BRITISH COLONIAL SCIENCE POLICY, 1918-1939

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In the period 1918-1939 British natural scientists were mobilised to accelerate the economic development, or what after Frank we would now call the "underdevelopment", of Britain's tropical colonies (1). In this paper I discuss the political and economic context that generated this initiative, highlighting two factors in particular: i) attempts to promote what was called "complementary development", i.e. where the colonies provided raw materials and agricultural products to be traded for manufactured goods from Britain, essentially "underdevelopment"; and ii) attempts to advance inter-imperial trade and political relations in the change from Empire to Commonwealth. The British government and its expert advisers produced a series of, it has to be said, largely implicit colonial science policies, that spanned the whole range of biological and environmental sciences, as part of these larger enterprises. It is these policies and the way they shaped British colonial science that is the focus of my discussion.

Before considering these issues, it is necessary to outline the way in which science was organised in that quarter of the world that was British Empire at its zenith. The essential point to note is that there were three separate spheres of Empire. First there were the Dominions (Australia, Canada, New Zealand, South Africa) – territories with large settler populations that had displaced or subordinated indigenous peoples. The second sphere was India, often termed an empire in its own right – which then included within its borders the modern states of Pakistan, Bangladesh and Burma – where British rule over the large indigenous population was maintained by military and cultural power. Finally, came the Crown Colonies and Protectorates (usually shortened to the Colonial Empire) – over 30 territories spread across East and West Africa, the Far East, the West Indies and a number of islands, where the British usually ruled with tiny administration, backed up by a military, and commercial presence. In the inter-war period there were no scientific institutions that were fully imperial in covering all three spheres of Empire, except perhaps the abstracting services of the Commonwealth Agricultural Bureaux (2). By 1918 it was already clear that Australia, Canada, New Zealand, South Africa and India would establish their own government scientific departments, scientific societies, universities, and scientific communities (3). There was, of course, considerable movement of personnel between these countries and Britain, together with informal influences, but at most levels there was a perhaps surprising degree of autonomy (4). In the Colonial Empire in 1918, science barely had a foothold, and those scientists who

worked in and for these territories mostly worked in applied research, or in technical assistance to government and commercial enterprises.

Colonial Science Policy, 1918

In the decade before the First World War, the Colonial Office adopted a policy known as "constructive imperialism", which, at least in the initial formulation of Colonial Secretary Joseph Chamberlain in the late 1890s, aimed to give loans and grants for transport and other infrastructure projects to attract capital investment, facilitate trade and hence promote the development of the Colonial Empire's "vast estates" (5). Implementation did not match ambition and economic historians have tended to write off the policy as of domestic political importance, through its links to tariff reform, but have played down its impact in the Colonial Empire. Yet, what were small measures in the context of the British and imperial economy often had a large impact on the tiny agricultural and commercial systems of undeveloped colonies. More importantly for science, the collapse of the grand design did not prevent the establishment of the technical services that were primed to guide and service the expected flow of investment and personnel. These new colonial science institutions survived and flourished, as both colonial and imperial governments found them practically and ideologically useful. To begin with the work on the exchange, acclimatisation and distribution of economic plants, previously performed by Kew Gardens, was transferred to local departments of agriculture, which also offered technical support to local planters and traders (6). Various metropolitan institutions took on the mantle of technical departments of the Colonial Office: medicine – the London and Liverpool schools of tropical medicine; entomology – the Natural History Museum; raw materials, natural products and their chemistry – the Imperial Institute (7). Also, many individual scientists were employed to work on colonial natural products and biological problems in their laboratories in Britain, or took part in surveys and investigations in the colonies themselves. Research and technical services were a form of government assistance that did not compromise the principles of *laisser-faire,* and it was politically attractive as an alternative to highly contentious policies such as tariffs. It was cheap and could always be portrayed as progressive and a sound long-term investment. On a linear model of economic and technical development, research was the necessary first step to "opening up" (a favourite phrase) the colonies.

The commitment to "scientific assistance" was still evident at the end of the First World War. An initiative came up from a civil servant in the Colonial Office to establish the colonial equivalent of the newly formed British government agency for applied research – the Department of Scientific and Industrial Research (DSIR) (8). To the surprise of Office's staff and the Minister, the Treasury agreed with the proposal and gave a grant of £100,000. A Colonial Research Committee was formed to advise on spending (9). That the grant was one tenth of that given to the DSIR, can be taken to indicate that the relative economic worth of the Colonial Empire was thought to be some 10% of the domestic economy. There were a number of other initiatives in a similar vein: committees of inquiry advised on the conditions of service in colonial technical departments; efforts were made to link research in provincial universities to local industries

dependent on colonial commodities (e.g. Manchester – cotton; Dundee – jute); and there were specific proposals for science-led development, as in the Falkland Islands (10). The most notable new institution founded as a result of this burst of activity was the Imperial College of Tropical Agriculture (ICTA) in Trinidad, the long promised "tropical university", or as some preferred to call it, the "South Kensington of the Tropics". Later in 1923, the Imperial Institute was put on a more secure footing as the central commercial research department of the Colonial Empire (11).

Tropical and Biological (Under)Development

Most territories in the Colonial Empire were located in tropical latitudes and the terms "Colonial Empire" and "tropical Empire" were used interchangeably. This tells us a lot about the assumptions that informed colonial science and economic development policy, particularly as the notion of the "tropics" was "Orientalist" in the way it stressed *difference*. The tropics were not an area one reached at the end of a climatic gradient, but a distinct environment with its own diseases, crops, and perhaps its own laws of nature. Societies there were certainly expected to follow a unique path of economic development. In both elite and popular culture, the tropics were a racial domain, populated by "backward, dark races" who required Western guidance to develop materially, socially and morally. However, there was still some ambivalence about the tropics. Wealth seemed to be ready-made, awaiting collection – in the ground as minerals or in the luxuriant growth of tropical fruits and foliage; yet the tropics were still a "danger zone" of high mortality and morbidity. Agricultural production in the tropics had proved to be a precarious enterprise, especially prone to pest problems, soil exhaustion, and natural disasters. None the less the greater heat and intensity of sunlight promised faster growth, higher yields and a greater range of crops. The great hope in the 1920s was that days when the tropics offered high risks and uncertain returns were over; now accumulated experience and Western science ought to reduce the risks and multiply the benefits by securing and extending material development possibilities.

Despite the attempts of adventurers, settlers and various companies, most colonial territories remained undeveloped rather than "underdeveloped" in the 1920s, in the sense of only having a subsistence economy, with rudimentary and inefficient forms of agricultural production (e.g. slash and burn), primitive craft production and poorly developed markets. However, there were exceptions where (under)development ran apace, notably in the export oriented economies of Ghana, based on cocoa, and the rubber plantations of Malaysia. These were the principal post-war reference points for development thinking and models for other colonies to follow. Their "success" was understood to have been in part accidental, following trials and heavy losses with various crops, until suitable commodities and methods of exploitation were found (12). The aim after 1918 was to avoid similar waste and create plantations, cash crops, or mining-based economies more quickly and efficiently by research-led and expert advised measures. For example, it was hoped that scientists would select the right crops for the right areas, and tell planters and the indigenous peoples how to grow them. They would then advise on processing and transport, while economic researchers would match products to known markets in Britain and elsewhere. When constructed in these

terms, colonial development offered great opportunities for natural and social scientists: it was a realm for botanists, agricultural scientists, zoologists, entomologists, and geologists, as well as anthropologists and economists. What was most significant in the longer term was how colonial economic development was constituted largely as a technical matter.

Science for "Development"

Colonial science policy was elaborated in the mid-1920s by a group of politicians and scientists that formed a well-defined group. The politicians were from all parties and included government ministers. The leading figures were: Leopold Amery, William Ormsby Gore, Walter Elliot, A. G. Church, and Lord Balfour, backed up by civil servants like Stephen Tallents and Francis Hemming (13). Support came from science journals like *Nature*, organisations like the revamped British Science Guild, and many senior scientists, including: Richard Gregory, A. E. Shipley, J. B. Farmer, Daniel Hall and Julian Huxley.

The group first coalesced in 1924 over the fate of the former German Institute of Agricultural Research at Amani in Tanzania. It was widely believed that in their colonial policy, as elsewhere, the pre-war German government had given priority and generous support to scientific research, with consequent economic benefits. Thus, the post-war neglect of Amani by the local administration and British imperial government was portrayed as another example of the failure of successive British governments to support scientific research. The condition of the Amani station was revealed by the members of a Commission, including Ormsby Gore, Conservative M.P. and junior Minister, and Church, who was a Labour M.P. and General Secretary of the Association of Scientific Workers, who had been sent to East Africa in 1924 to report on ways in which the economic development of the British colonies there could be accelerated. Their Report, which became for a while a definitive document in colonial development policy, looked to back to "constructive imperialism" and followed Amery's favourite themes that a twin investment in "railways and research" would unlock the economic potential of the tropical Empire (14). As in the 1900s, hopes of major infrastructure and other investments came to very little and research was the main beneficiary. The Commission also represented colonial development as a biological matter, both in relation to the importance of agriculture and the supposed closeness of colonial peoples to nature.

Colonial development policy overall aimed at integrating Colonial economies into a dependent relationship with Britain. The importance of the economic dimension was evident in the way the plans, programmes and spending on colonial science fluctuated with the business cycle and its political repercussions. The period of post-war economic boom coincided with the reorganisation of the technical services and the Colonial Office initiatives noted above. However, many plans foundered with the public spending cut backs of 1922, notably the Colonial Research Committee. After 1926, in the context of the East African Commission Report, growing interest in imperial federation and the promotion of inter-imperial trade, new policies were pursued. The most ambitious was the creation of a Colonial Research Service and a chain of tropical research stations, both to be funded by a new agency for colonial science – the Empire Marketing Board

(EMB). The "Crash" of 1929 precipitated years of economic depression and recession, which again saw cuts in scientific services. A further blow to colonial science came with the demise of the EMB in 1933, following the acceptance of imperial preferences at the Ottawa Conference. The continuing recession of the mid-1930s ensured that recruitment of colonial scientific services remained at a low level and major research initiatives were rare. However, science remained central to development thinking and colonial policy more widely, as was evident when Lord Hailey's canonical *African Survey,* published in 1938, was accompanied by a companion volume on *Science in Africa* by E. B. Worthington (15).

The main results of these twists and turns in policy by 1939 were: that the main colonial scientific and technical institutions moved from Britain to the colonies; and that scientific institutions at the periphery increasingly provided advice and technical services as well as undertaking research. During the inter-war period there was only one new imperial scientific institution established in Britain – the Imperial Forestry Institute in 1923 – otherwise all institution building was overseas. This began with the ICTA in 1922 and by the 1930s included regional research stations for tropical agriculture and tropical medicine, along with local technical departments, commodity research stations, and the beginnings of scientific and technical education. There was no formal decision to shift institution building from centre to periphery, rather the change developed as local colonial administrations increasingly refused to support remote and shared metropolitan research agencies (as with the Imperial Institute in 1923), they preferred to have their own experts and research facilities on the spot. This expansion in personnel was not without its effects in Britain, where the colonial scientific services were in some years the single largest employer of biology graduates. Indeed, the major government inter-war enquiry into biology education was instigated by the Colonial Office. In turn, the number of scientists resident in the colonies, which tripled between 1918 and 1928, facilitated the emergence of colonial and regional scientific communities. These produced their own journals, research networks and opportunities for specialist research, both pure and applied (16).

The "scientific" and "technical" departments (e.g. agriculture, veterinary, forestry, medicine) built up in each colony usually comprised a central laboratory, with a small number of specialists, to which district officers, commercial growers and others could refer problems, seek advice, or have investigations made. Most colonial scientific and technical officers were not working as "scientists", but were "up country" as District Officers dealing with all aspects of their specialism and routine administration. Indeed, their main loyalty was to their "district" and their colony, not the British scientific community, which most had only known as undergraduates and was geographically and professionally remote (17). This distinct identity was fostered by the common experience of colonial service postgraduate training and the system of promotions that involved movement around the Colonial Empire. The new colonial scientific and technical journals showed not only the presence of a critical mass of staff and local activity, but the opportunities for intercommunication within the service. The cut-backs and reduced professional mobility of the 1930s further eroded any wider imperial or colonial allegiance amongst scientific and technical staffs and bolstered local loyalties further.

Science, Empire and Tariffs

At the same time as the "science for development" group was active, the idea of an "imperial scientific community" was mobilised as a resource in debates over the future of Empire, especially in defining the notion of Commonwealth. Imperial scientific co-operation was first raised by politicians, not scientists, at the Imperial Economic Conference in 1923, when resolutions were passed calling for co-operation and the exchange of information. The creation of an imperial scientific community was also canvassed as a counter weight to the growing dominance of the United States in the applied sciences and to meet Treasury worries in Britain about the duplication of research consequent upon the growth of government science. The hope was that science, being apolitical and neutral, was an area where the countries of the Empire could begin co-operation. The scientific community, or at least its ideals of a federation of equals working co-operatively towards a common goal, was offered as a model of future imperial political relations. However, such hopes were quickly dashed when the concrete proposals put before the 1926 Imperial Conference proved as contentious as any other and were watered down in negotiation. At the end of the Conference, Balfour conceded that all that could be agreed was to promote better and easier communication in science (18). Balfour's interest in science policy at this time came from his wish to see an increasing role for expert advice in government policy and in co-ordinating departmental work. The formation, at Cabinet level, of the Committee of Civil Research (CCR) in 1925, was an embodiment of these aims (19).

At the 1926 Imperial Conference in London, "research" became openly involved in the debate over the future of Empire-Commonwealth and inter-imperial trade. With the latter, the British government assumed that a leading role would continue to be given to the Imperial Economic Committee (IEC), which had been set up in 1923 with Sir Halford Mackinder as its chair. The Committee's political aim was to pacify supporters of imperial preference, with a brief to further inter-imperial trade by improving market intelligence, financial information and economic research. It was given no resources nor any powers, so it was no surprise that most countries of the Empire regarded it as an irrelevance. However, powerful forces in Britain and in the Dominions continued to push for imperial economic preferences and sought to build inter-imperial links on other fronts as well.

In 1925-26 there was a political crisis in inter-imperial relations over an ill-advised promise to introduce limited preferences made by the Conservatives during the election campaign of 1924. This was never honoured, but as the new government they remained under pressure from Dominion leaders to meet their commitment. Finally in 1926 they offered a compromise package which made available £1M per annum, a figure that preferences would have cost Britain, to assist inter-imperial trade by non-tariff means (20). The initial proposals involved an expansion of the kind of information services developed by the IEC, thus, the plan was for 60% of the money to go to marketing, 25% to improving transportation and production, and 15% to economic and scientific research. On hearing of the scheme, Balfour wrote to the Cabinet Secretary objecting to the plan.

> *"I understand that more than £600,000 of the annual million is to be spent on 'publicity', which I presume means advertising in some form or another. Just*

think what £600,000 a year would do for the colonies and ask yourself whether with appeals like Ormsby-Gore's ringing in one's ears, one can contendedly acquiesce in the policy of Mackinder's Committee." (21)

Balfour's main reference was to the work of the Report of the East Africa Commission, though his suggestion would have been reinforced by Ormsby Gore's interests in the "scientific" reform of government. Balfour's action may have had some effect, for when the EMB was announced in 1926, as the agency to administer the £1 million grant, research was prioritised over marketing schemes and publicity (22).

At its first meeting in May 1926, the Board appointed provisional committees to advise on possible activities in its three designated areas of work. In research it was decided not to co-opt experts, but to maintain a permanent sub-committee of non-scientists chaired by Walter Elliot (23). This was because the range of disciplines covered and the geographical spread of work would have made a representative committee impossible. The Research Committee defined its role as doing for applied biology in the Empire what the DSIR was doing for applied physics, chemistry and engineering in Britain. This policy confirmed the identification of the biological sciences with the tropical Empire and its development. The immediate priorities identified were in animal husbandry, tropical agriculture, and food preservation. In making awards the Board proposed to support "basic research work, applicable sometime to the whole empire, but always to more than one of its countries" (24). This principle, essentially drawing upon the notion of the universality of basic science, allowed the Board to argue that research outcomes would be transferable and applicable across the Empire. Such potential even-handedness had obvious political attractions, not least the way it allowed the EMB to discount political geography in the allocation of research funds.

These priorities seemingly had little impact on the selection of projects and support given by the EMB. The Board decided not to create its own institutions, but to fund research in existing government laboratories, universities, and private institutions. These bodies and individuals were all invited to submit applications for grants. The EMB immediately ran into the problem of the dearth of applied biology institutions and personnel in the Empire. In its first year, 88% of the proposals submitted were supported, in the following year the figure was 83%. The main reason for the rejection of applications was that projects fell outside of the Board's terms of reference, few were turned down on their quality. The procedures for refereeing proposals were casual and the EMB soon gained a favourable reputation amongst biologists, one of whom described it as "that Fairy Godmother of Research" (25). In spite of its liberality, the Board had trouble spending its grant, in part because of the weakness in applied biology mentioned above and in part because of the nature of research funding. An annual grant was fine for marketing, publicity and intelligence work, where all expenditure would fall in the current year, but research spending tended to be spread over a number of years. So while actual research spending was low in the early years, substantial forward commitments were made on the basis that unspent balances would be protected and rolled forward. In the period 1926-29, £606,000 was spent on publicity, while only £384,000 went to research; however, forward commitments to a research stood at £1,460,000 (26). The actual expenditure of the EMB between 1926 and 1933 is shown in Table 1.

Table 1. EMB Expenditure by Activity, 1926-1933 (£s) (27)

Year	Research	Publicity	Other	Total
1926-27	30,708	89,843	14,253	134,804
1927-28	121,279	238,126	44,474	403,879
1928-29	231,619	278,414	51,460	561,493
1929-30	376,738	222,361	53,300	652,399
1930-31	398,606	199,411	115,891	713,908
1931-32	335,000	92,000	0	427,000
1932-33	296,620	62,820	0	359,440
1933	97,000		0	97,000
Total	£1,887,570	£1,182,975	£279,378	£3,349,923
% age	56.3	35.3	8.3	100

The two areas of scientific work that were promised the largest sums were: i) the low temperature storage and transportation of food, and ii) the establishment of tropical research stations. The support of research on the refrigeration and gas storage of food was always cited as the exemplar of EMB work. The Board's officials and supporters claimed that by making the transportation of perishable foodstuffs easier, cheaper and more reliable, British markets would be opened up to producers throughout the Empire. Indeed, it was speculated that the value of such research would be greater than that of tariffs, as other European and world markets would also become potential importers – science and technology knew no boundaries. Most of the funding went to British research laboratories, much of its channelled through the Food Investigations Board of the DSIR. Thus, the institutions to benefit most from food research were the Low Temperature Research Stations at Cambridge, East Malling (fruit) and Aberdeen (fish) (28). Small sums also went to the Imperial College of Tropical Agriculture for research into the cold storage of bananas.

The other main area of funding was in the improvement of agricultural production through the planned chain of tropical and sub-tropical research stations. Most of these were to be based on existing institutions, but such was the dearth of research support in certain areas and for certain commodities, that the Board found itself having to create new research laboratories and experimental stations. This policy was only just off the ground when the EMB began to have its grant cut. The other main areas to receive grants were: pest control, husbandry, breeding and dietetics. The EMB also gave consistent support to research efforts in locust control, dietetics and animal husbandry, as well as one-off grants to mineral surveys, road vehicle research, forestry, poultry and weed control (29).

In the period 1926-1933 some 250 research projects were supported at a cost of over £1.8 million. Leopold Amery described the early years of the EMB as a period when 'it was heaven to be alive', as those involved "shared our ideas, we each made our several contributions and we rejoiced in our freedom from official routine and Treasury control" (30). British government ministers and civil servants had always moaned about the dead hand of the Treasury, however, the freedom given to the EMB seems

not to have been wisely used. Administrative and financial control was poor and there was little monitoring of activity. For example, while the Board had been set up to appease the Dominions, as early as 1928 it was evident that over three quarters of all research grants were being awarded to British institutions, 14% to those in the Crown Colonies, and a mere 9% to the Dominions (31). This was a huge political blunder as the Board did not enjoy Dominion support. Moreover, many of the awards made were not spent up and large balances remained (32). After 1929, unspent balances and forward commitments came under threat when the government sought public expenditure savings. Things went from bad to worst in succeeding years as the EMB's grant was progressively cut. Yet, within the Board research enjoyed relative protection, being seen to be more defensible in straightened times than publicity (33). However, the eventual disbanding of the EMB in 1933 had little or nothing to so with these problems, it was solely the result of the decision at Ottawa in 1932 to introduce imperial preferences.

Colonial Development Fund

Before the EMB ran into trouble, worries had already been expressed about the possible overlap of its work with that of the Colonial Development Fund (CDF) set up in 1929 with research one of the activities it was to support. The ideas of a "development fund" suggests an agency that would stimulate economic growth in the Colonial Empire, but this was only part of its brief. The British government hoped that the Fund would help reduce domestic unemployment and aid British exports by facilitating "complementary development" (i.e. colonial underdevelopment). The inclusion of the "encouragement of scientific research" within the CDF Act came as something of a surprise to contemporaries, though it further confirms my claim of the strong association between science and colonial development at this time. There should have been little or no overlap between the CDF and EMB in research, as the former served only the Crown Colonies and tried to promote development schemes in the colonies themselves, whereas the EMB had a wider geographical brief and was targeted on enhancing the volume of inter-imperial trade. Also, it was envisaged that the CDF, while giving some free capital grants, would largely support capital investment projects by giving loans to local colonial governments. In the event the work of the two did overlap and when the EMB was wound up in 1933, a number of its schemes were taken over by the CDF.

Three different types of expenditure were allowable through the Colonial Development Act: i) loans; ii) grants for interest on loans; and iii) free grants. In each category, the funds were for one-off expenditures, not to meet recurrent or revenue costs. However, the economic conditions of the 1930s had a major impact on the operation of the CDF. The slump commodity prices meant that colonial governments were unable to commit themselves to loans on the scale initially envisaged, hence grants were a much larger proportion of expenditure than planned and this led the Fund to become more of an 'aid agency' than expected.

If my claims about the importance of science to colonial development policy are correct, the spending pattern of the CDF ought to show substantial support for scientific and technical projects. The official figures do not bear this out, they show a mere

7% allocated to "scientific research". However, if one goes beyond the official figures a rather different picture emerges. Spending was decided by the Colonial Development Advisory Council (CDAC) and its Annual Reports carried details of planned allocations, though not actual expenditure. Expenditure figures are available and these show some 81% of planned expenditure was made, but as my concern is policy, planned spending is the most appropriate data to analyse. The official categorisation of projects in the CDAC's annual reports was somewhat erratic, especially over what was "scientific research". This heading carried all kinds of endeavours, including the purchase of ships and the building of markets – perhaps the legacy of the EMB was apparent here? Many research projects were counted under other headings, especially in Agriculture, Forestry, Public health and Geology. I have recategorised the CDAC Report data and counted as 'science' any project described as "research", "experimental", "surveys", "training" or "expert-visit". The results of this analysis are presented in Table 2 for two five year periods: 1929-34 and 1934-39.

These show "science" spending was 10.7% of the total as against the official figure of 7%. More significantly, the figures show a major change between 1929-34 and 1934-39, with the absolute and relative spending on "science" increasing substantially in the later period. The allocation to "science" in 1929-34 was £437,000, while in 1934-39 it was £1,472,000. As a percentage of total allocations, there was a rise from 3.8% to 23.8%. If we look solely at grants, where we might reasonably expect "science" spending to be more concentrated, we find an even higher level of committed money; 26% of grants over the whole decade, with over 50% 1937-38.

Conclusion

What impact the work of colonial scientific and technical services had on the economic and material development of the Colonial Empire is impossible to say because of the multiplicity of factors that shape any such change. What is evident, however, is the importance of science in colonial development thinking and policy between the wars. It was expected that science and scientists would be catalysts of development by discovering economic opportunities, making the tropical environment safe, solving technical problems in production, processing and distribution, directing and improving the productivity of investment, and generally demystifying the tropics and their people.

Table 2. Allocations from Colonial Development Fund to Science Projects as 1) proportion of total allocations, and 2) proportion of free capital grants (£1000s)

Years	All projects	Science projects	% age to all projects	All projects grants	Science grants	% Age to all projects grants
1929-34	11,634	437	3.8	1,254	238	19,0
1934-39	6,192	1,472	23.8	2,543	746	28.3
1929-39	17,826	1,909	10.7	3,797	984	26.0

Science became a major factor largely by default, when more conventional but expensive and contentious economic alternatives failed, but colonial scientists made the most of the opportunity and made themselves seemingly indispensable agents of change in the Colonial Empire. Indeed, the influence of this inter-war construction of colonial development as a "technical", even biological affair, was evident in post-1945 programmes of technical assistance from Point Four to the Green Revolution.

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NOTES

1) A. G. Frank, *Development and Underdevelopment*, London, 1968.

2) For details see; M. Worboys, *Science and British Colonial Imperialism, 1885-1940*, Unpublished D. Phil. thesis, University of Susex, 1979.

3) On Australia see: N. Reingold and M. Rothenberg, eds., *Scientific Colonialism: a Cross-Cultural Comparison*, Washington D.C., 1987. On India see: D. Kumar, *Science and the Raj*, 1857-1948, New Dehli, 1995.

4) R. MacLeod, "On visiting the moving metropolis: Reflections on the architecture of imperial science", *Historical Records of Australian Science*, 5 (3), 1982, 1-16.

5) See: P. J. Cain and A. G. Hopkins, *British Imperialism: Innovation and Expansion, 1688-1914*, London, 1993.

6) L. Brockway, *Science and Colonial Expansion: The Role of the British Botanical Garden*, New York, 1979.

7) M. Worboys, "Manson, Ross and colonial medical policy: tropical medicine in London and Liverpool, 1899-1914", in R. MacLeod and M. Lewis, *Disease, Medicine and Empire*, London, 1988, 21-37; W. Golant, *Image of Empire: The Early History of the Imperial Institute, 1887-1925*, University of Exeter, 1984; M. Worboys, "Science, development and the state: The Imperial Institute", in J. M. MacKenzie, *Empire and the Natural World*, Manchester, 1990.

8) For details see: Worboys, Science and British colonial imperialism, passim.

9) *First Annual Report of the Colonial Research Committee*, 1921, British Parliamentary Papers (B.P.P.), 1921, Cmd. 1144, xxiv, 387.

10) *Report of a Committee on Research in the Colonies*, B.P.P. 1921, Cmd. 1472, xxiv, 419; *Report of the Committee on the Staffing of the Agricultural Departments in the Colonies*, 1920, Cmd. 730, xiii, 253; *Report of the Committee appointed to enquire into the Colonial Medical Service*, B.P.P. 1920 Cmd. 1997, xii, 197.

11) M. Worboys, "Science, development and the state", passim.

12) P. J. Cain and A.G. Hopkins, *British Imperialism: Crisis and Deconstruction, 1914-1990*, London, 1993, 201-34.

13) Some of the defining statements of this programme were: Sir Frank Heath, "A scientific strategic front for the the Empire", *British Science Guild Journal*, August 1925, 17-19; J. W. Gregory, "Science and administration in East Africa", *Nature*, 115, 1925, 753; W. G. A. Ormsby Gore, "Developments and opportunites in the Colonial Empire", *Scientific Worker*, 4 (6), 1928.

14) *Report of the East Africa Commission*, B.P.P. 1925, Cmd. 2387, ix, 855; L. Amery, *My Political Life, Volume II*, London, 1953, 340.

15) Lord Hailey, *African Survey*, London; E.B. Worhthington, *Science in Africa*, Oxford, 1938.

16) C. Jeffries, *The Colonial Empire and its Civil Service*, Cambridge, 1938, Appendix.

17) G. B. Masefield, *A History of the Colonial Agricultural Service*, Oxford, 1972.

18) *Imperial Conference 1926*, Appendices to the Summary, B.P.P. Cmd 2769, xviii, 301-3. The words Balfour used and were much quoted in inter-imperial scientific relations, were, «Let us cultivate easy intercourse, and full cooperation will follow». Also see: Public Record Office, London, CAB 32/63 EE (R/26) and CAB 32/50 E(EB)40.

19) E. K. Andrews and R. MacLeod, "The Committee of Civil Research: Scientific Advice for Economic Development, 1925-30", *Minerva*, 7, 1969, 680-705.

20) S. Constantine, *Buy and Build: The Advertising Posters of the Empire Marketing Board*, London, 1986.

21) CO 323/946 6732/26 23 March 1926. Letter dated 20 October 1925.

22) On the E.M.B. see: W. K. Hancock, *A Survey of British and Commonwealth Affairs Volume II: Problems of Economic Policy, 1918-1939*, Oxford, 1942.

23) CO 760/15 EMB/RC/22.

24) *The Empire Marketing Board: a second year's progress from May 1927 to May 1928*, London, 1928, 7.

25) WB Brierley, «The Association of Applied Biologists and the Annals of Applied Biology – a retrospect, 1904-1938», *Annals of Applied Biology*, 26, 1939, 187.

26) CO 760/19 EMB/RC/547.

27) CO 760/39 Authorisations; Annual Reports of the E.M.B., 1929-1933.

28) H. Melville, *The D.S.I.R.*, London, 1962.

29) Details of many of these projects are given in: C.J. Jeffries, *A Review of Colonial Research, 1900-1960*, London, 1964.

30) Amery, *My Political Life*, 354.

31) CO 760/12, 270.

32) CO 760/18 EMB/RC/408; CO 760/12 Minutes of the Board, 12 February 1930; CO 760/19 EMB/RC/543 Memorandum of estimates for 1931-32.

33) *Report of Committee on National Expenditure*, B.P.P. 1930-31 Cmd. 3920, xvi, 1.

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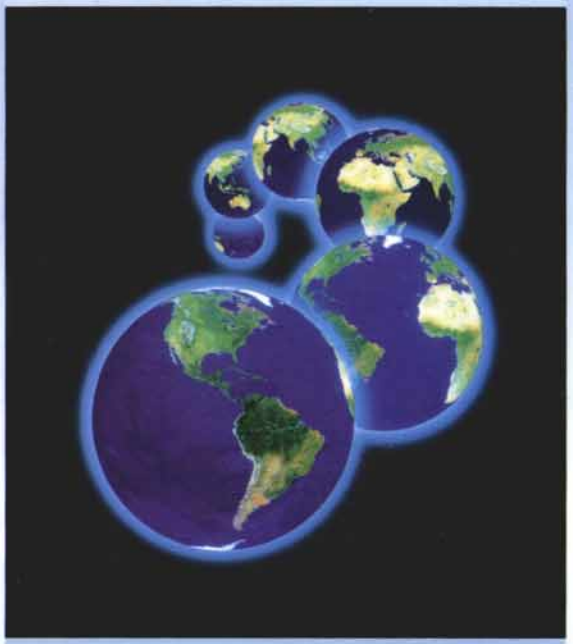

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PARIS 1996