

# **THE EMPIRE, COLONIES, AND LESSER DEVELOPED COUNTRIES AS MIRROR:**

**Critical Reflections on Science for Economic Development  
in the Colonial and Post-Colonial Periphery, 1930-1970**

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## **Introduction**

The aim of the following paper is to be wilfully polemical, hoping thereby to encourage critical reflection and questioning of what seem to me some very problematic assumptions underpinning many studies of science and technology in the political economy of colonial and post-colonial development in the lesser developed countries of Latin America, Asia and Africa.

There is today a vast and critical literature on the accomplishments and failings of Green Revolution. It focuses on the relationship between technical innovations to raise the productivity of agricultural producers in the lesser developed countries, chiefly high yielding rice, wheat, and maize varieties, and the distribution of their costs and benefits. The main criticism is that the introduction of these high yielding varieties, and the concomitant changes in agronomic practices, were directly responsible for increasing both the disparities between the wealthiest and poorest local producers, and the economic dependence of these lesser developed countries on the more developed countries exporting the technical capacities and material required to establish these innovations. This assessment has been translated into a view of science and technology for economic development as bolstering neo-colonial relationships between these two groups of countries. This view has found much support among historians interested in the relationship between science and imperialism. During the past three decades, they have focused much attention on the emergence in the imperial outposts of Great Britain, France, United States and elsewhere, of distinctly imperial sciences (1). This claim to a distinct nature is based on the observations that medical and agricultural programmes for the empire were characterised by a problem-orientated, vertically integrated approach, which encompassed a very limited definition of socio-economic problems favouring the political agenda of the imperial powers. This, these historians sometimes argue, is an important cause of present rural poverty and ill-health.

My main objection is that these views on science and socio-economic development

in the colonial and post-colonial periphery beg a number of questions about the nature of metropolitan science and connected historical experiences. By drawing attention to these questions, I wish to argue that if work on imperial or neo-colonial science were more explicitly comparative, the contrast between, on the one hand, science for the colonial and post-colonial periphery and, on the other, science in the North American and European metropolises, would have to be seriously reconsidered. I will begin to do so by first turning, ironically, to the evolution of so-called "appropriate technologies" to replace and avoid the problems linked to the agronomic technologies of the Green Revolution, to illustrate how deeply embedded are the assumptions underlying this contrast between the colonial (or post-colonial) and metropolitan experiences.

### **Science in the Colonial Context**

Until the 1960s, there existed in both Great Britain and France a set of institutions especially dedicated to agricultural work in the colonial or formerly colonial possessions of these two countries, such as, for example, the Imperial College of Tropical Agriculture, and the Institut d'Enseignement et de Recherches Tropicales (2). These institutions were also quite distinct from organisations for agricultural work in the British and French metropolises by enjoying separate sources of funding, namely the Colonial Research Council and the *Office de la Recherche Scientifique et Technique d'Outre Mer*. More significantly, Daniel Headrick has suggested, in his grand study of science and imperial development, that these institutions were particularly notable for their unrelenting efforts to transform indigenous modes of agricultural production and develop export agricultural economies in British, French and Dutch imperial possessions (3). This, Thomas Eisemon and others have suggested, meant that the emphasis was on single commodities and associated agronomic problems (4). This view is further sustained by Christophe Bonneuil's and Norman Simmonds' more detailed histories of French and British colonial agricultural research (5). It also echoes Michael Worboys' views on a distinctive intellectual organisation of tropical medicine, which focused on the vectors of disease and paid, thereby, very little attention to any of its broader social dimensions (6).

It is important, however, to recognise firstly that these historical analyses have encompassed and reflected the views of policy-makers in the metropolises, and that, actually, local experiences might have been quite different from those envisaged or expected by the metropolitan policy-makers (7). Secondly, it is clear that from the late 1930s, even these policy-makers' plans, especially those for agricultural development in the British colonial domain, and perhaps to a lesser extent those for the French one as well, were far more complex. There was a very definite dual approach, emphasising, on the one hand, the development of crops for export to the imperial metropolis, and, on the other hand, problems of food production for indigenous populations (8). The latter was perhaps one aspect of a broader effort to promote the general welfare of these populations and thus support the former activity against the kind of social unrest which had rocked the British West Indies in 1938. Greater attention began to be paid to the social implications of programmes to transform indigenous modes of food production, sometimes by calling, in the typically technocratic fashion of the day, on the technical expertise of social as well as agricultural scientists (9). Modern British

anthropology owes a great deal of its institutional expansion to efforts during the 1930s and '40s to promote the socio-economic development of Africa.

The most articulate institutional expression of this broader approach to socio-economic development were the Community Development programmes established during the 1950s by a new generation of vocally anti-colonial British experts in the problems of post-colonial development (10). Aided by the Ford Foundation, the British (and, later, American) proponents of Community Development sought to integrate lessons drawn from metropolitan adult education programmes during the inter-war years, and the self-help programmes developed at the same time by the nationalist movement in India. Education and the involvement of local communities were seen as essential prerequisites for an effective transfer of agricultural and sanitary technologies, and for the consequent transformation of indigenous modes of social organisation and economic production.

### Science for Development

By the early 1960s, Community Development programmes were being strongly criticised by both governmental agencies for foreign assistance and the recipient governments. The former, and especially the United States Agency for International Development, which had become by the late 1950s the major patron of programmes of technical assistance for the economic development, were divided between those who supported the broadly sociological approach of Community Development programmes, and those like the American economist Theodore Schultz, author of the very influential *Transforming Traditional Agriculture* (1964), who believed that programmes for development should focus firstly on enhancing agricultural productivity because institutional change would anyway follow quite automatically in its wake. Recipient governments also lost interest in Community Development programmes, ostensibly because they had failed to produce the desired economic change.

The Agency for International Development soon abandoned Community Development programmes, and turned very successfully to enhancing the productivity of agricultural producers by providing them with improved crop varieties and the wherewithal to make the most of them. The struggling agricultural economies of Pakistan, India and the Philippines quickly became fully self-sufficient ones (11). This success provided the impetus for the evolution of an international system for agricultural research in the lesser developed countries under the guidance of the Consultative Group for International Agricultural Research (12). While there was some limited input from British scientists and British institutions such as the Leverhulme Trust, the agenda of this organisation was largely dominated by American scientists whose outlook was close to Theodore Schultz's (13). The French, instead, did not figure very prominently at all in the activities of the Consultative Group, even though the emphasis on the seed as essential vehicle of transformation seems to have been favoured quite early on in the century by agricultural scientists concerned with the social and economic development of the French colonial domains (14).

In the early 1970s, the Green Revolution promoted by the Consultative Group was severely criticised by a number of authors. While most critics recognised that it had enhanced quite considerably the agricultural output of a number of Asian countries, they pointed out that the Green Revolution also resulted in severe social dislocation

both there and in Latin America. In Africa it seemed to achieve very little at all. Since efficient use of the new crop varieties produced by the international agricultural research system entailed the creation of irrigation schemes, as well as heavy use of agrochemical and mechanical inputs, this programme, the critics argued, favoured larger and better capitalised farmers. Furthermore, in the process of increasing these farmers' productive efficiency, the Green Revolution also created an increasingly larger pool of surplus labour with no avenue for employment, either rural or industrial (15). Lastly, more radical political economists, such as Samir Amin and Alain De Janvry, argued that the Green Revolution had failed to change either the relationships between different national economic sectors and groups, or between the lesser and more developed countries. According to them, without such institutional and political change, technical innovation was useless and the lesser developed countries would never become either fully economically developed or truly politically independent (16). Science for development came then to be seen as intrinsically neo-colonialist with all its imposition of technical solutions for essentially social problems.

### **Appropriate Technology**

One response to the debates surrounding the Green Revolution was the idea that programmes of technical assistance for the lesser developed countries should strive to develop technologies that were more appropriate to the needs of small producers.

A frequent complaint about the Green Revolution was that it depended on technical input from American scientists who were not permanently based in the hosting countries, but were instead temporarily seconded from Land Grant Universities on projects funded by institutions such as the Agency for International Development. Under these circumstances, it was believed, these scientists could have but very little understanding of the full complexities of agricultural production in the lesser developed countries, where small producers still played a critical economic role, and, thus, produced inevitably technologies that were ill-suited to the latter's needs (17). Many of those experts in problems of development sympathetic to the anti-capitalist and anti-technological philosophy outlined in Erich Schumacher's *Small is Beautiful* (1973), argued, in response to this situation, that only technologies designed in a more democratic fashion than was the case within the sphere of the Consultative Group for International Agricultural Research would reach the small farmers who had failed to reap any benefits of the Green Revolution (18). The latter, they claimed, had to be actively involved in the process of technical change.

Robert Chambers' and Paul Richards' ideas, as outlined in *Rural Development* (1983) and *Indigenous Agricultural Revolution* (1985), provide useful foci for a close examination of the assumptions underlying this appropriate technology perspective. Unlike the critiques based on considerations of political economy, which suggest that the poverty of indigenous agricultural producers is a symptom of their unfavourable political position, Chambers and Richards tend to view traditional societies, firstly, as organised in a manner efficiently adapted to the prevailing natural and socioeconomic environment (19). Furthermore, following John Ford's work on trypanosomiasis, they argue that the cause of the observed rural poverty is that these traditional modes of social organisation and

economic production were disrupted by colonial and neo-colonial efforts that were ill-suited to the peculiarities of the tropical environment. They then move on to claim, secondly, that under their special environmental circumstances indigenous producers will not seek to increase their agricultural output by adopting the costly technologies offered by the Consultative Group for International Agricultural Research. However, they will alter their modes of production if offered low-input technologies that bring together traditional knowledge and the metropolitan scientific insight into both the efficiency and lacunae of this knowledge (20). Interestingly, Richards locates himself in a long tradition of British, ecologically minded development experts who have sought to reinterpret traditional modes of production in ecological terms to establish thereby its scientific merits (and thereby also establish for them a legitimate place in programmes for socio-economic development). Moreover, his recommendations echo these same experts' suggestions during the 1940s that it was preferable to help primitive, unskilled indigenous agricultural producers to improve traditional tools, such as the hoe and ox-drawn plough, before teaching them how to use a mechanical cultivator because it was more appropriate to the indigenous peoples' cultural endowment (21). The technologies developed in this framework proposed by Richards and Chambers are those often discussed with great approval in the various publications produced by the Intermediate Technology Development Group established by Schumacher during the early 1970s.

Why is it, however, that these traditional societies have been able in the past to adapt very effectively to their changing environment, but must now await the technical innovations proposed by the Intermediate Technology Development Group? (22) It seems that for all their discourse of opposition to the productionist, vertically-integrated approach promoted during Green Revolution by the Consultative Group, the appropriate technology approach is strikingly similar to that proposed by Theodore Schultz and his followers in the Consultative Group: externally generated technical change will drive the institutional changes desired by all these external donors and their local allies, namely the transition from a pre-capitalist social organisation (or at least from small scale, local agrarian capitalism) to a modern capitalist order, fully integrated into the global economy. In fact, this philosophical agreement was cemented during the 1980s by the incorporation of the appropriate technology approach into the agenda of the Consultative Group. The global perspectives on rural social and technical modernisation motivating the latter's Integrated Rural Development programmes, as well as its later Farming Systems Research approach, seek a balance between, on the one hand, the explicitly productionist approaches that characterised the Green Revolution and, on the other hand, the need to reabsorb into the rural economy the impoverished surplus labour created by the former approach by providing these unemployed with opportunities to earn some small income through low-input cottage industries (23).

### **Technical Change and Social Transformation**

The proponents of appropriate technologies, as well as the scientists associated with the Consultative Group for International Agricultural Research, seem then to assume that there is a way to increase the economic productivity of social organisations without fundamentally disrupting them (24). However, technical change aims to, and always

entails, change in the relationships between adopters, capital, and labour; in other words, as social historians of science and technology have been arguing over the past twenty years, it must always be accompanied by social change. More significantly, the notion of the inappropriateness of the Green Revolution begs questions about the appropriateness of its underlying philosophy in the metropolitan context. Was the role of technical change in metropolitan experience, however, so different from, and any more socially unproblematic than that in the lesser developed countries?

There is an abundant literature which suggests that changes in agricultural modes of production, as well as the emergence of metropolitan national organisations for agricultural research, was shaped by alliances of agricultural and industrial elites, represented by governmental organisations, seeking to rein in the centrifugal tendencies of rural society. In Great Britain, for example, agricultural productivity was greatly expanded during the eighteenth century by institutional reforms and subsequent changes in technical aspects of production whose social cost in terms of increased rural poverty was enormous. The growth of landless, unemployed labour with no chance for escape was not fundamentally dissimilar from the modern experience of agricultural producers in the lesser developed countries. Moreover, it could be argued that this disruption was fundamentally important for industrialisation, by creating the large pool of unemployed labour needed to fuel the workshops of Manchester (25). It also seems rather significant that the strongly technocratic approach of British agricultural scientists trained in the colonial and post-colonial context, during the 1940s and '50s, could be exported back to the post-imperial metropolis without too much trouble. This suggests an essential congruence between the models deployed to solve the problems of post-war British agriculture and those for the lesser developed countries.

In France, there is good evidence that the plans for afforestation and forest management under the Ancien Régime paid very little regard for any possible social impact on local populations (26). More significantly, a wide array of centres for agricultural research was slowly established during the late nineteenth century against a background of struggles to bring rural society within the scope of a growing capitalist, industrial order, struggles which Eugen Weber has compared to a form of metropolitan imperial expansion (27). Similarly, in the United States, the first scientific surveys during the early nineteenth century to more fully assess the nation's natural wealth were organised in a fashion very similar to that of contemporary European imperial expansion across Asia and Africa, and at a great cost for indigenous populations. Furthermore, the emergence of a national system for agricultural research, during the late nineteenth century and the first decades of the twentieth, was a response of Progressive industrialists and agricultural producers to the increasing restiveness of those farmers who had displaced the vanquished indigenous populations, as the latter faced the costs of integrating American agriculture into a fully capitalist mode of production (28). Contrary to Robert Chambers and Paul Richards, there were winners and losers there too, and the earliest advocates of the institutional organisation of American agricultural science were fully conscious of this. Just as in the lesser developed countries today, they were tied to the interests of the most progressive farmers; the stratification of society in the lesser developed countries which so worries these development experts was an intrinsic part

of the metropolitan experience as well (29). Interestingly, the recovery of this history of exogenously generated, socially disruptive technologies coincided with debates during the 1960s and '70s over both the place of science, technology and modern agriculture in American society, and the problems of the Green Revolution.

In all these metropolitan contexts, it is not easy to characterise generally the approach to the disciplining of rural society into new modes of production as either horizontally or vertically integrated because it was a mixture of both, with greater or lesser emphasis on one or the other depending on the exact specificities of context. They are not very useful analytical categories. More significantly, the appeal to technologies developed and deployed at the grass-root level as somehow less socially disruptive must be carefully assessed against this assimilating perspective. For example, it is very tempting to view the "barefoot doctors" of China as models for the development of programmes of rural change more appropriate to the lesser developed countries than those of the Consultative Group for International Agricultural Research (30). Yet, the literature on these doctors' metropolitan counterparts, such as the *Officiers de Santé* in nineteenth century France, or health visitors in twentieth century Great Britain, suggests that they were quite powerful (and resisted) agents of social disciplining (31). This intrinsic connection between technical and social change needs to be more fully recognised, even if only to recognise the profound contradictions of all these programmes of technical assistance for the lesser developed countries, which are constantly torn between the principal aim to modernise and integrate indigenous economies into an international market, and the politically unpalatable social costs of this transformation.

Lastly, critics of the Green Revolution, and many historians of imperial science as well, seem to view indigenous producers as the passive victims of an imported, narrowly technical approach to problems of agricultural modernisation. Yet, Deborah Fitzgerald's work on the efforts of the Rockefeller Foundation during the 1940s to improve the agricultural productivity of Mexican farmers suggests that different groups of Mexicans were actively engaged in the narrow construction of development programmes as purely technical problems (32). The American scientists engaged by the Foundation sought to export to Mexico the social as well as technical approach to agricultural modernisation pioneered by the American Land Grant Universities during the first decades of this century. Two important components of this approach were education and extension. The Foundation chose not to become involved in these two areas because it was bound to be politically controversial, and in fact many Mexican officials were opposed to any American involvement in primarily domestic, political matters. The compromise between the American and Mexican positions was to focus on just the most strictly technical aspects of programmes for modernisation, the production of improved wheat and maize varieties. It is, then, worth asking whether the Community Development programmes during the 1950s were not simply victims of a productionist bias among scientists in external agencies for technical assistance, but also of local governmental concerns about the creation or stabilisation of independent foci of socio-economic (and inevitably political) authority (33). This is certainly a problem today for the French *Office de la recherche scientifique et technique outre-mer* as it seeks to promote the preservation of fisheries in Mali; maintaining local, customary regulation

of fishing on the Niger runs counter to the political interests of a weak central government. The situation in the lesser developed countries must be treated in just the same way as that in the metropolises by acknowledging the crucial importance of social heterogeneity and internal conflict, and not simply dismissing these countries' socio-economic difficulties as a product of external domination (34).

### Conclusion

This discussion, with all its criticism of the proponents of alternative, intermediate, and appropriate technologies, is not intended as a defence of the status-quo. These proponents have rightly suggested that one principal cause of the failure of the Green Revolution was the problem-oriented, vertically integrated approach adopted by scientists supported by the various metropolitan agencies for technical and economic assistance to the lesser developed countries. As they point out, in so doing these scientists lost sight of the possible repercussions of their activities on the organisation of indigenous rural life. There is now a concerted effort involving even the Consultative Group for International Agricultural Research to establish an approach that is more attuned to the complex cultural and economic endowments of the indigenous societies. These are interesting ambitions, but the point of the foregoing discussion has been to highlight the presuppositions underlying the appropriate technology alternative, which in many ways are not fundamentally dissimilar from those of mainstream governmental agencies. By stressing the need for *assistance*, even the proponents of appropriate technologies for development seem to assume that indigenous people are incapable of developing even the low-input technical innovations which they have proposed in conjunction with the latter. More significantly, they seem to presume like these mainstream governmental agencies that there can be technical change to produce more food without altering indigenous social patterns. Yet, even a passing overview of the role played by technical innovation in the history of metropolitan agriculture, suggests that it has always caused enormous social disruption: to paraphrase Bruno Latour, technical change, all technical change, is a continuation of politics by another name (35). Admittedly, the pace of socio-economic transformation in the metropolis was *sometimes* slower than it has been in the lesser developed countries, and was *perhaps* more open to local negotiation, but the problems it engendered do not seem so fundamentally different from those in the lesser developed countries today. This problem is not limited to agriculture, for it is not at all obvious that current policies to control, for example, cancer or heart disease in the metropolis are any less vertically integrated than any project in tropical medicine. It seems that when North American and European scholars such as myself examine what happened (and is still happening) in these lesser developed countries, we are looking in a mirror. It befits us to realise this more fully. In so doing, we will be able (if we so desire) to turn any lessons we might draw therefrom to some use at home. There is a profoundly ethical point here: not coming to terms with this reflection and its implicit meaning, and seeking instead a special analytical framework to give an account of the colonial and post-colonial experiences is to replicate the imperial relationship (36). We would be simply telling the natives' *peculiar, other* story and thus perpetuating the orientalist narrative (37).



## NOTES

- 1) For a critical overview of the organisation of science for development, see Robert Chambers, *Rural Development: Putting the Last First* (London: Longman, 1983). The literature on science and colonialism is usefully summarised in Nathan Reingold & Marc Rothenberg (eds), *Scientific Colonialism: A Cross-cultural Comparison* (Washington: Smithsonian Institution, 1987). Deepak Kumar (ed.), *Science and Empire: Essays in Indian Context, 1700-1947* (Delhi: Anamika Prakashan, 1991) provides an interestingly different, non-Western perspective on the history of science and colonialism.
- 2) For a review of the British and French organisation of scientific education and research in their former colonial domains, see Thomas O. Eisemon, Charles H. Davis & Eva-Marie Rathgeber, "Transplantation of science to Anglophone and Francophone Africa", *Science and Public Policy* 12 (1985): 191-202.
- 3) Daniel R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism* (Oxford: Oxford University Press, 1988), pp. 3-17 and 207-258.
- 4) Eisemon, Davis & Rathgeber, "Transplantation of science", p. 193.
- 5) Christophe Bonneuil, *Des savants pour l'Empire: La Structuration des Recherches Scientifiques Coloniales au temps de "La Mise en Valeur des Colonies Françaises" 1917-1945* (Paris: Orstom, 1991); N.W. Simmonds, "The earlier British contribution to Tropical agricultural research", *Tropical Agriculture Association Newsletter* 11 (1991): 1-7.
- 6) Michael Worboys, "Tropical diseases" in W.F. Bynum & Roy Porter (eds), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), pp. 512-536.
- 7) See Paul Richards, *Indigenous Agricultural Revolution: Ecology and Food Production in West Africa* (London: Hutchinson, 1985), pp. 18-21; and also the heterogeneity of medical practices in colonial Africa discussed by Philip Curtin in "Medical knowledge and urban planning in colonial tropical Africa" in Steven Feierman & John M. Janzen (eds), *The Social Basis of Health & Healing in Africa* (Berkeley: University of California Press, 1992), pp. 235-255.
- 8) G.B. Masfield, *A History of the Colonial Agricultural Service* (Oxford: Clarendon Press, 1972), pp. 65-75. See also E.B. Worthington, *Science in Africa* (London: Oxford University Press, 1938), pp. 394-403; *Science in the Development of Africa* (London: Commission for Technical Cooperation in Africa South of the Sahara, 1958), pp. 262-288; and Charles Jeffries, *A Review of Colonial Research* (London: HMSO, 1964), pp. 19-22 and 52-53. On French efforts, see Christophe Bonneuil & Mina Kleiche, *Du Jardin d'Essais Colonial à la Station Expérimentale, 1880-1930* (Paris: CIRAD, 1993), pp. 39-42.
- 9) See Worthington, *Science in the Development of Africa*, pp. 377-385; and Jeffries, *A Review*, pp. 46-47 and 59-70.
- 10) Lane E. Holdcroft, "The rise and fall of community development, 1950-65: A critical assessment" in Carl K. Eicher & John M. Staatz (eds), *Agricultural Development in the Third World* (Baltimore: Johns Hopkins University Press, 1984), pp. 46-58; see also Masfield, *A History of the Colonial Agricultural Service*, pp. 73-74. See also Richards, *Indigenous Agricultural Revolution*, pp. 28-31; and Chambers, *Rural Development*, pp. 40-41.
- 11) Bernhard Glaeser, "Agriculture between the Green Revolution and ecodevelopment: Which way to go?" in Glaeser (ed.), *The Green Revolution Revisited* (London: Allen & Unwin, 1987), pp. 1-9.
- 12) Edmund K. Oasa, "The political economy of international agricultural research: A review of the CGIAR's response to criticism of the Green Revolution" in Glaeser, *The Green Revolution Revisited*, pp. 13-55.
- 13) John M. Staatz & Carl K. Eicher, "Agricultural development ideas in historical perspective" in Eicher & Staatz, *Agricultural Development in the Third World*, pp. 3-30, on pp. 8-9.
- 14) For a comparative overview of French and American foreign technical and economic assistance programmes, see Jacques Gaillard & Lawrence Busch, "French and American agricultural science for the third world", *Science and Public Policy* 20 (1993): 222-234, especially p. 224. See also Bonneuil & Kleiche, *Du Jardin d'Essai Colonial à la Station Expérimentale*, p. 49. It is unfortunate that the only exten-

- sive study of French programmes during the post-war period focuses on policy developments in France with little attention to their implications for the relationship between science and socioeconomic development in the lesser developed countries (see Michel Gleizes, *Un Regard sur l'ORSTOM, 1943-1983* (Paris: ORSTOM, 1985).
- 15) See Keith Griffin, *The Political Economy of Agrarian Change: An Essay on the Green Revolution* (Cambridge: Harvard University Press, 1974).
  - 16) Samir Amin, *Unequal Development: An Essay on the Social Formations of Peripheral Capitalism* (New York: Monthly Review Press, 1976); Alain de Janvry, *The Agrarian Question and Reformism in Latin America* (Baltimore: Johns Hopkins University Press, 1981); and de Janvry "The political economy of rural development in Latin America: An interpretation", *American Journal of Agricultural Economics* 57 (1975): 490-499.
  - 17) See Gaillard & Busch, "French and American agricultural science for the third world"; and also Worthington, *Science in the Development of Africa*, p. 34. Cf. Chambers, *Rural Development*, p. 45.
  - 18) E.F. Schumacher, "Introduction", *Appropriate Technology* 1 (1974): 1.
  - 19) See Richards, *Indigenous Agricultural Revolution*, pp. 41-84; and Chambers, *Rural Development*, pp. 82-92.
  - 20) Richards, *Indigenous Agricultural Revolution*, pp. 43 & 150-151.
  - 21) Worthington, *Science in the Development of Africa*, pp. 276-279. Cf. Richards, *Indigenous Agricultural Revolution*, p. 43.
  - 22) See David Wade Chambers, "Period and process in colonial and national science" in Reingold & Rothenberg, *Scientific Colonialism*, pp. 297-321, on p. 298.
  - 23) Oasa, "The political economy of international agricultural research".
  - 24) Chambers, *Rural Development*, p. 187.
  - 25) Robert C. Allen, *Enclosure and the Yeoman* (Oxford: Clarendon Press, 1992), pp. 283-311.
  - 26) Andrée Corvol, *L'Homme et l'Arbre sous l'Ancien Regime* (Paris: Economica, 1984).
  - 27) See Harry W. Paul, *From Knowledge to Power: The Rise of the Science Empire in France, 1860-1939* (Cambridge: Cambridge University Press, 1985), pp. 180-220; and Eugen Weber, *Peasants into Frenchmen: The Modernisation of Rural France, 1870-1914* (London: Chatto & Windus, 1979), pp. 485-494. See also Jean Boulaïne, *Histoire de l'Agronomie en France* (Paris: TEC&DOC Lavoisier, 1992).
  - 28) David B. Danborn, *The Resisted Revolution: Urban America and the Industrialisation of Agriculture, 1900-1930* (Ames: Iowa State University Press, 1979). Cf. Richards, *Indigenous Agricultural Revolution*, p. 16; and Chambers, *Rural Development*, p. 45.
  - 29) See Eugene Davenport as quoted in Deborah Fitzgerald, "Exporting American agriculture: The Rockefeller Foundation in Mexico, 1943-53", *Social Studies of Science* 16 (1986): 457-483, on p. 462. Cf. Richards, *Indigenous Agricultural Revolution*, p. 117.
  - 30) See John Farley, *Bilharzia: A History of Imperial Tropical Medicine* (Cambridge: Cambridge University Press, 1991), pp. 201-215.
  - 31) On France, see Jacques Léonard, *Médecines entre les Pouvoirs et les Savoirs* (Paris: Aubier Montaigne, 1981); for Britain, see Elizabeth Peretz, "The professionalisation of childcare", *Oral History Journal* 17 (1989): 22-28.
  - 32) Fitzgerald, "Exporting American agriculture".
  - 33) Cf. Holdcroft, "The rise and fall of community development", p. 52; and also Richards, *Indigenous Agricultural Revolution*, p. 34. Also Hebe Vessuri (course of lectures on science and under-development presented at the International Summer School for History of Science, Cité des Sciences et Techniques, Paris 11-15.VII. 1994).
  - 34) Cf. Richards, *Indigenous Agricultural Revolution*, p. 162.
  - 35) Bruno Latour, *The Pasteurization of France* (Cambridge: Harvard University Press, 1988).

- 36) See the debate during the past ten years over the legitimacy of development economics as a discipline distinct from economics, which was started by Deepak Lao in his *The Poverty of Development Economics* (London: Institute of Economic Affairs, 1983). For responses to Lao's critique, see John Toye, *Dilemmas of Development* (Swansea: University College of Swansea, 1984); and Tony Killick, *A Reaction Too Far: Economic Theory and the Role of the State in Developing Countries* (London: Overseas Development Institute, 1989).
- 37) See Edward W. Said, *Orientalism: Western Conceptions of the Orient [1978]* (London: Penguin, 1991), pp. 1-110.



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