivity are best devised and taken by that industry itself'. But the urgency of Tizard's plan to revamp the RAs was lost. The CIP gained no powers to oversee them.³

¹ Morgan, Labour in Power, p 87.

² PRO, PREM 8/877, 'Coordination of government activities for the promotion of industrial productivity', 4 Aug. 1948.

³ Ibid.

Morrison warned that the OP 'should understand that its job is to push things on and not to find reasons for going gently. . . .we have got to get a move on and there is no time to lose'. He sensed that a desire to tidy up the unorthodox role of the CIP, which had strayed too far into making policy for some officials' taste, may have lain behind the OP's creation. 'I do not want the scientists pushed into the back room again; nor do I wish Departments or industry to be able to evade or brush aside practical propositions of economic advantage brought forward by the scientists'. He also disagreed with the Machinery of Government Committee's view that government could not teach industry about productivity. 'Generally, I would observe that a good deal wants shaking up', either by 'good advice and kindly cooperation' or if necessary by 'push[ing] the industrial leaders around in cases where they are slacking'.¹

The new official committee worked hard over the next 18 months, collecting extensive materials from every department on their productivity-related tasks and producing a huge report. The departments' submissions listed as relevant virtually every official contact with industry, even when the consequences for productivity were remote. Some were defensive about current arrangements.² The committee's members, however, had long experience in seeing through smokescreens. How the government could stimulate productivity in private industry remained the central problem. Should the RAs, the farthest official outstation on the way to private business and thus presumably the most knowledgeable about its problems, be appropriately strengthened? Or, recognising the RAs' traditional smallness of

¹ PRO, PREM 8/877, letter from Morrison to Bridges, 13 Aug. 1948.

² PRO, CAB 134/591, O.P. (48) 10, 'Existing departmental activities and organisation for the promotion of industrial productivity', 30 Oct. 1948, contains all the departmental submissions. The DSIR report, Annex 10a, is a good example of exalting the status quo.

vision and unsatisfying performance, should the production departments like BOT -- closer to ministers, stronger, more accustomed to surveying the broad structural problems of industry -- be charged with more extension work? The committee's September 1949 report came down on the side of the production departments, but crucially failed to specify any new mechanism for how they might accomplish this except for the familiar 'better liaison with the DSIR and RAs'.¹

Indeed the committee was pessimistic about the chances of any government body making industry pay more attention to productivity. The government, it said, could help productivity in a general way by ensuring that controls did not impede a steady flow of raw materials, by setting taxation levels at a rate which made re-equipment attractive, and devoting a high fraction of the national income to investment.² But statistics were too crude to be able to identify a specific company or group of companies as a target for government productivity assistance; and even if a department thought it had found one,

the methods open to it to secure the [productivity] improvement are limited. In particular, these are of a general administrative character and rarely involve a direct contact between the Department and individual managements on which. . .the primary responsibility for improving productivity lies.³

OP's head wrote to Sir Edwin Plowden, the Chief Planning Officer, that its recommendations 'are almost more important for what they do not say than for their specific proposals. There is, in fact, no quick way by which the Government by direct action can rapidly improve productivity'. The only way the government could replicate in civil industry the undoubted success of the

¹ PRO, CAB 134/592, O.P. (49) 31, Productivity (Official) Committee, 'First report', 3 Sept. 1949, para. 126.

² Ibid., paras 8-11.

³ Ibid., para 60.

agricultural extension service was for the RAs to work harder and in closer contact with the production departments -- 'a long-term and not a glamorous recommendation', to say the least.¹

As Chapter 3 recounts, the BOT never did establish a close link with the RAs despite many attempts, nor did any other production department. Lockspeiser's bid in late 1949 to make DSIR responsible for the RAs' work (page 187) also sought to take the productivity drive into individual factories,² but it too failed. The RAs remained chronically weak, poor and unfocused. Seemingly Morrison had been right to doubt that an official committee could tackle the problems raised by Tizard's May 1948 letter with creativity and freshness.

Meanwhile, the CIP continued to operate in the pattern established in its first months. The panels on Human Factors and Technology and Operational Research had trouble producing useful results speedily, the former because its subject was vast and understudied, the latter because it crossed lines with many other official bodies.³ Imports Substitution and Technical Information Services were active and stirred scant criticism. The Committee as a whole raised some additional questions about productivity, but raising questions was about as far as its work went. Its first annual report, for instance, mentioned the importance of standardisation as a way of increasing production runs and thus productivity; though the Minister of

¹ PRO, BT 195/30, minute from E.A. Hitchman to Plowden, 20 June 1949.

² PRO, CAB 132/29, C.I.P. (49) 25, 'Contributions of the R.A.s to industrial productivity', note by Lockspeiser, 15 Aug. 1949; C.I.P. (49) 7th meeting, 16 Sept. 1949, comments by Lockspeiser.

³ The Productivity (Official) Committee received no response when it asked departments for suggestions about what T&ORP could do, and consequently the CIP suspended its work in October 1948 until fresh ideas did arrive. They never did. PRO, CAB 132/28, C.I.P. (48) 6th meeting, 4 Oct. 1948; CAB 132/29, C.I.P. (49) 28, 'The future work of the CIP', note by Blaker, 19 Oct. 1949, para. 10.

Supply had recently appointed a committee on this subject for the engineering industries, the CIP did not suggest a way of extending this work elsewhere. It recommended to industry that it employ industrial consultants, but observed without suggesting a remedy that progressive firms were likelier to use them than 'those which require their services most'. It recognised that few industries had adequate facilities for developing laboratory inventions into marketable innovations, but could only hope lamely that the RAs would take a more active role in this area.¹

4.4.3.2 The Midlands Advisory Council on Industrial Productivity

The CIP's first annual report also praised the work of the Midlands Advisory Council for Industrial Productivity (MACIP), a joint venture between industry and Birmingham University for channeling expert advice into needy firms. It hoped that firms and universities in other areas would collaborate in a similar way, which 'might prove a most fruitful method of enlisting local loyalties and accelerating the transfer of scientific knowledge from the laboratory to the factory floor'.² In reality MACIP did almost nothing of value and was repeatedly denied government assistance which would have materially assisted its work. Here was an opportunity for aiding productivity within individual factories which the government, had it been seeking ways to disprove OP's depressing conclusion that government was virtually powerless in this area, could have seized upon eagerly. Yet MACIP was ignored and allowed to wither away. Its story shows the practical limits on the CIP's ability to make things happen in industry, and demonstrates once again the government's inability or unwillingness to commit significant resources to the practical problems of scientific production.

¹ CIP, Final Report 1948-49, Cmd. 7665, Apr. 1949.

² Ibid., para. 32.

The driving force behind MACIP was Thomas Matthew, Professor of Engineering Production at Birmingham University and a member of T&ORP. After a series of letters and meetings with Schuster, Tizard, Zuckerman, King and others in early 1948, he organised a council of 40 members including industrialists, union members, RA directors, and regional representatives of the BOT and Ministry of Supply. The industrialists were 'enthusiastic' and agreed to share their in-house experts with more troubled firms. An office was set up and Birmingham University agreed to provide a lecturer to work as a consultant full-time.¹ Cripps found all this 'very interesting' and hoped MACIP would link up with the appropriate Regional Board for Industry which the Treasury oversaw.² MACIP requested that DSIR detach an officer for full-time information and liaison work, and Appleton asked Morrison's permission in June 1948 not only for that but for a series of regional DSIR extension offices. This was the closest Appleton came to proposing a full-scale R&D extension service. Morrison refused this latter request because satellite offices 'lock up valuable [people] who might be better used elsewhere', but approved a three or four month trial for DSIR assistance to MACIP. Between DSIR staff shortages and MACIP's difficulties in finding accommodation and establishing a specific work programme, however, the DSIR liaison did not arrive until the autumn of 1948, and worked in Birmingham only two days a week for three months.³ DSIR officials nevertheless thought this experiment justified a renewed appeal for a network of extension officers. But this recommendation, for reasons which

1 There is some confusion in the record as to whether this consultant agreed to was ever appointed.

2 PRO, BT 195/6, 'Midland productivity council', minute from the Lord President's office to Cripps, 3 Apr. 1948; Cripps' comments, reported in note from D. D. Henley to Spicer, 6 Apr. 1948.

3 PRO, DSIR 17/434, letter from Morrison to Appleton, 23 June 1948; memorandum by W.L. Francis, 21 Jan. 1949.

are unclear from the record, was never carried up to ministers. Nor did DSIR's liaison officer continue regular work with MACIP. In March 1950, Birmingham University's Vice-Chancellor renewed the request for a local DSIR office to Lockspeiser, but DSIR officials advised their secretary that 'we have no staff immediately available' and that several other regions were more primitive and thus more deserving anyway.¹ By 1950 the Council had no full-time staff, several projects had been scotched because of union or management opposition, and the research programme had become entirely long-term and academic. Another problem was that 'the Council ha[d] no funds' -- £250 in total, provided by the University to publish monographs.² The reality of MACIP -- underfunded, understaffed, left to flounder after an initial burst of government interest -- is reminiscent of the MJCR, indeed of many postwar civil science initiatives. It contrasts sharply with the enthusiasm for extension work which Tizard and CIP displayed. But of course it is much easier for advisory committees to point in a desirable direction than for them to shift the course of government accordingly.

4.4.3.3 The CIP's dissolution

After Tizard failed in June 1948 to provoke Morrison and Cripps into making the RAs responsible to the CIP for "quantity research," he concluded that the committee should fold itself up, nine months after starting, for lack of useful work. While he wanted its work on imports substitution and technical information services to continue, the overall committee would dissolve. HFP's work would go to the MRC and T&ORP's would go to the

¹ PRO, DSIR 17/434, minute from W. L. Francis to Butler, 9 Mar. 1950.

² PRO, DSIR 17/434, minutes of MACIP second meeting, 11 Jan. 1950.

DSIR and RAs in conjunction with the production departments.¹ Blaker endorsed this idea.² So did the BOT's Nowell. He thought 'it would be a relief to be rid of Schuster and his panel', though he was irritated that Tizard seemed to be rushing through the CIP's dissolution when many ministers were away. 'No doubt there are his usual personal reasons for this sudden eruption', wrote Nowell.³ Surprisingly, when the CIP discussed Tizard's memo at its next meeting in October 1948 there was no mention of winding up its work. HFP and T&ORP, though not universally admired, also emerged intact, at least for a while:⁴ the Productivity (Official) Committee was asked to review T&ORP, and Schuster was to explore with the MRC whether it might take over all of HFP's research.⁵ One possible explanation for CIP's resuscitation is that the government, extremely concerned at this stage to convince American Marshall Plan administrators that Britain was straining every muscle to improve productivity (see Section 4.6), preserved CIP for appearances.

Since the CIP was to continue, Tizard tried again to make it more useful. In May 1949 he proposed some new tasks for it. He thought it was no longer worthwhile to investigate the particular industries pegged as problems by the Economic Planning Board, since these were 'already the responsibility of a Development Council or some other advisory body set up to consider them'. Instead the CIP should address problems common to many industries, including the role of the RAs in encouraging productivity improvements, the

¹ C.I.P (48) 27, op.cit; PRO, BT 64/2360, letter from Blaker to Dakin, 11 Sept. 1948.

² Blaker to Dakin, op.cit.

³ PRO, BT 64/2360, note from Nowell to Miss Thomson, 14 Sept. 1948.

⁴ PRO, CAB 132/28, C.I.P. (48) 6th meeting, 4 Oct. 1948.

⁵ PRO, CAB 124/1096, minute from Tizard to Morrison and Cripps, 12 Oct. 1948.

possibilities of increased standardisation, and whether the government might do something to expand training facilities in production engineering, an area in which Britain was 'particularly deficient'.¹ Tizard thought standardisation of components to achieve longer production runs and simpler designs the most promising way of applying technology to increase productivity. However, the Ministry of Supply had established a committee under Sir Ernest Lemon to promote standardisation of engineering products, and the British Standards Institution was being strengthened to promote voluntary standardisation among manufacturers.² Tizard's other suggestions for what the CIP might take up did not work out either. The role of the RAs was already the province of the Productivity (Official) Committee, formed in response to Tizard's earlier attempt to get the CIP to supervise the RAs' work. The deficiency of production engineers was only one small part of the shortcomings of technological education, in which the ACSP was already immersed.

Tizard had once said of the CIP that while 'a little stimulant is a tonic, too much is a poison'.³ In October 1949 G.B. Blaker from the Treasury, one of the CIP's original architects, wondered whether 'this stimulating process has now gone far enough' and formally proposed the committee's dissolution. Blaker's report said that many bodies had responded to CIP's impetus and were trying to achieve productivity gains in specific areas. The Engineering Advisory Council to the Ministry of Supply, working through more than 20 trade associations, had established mutual aid schemes

¹ PRO, CAB 132/29, C.I.P. (49) 18, 'Future programme', note by Tizard, 19 May 1949.

² PRO, CAB 132/29, C.I.P. (49) 23, 'Standardisation', note by E.D.T. Jourdain, 21 June 1949.

³ quoted in PRO, CAB 132/29, C.I.P. (49) 28, 'The future work of the CIP', note by Blaker, 19 Oct. 1949, p 1.

helping many firms trade productivity data and techniques of more efficient manufacturing. The BIM had provided a popular handbook of modern factory practice; joint consultation between labour and management was spreading; the NRDC had just been created; and the TUC had recently held conferences with several unions on ways to improve productivity. The Anglo-American Council on Productivity (described below) had also begun its extensive series of industrial exchange visits.

Of the CIP's four panels, Blaker wrote, only Imports Substitution had a significant programme which could aid productivity in the relatively short term as the CIP had been established to do. It could be attached to the Economic Planning Board. Human Factors was engaged solely in long-term work and should be attached to the MRC if the Lord President and the MRC secretary agreed that it should continue at all. The Technology panel overlapped other bodies' work and should be abolished. The panel on Technical Information Services was relevant to all science, not just industrial productivity research, and should be returned to the oversight of the ACSP where it originated.¹ Nicholson had written King in July 1949 proposing a very similar plan for winding up the CIP: 'We are now in sight of being able to get the C.I.P. work into the machine, but it is clear that the process cannot be hurried until the various parts of the machine are ready to take over the load'.²

In January 1950 the CIP accepted Blaker's plan for abolishing itself, though Schuster had to fight off the proposal of E.W. Amphlett, a recently added employers' representative, to end human factors research altogether

¹ 'The future work of the CIP', by Blaker, op.cit.

² Nicholson to King, 25 July 1949, op.cit.

because its conclusions often seemed to favour greater workers' control.¹ The committee spent its remaining time producing a final report. Four drafts were required, mostly because of the Schuster-Amphlett controversy. In the end, the CIP followed Blaker's October memo in citing the good productivity work of other bodies as the chief factor permitting dissolution, and in the disposition it recommended of the panels' responsibilities. The committee's final report, issued in July 1950, echoed its May 1948 first interim report in warning against expecting the natural sciences to raise productivity quickly:

The part played by science and technology in promoting productivity is clear and well recognised, but. . .the achievement of potential increases in productivity is subject to the fulfilment of certain basic conditions, such as an ample supply of power and of capital for improvements.

The CIP also restated its conviction that human factors work, which the interim report had termed 'psychological', could produce significant results.

We doubt. . .whether the importance of the human side of the problem has even yet been given sufficient recognition. . . .We believe that the promotion of good human relations can be helped by scientific investigation, and that it is necessary to develop the social sciences side by side with the physical sciences.

But the committee believed it had done a respectable amount to educate the country about the causes of low productivity, as well as to set in train some valuable research and practical reforms. The most recent figures showed a 27 percent increase in the nation's production between 1946 and the second half of 1949 compared to one and a half percent rise in employment. The CIP did not seek to take credit for this productivity growth, but the figures did justify some optimism.²

¹ PRO, CAB 132/30, C.I.P. (50) 1st meeting, 25 Jan. 1950; 2nd meeting, 24 May 1950. For Amphlett's views on HFP generally, see CAB 132/32, C.I.P. (H.F.) (49) 7th meeting, 24 Nov. 1949. Schuster's panel had by then spent £50,000 on commissioned research. HC Debates, Hansard vol. 474, col. 2140, May 1950.

² CIP, Second Report, Cmd. 7991, July 1950.

The CIP's final report did not draw special attention to what the Committee perceived as the weaknesses of its work. These had been laid out at a meeting where the final report was discussed:

(a) No real solution had yet been reached to the problem of ensuring the early application of the results of basic research, particularly that conducted in Research Associations or other central establishments.

(b) Attention had so far been focussed mainly on the manufacturing industries, but it was equally necessary to improve the efficiency of the distributive industries, including transport.

(c) There was need for further attention to technical development work in industry and a greater degree of technical education of those employed, particularly in the higher ranks.

(d) It appeared to be the case that, in general, those industries showed the greatest increase in productivity which had the highest amount of capital investment in them in recent years. It seemed probable that no substantial advance could be achieved without considerable capital expenditure.¹

None of these problems was scientific in any pure sense. Instead they were political, cultural and economic, with a scientific flavour. Solving them would require shifts in educational patterns, industrial practice and investment proclivities. These were beyond the capacity of any advisory committee to alter. Perhaps they were beyond the capacity of the entire government. Tizard pointed this out to Cripps and Morrison as the CIP was in its final stages, implicitly criticising Cripps' oft-repeated statement that the economy's problems would end if the least productive firms would only improve to the level of the best. 'One might as well say that if all the [people] who take third class degrees at the University could be brought more to the level of those who take first class degrees, it would be of great benefit to the country. It certainly would, but no one would argue that it

¹ PRO, CAB 132/30, C.I.P. (50) 1st meeting, 25 Jan. 1950.

was feasible', he wrote.¹

No reply by Cripps or Morrison to this memo has survived. (Indeed to judge from the public record Morrison made virtually no contributions to productivity policy after 1948.) But it would have been consistent with their previous work had they taken a more ambitious view than Tizard of what government encouragement and propaganda could do to change ingrained cultural patterns. Indeed, as it became increasingly clear that scientific committees like the CIP could only point in desirable directions but not alter industrial practice, Cripps in particular devoted more attention to publicity work aimed at changing the minds of workers and managers all over the country. As Chancellor of the Exchequer he no longer controlled specific programmes for improving productivity such as the Production Efficiency Service or the British Institute of Management. Publicity was one of the few ways he had to reach into individual factories, and as the CIP slackened he turned to it more and more.

¹ PRO, BT 195/29, letter from Tizard to Blaker enclosing a copy of a letter from Tizard to Morrison and Cripps, 19 Oct. 1949.

4.5 'Productivity is the fashion': publicity and the Economic Information Unit¹

Section 4.2 described the creation of the Economic Information Unit in June 1947. A small but highly expert body directed by S.C. Leslie and reporting to Cripps, first as Minister of Economic Affairs and then as Chancellor of the Exchequer, its task was to develop main themes for the government's economic publicity and ensure that they were consistently followed in the varied campaigns controlled by the Central Office of Information and individual departments. As Cripps' authority in the government and his attention to economic publicity mounted, so did the unit's importance, not least because Leslie (originally a Morrison protégé) became Cripps' close personal adviser. The EIU worked hard to explain the rationale for the government's economic policies, exhorted people to greater effort and frugality, and disseminated productivity techniques to management, workers and the public at large. The need for workers and managers to be more science-minded was a central theme of productivity publicity, partly because it was less controversial and more appealing than wage freezes, the need for continued rationing and other topics covered in more general economic campaigns.

A 'Report to the Nation' campaign began in November 1947 which used ads, 'large in size in relation to the shrunken dimensions of the British press', in most national daily and Sunday papers, as well as Radio Times which reached half the homes in the country. At the bottom of every ad (which was also distributed in poster form to 45,000 factories and stores each week) appeared the slogan: 'The call is still for MORE AND MORE PRODUCTION'.² In the spring and summer of 1948, Cripps and Leslie con-

¹ 'The warning voice', Times leader 13 Aug. 1948.

² PRO, T 245/6, Report on the EIU by Leslie, Oct. 1948; INF 2/113, records of the 'Report to the Nation' campaign.

cluded that the government's publicity should stress productivity even more and aim itself at industry as well as the general public. 'The greatest need for 1948', Cripps said in a March broadcast, 'is more efficient production and I hope all managements and workers will get down to a close study of how they can achieve it. That is the sure way to our salvation. . .'.¹ In July Cripps secured the assent of the Cabinet's Economic Policy Committee to a sharp expansion of the productivity campaign.² Other ministers, Morrison particularly, shared Cripps' conclusion that the government's productivity publicity had not yet reached 'deep enough under the skin' of the public. At the 1948 party conference in May, it had become evident that many workers felt they alone were bearing the brunt of the government's call for higher production while industrialists continued to profit from outmoded methods. One Labour MP complained to the conference that the publicity campaigns 'perpetually. . .appeal[ed] only to the knotted muscles and the sweat of the worker'.³

Morrison's keynote address to the conference in the debate on 'Production - the bridge to socialism' struck the themes which came to characterise the expanded productivity campaign the EIU was then preparing. Its dominant message was that British industry had to become more scientific if the country was to prosper. While he sought to allay workers' resentments about bearing the brunt of previous publicity campaigns, he challenged them to realise that their backward thinking was still obstructing the application of science in industry on which a more prosperous and just society depended. 'Most of us must sometimes have felt worried', Morrison said,

¹ Cripps papers, 1080, 'Economic broadcast to the nation', 10 Mar. 1948.

² PRO, CAB 134/220, E.P.C. (48) 27th meeting, 6 July 1948.

³ Labour Party, 'Report of the 47th Annual Conference', 17-21 May 1948, statement of Harold Davies MP, p 136.

to see how slowly the nation was facing new and unpleasant facts, but are we sure that we in the Labour Movement have really adapted ourselves to our new role in the nation? . . . Are we growing into a modern, scientific, Socialist movement of high public spirit, or are we still looking backwards and clinging to past habits which no more longer make sense?

For two decades repeated inquiries had shown an 'alarming degree of incompetence, lack of human understanding, waste and lack of enterprise in some of our industries'. These revelations had placed the Labour Party 'in a somewhat difficult position', because its traditional assumption had been 'that production was something which would happen [automatically] and that our concern was to get a fair share of the proceeds for the under-privileged'. Now it was clear that ten or fifteen years would be required to re-equip obsolescent industries fully, and during that period 'restraint is going to be badly needed. We haven't the resources to do all we want'.

Long-term investment would have to stress factories, research labs, university buildings, oil refineries and other contributors to a modern economy. In the short term all managements and workers should adopt the 'simple commonsense improvements' already employed by the best firms, and more importantly 'tackle our problems scientifically'. Morrison closed by entreating workers to embrace scientific production as their own cause:

The more I see of scientists -- and I am. . . bringing them more and more into the industrial picture -- the more I find out about the wastes we go on committing through jogging along in our conventional ways. . . . We must learn to bring the ways of thought and the spirit of science into our industry and our Government to an extent that we have hardly yet dreamed of.

. . . .

You will often find that [the scientist] can give you help that you cannot afford to be without.¹

Party Chairman Emmanuel Shinwell and Minister of Health Aneurin Bevan also appealed to delegates to encourage a greater role for science in their

¹ Ibid., Morrison speech pp 129-32.

workplaces.¹ But in the ensuing debates the delegates ignored Morrison's speech. Thus it was clear that the government's developing productivity campaign would not face an immediately receptive audience even among its normal supporters. Management, too, resented the implication of incompetence and the undermining of its authority produced by repeated government exhortations to shape up.

In November 1948 the theme of 'Report to the Nation' and its subsidiary campaigns switched exclusively to productivity, linking practice in individual factories to the national economy, with a slogan of 'That'll get us somewhere'. 'Your prosperity depends on full employment which depends on higher productivity (making more things in the same time, as good as ever, but at lowest cost). . .'² A blizzard of speeches from Attlee, Cripps, Morrison, Wilson, Defence Minister Alexander, and Fuel and Power Minister Gaitskell discussing productivity ensured that news stories reinforced the themes of government advertising. The EIU also deployed films, posters, exhibitions, pamphlets and official speakers.³

This enlarged productivity drive got under way at the same time as a committee to review the home information service, whose cost and activities had aroused Conservative suspicions. Leslie's reported salary of £5,000, equal to the Prime Minister's,⁴ was considered profligate, as was the whole idea of buying ads to promote the government's economic analyses and criticise industry. In the wake of a hostile report, the government reduced spending

¹ Ibid., Shinwell, p 107; Bevan, p 137.

² PRO, INF 2/113, economic information campaign materials, 1948.

³ PRO, T 245/6, minute from D. Gowing to Leslie, 28 June 1949; CAB 134/592, O.P. (49) 31, Annex IV, 'Publicity about productivity', 3 Sept. 1949; 'How are we doing?', News Chronicle, 29 Oct. 1948; 'Production', Manchester Guardian, 20 Nov. 1948; 'National priorities', Economist 22 Jan. 1949, p 130.

⁴ Cripps papers, A5, Chicago Tribune, 4 Oct. 1948.

on economic publicity (of which the productivity campaign took about a quarter) from £2.7m in 1949/50 to £1.9m the following year. The EIU suspended its poster and most of its press ads.¹ Nevertheless the government continued to emphasise the importance of productivity to Britain's future and relied on the EIU's smaller campaigns 'to explain to the public and particularly to industry the role of the three major factors in productivity -- mechanisation, healthy industrial relations, and sound technical management' -- because without such explanation 'productivity would be connected by many people with longer hours and nigger-driving [sic] methods'.²

It is probable that government productivity publicity did make a lasting impression on the public mind. From the middle of 1947 through 1949 productivity was widely discussed, in news stories, leaders, advertisements, BBC programmes, Parliamentary debates, factory bulletin boards, outdoor hoardings, films, pamphlets and other media.³ A 2000-person survey on economic affairs in September 1949, just after the devaluation of the pound, found that 87 percent of the sample had opinions about what should be done to increase production, including bonus pay schemes, longer working hours, and 'a greater emphasis. . . on efficiency'.⁴ And David Butler's analysis of 1951 General Election addresses found that 24 percent of Labour candidates mentioned 'the need for increased productivity', while 69 percent of

¹ PRO, CAB 134/359, I.H.(O)(50) 18, 'Economic publicity programme 1950/51', 15 June 1950. See also T 245/6, Leslie to Douglas Jay, 9 Nov. 1949.

² O.P. (49) 31, op.cit., Annex IV, p 33.

³ See generally Cripps papers, A5, press clippings from this period.

⁴ PRO, CAB 134/371, I.H.(O)(50) 8, Jan. 1950.

Conservative candidates spoke of 'the need for increased production'.¹ The EIU's publicity campaigns did succeed in bringing home to most workers and managements throughout the country that productivity was important. It also pointed them to sources of more detailed aid. This was achieved at comparatively modest cost, without disrupting existing patterns of ownership or management, and indeed in a way which reinforced the taking of individual responsibility by workers and management which Labour considered part of its philosophy of democratic socialism. The obstacle was the entrenchment of existing patterns of management, investment, restrictive practices, and work organisation, which in combination usually proved highly resistant to the EIU's necessarily superficial general themes.

4.6 The Anglo-American Council on Productivity

Cripps once told an audience of cotton workers that the best way to raise productivity was to observe best existing practice and 'Go thou and do likewise - [it] is an excellent text from the best of books and that really is the most vital need'.² In the summer of 1948 a new method for injecting productivity consciousness into large numbers of individual factories was suggested to Cripps, and through his patronage it was developed into the Anglo-American Council on Productivity (AACP). The AACP was a kind of cross between a publicity campaign, superficial but wide-reaching, and the intensive consultancy services which the government found too expensive and

¹ This difference in terminology may reflect an actual difference of view between the parties -- Conservatives implicitly calling for longer hours and harder work, Labour preferring re-equipment, R&D and more intelligent organisation of work to secure the desired output -- or simply that Butler did not himself distinguish between 'production' and 'productivity' in his analysis. David Butler, The British General Election of 1951 (London, 1952), p 54.

² Cripps papers, 223, speech to Buxton conference on the cotton industry, 10 Oct. 1947.

out of character to implement on the scale required. The AACP arranged for plant visits and the trading of information and statistics among British firms. More importantly, it sponsored tours of comparable American factories, where output per person hour was on average twice the British level, by teams drawn from management and workers in 72 different industries. These teams produced widely publicised reports which went deeper than EIU materials in recommending specific practices and apparatus to adopt.

The inspiration for the AACP came from the productivity expert of the United States Bureau of Labor Statistics, J. Silberman. He came in June 1948 to tour British factories after informal discussions with American officials responsible for the European Recovery Programme (ERP). They had agreed that some good comparative productivity statistics were required between Britain and the United States, and were concerned lest backward industrial practices keep Britain dependent on Marshall Aid. Silberman was 'deliberately kept out of contact with ministers or people responsible for policy', and the BOT's idea was to send him 'back to Washington content with having learnt something in the hope that no more would then be heard about it'.¹ At the last moment, however, Silberman saw and impressed a TUC official, who arranged for him to see Morrison's aide Nicholson.

Nicholson ensured that something more would indeed be heard from Silberman. He reported to Morrison that 'although very friendly, Mr. Silberman has formed a devastatingly adverse view of British productivity', one which Rostas was willing to confirm and more importantly was likely to be reported back to ERP administrator Paul Hoffman.

In some industries it was his view that the least efficient plants in America were appreciably more efficient than the most efficient in Britain. . . .He thought that taking the radio industry, a 20% increase in productivity could be immediately realised in the twelve main factories at a cost of not more than £1,000 per factory by

¹ PRO, BT 195/62, minute from S.A. ff. Dakin, 2 July 1948.

introducing a few hundred simple modern tools, such as pneumatic and electric screw drivers. The design of our products was often fantastic in terms of labour and material costs. . . .He made similar criticisms of other industries including motorcar manufacture.

Silberman suggested several remedies: circulating abstracts of world technical advances to British industry; spending ERP dollars to distribute samples of the most recent foreign products to British firms; a vastly expanded selection of trade magazines on 'different levels of technicality' which in the U.S. were read even by low-level supervisors and helped spread a new development through an industry in about six months; greater expenditure on collecting productivity statistics; a more general application of the utility clothing and furniture schemes in order to speed up the standardisation of components from its present 'snail's pace'; and most importantly, 'sending very large numbers of picked managerial, technical and workers' representatives to the United States to work for some weeks or months with their American opposite numbers'. Nicholson recommended that a minister see Silberman to convince him of the government's commitment to 'a really energetic campaign to raise productivity' and guard against a move in Washington towards 'some unpalatable degree of American intervention' in the affairs of British industry, or worse still a reduction in Marshall Aid.¹

Neither Cripps nor Morrison could see Silberman, but a 9 July 1948 meeting was set up with Plowden, head of the Economic Planning Board, and other high officials. Dakin, the BOT official in charge of productivity, was greatly pained:

I think the impression to be given should be that what Mr. Silberman has said is interesting, as coming from an American, but not new. It should be emphasised that what we can do is finally limited by our respect of the liberty of the manufacturer and the virtue of free enterprise; we cannot force people to be efficient.²

¹ PRO, BT 195/62, Nicholson to Morrison, 25 June 1948.

² Dakin minute, op.cit.

At the meeting Silberman summarised his criticisms and both sides focused on the technical exchange as a practical step forward. Cripps concurred on July 15: 'I also think there is something in Mr. Silberman's suggestion and it would be good to launch it with our Production Efficiency Blitz [in the autumn]'.¹

Silberman's report to ERP officials in Washington, as Dakin and Nicholson feared, did generate pressure on the British government to do something dramatic about productivity. On 19 July 1948 Hoffman saw the British Ambassador in Washington and said that 'to him it seemed that the essential problem for [Britain] was the increase of productivity. . . .he felt that some of our industries were really backward and illustrated his theme by examples which had come within his own experience'. He was sensitive to British fears of American interference in domestic policies, however, and emphasised that any request for American productivity assistance would have to come from London.² The telegram from Washington reporting Hoffman's implied offer of assistance triggered an immediate response in Whitehall. Officials met to discuss it on 22 July, 'fully realis[ing]. . .the importance of this offer, and the need to be as forthcoming as possible'.³ They reviewed all the government's productivity programmes including the CIP, EIU, RAs, NRDC, PACT, PES and others, but realised that Silberman and thus presumably Hoffman had already concluded that these 'constitute[d] only a minor effort'.⁴ The officials supported Cripps' recent suggestion 'that a

1 PRO, BT 195/62, Cripps marginal note on minute from S.B. Bowyer, 12 July 1948.

2 PRO, BT 195/62, telegram from Sir Oliver Franks to Foreign Office No. 3550, 19 July 1948.

3 PRO, BT 195/62, Geoffrey Wilson to Rowan, 22 July 1948.

4 PRO, BT 195/62, Blaker to Rowan, 29 June 1948; memo from Nowell summarising the government's existing programmes, undated.

group of Americans should be invited here to discuss with representatives of the Employers and of the T.U.C. what could be done', despite their fears of 'an unregulated stream of Americans. . .making superficial investigations and ill-considered reports'.¹ The NPACI, comprising industry and labour representatives, approved Cripps' suggestion too. It only remained for Cripps to make the 'request' for American productivity aid to Hoffman, which he did at a 24 July meeting in Paris.

Announcing to the Commons on 28 July the details of his understanding with Hoffman which established the AACP, the Chancellor of the Exchequer ran into an unexpected 'forest-fire of criticism'.² It was not the details of the scheme -- business and labour leaders from both countries meeting as kind of steering committee to set up a programme of research and exchange on productivity -- which proved objectionable, but its whole conception. Some trade union MPs distrusted American labour relations for their reputed rapacity. More importantly, Conservatives' amour propre was badly bruised by the thought that British industry was no longer the world's leader. Anthony Eden said: 'What seems to me difficult to accept is that any country could give us instructions how to conduct our business'.³ Cripps had however been careful to cover his flanks by clearing his plans with the NPACI before seeing Hoffman. He also deliberately minimised the government's role in the new body to encourage the TUC and FBI to dispense with political posturing and get down to work. The FBI remained more skittish about the AACP than the TUC, but both decided to participate, convinced by Cripps' tactical skill, conversations with their American counterparts, their own sense of the importance of productivity and the need

¹ Nowell memo, op.cit; Wilson minute, op.cit.

² Cripps papers, A5, p 24, Liverpool Daily Post, 29 July 1948.

³ Daily Mirror, 29 July 1948.

to protect ERP's dollar pipeline. They may also have felt that exposing the other to American methods would further their own cause, since each took different and somewhat self-serving lessons from America's productivity superiority.

The Council's early work was poorly focused, mostly because its members were 12 top leaders from the FBI, British Employers' Confederation and the TUC who lacked training in productivity measurement or improvement. Without a clear agenda in their own minds they resorted to routine political posturing. At the first meeting between the Council's British and American sides in October 1948, it was the Americans, well-briefed by Silberman, who proposed the list of specific topics for staff to study in detail before the next joint meeting of the Council; the British chairman, Sir Frederick Bain, merely said his section would offer topics for further study "at a later meeting."¹ Surprisingly, the AACP included no member of the CIP, who could have provided quick access to all the specific work the CIP had already commissioned on productivity measurement and improvement. It is not clear from the record whether this was an oversight, a deliberate exclusion because the CIP's work was thought unimpressive, or the logical byproduct of Cripps' decision to keep government involvement in the AACP scarcely visible.

Another problem with the Council's early work was the British representatives' tendency to parry constructive criticism rather than absorb it. Dr. Alexander King, head of the civil science secretariat, spoke with several members and staff of the American side when they returned to Washington after the first joint meeting in London. He reported:

¹ PRO, BT 195/62, 'Anglo-American Council on Productivity, Sessions on Friday, 29th October' and 'Summary of discussions on October 26th', Oct. 1948.

(1) Apparently all the members of the American side were impressed and depressed by the united front put up by the F.B.I. and T.U.C. Several members of the American side mentioned that when a British representative spoke, it was impossible to tell whether he was employers or labour. The Americans concluded that this was a temporary defensive alliance.

(2) The Americans apparently agreed amongst themselves that the plants which they visited were among the more efficient units of British industry. Discrepancies between American and British practice were pointed out on many occasions and the impression gained was that while the British admitted to a considerably lower degree of productivity, they always felt it necessary to put forward an excuse which generally came down to 'British practice is suited to British conditions'. In general, apparently, they were unwilling to probe deeply and ascertain the real reasons for differences.¹

Once the Council's work began in earnest, the defensiveness did prove temporary, as did the dominance by figures too senior to know anything detailed about productivity. The central feature of the AACP programme was the series of visits to American factories by British study teams comprising managers, technical experts and workers from a given industry, usually numbering about 20 in each team. The basic form of these visits was established at the first joint meeting of the American and British sides in October 1948. After a tour of its own home industry, each team spent six weeks visiting comparable American plants and wrote a report about its findings for dissemination throughout its industry. In some cases a popular digest of the report was also widely circulated. This was followed by national and local conferences of trade associations, trade unions and professional institutes, as well as meetings in individual plants. Exhibitions, films, posters, the national and technical press, the EIU's newspaper Target, and the BBC also gave extensive coverage to the teams' findings; the BBC was particularly devoted to discussing the details of their work.² The work

¹ PRO, BT 195/66, Document E12, private and confidential 'Memorandum for the files' by A[lexander] K[ing], undated [Nov. 1948].

² PRO, BT 195/67, letter from S.C. Leslie to P.D. Fahnestock, undated [summer 1949].

of each team lasted about four months. The AACCP recognised that it "will never be possible accurately to determine what part of Britain's improved productivity is attributable to the work of the Council," but in November 1950 it was able to report that

[m]any individual cases have been reported to the Council of new methods adopted and new machinery installed. . . . Both manufacturers of machinery and industrial consultants have recorded an increased demand for their services directly attributable to the Council's activities.

200,000 copies of team reports had already been distributed, although only 13 of an eventual 72 reports had been completed.¹

A vast range of industries was studied, including materials handling, building, fertilisers, electric motor control gear, diesel locomotives, meat packaging, welding, fruit and vegetable storage, lithography, electricity supply, aluminium die casting, brushes, brass founding, and woodworking machinery, to name a few. The experience of traveling together and seeing the sobering American productivity lead spurred effective collaboration between employers and workers on the British teams. All the reports were unanimous. They differed in quality, but most tried to learn specific American techniques of value and translate them for quick application at home. The first completed report, for example, 'Steel Founding', contained 63 illustrations and tables, including number 48, showing the 'method of running and heading double pump impeller', and number 56. showing the 'layout and isometric view of valve body production shewing use of remote heater pads and feeder pads'. 'Let each person who reads this', the report pleaded, 'see to it that his immediate contacts in the steel founding industry know what is meant by the term Productivity - not in any formal definition, but in the language of everyday life. . . . This is not a job to be left to the

¹ PRO, BT 195/68, AACCP, "Report of Third Session," Nov. 1950, pp 3-5.

efforts of official bodies'.¹ Many reports contained extensive technical appendices, giving chemical formulas for improving specific processes, detailed photos of ingenious American equipment, and long fold-out charts showing a particularly efficient factory layout or how to cut more suits out of a length of cloth.² The teams' dissemination work also included visits to British plants from American members of the AACCP and more importantly their productivity experts. British factories were spurred to arrange exchange visits among each other much more frequently, and a large booklet was prepared under the AACCP's direction revealing the productivity measurement techniques of the best British firms.³ Because the teams included workers and technical experts as well as managers, they could absorb practical details in a way the parent AACCP could not.

The teams were remarkably uniform in criticising the quality of British management. Virtually without exception, the reports found that British managers paid less attention to productivity and simplification of products, had poorer technical qualifications, and were more remote from their subordinates than their American counterparts; that they neglected the easy improvements possible from simple changes in layout; and that American workers had more opportunities for education and promotion which encouraged loyalty and productivity consciousness.⁴ The Management Accounting team said bluntly: '[A]fter very careful consideration, the greatest single factor in American industrial supremacy is the effectiveness

1 'Steel founding', Report of the AACCP Productivity Team, Aug. 1949, p 36.

2 See the 'Pharmaceuticals,' 'Valves,' 'Materials Handling in Industry', 'Metalworking Machine Tools' and 'Men's Clothing' reports for examples.

3 AACCP, 'Report of Third Session', op.cit., p 5; AACCP, 'Productivity measurement in British industry', 1951.

4 See for example the Cotton Spinning report, pp 15-16, and the Machine Tools report p 42.

of its management at all levels'.¹ The teams also regularly envied the greater abundance of mechanical aids for American workers (who used approximately three times more electricity per capita), which they attributed to the historic scarcity of labour in the United States, a significant lead in machinery and electricity supply and more enthusiasm for R&D. They noted that American workers were generally more eager to adopt new materials, machines and practices than British workers.² Altogether the teams recognised that improving British productivity was going to take considerable time, imagination and hard work. But their tone, though urgent, was basically optimistic.

The government maintained the public fiction that the AACCP was the independent offspring of industry and the TUC. Once however it became evident that the Council and its teams would basically agree with the Morrison-Cripps line on the importance of better management, fewer restrictive practices and more scientific production, the government concentrated on ensuring the widest possible dissemination of team reports. Not surprisingly, their recommendations were more readily accepted on small matters than large. The 'Education for Management' report, for example, issued in 1951, cited 19 previous reports' praise for American methods of training and promoting managers to bolster its own endorsement of greater educational opportunities for all, more use of graduates (including engineers) in industry, and intensive development of university and postgraduate courses in business administration. But as we have seen already in the debates surrounding the British MIT, powerful forces eviscerated through the 1950s most of the proposals for making universities more relevant to industrial

¹ 'Management Accounting', p 6.

² See the 'Steel Founding', 'Trade Unions and Productivity', 'Simplification in Industry', 'Canning', 'Packet Foods', and 'Management Accounting' reports.

problems. Most of the teams also advised British industry and unions to wean themselves quickly from restrictive practices, but this had little chance against decades of habit and institutional pattern.

Overall the Council proved a useful mechanism for informing British industry, at relatively low cost,¹ about productivity's importance and how to achieve it. The reports were not a cookbook from which every firm could pull out an instant recipe for productivity growth; the teams, despite their earnest hard work, were too short-lived to substitute for a full-fledged Production Efficiency Service capable of walking firms through difficult problems and monitoring results. (It is interesting to note that Silberman's original idea for US-UK productivity exchange would have brought thousands of UK workers and managers to US plants for many months of actual work experience.) Nevertheless the reports and the dissemination work which accompanied them partially succeeded in counterbalancing the inherent generality of the government's publicity campaigns.

4.7 Measuring the success of postwar productivity policy

The AACCP proved to be the government's last major productivity initiative. Indirect intervention through barrages of EIU publicity, the encouragement of mutual aid among firms, and the despatch of the AACCP teams had reached the point of diminishing returns by 1950. Managements and workers now certainly knew what productivity was and that increasing the country's standard of living, in a period of full employment, depended

¹ The AACCP's functions cost the Exchequer £25,000 in 1948-49, one-quarter of which came from Marshall Aid, and £87,500 in 1949-50. (The public record has been searched unsuccessfully for later figures.) The FBI, TUC and other private British bodies spent slightly less than that in addition. Much of this expenditure was on dissemination of results. Marshall Aid paid for the journeys of the productivity teams to and in the United States. PRO, BT 195/67, memo from J. Hutton to Blaker, 9 Aug. 1949; AACCP, 'Report of Second Session', 20 Oct. 1950, p 5.

upon it.¹ The problem was getting workers and management to take specific actions to boost productivity; and, once they did, to procure the new buildings, equipment, raw materials and trained personnel necessary, in an economy still constrained by scarcities. As the AACCP recognised, 'The worth of the teams' reports depends directly on the degree. . . .[of] implementation, which must generally take place within the individual firm'.² But the government lacked powers to intervene directly in individual firms to compel higher productivity. Richard Stokes, the energetic managing director of the engineering firm Ransomes and Rapier Ltd. and a Labour MP, put it bluntly:

[T]he scientific control of industry and the increase of production fundamentally depend on the good will of the people in the industry. We can shout 'science' until the cows come home, but we shall not get anything more unless we tell the men what we want them to do, why we want them to do it, and what they are going to get out of it.³

The Development Councils were moribund, lacking the apparatus envisaged in Gordon's 'Provision for development' memorandum for commissioning new capital goods for industries too backward to do it themselves. The Production Efficiency Service, never very robust, had been wound up. The Midlands Advisory Council for Industrial Productivity had come to naught. The Panel on Automatic Control Techniques was defunct. The DSIR and RAs were told to make productivity a higher priority, but as we have seen in

¹ In 1950, for example, the TUC sent its own AACCP-like team to the United States to see whether there were practices of American unions it could adapt to the problems of British productivity. Its report endorsed time and motion study, wage restraint, subordinating consumption to investment and expanding union staffs capable of advising inefficient managements, all traditionally opposed by left-wing trade unionists. TUC, 'Trade Unions and Productivity'. 1951, p 59.

² AACCP, 'Report of Third Session', Oct. 1951, p 4.

³ HC Debates, Hansard vol. 518, col. 54, 30 July 1953.

Chapter 3, were also deprived of personnel and funds to try anything bold, and in fact were hard-hit by rearmament budget cutbacks.

Of course, government inactivity was not necessarily a bad sign. Indeed it could indicate that industry had conquered the problem of productivity. Statistics available at the time, and the subsequent verdict of economic historians, do reveal healthy productivity improvements during reconstruction from which the government could have justly decided that other problems were more pressing. A 1948 UN economic survey of Europe revealed that the only Marshall Aid participant with better productivity relative to 1938 was Sweden, which had not been in the war:

Table 4.1 Labour Productivity 1948

(Output per worker; 1938=100)

Belgium	97
Denmark	98
France	99
Italy	76
Netherlands	84
Norway	86
Sweden	116
United Kingdom	108

Source: Labour Party, Speaker's Handbook 1949-50, p 18.

In 1952 Rostas reported in the Economic Journal his assessment of productivity changes since the war, consolidating analyses he had been generating periodically within the government.¹ His best estimate of annual productivity growth (defined as change in real product per worker) from 1946-51 was between five and six percent.² Statistics were not precise, and there

¹ L. Rostas, 'Changes in the productivity of British industry 1945-51', 62 Eco. J. (1952) 15-24; Table I, p 17.

² Ibid., p 20.

was considerable variety among industries, but all participated in the improvement to some extent. This was found to be 'not substantially different' from postwar American experience (although America's base level was some two to three times better than Britain's), and a considerable improvement on the British prewar rate of about two percent annually.

Recent estimates suggest that the work of Rostas and others on which the Labour government relied may have overestimated the gross rate of postwar productivity growth, but accurately grasped the basic trends within Britain itself, especially about the relative productivity shifts among various industries and between postwar and prewar experience. Cairncross says that labour productivity as measured by the change in gross domestic product per head averaged 1.6 percent annually between 1946 and 1951. The rate improved between 1948 and 1951 to 2.5 percent annually, and was better in manufacturing than in the rest of the economy by about one percent (meaning a total of 3.5 percent between 1948 and 1951).¹ Altogether the country's achievements in productivity were impressive, certainly better than Rostas or the government expected.

Unfortunately, 'impressive' turned out to be not good enough by comparison with Britain's major trading competitors. Whereas the 1948 UN survey showed Britain at the forefront of productivity improvement in Europe (Table 4.1 above), the comparative growth rates reversed very quickly; Cairncross says that 'the trend in productivity in Britain [from 1945 to 1975], which is what matters to the standard of living. . .diverged from the start from the steeper trend in other countries'.² Although economists

¹ Years of Recovery, p 18. See also C.H. Feinstein, National Income, Expenditure and Output of the United Kingdom, 1855-1965 (Cambridge, 1972), Tables 51 and 20.

² Years of Recovery, p 500. Of course the UN survey excluded the US, Germany and Japan, which were some of Britain's most important postwar competitors.

differ about the causes of productivity differences among industrial countries,¹ they overwhelmingly agree that postwar Britain did not match the productivity growth of its competitors. Germany, for instance, improved its labour productivity relative to Britain from a ratio of less than 1 in 1950 to 1.4 in 1977.² Between 1954 and 1972 Britain's labour productivity (measured as output per person-year) grew at a yearly average of 2.9 percent; Germany's grew 4.6 percent.³ America's comparative advantage over Britain in output per worker was 2.2 in 1935-9, 2.7 in 1950, 2.85 in 1970, and 3.0 in 1978.⁴ The ratio of British productivity growth to American was especially weak in manufacturing, in a period when American performance was not impressive by world standards.⁵ France overtook Britain in labour productivity in 1955, Italy did so in 1968.⁶ It should be recalled that labour productivity is only one constituent of economic efficiency and that it is appropriate for a country with relatively low wages to employ a higher ratio of labour to capital than a country with relatively high wages. It should also be noted that British industries and firms have varied considerably in their postwar productivity performance, as they did before and during the war,

¹ For a good summary of their theories see R.E. Caves, 'Productivity differences among industries', in R.E. Caves and L.B. Krause, eds., Britain's Economic Performance (1980), pp 135-56.

² A.D. Smith, D.M.W.N. Nitchens, S.W. Davies, International Industrial Productivity, NIESR Occasional Paper 34 (1982) 90-3.

³ M. Panic, ed., The UK and West German Manufacturing Industry 1945-72, NEDO monograph 5 (1975), Table VI. See also C.F. Pratten, Labour Productivity Differentials within International Companies, Cambridge Dept. of Applied Economics, Occasional Paper 50 (1976), which estimates that German labour productivity in manufacturing was about 50 percent better than Britain's by 1971.

⁴ S.J. Prais, 'Comments', in Britain's Economic Performance, p 193.

⁵ Smith, Nitchens and Davies, op.cit..

⁶ D.T. Jones, 'Output, employment and labour productivity in Europe since 1955'. 77 National Institute Economic Review (Aug. 1976) 72-3.

with some doing quite well by world standards. Nevertheless, recent research indicates that whatever were the accomplishments achieved or set in motion by British industry between 1945 and 1951, they were inadequate to launch it on a path of productivity growth equal to its competitors.

It would be wrong to blame the postwar government for failing to prophesy the persistence of the British disease into the 1980s, especially when the contemporary indicators were so promising. Indeed they deserve credit for their significant economic accomplishments under great adversity, productivity growth among them. 'Taken in isolation', writes Cairncross, 'the British economy recorded a much improved performance between 1945 and 1975', years which were 'little more than an extrapolation' of the trends set by the postwar Labour government. 'Could the [productivity] trend', he asks,

have been steepened by action on the part of the Attlee government?

.....

[Only a bold person] would answer that question in the affirmative. Few governments have proclaimed more insistently the need for higher productivity. . . . Few governments. . . have held back consumption more assiduously so as to let the pace be set by exports and investment, as recommended by a later generation of experts on growth. They were successful in achieving a fast growth in exports, eliminating in turn the external deficit and then the dollar deficit and sustaining a high level of industrial investment in spite of the virtual cessation of personal savings. . . . It must be very doubtful whether any set of government policies could have done more.¹

4.8 Labour's growing frustration with the government's productivity tools

Cairncross' conclusion is true, but it does not explain why the Attlee government failed to endorse many of the bolder policies related to productivity it actively entertained during its tenure of office, or to implement effectively those it did endorse. For even while in power the government itself was not satisfied with industry's productivity achievements

¹ Years of Recovery, pp 499-500.

or the powers it possessed to hasten them. It is interesting to ask not only whether the Attlee government could have done anything to steepen the productivity trend but also why it shrank from going forward with policies that many expert advisers, civil servants and some ministers thought would do just that.

What is striking about postwar productivity policy, as with R&D policy, is how many potentially promising ideas were discarded or implemented so desultorily that failure was inevitable. The Development Councils, intended to collect compulsory levies for research and identify common problems of production and export, covered only a tiny portion of industry before industry opposition scuttled the whole scheme. The Production Efficiency Service, despite Cripps's patronage, was much too small for its task and was left to wither in the stony soil of BOT officials' hostility. The DSIR and RAs never received the dramatically increased powers and funds necessary to conduct serious productivity-related investigations, despite the the strong advocacy it won at various times from Tizard, Appleton, Lockspeiser, the ACSP and CIP. The Midlands Advisory Council for Industrial Productivity had powerful backers and seemed tailor-made for 'bridging the gap' between research results and industrial practice in a crucial industrial region, but its help from Morrison and DSIR was miniscule. The Panel on Automatic Control Techniques, after a promising start aiding British electronics manufacturers in 'do[ing] the really big thing - to skip a whole historic phase in machine design', folded up due apparently to inadequate funding and staffing compounded by rearmament economies.

The only productivity-related initiatives which accomplished anything tangible were those which cost little, left private industry's autonomy intact, and required Whitehall to undertake no substantially new functions. These included the publicity programme of the EIU, the largely publicity-orientated AACCP and the creation of two essentially powerless advisory committees.

the ACSP's Committee on Research and Productivity and its successor, the Committee on Industrial Productivity. The CIP's various panels generated some interesting practical ideas and the Human Factors panel funded some worthwhile social science research aimed at boosting output. Nevertheless the CIP's chairman, Tizard, wanted to dissolve it within nine months for lack of useful work, and it repeatedly cast about for a more significant role. The British Institute of Management and the Council on Industrial Design, both Cripps creations, were the only new semi-governmental bodies related to productivity to survive the Labour government, and their functions were fairly tangential to the most pressing problems of production.

Dissatisfaction with this record of half-hearted accomplishment did not begin with a later generation of economists. Concern that existing governmental tools were inadequate to the task of supporting and, where necessary, prodding business towards the vital national goal of higher productivity was evident in many powerful quarters during Labour's term. Tizard, exalted by Labour's A New Deal for Science as the director of the "Scientific General Staff",¹ told Morrison and Cripps in May 1948 that the RAs, the government's main vehicle for reaching individual firms, 'had been of little help to industry'.² Lockspeiser told Morrison in December 1949 that DSIR had to 'be given new life and brought up-to-date with the realities of our economic situation, or it will almost certainly continue to drift further and further from the centre of Government activity'.³ Morrison himself grew frustrated in August 1948 that civil servants seemed to be sandbagging his plans for injecting more science into industry. 'I do not want

¹ Labour Party, A New Deal for Science, May 1949. para. 11.

² See page 259 above.

³ See page 188 above.

the scientists pushed into the back room again', he warned Bridges.¹ The nationalised firms, the 'commanding heights of the economy' as Labour conceived them, contributed to the government's frustration over persistent inefficiency. They did not spend enough on R&D and dragged their feet over becoming more scientifically minded.²

Furthermore Labour ministers came to recognise that 80 percent of the economy remained in private hands, and would have to remain so: of 51,000 workplaces in the country, over 49,000 employed fewer than 500 people and were awkward candidates for state ownership. The private sector also bore the brunt of the export drive and supplied most consumer goods. Acutely aware that the government had for good reason forsaken the detailed economic controls of wartime, Labour ministers ruminated about less coercive mechanisms for influencing the decisions taken in private boardrooms and on assembly lines in the direction of higher productivity. The 1949 economic statement Labour Believes in Britain contained a section on 'Encouragement for Enterprise' which reflects the influence of Morrison, Wilson and Bevan. Its topic was how to make the private sector in a mixed economy work better and in closer partnership with the government. It endorsed the NRDC, the new Monopolies and Restrictive Practices Commission, DSIR, the RAs, and other ways of prodding private industry to perform better. Its basic philosophy was that 'the managers and owners of

¹ See page 262 above.

² PRO, CAB 130/41, meeting of GEN 255 Committee, considering how to improve productivity in the socialised industries, Nov. 1948. See also CAB 124/202, minute from Tizard to Morrison, 22 Aug. 1950, saying that research expenditure in socialised industries was 'still on far too low a scale'; the fuel and power industry, the best of them, was spending less than £1m annually on R&D out of a total income of £800m, 0.12 percent compared to the one percent target for progressive firms. In CAB 128/17, CM 26 50, the Cabinet criticised efficiency in the nationalised industries, with proposals for external boards to scrutinise them periodically. 27 Apr. 1950. See also Cairncross, Years of Recovery, pp 481-4; D.N. Chester, The Nationalisation of British Industry (HMSO 1975), pp 956-77.

private industry are trustees responsible to the nation; in this sense all business is the nation's business'. It also introduced the concept of 'competitive public enterprise' -- creating new public firms in non-nationalised industries which would turn all the mechanisms of the competitive free market to national advantage by setting a brisk pace of efficiency which private firms would have to meet or go bankrupt.¹ These ideas did not strike a chord with the rank and file of the Labour Party, who for many years had taken as an article of faith that central direction of the economy, paradigmatically in the form of nationalised industries, was the right way to achieve rational planning and cut the waste inherent in competitive capitalism. Aneurin Bevan complained at the June 1949 party conference that 'hardly anybody has said anything at all about [competitive public enterprise]' although it was of 'the utmost importance'. Trying to promote some enthusiasm, he told the conference that the government would reduce restrictive practices, support the NRDC, and invest in efficient private firms. These new nostrums were 'not, I beg you to realise, the abandonment of any of the principles that we have enunciated [meaning nationalisation], but rather the making of a realistic approach to the problem and the endeavour to make British society as efficient as it ought to be'.²

Harold Wilson's thoughtful May 1950 Cabinet paper 'The state and private industry'³ infused this concept of competitive public enterprise with more specifics, although no new policies emerged out of it during the Attlee government. He had been impressed with how effectively informal consultation between government departments and industry, wholly apart

¹ Labour Party, Labour Believes in Britain, 1949.

² Labour Party, 'Report of the 48th annual conference of the Labour Party'. 1949, pp 170-2.

³ PRO, CAB 124/1200, 'The state and private industry', memorandum by Wilson [second version], 4 May 1950.

from formal coercion through physical controls, had been working to further important national objectives such as the export drive. Businesses were often happy to follow the government's lead and were glad for the advisory bodies, mutual aid schemes, and expert advice available from government. The success of this sort of collaboration was evident in the export drive.

'What, in more detail, have we the right to insist on in the management of private industry'? Wilson asked. The first item was 'maximum productive efficiency', something industry was not providing. Unfortunately 'controls of the kind in force during and since the war are virtually powerless to influence' productivity; equally ineffective 'despite the text-books' were the 'forces of competition', because of full employment and a sellers' market for British manufactures. New instruments of state intervention were thus required. Wilson suggested state-owned factories to provide competition, powers to take over inefficient firms, price ceilings on certain products to encourage more efficient manufacturing, more stringent controls on restrictive practices, government representatives on the boards of key firms, a much expanded production efficiency service, and guaranteed markets and long-term contracts for utility consumer goods and approved capital equipment.¹ This was a profoundly interventionist industrial policy, but a much more sophisticated one than Labour's inherited orthodoxy of public corporations to govern the commanding heights of the economy, plus the use of trade associations to implement government controls elsewhere. This was socialism alloyed with a respect for the creativity and ferment of a decentralised economy. Attlee was intrigued by these ideas but apparently agreed with Wilson's assessment that they were 'not for this Parliament': he asked Wilson to chair a meeting of junior ministers, the party's future

¹ Ibid.

leaders, to thrash them out.¹ It seems probable that Wilson's proposals did not appear publicly during the Attlee government because they were too novel and rough to gain widespread political support, even within the Labour Party. Nevertheless they demonstrate that even during Labour's term of office serious doubt existed within the government about whether it was doing enough to 'steepen the productivity trend'.

4.9 Conclusion: Why the ambitious ends-feeble means gap in productivity policy?

Yet these doubts did not crystallize into more concrete policies during the Attlee government. Conceding that Wilson's ideas were too novel to bear fruit by 1951, why did these doubts not prompt the government to commit itself seriously to some of the older ideas for productivity policy in circulation, like the Production Efficiency Service, the Midlands Advisory Council for Industrial Productivity, the Panel for Automatic Control Techniques, Gordon's 'Provision for development' scheme, or simply revamping the DSIR and RAs? The documentary record provides no conclusive answers. Many of these schemes faded away silently, leaving few hard clues about the reasons for their demise, much less about why no one thought to expand them. There is, however, some basis for informed speculation about why a gap grew up between ends and means in postwar productivity policy.

The most important reason was the economy's evident success in converting to peace, particularly in industrial production, which combined with a seller's market masked the underlying weaknesses in comparative productivity which would become so prominent in the 1950s and 1960s as

¹ PRO, CAB 124/1200, letter from Wilson to Attlee, 5 May 1950; minute by Attlee, May 1950.

other European countries overtook Britain. Another contributor was the relationship between Morrison and Cripps, the two central ministers in this area, as well as their individual approaches to productivity. Besides their consultation over the formation of the Committee on Industrial Productivity, the public record contains no evidence that they collaborated deeply on the subject. They may have consulted in person leaving no written evidence, and their staffs were in regular contact, but they never concerted a strong policy.

Cripps was more effective than Morrison. His initiatives at BOT were innovative and worthwhile, if not particularly radical. When he became Chancellor in November 1947 he lost responsibility for specific industrial programmes but gained a much larger pulpit, which he used ably to persuade the Cabinet, the Commons and the country to curb imports and consumption and boost exports, investment and productivity. (His protégé and replacement at the BOT, Harold Wilson, did not show Cripps' interest in productivity, at least as measured by specific BOT programmes, until his May 1950 Cabinet paper.) It may have taken American prodding to interest Cripps in a sizeable exchange scheme like the AACP, but he had been employing sophisticated publicity on productivity's behalf for several years and used the leverage the American offer gave him very deftly to gain the cooperation of civil servants, the FBI and the TUC. Nevertheless, publicity was the main lever he used at the Treasury to jack up productivity. His 1949 budget expanded initial depreciation allowances to encourage industrial investment, but these were cut back to help finance rearmament. By the end of 1949 Cripps was generating no new ideas in this area. Perhaps incipient exhaustion was partly responsible; like most of the Attlee Cabinet, he had been serving continuously in strenuous jobs since 1940, a 'severe test of physical

endurance'. He resigned in October 1950 for health reasons.¹ Morgan writes that after the 'hammer blows of the annus horrendus [1947], the government was beginning to lose the initiative', and that by 1951 a defensive outlook had become so pervasive that the government was 'pulverized. . .exhausted by intractable problems at home and abroad' and 'had no initiatives to offer'.² Cripps may have shared in this progressive drying up of ideas and energy. He may also have lacked resources to do much more even had he wanted to. Staff at the Treasury had been cut from 1001 in January 1948 to 792 in December 1949,³ and large spending cuts in economic publicity took effect in 1950.

Morrison too was in declining health, 'out of action for four critical months' in 1947,⁴ and his responsibilities for nationalisation, co-ordination of domestic policy and the Commons schedule stretched him very thin.⁵ His oratory on productivity was excellent. His speeches to party conferences and Parliament were inspiring, full of an expansive vision of what science could contribute to industry and what the government could contribute to science. His actual contributions to policy, at least to judge from the written public record, were sporadic, curiously uninspired and sometimes even harmful. Perhaps he believed his own rhetoric -- that 'we have done all that we could [for science], both in equipment and materials, and that science has had a

¹ Cairncross, op.cit., p 48.

² Morgan, op.cit., p 358, 462.

³ Cripps papers, 57, speech to staffs of Treasury and associated departments, 11 Jan. 1950.

⁴ Cairncross, op.cit., p 48.

⁵ Morgan. op.cit., p 334.

chance to throw itself about in recent years' as he told the Commons in 1950,¹ or that the ACSP, CIP and Defence Research Policy Council under Tizard's direction really comprised a 'Scientific General Staff' as claimed in A New Deal for Science. He was 'not in fact a forceful co-ordinator',² and was 'relative[ly] inadequa[te] in economic matters, for all his extraordinary administrative skills and political acumen'.³ When Morrison's and Cripps' officials worked to devise the CIP, Cripps' conception won out, leaving unfulfilled Nicholson's concern about creating a network for implementation that would reach into individual factories. Morrison never insisted that DSIR receive the funds and personnel approved by his Lord President's Committee in 1946 to implement the plan of DSIR's Post War Development Committee. He allowed opposition from Anderson, Barlow and others steeped in civil service tradition to shrink into insignificance the central secretariat for science urgently pressed by the 'radicals' on the Committee on Future Scientific Policy. Faced with Appleton's request for a network of half a dozen DSIR extension officers, or the Midlands Advisory Council's request for a single full-time DSIR liaison, he balked at investing the resources. Presented with Tizard's urgent proposal to let the CIP oversee the RAs because the RAs 'had been of little value to industry', and Nicholson's concurrence that 'something very much more comprehensive and full-blooded is called for', he nevertheless endorsed the classic civil service 'compromise' of creating the Productivity (Official) Committee which did nothing to rejuvenate the RAs or give them closer links with the production departments. He grumbled at Bridges that he did 'not want the scientists

¹ HC Debates, Hansard vol. 474, col. 2131, 5 May 1950.

² Cairncross, op.cit., p 50.

³ Morgan, op.cit., p 131.

pushed into the back room again', but there is no evidence of his taking concrete steps to prevent this.

Of course Morrison had to depend upon advice from officials, scientists and other experts which was often small-minded, and his schedule was 'an endless treadmill of work and official business'¹ with many pressing priorities. His advocacy of 'consolidation' as Labour's basic strategy after 1948, to protect middle class support as well as gains already made,² may have conditioned him against bold new policies in many areas, productivity included. Whatever the cause, it appears from the public record that after reviewing the initial work of the CIP in 1948, he did not grapple in a sustained way with the problems of applying science to industry. Without strong ministerial direction, institutional inertia combined with civil servants' customary caution to produce few novel ideas in productivity policy.

As with R&D policy, the tiny scale of resources devoted to raising productivity was another major brake on implementing new schemes. The number of experienced consultants required to staff a really comprehensive productivity extension service, for instance, probably did not exist in the country. Even if industrialists had been willing to hire QSEs in numbers comparable to American firms, the output from universities (not to mention the ever-postponed British MIT) was too scanty even after the postwar expansion. The government, despite the importance it attached to productivity, withheld resources even when small amounts could have been significant. The examples given above of denying Appleton a small extension service and MACIP a full-time DSIR liaison are characteristic. Unwillingness to expand the government's functions in novel and potentially expensive directions is also evident in the chilly reception given the PES and Gordon's

¹ Donoughue and Jones, op.cit., p 389.

² Morgan, op.cit., p 5.

'Provision for development', the difficulty in establishing PACT and its quick demise, and the frequent unavailing battles to expand the DSIR and RAs. The only sizeable government expenditure for productivity was the production-productivity publicity campaign, cut 40 percent (to about £450,000) in 1949. Marshall Aid paid for much of the AACCP; the Exchequer's share may have come to £200,000 over three years. The social science research commissioned by the Human Factors Panel cost about £100,000; otherwise the Committee on Research and Productivity and the Committee on Industrial Productivity cost virtually nothing. Estimating generously that the DSIR and RAs spent one-fifth of their budgets on matters relating directly to productivity, and adding in the cost of all other productivity programmes where a reasonable estimate can be made, it would appear that the government spent at most £6m on productivity programmes between 1946 and 1951, 0.023 percent of its £26.5b total revenues in this period.

The Attlee government might have devoted more people, money and thought to productivity and civil science generally had the framework of its economic thinking not derived so heavily from Clause IV and the corporatism inherited from the Thirties, both of which favoured large businesses 'rationally' administered from the centre. In important respects, the policies built on this framework were indifferent or even hostile to productivity growth. The government 'made no attempt to undo the work of concentration and cartelization which had been the response of private business to the inter-war depression'.¹ Throughout the Attlee government, physical controls were administered in detail by trade associations, 'to whom in the main the uncertainties of free competition were repugnant'.² It was not until 1948 that a weak restrictive practices bill was passed which provided only for

¹ Harris, Competition and the Corporate Economy, p 62.

² Allen, The Structure of Industry in Britain, p 66.

investigation with no sanctions.

The cornerstone of Labour's industrial reforms was nationalisation. It took more parliamentary time than any other programme, 530 hours in the Commons and 675 in the Lords, and was Morrison's special responsibility. Higher productivity in some of the candidates for takeover, like electricity, gas and coal mining, clearly required restructuring into larger units which might as well have been state-owned. But the overwhelming impetus for nationalisation was not the quest for productivity, writes Cairncross, but instead 'political aims and pressures', primarily 'antipathy to the existing economic system' and especially its 'reliance on the motive of private profit'. He continues:

Technical and economic considerations took second place.

.....

Since what was uppermost in their minds was the idea of social control [Labour ministers] welcomed the monopolistic powers that nationalisation conferred on the industries concerned without questioning whether such powers were in the best interests of efficient production.

.....

[I]f one asks what nationalisation contributed to economic recovery or to the resolution of the many urgent economic problems of the postwar years it is not easy to find a convincing answer.¹

Morgan lays more emphasis on the technocratic motive behind nationalisation, the desire to place industries which had 'failed the nation' on a more efficient footing through large-scale central planning.² Regardless of their motivations, Morrison and others closely involved with state-owned companies seemed to take for granted that science-mindedness and productivity growth would flow into them quite naturally once the focus on short-term profits imposed by capitalism was removed.

Experience disproved this assumption, helping propel the attention of younger leaders like Bevan and Wilson towards more subtle tools for

¹ Cairncross, op.cit., pp 463, 466-7, 464.

² Labour in Power, pp 94-99; see also pp 140-1.

energizing private enterprise. These new ideas were ultimately put to the test in Wilson's white-hot technological revolution. By 1964 they were certainly richer and more detailed than in Wilson's 1950 Cabinet paper. A long gestation period may have been necessary to make them coherent, as well as to condition supporters to a significant overhaul of Labour's doctrine about the relationship between state and industry. Nevertheless all the elements of the active collaboration between state and industry found in Labour's post-1964 civil science policy were present during the Attlee government. The National Economic Development Organisation and its "Little Neddies" to plan industry and hasten innovation by labour-management consensus were a descendant of Cripps' Development Councils and the informal consultation which had helped the export drive and so impressed Wilson as President of the BOT. The Ministry of Technology replaced the parsimony and pedestrian vision which had hobbled the DSIR and RAs with more bountiful finance and vigour, as had been suggested innumerable times between 1945 and 1951. By finally giving science a voice other Whitehall denizens could not ignore, it updated the FSP radicals' call for a strong science secretariat at the heart of government's daily work. Mintech's decision to build up specialist groups in computers, instruments, electronics and machine tools 'to get to know the main firms of each industry personally and elaborate possible ways by which a firm can be helped by the Government to remedy its defects' had parallels with the Sunday Soviets and Gordon's 'Provision for development'. There were more consultancy services for backward firms, in the mould of the PES. The Industrial Reorganisation Corporation which had funds of £150m to encourage and sometimes force consolidation among firms so that the successor could conduct more R&D was closely akin to the Industrial Commission suggested in 'General support of trade'. Though counterfactual questions can never be firmly answered, one cannot help wondering if the Attlee government's strong predisposition to 'an

economic philosophy favouring large, nationwide units of control¹ did not slow its recognition that the raw materials for a stronger productivity policy, capable of reaching more effectively into individual factories and boardrooms as it desired, already existed around it.

Of course, Britain's low productivity compared to other advanced countries was, and is, a vexingly complex and stubborn problem. It has long and tough roots in patterns of education, culture, investment, international trade, restrictive practices by business and labour, low management quality, the imperial tradition and other factors. Tizard was right that 'all improvements in manufacture depend ultimately on the advance and application of science',² but no government, whatever its dedication to the wider application of science, could make easy progress against so many interconnected shortcomings. British industry, on balance, still does not apply science as effectively to production as do its principal competitors. The Attlee government must take its share of the blame for the persistence of this malady. Despite instituting many programmes which can fairly be judged to have helped productivity, it skimmed on resources which would have made them more effective, and neglected other programmes which were within the realm of realistic possibility. Given however its many other trials and accomplishments in an extraordinarily taxing period, and the evidence available to it at the time showing remarkable progress in output and productivity, these failings in productivity policy can be excused more easily than those of its predecessors and successors.

¹ Cairncross, op.cit. p 494.

² 'Science in the war and after,' Mond Lecture, 9 Nov. 1945, p 4.

CHAPTER FIVE

Epilogue and Retrospect

This chapter describes the reforms which leading scientists envisaged for industrial innovation as the Attlee government drew to a close and measures them against a brief account of subsequent policy in this area. The chronicle of later developments finds many parallels with the Attlee government's efforts and shows that no postwar government has made major progress in restoring British industrial innovation to world rank, thus signifying the complexity and deep social and institutional roots of the underlying problems.

5.1 Crucible of the white-hot revolution: scientists' thoughts about Britain's industrial future at the end of the Attlee era

No consensus existed among British scientists and engineers around 1950 about how to alter civil science policy to help the country's economy. The Attlee government, unlike the wartime Coalition which had faced a scientific community whose "progressive centre" was united in endorsing Bernalism more or less dilute, thus lacked a ready-made prescription for reform which could be administered to industry or Whitehall. Some leading scientists were not content about the help civil science policy was giving to industry but had developed no coherent critical framework linking their individual complaints. Their ideas for change had to percolate through the progressive centre of the 1950s before gaining enough weight to affect politicians' thinking. This maturing process was well advanced by 1960.

putting science policy back into the parliamentary limelight and creating pressure for reform which led to the Trend Report of 1963 and Harold Wilson's detailed blueprint for a technological "revolution". The new policies of the 1960s, as discussed briefly in Section 4.8, resurrected in a more sophisticated guise many of the schemes for encouraging R&D and productivity which the Attlee government had abandoned. The added sophistication recognised that private industry was central to Britain's economic future and that its virtues of competition and decentralised initiative could be harnessed to the government's policy of quicker technological change. Insofar as scientists were thinking at the end of the Attlee government about specific new policies to combat Britain's continuing backwardness in industrial innovation -- and most were not -- they, like Harold Wilson, were increasingly considering methods of improving private industry's R&D and productivity.

Bernalism, ascendant in 1945 even if most scientists did not wholly share its passion for state control and planning, had by 1950 completely lost its impetus. During the 1947 convertibility crisis Bernal was still close enough to the government to lobby strongly for adding an energetic central secretariat to the ACSP to survey the economy's most pressing needs and supervise the R&D which would follow. He wrote letters to the Times, consulted ministers and civil servants, and hoped to orchestrate a nationwide campaign including trade unions, local and regional meetings, and a conference called by the Royal Society.¹ The campaign did not materialise. The Association of Scientific Workers, of which Bernal had recently become president, issued a pamphlet calling for a 'massive redirection of scientific resources' away from defence to industrial problems, pooling the laboratories of private firms, adding technical and scientific members to Plowden's

¹ Bernal papers, I.7.2, 'Crisis: plan of campaign', Aug. 1947.

Economic Planning Board, and the formation of 'regional research councils linked with the central organisations of production and research'.¹ The ACSP rejected this scheme. In Tizard's words, its job was 'purely advisory whereas the Association were suggesting that they should assume executive responsibilities' which were already the province 'of other bodies such as D.S.I.R. and the Agricultural Research Council'.² Isolated from influence and contemptuous of the government's feeble scientific advisory apparatus, Bernal bitingly criticised the government. In 1948 he said its policies 'were making it less rather than more likely' that 'scientific and technical knowledge [would be] adapt[ed] to the rapid improvement of productivity'. The government had admitted 'national bankruptcy' and was choking investment to encourage exports in pursuit of an economic policy too oriented towards earning American dollars and approval.³

The Cold War widened the gulf separating Bernal from the weight of scientific opinion. Stalinism and its effects in Eastern Europe discredited the Soviet system of central planning which was Bernalism's implicit and sometimes explicit model for Britain. In addition, the unwillingness of several radical scientists, Bernal especially, to denounce Lysenko's malign influence on Soviet genetics lost them much sympathy. As the Cold War intensified, the divisions between left and right in science polarized. Bernal, for example, told a Moscow audience in 1949 that in capitalist countries 'the direction of science is in the hands of those who hate peace, whose only aim is to despoil and torture people, so that their own profits can be assured for some years longer', a far cry from his genial 1945 broadcast with Dale and

¹ AScW, 'Science and the economic crisis'. 14 Aug. 1947.

² PRO, CAB 132/64, S.P. (47) 8th meeting, 20 Aug. 1947.

³ J.D. Bernal, 'Britain's economic future -- recovery or collapse', Scientific Worker 3 (Apr. 1948) 7. 5.

Hill.¹ The BAAS Council did not re-elect him as a member. The AScW also fell on hard times. Refusing to relinquish its affiliation with pro-Communist bodies proscribed by the TUC like the World Federation of Scientific Workers, it lost thousands of members and influence within the Labour movement.² Many other developments tended to wash Bernalism out of scientists' political attitudes: the military threat of the Soviet Union; the sheer size of the defence research effort funded by the government including the atomic bomb project approved at the start of 1947; a widespread belief that a Labour government would implement whatever mechanisms of planning were necessary; and perhaps also the relative bounty of resources available to science compared to prewar. The Soviet Union had never been taken seriously as a model for structuring British R&D except by those fairly close to Bernal, but by 1949 it had dropped completely off the civil science map, not to return until the mid-1950s when advocates of technological education like Sir Francis Simon and the ACSP pointed to the Soviet output of engineers to explain its impressive economic growth.³

The "free enterprise" United States was the most influential foreign model in the ideas for improving industry which circulated among scientists at the end of the 1940s. After the war, with Germany discredited and the rest of Europe prostrate, the United States with its lead in R&D and productivity became the only object of comparison. It was to America that the BOT Working Parties and AACCP productivity teams went; the Research Corporation of America which inspired the National Research and

¹ quoted in Werskey, Visible College, pp 300-1; see also Werskey's discussion of postwar leftist scientists generally, pp 277-304.

² Ibid., p 278.

³ Sir Francis Simon, 'Technologists and technicians', Sunday Times 4 Mar. 1956; ACSP/Ministry of Labour. Scientific and Engineering Manpower in Great Britain (HMSO 1956).

Development Corporation; the American land grant colleges like MIT which were invoked more than German or Swiss polytechnics as a model for British technological education; American industry which Rostas and thereafter ministers, MPs, scientists and journalists used as a benchmark of productivity achievement. The American system of government aid to research supplied large sums to university (and corporate) laboratories on open-ended contracts which permitted QSEs considerable freedom to follow their instincts without having to join the civil service, renounce teaching or, for corporate researchers, isolate themselves from development and production. It could not easily be adapted to British institutions; universities had comparatively little experience of collaborating with industry or government, and there were few first-rate industrial labs.¹ Nevertheless the American model alerted British opinion to competition's spur to business creativity and technological leadership. A flurry of interest in 1948 from American companies wishing to establish British subsidiaries even prompted one magazine to welcome the example they would set for retrograde British manufacturers.²

Such new ideas as were circulating among scientists around 1950 on improving R&D and productivity focused on the needs of private industry. Most who have left records of their thoughts on these problems were connected with the government in some way; the general ferment among scientists in 1945 about R&D had subsided.³ Lockspeiser, for example, wrote a memo for the ACSP in September 1952 summarising the 'volumes [that] have been written and spoken' about 'why the manufacturing industries

¹ J. Ronayne, Scientists in Government (London, 1984), pp 22-7.

² 'Competition is the spur', Everybody's 14 Aug. 1948, p 3.

³ Vig believes that widespread political interest about the organisation of civil science dropped off by 1947-8 and remained low for ten years. Vig, Science and Technology in British Politics, p 157.

as a whole do not make as much use of science as the interests of the country require'. The relevant reasons, which were 'no mystery', included boards of directors lacking QSEs, a shortage of technologists, insufficient steel and power, the 'size pattern of manufacturing firms', restrictive practices by management and labour, high taxes drying up investment and continued stultifying government controls.¹ That same month Zuckerman supplied to the ACSP a lengthy comparison between the spending and QSE hiring patterns of American and British firms. His conclusions emphasised the small size of many British firms which could not afford a decent R&D department; the modest investment of even large successful firms, hemmed in as they were by anti-inflationary taxation levels and a general shortage of capital, in new plant and equipment; the paltry salaries paid QSEs; and industry's low demand for QSEs compared to America's 'insatiable hunger'. British firms spent in 1950-51 somewhere between 50 and 100 percent more on R&D than they had in 1945-46, but Zuckerman warned that

if we view our activities in the light of those of the United States, it is obvious that the R&D efforts of British industry still need to grow greatly, in quality no less than in quantity if we are ever to reach economic safety. . . .The more limited [our production facilities] the greater the necessity for a really rich array of alternative schemes out of which winners can be picked for subsequent development. . .²

Some economists also turned their attention to R&D and productivity in ways which suggested an interesting cross-fertilisation with the scientists, as well as a greater focus on the microeconomic problems of individual firms. George Allen, elected president of the economics section of the BAAS in 1950, suggested that the government could best encourage productivity and innovation by encouraging 'resilience -- adaptability to change' in private

¹ PRO, CAB 132/106, S.P. (52) 23, 'The application of science to the manufacturing industries', 19 Sept. 1952.

² Tizard papers, HTT 471, S.P. (52) 22, 22 Sept. 1952.

industry. 'During the war', he said, 'industrialists lost their function of risk-bearing and became mere administrative agents of the government'. Since the war the government had tried to encourage efficiency by encouraging R&D and creating the British Institute of Management, Development Councils and Production Efficiency Service.

These measures probably represent about as much positive action as can be expected from the government in this field. For, in the end, industrial efficiency must depend, on the one hand, on the initiative and intelligence of manufacturers and workers themselves and, on the other hand, on the existence of an economic environment congenial to enterprise. . . .The government. . . .should aim to remove the barriers to initiative and to destroy any force hostile to innovation that appears in industry itself. . . .But it cannot compel us to be enterprising. . . .¹

The analyses of Lockspeiser, Zuckerman and Allen presaged several important themes of inquiry pursued throughout the 1950s and 1960s as QSEs and economists sought microeconomic cures to the British disease. Researchers emphasised especially the chilling effects of inept management and restrictive practices from management and labour, ways of inducing small firms to innovate, and the link between R&D, capital investment and economic growth.

Tizard became especially concerned with this last question. He believed that low capital investment imposed a precise limit on the benefits which R&D could confer upon the economy.² He turned the conventional wisdom on its head: instead of R&D automatically giving rise to capital investment and prosperity, a 'research-push' conception, useful R&D might be limited by availability of capital, a 'demand-pull' conception. In 1951 and

¹ G.C. Allen, 'British industry and economic policy'. 1948. reprinted in British Industry and Industrial Policy (London, 1979).

² This is discussed on page 209. PRO. S.P. (51) 12, 'Industrial research', note by Tizard, 29 Mar. 1951; Tizard papers. HTT 233, 'Bridging the gap between science and industry', 1949; HTT 623, 'Notes on industrial research and development'. 23 Mar. 1954.

1952 Tizard pressed the need to explore the economics of research on the BAAS, which set up a committee of economists and scientists that eventually commissioned the first of the thorough and important Carter and Williams studies of R&D economics.¹ Their work, and that of many economists who began to study the causes of growth in the 1950s, undercut Tizard's idea of a precise equation relating R&D, capital investment and economic growth. Nevertheless, they supported Tizard's conviction, which Zuckerman, Lockspeiser, Allen, and many other students of technical change in industry came to share as the Attlee government drew to a close, that the pitfalls separating a clever laboratory invention from a profitable innovation were many, complex and as often economic as technical. This understanding that every link of the innovation chain mattered found its way into the Wilson manifesto, with its goal of attacking all causes of innovative decline: economic, cultural, educational and technical.

If George Allen was right that the greatest help government could give to industry's innovative capacity was to get out of its way, the ACSP by 1950 was performing admirably. It met seldom and did little. It had a good grasp of what was retarding British productivity and R&D, as the Lockspeiser and Zuckerman memos show, but without power to allocate funds or personnel it was restricted essentially to public relations work, primarily through its annual reports and members' informal contacts. A telling indication of its minimal influence in Whitehall was a note sent by Attlee to the Cabinet in May 1949, reminding his colleagues of the ACSP's existence and encouraging them to make use of it.² Tizard, described by Sir Frederick Brundrett (then staff director of the Defence Research Policy Committee) as

¹ C.F. Carter and B.R. Williams, Science and Industry (London, 1959).

² PRO, CAB 129/35, C.P. (49) 126, 'Scientific policy', note by the Prime Minister, 24 May 1949.

'not a patient man', and one who 'did not excel in the fields of organisation and administration',¹ contemplated retirement from the ACSP in October 1949, tried to arrange it in 1950 and finally went in 1952.² He usually backed down when departmental representatives on the Council reflexively protected their turf against new ideas, as for instance in 1949 when the Treasury opposed improving the salaries of scientists in the civil service, and the University Grants Committee opposed a British MIT.³ He always shunned an executive role for the ACSP.

Tizard's part-time and long-serving successor as ACSP Chairman, Sir Alexander Todd,⁴ was content for the Council to remain a gadfly rather than an independent power base for science in Whitehall. His response to the Lockspeiser and Zuckerman papers mentioned above was to exclude many of the subjects they raised from the Council's future work, including the effects of taxation on investment, 'unbalanced boards of management, shortage of technologists and technicians, restrictive practices, etc.'⁵ In 1951 Brundrett aptly summarised how little power had been gained by the government's civil science machinery, the vaunted 'Scientific General Staff'. He likened it 'to the stage of development [of] the defence departments at the beginning of the recent war'. Despite the crucial importance of R&D and productivity, the scientific advisers to civil departments (and by implication the ACSP too) 'might be likened to a dog in a cage to which the owner

¹ Hartley papers, box 6, Tizard obituary in Times, undated 1959.

² Tizard papers, HTT 467, minutes from Tizard to Minister of Defence, 18 Oct. 1949 and 5 Jan. 1950; note to Sir Harold Parker, 7 Nov. 1950.

³ PRO, CAB 132/66, S.P. (49) 4th meeting, 1 June 1949.

⁴ Todd served from 1952 to 1964.

⁵ PRO, CAB 132/106, S.P. (52) 28, 'Research, development and investment', note by Todd, 15 Oct. 1952.

throws a bone occasionally to keep it quiet'. They were 'not. . .properly integrated into the policy making authority'.¹

5.2 A brief sketch of civil science policy after 1951

Frustration that the ACSP and the rest of the government's scientific apparatus could do little to help industry or inject more sophistication about science into the government's own decisions smouldered throughout the 1950s. Sir Francis Simon called for a Ministry of Science in 1955 to overcome resistance from classically educated politicians and civil servants to spending more on civil R&D and technological education.² Blackett's papers do not reveal any opinions on the organisation of civil science between 1948 and 1956, but after having lobbied on the Barlow Committee for a strong secretariat he is not likely to have been impressed with the accomplishments of DSIR, the RAs and ACSP. In 1956 the new leader of the Labour Party, Hugh Gaitskell, convened a group of senior scientists under Blackett's leadership to prepare a science manifesto for the next Labour government. Its recommendations can be taken as an implicit criticism of what the Attlee government left undone. It called for a great increase in the output of QSEs, concentrating their employment in industry rather than in DSIR or the RAs, more money for a more aggressive NRDC, a great expansion of development contracts for civil products (defence was in 1958

¹ Brundrett papers, BRUN 1/2, 'The place of science in the machinery of government', 21 Feb. 1951, pp 15-16. Zuckerman, vice-chairman of the ACSP for 17 years, concluded in 1975 that it 'did not. . .live up to what may expected of it' and 'was unable to penetrate the fastness of individual Government Departments', something which 'no committee of amateurs. . . meeting. . .at monthly intervals could even start doing. . .' Zuckerman, 'Scientific advice during and since World War II', *Proc. R. Soc. Lond. A* 342 (1975), 475-6. Vig agrees that the ACSP was quite weak (*op.cit.*, p 24) but Gummett points to a number of fairly uncontroversial areas where its advice may have been influential to warn that the 'conventional hasty dismissal of the ACSP' may not be warranted. *Scientists in Whitehall*, pp 35-6.

² 'A ministry of science?', *Sunday Times* 7 Aug. 1955.

spending £120m and employing 25,000 QSEs on development contracts, compared to £1m for all civil departments), and a robust secretariat serving a Scientific and Technical Planning Board under the Lord President.¹ Blackett's relationship with Gaitskell was not, however, close.² He was much closer to Harold Wilson, who even while Gaitskell lay dying told intimates that 'releas[ing] the energies of the scientists and technologists' would be one of his highest priorities if chosen party leader.³

Wilson's concern about civil science was not by this time unique among politicians. The country's stagnant economy, the so-called 'brain drain' of British QSEs to better-paid jobs in superior American laboratories, and rising concern in the bureaucracy that government funding for scientific research had grown too large to be correctly allocated by non-scientists in the Treasury had pushed science back to the centre of political debate. Between 1955 and 1959, 445 parliamentary questions were posed on science and technology compared with 77 between 1950 and 1955.⁴ Macmillan's government was pressured into appointing a Minister for Science (specifically not a Minister of Science, a title which would have implied stronger executive control) in 1959, a largely cosmetic change, and then into appointing a committee under Sir Burke Trend, Barlow's successor as Second Secretary in the Treasury, to study improvements in the government's civil science organisation. In 1963 it recommended that the DSIR's functions be split between a Science Research Council, which would fund "pure" research

1 Blackett papers, E28, 'A Labour government and science', papers presented to Gaitskell by Senior Scientists' Group, July 1959, pp 13-25.

2 'Seven months that changed the Party', Observer 6 Oct. 1963, p 5; Williams, Gaitskell, pp 782-3.

3 'Seven months', op.cit.

4 Gummett, op.cit., p 41; Vig, op.cit., p 28. See also Poole and Andrews, Government of Science, pp 159-93, for various proposals to reorganise civil science in the Fifties and Sixties.

at universities, and an Industrial Research and Development Authority (IRDA) which would take over the DSIR's labs, the NRDC and fund applied research. The Minister for Science would assume responsibility for setting priorities in the government's research budget and would acquire a new advisory council replacing the ACSP, the Council for Scientific Policy, composed entirely of outside scientists, economists and industrialists.¹ Gummatt rightly observes that these recommendations reflect poorly on the ACSP and DSIR.²

Wilson's government accepted many of the Trend recommendations, although some scientists argued that they were 'irrelevant' to industrial innovation because of the committee's 'narrow terms of reference'.³ The newly created Minister for Education and Science was given financial responsibility for the Science Research Council as well as the Medical, Agricultural and Natural Environment Research Councils. The wholly independent replacement to ACSP, the Council for Scientific Policy, was set up with a stronger secretariat to help the minister establish spending priorities. Having made 'redefining our Socialism in terms of the scientific revolution'⁴ its key objective, the Wilson government sought still larger powers for encouraging industrial innovation. Influenced by Blackett, who wrote a paper entitled 'The case for a Ministry of Technology' one month before the October 1964 general election,⁵ Wilson promptly created such a ministry which superseded IRDA. Blackett became its Scientific Adviser and

1 'Report of the committee of enquiry into the organisation of civil science', Cmnd. 2171, Sept. 1963.

2 Gummatt, op.cit., pp 42-3.

3 Lord Bowden, in HL Debates, Hansard vol. 256, col. 482, 11 March 1964.

4 Harold Wilson, keynote speech to Labour Party Conference, Scarborough, 1 Oct. 1963.

5 Blackett papers, H123.

de facto deputy minister.¹ Blackett's paper had argued the inadequacy of the general tax concessions for R&D and the £5m the NRDC could invest each year. The government was feeding only £1m annually into private industry's R&D out of its £450m total spending on research (of which £240m went to defence and £100m to atomic energy). The DSIR and RAs were basically peripheral to the economy; all really valuable research, especially in the pivotal export industries, occurred in firms. 'Since left to themselves many firms lack the necessary resources or dynamism, the state must use its financial resources to help'. The Ministry of Technology should therefore take over the NRDC (on whose board Blackett had sat since 1949) and expand its resources by perhaps a factor of 20 in five years, giving it powers to buy shares and create joint ventures as well as receive royalties. The NRDC, Blackett emphasised, should select projects on the basis of expected profitability, and should therefore not become attached to the non-commercial Minister for Science as Trend had recommended. In addition to the NRDC, MinTech would create intelligence divisions in the 17 industry sectors of the National Economic Development Organisation ('little Neddies'). The many QSEs who were being wasted on excessive or poorly conceived defence work could easily be transferred to the revitalised civil side.²

The new MinTech closely followed Blackett's blueprint, additionally inheriting the RAs and DSIR labs and taking special responsibility for the computer, machine tool, electronics and telecommunications industries. As Blackett said, its main job was 'to concern itself primarily with manufacturing industry in general and individual firms in particular'. This was the logical culmination of the ideas brewing among scientists and economists

¹ Sir B. Lovell, 'Patrick Maynard Stuart Blackett', Biographical Memoirs of Fellows of the Royal Society 21 (1975) 81.

² Blackett, 'The case for a Ministry of Technology', op.cit.

since the late 1940s. It also revived some older schemes, such as the DSIR's Intelligence Division. But MinTech and the Wilson government's other schemes for promoting innovation were little more successful than Attlee's in inspiring individual firms with the technological revolution. '[Firms] are rather like the little girl in the nursery rhyme', said Blackett. 'When they are good they are very very good, but when they are bad -- well, it is hard to know quite what to do about them. . . .The problem of the efficiency of British industry. . .is much more serious than was thought'.¹ His frustration echoes the pronouncements of earlier officials: George Allen, then at the BOT, who said in 1943 that 'regarding research in industrial firms, the Government could not do very much';² the Productivity (Official) Committee head who said in 1948 that there was 'no quick way by which the Government by direct action can rapidly improve productivity';³ the BOT official Dakin who said in 1948 that 'we cannot force people to be efficient'.⁴ A thorough chronicle of MinTech is outside the scope of this thesis. The purpose of this brief account is to show the continuity between MinTech's structure and mission and the unfulfilled plans of the Attlee government for planting science-mindedness widely and deeply in industry.

5.3 Déjà vu

Harold Wilson's overhaul of the government's civil science machinery was not its last. The persistent problems of British industry have prompted successive governments to revise the machinery regularly, with

¹ Blackett papers, H123, 'The first year of the Ministry of Technology', speech to assembly of government scientists, c. 1966, pp 24, 23.

² See page 78.

³ See page 263.

⁴ See page 281.

seemingly little effect. MinTech was turned into the Department of Trade and Industry in 1970 and its functions have since been repeatedly expanded, shrunk and allocated to different ministries. Wilson's Industrial Reorganisation Commission was eliminated by the Conservatives after the 1970 election. Zuckerman was appointed the Cabinet's chief science adviser in 1964, a post that was later moved sideways into the Central Policy Review Staff, demoted in rank, eliminated in 1974, and partially revived in 1976 with the appointment of a Chief Scientist in the Central Policy Review Staff. In 1967 the Council for Scientific Policy was merged with a similar body in MinTech to produce the Central Advisory Council for Science and Technology, to be replaced in 1976 by the Advisory Council for Applied Research and Development. In 1970 Lord Rothschild issued an important report advocating the 'customer-contractor' principle, whereby government departments would be able to place research contracts with outside universities or firms as well as with government labs. An Advisory Board for the Research Councils thereupon replaced the Council on Scientific Policy. The Lord Privy Seal, who had replaced the Minister for Education and Science as the minister responsible for the research councils, was given a Committee of Chief Scientists and Permanent Secretaries to improve coordination.¹ One is tempted to agree with George Allen that

postwar governments, unwilling to face the realities of Britain's deteriorating economy, have been inclined to fill their days with inessential, secondary or irrelevant activities. Their preoccupation with forms of organisation and the machinery of administration provides an outstanding example.²

While the government's reshuffling of its science policy apparatus evokes a disheartening sense of déjà vu, industry's inability to remove the barriers to successful innovation clearly identified by two generations of

¹ Gummett, op.cit., pp 47-54; Ronayne, Science in Government, pp 130-41.

² Allen, The British Disease, pp 59-60.

knowledgable commentators on British R&D and productivity has been more depressing. Only a small sample of these repetitive diagnoses can be given here. The BOT Working Parties and the AACCP productivity teams laid out comprehensively in the 1940s the backwardness of British management: its amateurism and low technical qualifications, the bias against industrial careers among top university graduates, the opposition to putting scientists on boards because scientists were to be kept 'on tap not on top'. A thoughtful financial journalist wrote a book reaching the same verdict in 1964.¹ So did Political and Economic Planning after a survey of 47 firms in 1965,² a distinguished group of American and Canadian economists in 1968,³ a distinguished group of British economists in 1980⁴ and another in 1981.⁵ The lack of top-flight engineers noted by the Percy Committee in 1944 and the ACSP in 1947 finally led to the Colleges of Advanced Technology in the 1960s. Yet British engineers continue to graduate in numbers which compare unfavourably to other countries: 8000 (not counting overseas students) in 1975, or 146 per million population, compared to 21,000 in West Germany (350 per million population) and 47,000 in the United States (209 per million population).⁶ 'The Balliol engineer, who connects his machines with the understanding of people and society, is the technological generalist for whom we are crying out', said Dr. Duncan Davies in 1981,

1 Rex Malik, What's Wrong with British Industry? (Harmondsworth, 1964).

2 Attitudes in British Management (Harmondsworth, 1965).

3 Caves and associates, Britain's Economic Prospects, especially Chapters 7 and 10.

4 Pavitt, Technical Innovation, especially Chapter 17, p 306.

5 Charles Carter, ed., Industrial Policy and Innovation (London, 1981), especially Chapters 2, 6, 7.

6 S.J. Prais, 'Comments on Chapters 2 and 3', in Carter, op.cit., p 33.

echoing Cherwell, Ewart Smith and Cockcroft in the 1940s.¹ In 1967 the National Economic Development Office issued a long paper on productivity which could have come from Tizard or Cripps. 'The immediate need is for a rapid increase in the use of known technologies', it said. There had to be better dissemination of existing information through government advisory services to bring all firms up to the level of the best.² In 1984 New Scientist reviewed what, remarkably, it called 'the first ever Annual Review of government spending on R&D' and was surprised to discover that while Britain ranked fourth among OECD countries for R&D expenditure per capita, it ranked tenth in civil R&D per capita because of its heavy commitment to defence.³ This imbalance has been well documented since the 1960s, and discussed since the late 1940s. These writings, and many more besides, show little awareness that industrial innovation has been, in Professor Henderson's words, a subject 'of virtually continuous concern to British governments over the past thirty years or so'.⁴

5.4 The Attlee government in retrospect

Since the NPL's founding in 1899, British governments have wanted to use science to promote industrial innovation and industrial competence. In its reconstruction planning, the wartime Coalition gave thought to these problems, but apart from limited taxation relief for R&D could agree on no

1 'Technologists as national policymakers', Maurice Lubbock Memorial Lecture 1981.

2 NEDO, 'The role of technology in productivity', NPC (67) 3, National Productivity Conference 1967.

3 Ros Herman, 'Britain slips down the science league', New Scientist (9 Aug. 1984) 24-5.

4 P.D. Henderson, 'Comment on Chapter 7', in Carter, op.cit., p 172. For another good example of déjà vu in postwar innovation policy, see a 1978 report by the government's Advisory Council for Applied Research and Development, 'Industrial innovation'.

important new policies. The Attlee government's proposals for R&D and productivity (however weakly implemented) were highly ambitious by these earlier standards; those of some later governments were still more ambitious. It is impossible within the limits of this thesis to trace the result of all these governments' measures in industry. Some clear failures of British science-related industry have been documented but it is impossible to analyse what other specific economic factors, for example rates of exchange or domestic investment, affected industrial performance in various periods. Indeed the whole concept of 'success' and 'failure' is difficult simply because it is relative. Government policies may have improved innovation and productivity in industry beyond what would otherwise have occurred and the improvements may have been substantial. But industrial success is a relative concept. Compared with its principal competitors, the record since the Second World War of British science-related industries, and indeed of some traditional industries affected by new technologies, has been relatively gloomy.

Brief examples have already been given which demonstrate a relative decline, since 1945, in R&D, productivity and competitiveness for several industries: shipbuilding and textile machinery (pages 205-6), civil aircraft and electronics (page 203).¹ These examples are not anomalous. In steel and automobiles, where 'in 1950 Britain was far and away the leading producer outside the United States for both products, today she has completely dropped way out of sight: in the case of steel she has been overtaken even by Italy [in tons produced per capita]; in motor cars [produced per capita]. . .by Spain'.² The competitive decline can be attributed partly to low labour

¹ Comparative productivity statistics for postwar British industry as a whole were given on pages 290-4.

² Pollard, Wasting of the British Economy, p 8.

productivity. In 1978 producing a ton of steel took 10.9 person hours in Britain, 6.4 in France and 4.8 in Luxembourg. British productivity in automobiles was superior to all European competitors in 1955; in 1973 making a Ford Escort took German workers 100 person hours and British workers 167.¹ British machine tools have not regained either technical or commercial leadership. Britain tends to export relatively simple devices and import more advanced (therefore more expensive) ones from other countries, as shown in the following table:

Table 5.2 **Export-import unit value ratios for selected countries'**
trade in machine tools, 1979

	Average export value (\$/tonne)	Average import value (\$/tonne)	Exports/imports value per tonne
France	7,200	6,900	1.0
Germany	9,100	6,700	1.4
Italy	5,800	4,900	1.2
Japan	5,400	9,300	0.6
Switzerland	15,000	7,400	2.1
UK	4,700	6,600	0.7
USA	10,100	4,700	1.8

Source: Anne Daly, 'Government support for innovation in the machine tool industry: a case study', in Carter, Industrial Policy and Innovation, Table 5.3, p 63.²

Pavitt and Soete have examined the number of United States patents taken out by non-United States companies and individuals in various industries, and have found it to correlate well with other indicators of innovative activity (such as R&D spending) and shares of world exports. They found a significant decline in US patenting activity by UK companies during

¹ Ibid., p 11. See also NEDO, 'Conditions favourable to faster growth', 1963, Tables 6-9, pp 48-9.

² Even though Japan's export-import ratio was worse than Britain's, the table shows that British machine tool exports had the lowest value per tonne of any in the survey.

the 1960s and 1970s, as well as in staff and company budgets devoted to R&D:

Table 5.3 R&D indicators in UK manufacturing industries

	US Patenting-- UK/all non-US (%)			R&D personnel 1975 (1967=100)	Industry-financed R&D as % net output	
	1963	1976	change		1964	1975
Electrical	21.9	14.1	-7.8	82	3.8	3.1
Electronic	28.2	12.3	-15.9	88	13.3	10.1
Fabricated metal	25.3	14.5	-10.8	n.a.	0.9	0.5
Iron, steel, non-ferrous metals	17.3	9.5	-7.8	n.a.	2.5	1.4
Mechanical engineering	22.9	11.0	-11.9	52	2.7	1.9
Motor vehicles	25.5	14.6	-10.9	102	n.a	5.1
Aircraft & missiles	42.1	18.2	-23.9	77	4.2	5.2
Chemicals & allied prods.	16.0	12.0	-4.0	98	6.0	5.8
Total manu. industries	22.0	12.6	-9.4	81	2.7	2.4

Source: K. Pavitt and L. Soete, 'Innovative activities and export shares: comparisons between industries and countries', in Pavitt, op.cit., Table 3.5, p 57.

The postwar record of comparative sluggishness in individual industries is summarised and confirmed by the following table, showing the aggregate decline in the British share of world manufacturing exports:

Table 5.3 Shares in world exports of manufactures (percent)

	Average of years		Change
	1951-5	1973-7	
USA	25.8	16.8	-7.0
UK	20.5	9.1	-11.4
Germany	13.1	21.1	+8.0
France	9.4	9.7	+0.3
Japan	4.4	14.2	+9.8
Italy	3.5	7.1	+3.6

Source: Pollard, op.cit., Table 1.2, p 12.

Whatever good the Attlee government's programmes to boost innovation and productivity may have done, they did not reverse Britain's deep-rooted relative industrial decline.

The failure of every government since 1945 to improve Britain's relative R&D and productivity performance demonstrates that the underlying maladies are complex and stubborn, that officials have often failed to understand industry, and that industrialists have frequently distrusted and resisted the government's remedies even when sound.¹ As C.E.K. Mees said in 1943, and case studies of individual industries have repeatedly confirmed, government intervention, far from being a panacea, may dull sensitivity to market needs and back new technologies for prestige not profitability.² But government intervention can be useful, and many significant postwar

¹ Allen, The British Disease, pp 61, 59.

² The machine tool industry, for instance, received various kinds of government aid between 1966 and 1978 costing some £100m. An analysis of these programmes concludes that some worked but many were ignored by industry or addressed the wrong problems. By 1979 there had been almost no progress from the finding of the 1960 Mitchell Committee that imports consisted of 'high performance and high precision advanced types of special machine tools, whilst. . . exports are mainly standard machine tools'. Daly, op.cit. In shipbuilding, motorcycles, automobiles and other industries, government intervention has been aimed mostly at saving failing plants, not at promoting innovation. Austen Albu, 'Shipbuilding', in Pavitt, op.cit., p 176; Allen, op.cit., p 23. That government can pick technological losers or impede the development of winners is shown in many industries: large government-sponsored purchases of the Northrop loom in the late 1940s, the history of Concorde and the TSR2, and the Industry Department's 1982 plan to spend £250m on 'fifth generation' computers over ten years when IBM alone, already far ahead of British firms in this area, was planning to spend the same amount in three years. G.R. Simmonds, 'British industry', Economist 17 Apr. 1982, p 2.

innovations owe something to it.¹ A large literature has grown up in the past decade analysing what makes innovation successful and suggesting steps government can take to nurture it.² Evaluating the many detailed programmes of government aid proposed in it lies outside the topic of this thesis, except to note that many contradict each other (notably the free market or 'supply side' solutions versus those trying to perfect the Wilson system of state intervention) and ignore the record of all but recent policies. This ignorance of past failures is perhaps responsible for the most striking feature about the proffered reforms: their modest scale compared to the immensity of the problem. Britain's relative decline in science-based manufacturing has been gaining momentum for more than a century and has resisted forty years of countervailing effort by various governments. Thus 'raising the share of GDP spent on general advancement of knowledge from 0.22 percent to 0.3 percent', and 'more constructive use of the Sector Working Parties to identify technology gaps and product opportunities', two typical suggestions contained in the 1981 book Industrial Policy and

1 Rothwell's study of postwar textile machinery found that direct government support contributed to seven out of 15 'radical' innovations and three out of 10 'incremental' ones. 'Innovation in textile machinery', in Pavitt, op.cit., p 139. The RB211 jet engine, the Airbus, cephalosporin, linear electric motors, CAT scanners, and many other postwar innovations received government help. Davies, 'Technologists as national policymakers', p 19. A small group of 'creative technologists' (in Cockcroft's words) working directly for the government produced with great skill an early British lead in civilian atomic energy (as well as successful bombs). Gowing, Independence and Deterrence, vol. 2. The contribution of Japanese government-industry cooperation to that country's marked progress in civil technologies is well known.

2 For a small sample see Blackaby, De-industrialisation; Carter, op.cit.; S. Davies, The Diffusion of Process Innovations (Cambridge 1979); Freeman, The Economics of Industrial Innovation; T.D. Long and C. Wright, eds., Science Policies of Industrial Nations (New York 1975); Pavitt, op.cit.; Pollard, Wasting of the British Economy; Ronayne, op.cit.; Williams, Science, Technology and Economic Growth.

Innovation, seem feeble if viewed in historical context.¹

Economists and economic historians have identified some underlying features of British culture which they consider far more responsible for industry's innovative decline than any faults of specific policies.² These broader causes include rigid and poorly trained management, inadequate QSE supply, anti-industrial bias in society, inadequate general education, anti-graduate bias among industrialists, overcommitment of R&D resources to defence in pursuit of great power status, civil servants poorly equipped to understand or help industry, and preference for stability over competition's uncertainties among both managers and workers, with governments often inclined to collaborate. This is a complex of problems referred to as the 'British disease'. It is inherently impossible to ascribe to any one of them a quantitative place in Britain's relative economic decline. Since many of these deep-rooted factors were only dimly perceived at the time of the Attlee government, overwhelmed as it was by the enormous problems of a war torn country and world, its performance in civil science policy cannot fairly be judged by the progress it made against them.

Nevertheless, in one very important respect these enormous problems of reconstruction directly affected the prospects for postwar success in science-related industries, because they convinced postwar governments that heavy priority should be given to defence R&D in pursuit of great power status. Because of its role in the Second World War Britain was indeed a

¹ Henderson, op.cit; C. Carter, 'Report of the discussion', in Carter, op.cit., pp 230, 228.

² A brief sample is Allen, The British Disease; Cardwell, The Organisation of Science in England; Caves and associates, Britain's Economic Prospects; M.W. Kirby, The Decline of British Economic Power Since 1870 (London, 1981), especially Chapter 5; Landes, Unbound Prometheus; Sir Henry Phelps Brown, 'What is the British predicament', Three Banks Review (Dec. 1977); Pollard, Wasting of the British Economy; Feinstein et al., British Economic Growth, pp 112-117.

great power in 1945 -- only one step behind the two superpowers when other European and Asian countries were devastated. Morgan is correct that 'the Attlee government believed it was undertaking an involvement in world leadership that was inescapable'.¹ This belief carried heavy costs in terms of civilian industry. Ever since 1945 Britain has spent a higher percentage of its R&D funds on defence than any Western country but the United States; in 1955-56, military projects took 60 percent of all money spent by industry and government on R&D. Cutting back heavily on defence commitments and research during the Attlee government would have sparked much opposition, but it was conceivable. Dalton threatened resignation over the size of the defence budget in 1947.² In 1949 Tizard opposed the building of atomic weapons because the programme's requirements were choking other vital areas of defence research. 'We are a great nation, but if we continue to behave like a Great Power we shall soon cease to be a great nation. . . . Let us. . .not burst ourselves with pride (see Aesop's fable of the frog)'.³ By contrast the defeated countries Japan and Germany were, in the early postwar years, able to use their R&D resources wholly on civilian production. However, it must be remembered that postwar France has built the technological strength necessary both for its home-made nuclear weapons and delivery systems and also for commercial success in science-related industry, from railway trains to space rockets.

In assessing the Attlee government's policies specifically aimed at improving innovation and productivity, both successes and failures are

¹ Labour in Power, p 498.

² High Tide, pp 193-5, 258.

³ quoted in Gowing, Independence and Deterrence vol. 1, p 229. Tizard did not extend this argument to civil research, but as discussed on page 206, he overestimated during this period the ratio of R&D funds and QSEs being devoted to civil as opposed to military research.

evident. In education, perhaps the most important long-term determinant of innovative capacity, the record contains both solid achievements and bad mistakes. University expansion was the greatest accomplishment. As shown in Table 3.2 (page 145), the number of full-time university students more than doubled between 1938-9 and 1961-2, to 113,000. Forty percent studied science or technology in 1961-2, compared with 26 percent in 1938-9. On the other hand, many more graduates were needed by industry than Barlow's Future Scientific Policy committee had estimated, and certainly more than the Ministry of Labour's gloomy 1949 forecast which angered the ACSP but prevailed. 'However creditable the expansion and the swing to science were in these post-war years they did not keep pace with the consistently heavy demand of industry for university scientists'. By 1956 firms were having to grant university scholarships to promising schoolboys to assure sufficient graduate recruits.¹ Science teachers remained poorly paid and in chronic short supply. Technological education of the first rank was inexcusably bungled. The real barrier to a British MIT was not money but institutional inertia, weak ministerial leadership and anti-engineering bias. No attempt was made to alter the curricula or student population of the public schools, still highly influential, whose graduates thus had no reason to doubt R.A. Butler's conviction that anyone who knew Latin could figure out an internal combustion engine. Blackett's politics differed considerably from Butler's, but even he told scientists in 1945 'not to sell their brains for high prices to industrial firms' and contemptuously dismissed university training for business as something that 'could not be done'.² The government did little to encourage university schools of business to counteract the amateur management it decried. For several decades British management schools

¹ Sanderson, Universities and British Industry, pp 352-3.

² Page 111.

continued to be small and primitive compared to those in other advanced countries.

Another major accomplishment of the Attlee government in civil science was to increase the resources devoted to civil R&D, as shown in the following table:

Table 5.4 **Estimated government expenditure on civil R&D**
(£ million)

Source of expenditure	1938-9	1945-6	1950-1	1955-6	1960-1
1. DSIRa	0.7	2.3	4.9	7.5	16.0
(number scientific staff)	918	1500b	n.a.	2430c	n.a.
(number RAs)	21	28	40	44	43
(capital expend. bldgs, £000)	19	50	n.a.	1344	n.a.
2. MRC	0.2	0.3	1.7	2.3	4.5
3. ARC	0.3	0.3	0.8	1.2	5.6
4. Nature Conservancy	nil	nil	0.08	1.2	0.5
5. Total resrch. councils (1-4)	1.2	2.9	7.5	11.2	26.6
6. Other govt. departments	n.a.	2.2	13.9	11.8	34.3
7. Universities and learned societies	1.5	8.3	11.0	19.4	19.4
8. Total (5-7)	2.7	13.4	32.4	42.6	80.3
9. Line 8 indexed for changes in wholesale price index (1938-9 = 100)	100	270	480	538	939

Source: Gummett, Scientists in Whitehall, Table 2.1, p 39; DSIR 8th Annual Report, 1954-55 (Cmd. 9537), Appendix III; British Political Facts 1900-1975, pp 306-7; Johnson, Co-operative Research, p 38.

a Some of DSIR's budget, especially in the 1950s, was spent on military R&D brought into DSIR labs, but the amount cannot be determined. See discussion in Section 3.4.2.

b 1945-6 figures for DSIR scientific staff and building expenditure are estimates based on 1947-8 actual figures.

c 1955-56 figures for DSIR scientific staff and building expenditure are the DSIR's 1954-55 estimates for 1955-56, not actual figures.

It was this postwar increase of expenditure on civil R&D which prompted Cottrell to say that 'science policy [between 1945 and 1963] was reduced to a naivety of simply spending money freely in all scientific directions'.¹

¹ 'Science policy in Britain', op.cit., p 182.

As previous chapters have repeatedly shown, however, the funds available to the government's civil R&D arms were miniscule compared with the economic problems they were supposed to solve. Existing entities such as DSIR and the RAs were always starved of money and QSEs, unable to launch quite modest schemes for getting research results into industry. Especially during post-Korea rearmament, their modest resources were further drained by defence programmes. Many new bodies were never launched or collapsed for lack of support, such as the Midlands Advisory Council for Industrial Productivity, the Panel on Automatic Control Techniques, Gordon's 'Provision for development' machinery research boards, and the Production Efficiency Service. Others which managed to survive were much less effective than originally conceived, such as the civil science secretariat and the National Research and Development Corporation. Productivity policy never achieved an effective extension service, having to rely instead on much cheaper public relations work. 'Spending money freely in all scientific directions' is a completely misleading description of the Attlee government's industrial civil science policy; more accurate would be 'doing too much with too little, which leaves no room for revolutions'.¹

Civil service reform is another area where the Labour government did not do as much as it could have. The conditions and pay of scientists working for the government improved after 1945 in response to pressure from all scientific quarters, but there was no merger at the top of the scientific and administrative classes nor any reform of the administrative classes (such as periods of rotation between government and industry) which would have institutionalised greater sensitivity to industrial innovation. With a few important exceptions, the BOT, Treasury and DSIR officials whose records are the foundation of this study were intellectually remote from industry and

¹ Peck, 'Science and technology', in Caves, *op.cit.*, p 448.

sometimes even disdained it, a characteristic still noted by observers of the civil service.¹ In the 1970s fewer than seven percent of administrative officers took their entrance exam in science, despite their role as advisers on complex issues of investment, technology and R&D.²

It is fair to conclude that the Attlee government took more seriously than any previous government the importance of government action to promote the scientific aspects of industrial innovation and productivity. In purely British terms its success was notable. International competition transformed that success into a relative failure. The failure to match international standards was due to the unquantifiable but important factors which comprise the British disease, from which the government itself was not immune. Perhaps arresting this disease has lain beyond the powers of any postwar government, especially since many competing economies have built their successes into a 'virtuous circle' of accelerating technological advance and economic growth. Nevertheless the Attlee government, in an environment unfavourable to industrial innovation and professional management, and not grasping how deeply rooted was Britain's relative industrial decline, did not back its own programmes in industrial civil science with enough resources to give them a fair chance.

¹ Norman Crowther-Hunt and Peter Kellner, The Civil Servants: An Enquiry into Britain's Ruling Class (London, 1980).

² Allen, 'Industrial policy and innovation in Japan', in Carter. op.cit., p 84.

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