



Haines, E. (2016). 'Pledging the future': Investment, risks and rewards in the topographic mapping of Northern Rhodesia, 1928–1955. *Environment and Planning A*, 48(4), 648-664. <https://doi.org/10.1177/0308518X15594808>

Peer reviewed version

Link to published version (if available):  
[10.1177/0308518X15594808](https://doi.org/10.1177/0308518X15594808)

[Link to publication record in Explore Bristol Research](#)  
PDF-document

This is the author accepted manuscript (AAM). The final published version (version of record) is available online via SAGE Publications at <http://journals.sagepub.com/doi/full/10.1177/0308518X15594808> . Please refer to any applicable terms of use of the publisher.

## **University of Bristol - Explore Bristol Research**

### **General rights**

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:  
<http://www.bristol.ac.uk/pure/about/ebr-terms>

1 Elizabeth Haines

2 Royal Holloway, University of London and Science Museum, London

3 elizabeth.haines.2011@live.rhul.ac.uk

4 I 'Pledging the future': investment, risks and  
5 rewards in the topographic mapping of Northern  
6 Rhodesia, 1928-1955

7 I.1 Abstract

8 This article explores the uneven patterns of topographic mapping of colonial Northern  
9 Rhodesia (today Zambia). These patterns were generated in the years 1927-1931 and have an  
10 enduring effect today. Previous accounts describe colonial mapping in Africa as 'incomplete',  
11 but this is an inadequate conclusion. The article proposes that these unsatisfactory narratives of  
12 cartography can be corrected by applying the model of a *cartographic economy* to the close  
13 reading of archival sources. This model is used to interrogate topographic unevenness within  
14 the framework of the interests of diverse parties, with differing values and resources. It reveals  
15 that the patterns of topographic production were particularly strongly linked to aerial  
16 photographic projects. These projects documented areas that were preconceived as valuable.  
17 However the article reveals that the cartographic economy was determined by more than just  
18 the value of the land, as the value of the cartographic representation itself could be  
19 manipulated independently. This perspective should be considered in the study of British  
20 mapping of other colonial territories.

21 I.2 Introduction

22 The question this paper addresses is encapsulated in Figure 1, a representation of the radically  
23 uneven production of topographic mapping at 1:250,000 in the British African colony of  
24 Northern Rhodesia (today's Zambia).<sup>1</sup> This schema shows that parts of the territory were

---

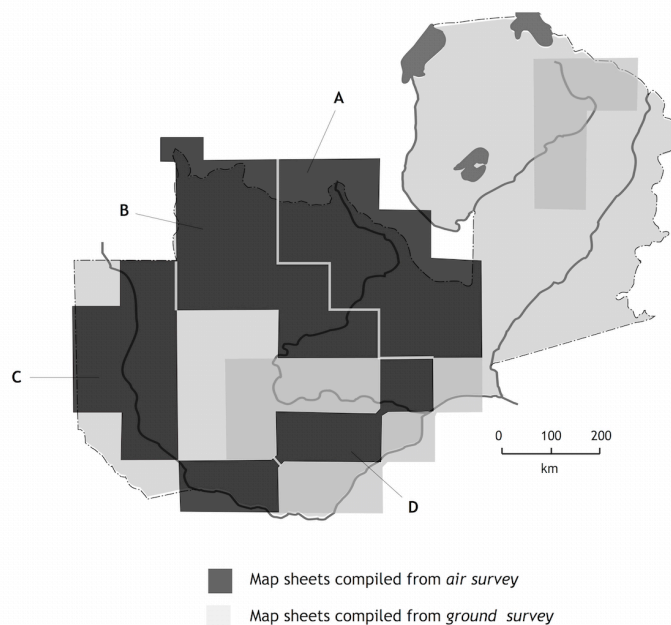
<sup>1</sup> Northern Rhodesia was under British crown rule between 1924 and 1964. However from 1953 onwards the colony was part of a conglomerated territory, the Federation of Rhodesias and Nyasaland. Responsibility for topographic production was transferred to the Federation in 1955, and was organized under federal authority until Zambian independence in 1964. Figure 1 only depicts the topographic maps produced by the Northern Rhodesian Survey Department, thus before 1955.

25 mapped at very different densities of detail. For certain areas topography was drawn up from  
26 aerial photography; for others it was drawn up with much sparser information from land-based  
27 survey. Up until 1955, a significant proportion of the colony saw *no mapping at that scale at all*.  
28 1:250,000 was considered to the minimum necessary scale for governance, yet mapping at  
29 1:500,000 (a scale at which entire Benelux region could be represented on a single sheet) was  
30 the most detailed published mapping available to many local administrators during colonial  
31 rule, particularly in the West of the colony.<sup>2</sup> The unevenness generated at that time has  
32 remained the status quo.<sup>3</sup> Patterns of knowledge, and absence of knowledge, persisted largely  
33 intact in the print publication of maps throughout the twentieth century, and continue to be  
34 reflected in the geo-coding of satellite data. Anecdotally, this situation is familiar, but it has not  
35 been adequately addressed by literature on the role of cartography in twentieth-century state  
36 formation and governance. This article proposes a new mode of analysis to explore this  
37 cartographic heterogeneity. It proposes that the necessity (even the relative usefulness) of  
38 topography to the colonial state cannot be taken for granted. We return to the archives to ask  
39 under what circumstances topographic maps were considered to be worth producing, and  
40 whose interests determined that 'worth'.

---

<sup>2</sup> Mapping was produced for some areas at a larger scale, this was only occasional until the 1950s.

<sup>3</sup> From 1946 mapping of certain areas of Northern Rhodesia was at 1:50,000 produced by a further agency, the Directorate of Colonial Surveys (DCS). The work of the DCS is not discussed here, but conformed to the pattern of unevenness for more than another decade, during which time it was tightly tied to high capital development projects (Macdonald, 1996).



41

42 **Figure 1: Distribution of map sheets at 1:250,000 compiled by the Survey Department of Northern Rhodesia,**  
 43 **1928-1955 (Pullan, 1978)**

44 This position breaks strongly from prevailing conceptualisations of state topography. Amongst  
 45 the variety of forms that state visualisations can take, topography has a privileged status since it  
 46 forms the 'base map' or geographical index for a much broader range governmental projects:  
 47 whether the organisation of cadastral records; the notation of vegetable, mineral, animal, and  
 48 water resources; or the analysis of demographic data (Monmonier, 1985). The very notion of the  
 49 base map suggests the unification of multiple cartographic functions into a single cartographic  
 50 system, "an epistemological singularity that required that at any *one* time there should be only  
 51 *one* map of *one* territory" (Edney, 2011, page 78). Scholarship since the 1990s has made it a  
 52 commonplace that the topographic or base map is not 'neutral' or experienced as such  
 53 (Blomley, 2003; Harley, 1989; Wood and Fels, 1992)). Nonetheless, topography is generally  
 54 considered to have uniform characteristics and function within a single 'state-space'. This  
 55 perspective prevails to the point that the homogenisation of heterogeneous sites and spaces

56 through topographic mapping has come to be seen as a necessary condition for the genealogy  
57 of the 'state-space' or 'territory' (Biggs, 1999; Branch, 2014; Elden, 2013).<sup>4</sup>

58 Assumptions about the uniformity and ubiquity of state cartography underpin a wide variety of  
59 literatures. General treatments of state cartography tend to accentuate the ways in which  
60 governmental power is increased through the centralised accumulation of territorial  
61 visualisations, and state-determined ontologies of natural resources (Crampton, 2011; Demeritt,  
62 2001; Scott, 1998; Whitehead et al., 2007). Marxist spatial theory brings a vocabulary that is  
63 highly-attuned to various forms of unevenness (Harvey, 1982, 2006; Lefebvre, 2009), and might  
64 have assisted our understanding of this topography as related to the production of "a  
65 differentiated and integrated space economy" (Harvey, 1982, page 375). But this scholarship  
66 offers us surprisingly little purchase on differences in the deployment of cartographic  
67 visualization.<sup>5</sup> The *principle* of uniform topographic coverage is also taken up by technical  
68 histories of African cartography: which therefore explain unevenness as failure on the part of  
69 British colonial regimes due to insufficient governmental resources (McGrath, 1976; Stone,  
70 1995). This explanation clearly falls into the mode outlined by James Ferguson, in which  
71 political intent is obscured by narratives of technical inadequacy (1990). The positive choices –  
72 which areas *were* mapped – remain naturalised or unaccounted for. It is this challenge, to  
73 account for the positive choices, that forces a new approach.

74 To address that challenge this article proposes the model of a 'cartographic economy'. This  
75 work follows the lead of scholars who have cautioned against treating imperial or colonial  
76 agencies as monolithic, and demonstrated them to be distributed networks of groups,

---

<sup>4</sup> There has been debate over whether colonial mapping practices allowed for, or stemmed from, those of European states but a resultant homogenisation of space is assumed to be similar for both colonised and colonising countries (Branch, 2012; Escobar, 1997).

<sup>5</sup> The emphasis on the homogenizing quality of mapping has obscured the variety of relationships that modern state-mapping might have to forms of economic activity, the mobilities of capital and of labour. A uniform one is assumed. Genealogically, cartography is seen as the basis for both "the commodification of space *and* the production of new but equally oppressive geographical systems for the containerization of power" (Harvey, 1989, page 258) (my emphasis). The state is considered the progenitor of the 'space' of the space-economy.

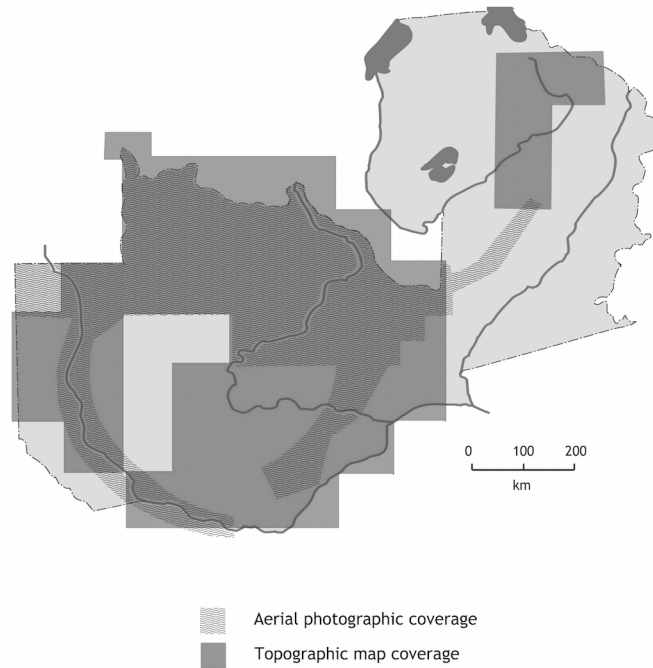
77 individuals and influences.<sup>6</sup> In particular it borrows from an expanding body of work on the  
78 representational economies of governance (Agrawal, 2005; Ghertner, 2010; Hull, 2012).<sup>7</sup>  
79 Participants in the early twentieth-century Northern Rhodesian cartographic economy  
80 included the imperial mapping authorities, as well as the Northern Rhodesian ones; the  
81 Northern Rhodesian secretariat; colonial scientific officers; the mining (and other) companies  
82 who invested in the Copperbelt during that period; and an early aerial photographic business.  
83 For each of these groups topography represented the means to a different end, they had  
84 differing resources, and variable leverage.

85 In exploring the history of the 'value' of Northern Rhodesian topography, the article focuses, in  
86 particular, on *aerial photography as a cartographic technology*. Critical literature is beginning to  
87 address the variety of civil uses of early twentieth century aerial photography (Cronin, 2007;  
88 Dyce, 2013; Haffner, 2013; Monmonier, 2002), we are focusing here on its use for mapping for  
89 two reasons. Firstly, because as seen by comparing Figure 1 and Figure 2, the production of  
90 topography was tightly linked to the deployment of aerial photography. Four aerial  
91 photographic projects that were carried out in quick succession between 1927-1931 became the  
92 basis of three-quarters of the mapping at 1:250,000 produced by the Northern Rhodesian  
93 government *for the subsequent twenty-four years* (Blocks A-D in Figure 1). Secondly, aerial  
94 photography was more capital-intensive than traditional land-based surveying methods and as  
95 a result it allows us to see the workings of the cartographic 'economy' in more vivid relief.

---

<sup>6</sup> This is a large body of work, but expansions of this in relation to colonial knowledge production include (Anderson, 2009; Stoler 2010; Tilley 2011).

<sup>7</sup> Elsewhere, I have used that literature more closely in examining the intersection between Northern Rhodesian cartography and the spatiality of indirect rule (Author, forthcoming). Here, by contrast, I focus on the value of the topography in directly financial terms. It should be noted that the 'successful' production of topography is less socially complex than the 'successful' production of cadastral cartography and that as such indigenous resistance has much weaker influence on outcome (Braun, 2005; Craib, 2004).



96

97 **Figure 2: Aerial photography carried out in Northern Rhodesia 1927-1931, against topographic mapping at**  
98 **1:250,000, 1928-1955 (Pullan 1976; Pullan 1978)**

99 Here we will explore the Northern Rhodesian cartographic economy from three different  
00 perspectives. The first section sets out contrasting positions; the role of cartography in a  
01 planned ‘spatial order’ versus its role in the responsive, tactical management of colonial assets.

02 The latter scenario better describes the Northern Rhodesian government’s territorial (dis)order,  
03 as the foundation for a cartographic economy subject to diverse influences. The second section  
04 returns to the focus of previous scholarship on the territorial visualization of Northern  
05 Rhodesia - the period 1927-1931 - and the arrival of aerial photography into the colony. This is  
06 revealed to have provided an impetus for topographic production, but only transiently. The  
07 final section uses the deployment of aerial photography to measure the comparative influence  
08 of different parties on the production of a conceptual framework for organizing colonial  
09 resources. All three sections reveal a relationship between the perceived value of topography  
10 and the anticipated value of territory that was both dynamic and reciprocal.

### 111 **1.3 The cartographic economy and colonial ‘spatial orders’**

112 In histories that consider the *raison d’être* of colonial cartography, the dominant tendency is to  
113 see it as a mechanism for overturning pre-colonial spatial practices and establishing a new  
114 spatial order. This can be seen strongly, for example, in Matthew Edney’s account of the East India

115 Company's Survey of India (1999); Timothy Mitchell's depiction of cartography in nineteenth-  
116 century colonial Egypt (2002); in the dislocation of colonial cartographic principles into Siam as  
117 described by Thongchai Winichakul (1994); and more recently Raymond Craib's investigation  
118 of modern cartography in Mexico (2004). Whilst technical studies of cartography tend draw out  
119 the differences between varieties of maps and mapmakers, contextual studies of late  
120 nineteenth- and early twentieth- century colonial cartography tend to frame all government  
121 mapping activity within the context of singular, unified outcome: the consolidation of  
122 centralised, distanced power. So although, for example, in *Cartographic Mexico* Raymond  
123 Craib elaborates a diversity of mapping projects, emphasis is placed on the ways in which  
124 successive regimes *intended* to break with the one before, and produce diachronic spatialities or  
125 'fixations' (2004). This tendency has been somewhat compounded by the success of the  
126 literature on mapping in South-East Asia where this characterisation of the relationship  
127 between cartography and centralised power is particularly apt. Studies of colonial rule in this  
128 region have given us evidence of how cartographic practices served the centralised organisation  
129 of forestry (Agrawal, 2005; Barton, 2001), the implementation of a cadaster (Edney, 1999;  
130 Michael, 2007), and the creation of a cartographic icon that cohered 'an' Indian identity  
131 (Anderson, 1983; Ramaswamy, 2001).

132 Although this literature offers many insights, it is difficult to apply the principles of 'spatial  
133 ordering' to Northern Rhodesia. In comparison to other imperial territories, there was little  
134 military action against the colonised and the conflicts on its borders during the First World  
135 War were not cartographically productive for the colony.<sup>8</sup> 'Spatial ordering' would therefore  
136 need to come from civilian visions for the future of the colony and its resources, but these were  
137 not tightly defined. The first years of colonial governance (1890-1924), took place under the  
138 British South Africa Company who had inconsistent policies regarding the desirability of white  
139 settlement (Slinn, 1971). Under Crown rule, from 1924, there was still hesitation about what best  
140 'to do' with Northern Rhodesia. Initiatives encouraging settler plantations and farming were  
141 not fully embraced (Gann, 1964). Further dramatic shifts in governmental policy followed the

---

<sup>8</sup> This observation can only be made from the absence of map production by British military forces in Central Africa as recorded in the catalogued output of the War Office. There has been minimal treatment of this region in secondary literature on war cartography (Chasseaud, 2013).



42 sequential discovery and exploitation of different natural resources in the colony, namely teak  
43 timber, from around 1911, and then copper from the 1920s. The taxation of Africans on a *per*  
44 capita/per household basis was aligned to the organisation of the population as a labour reserve  
45 (Meebelo, 1986), but the economic organisation of Africans was not pursued with the rigour  
46 demonstrated in Southern Rhodesia or South Africa; an attempt at the geographical  
47 segregation of Africans into 'native' areas was enforced only half-heartedly (Gann, 1964; Wills,  
48 1985).



155 Within this staccato-ed set of policies, governmental cartographic expertise was also fractured.  
156 Three major kinds of mapping were undertaken. Geodetic survey and international boundary  
157 work were carried out on an exceptional basis by visiting Imperial parties that were funded by  
158 London government. By the late 1920s, these parties had produced thin stretches of mapping  
159 around the borders of the territory, and a strip of geodetic mapping that followed the 30<sup>th</sup>  
160 Meridian from Southern Rhodesia (now Zimbabwe) to Lake Tanganyika (Donaldson, 2008;  
161 Smith, 2006; Stone, 1995). The less highly technical work of 'routine mapping' was considered to  
162 be the financial responsibility of individual colonies, and therefore of the local Survey  
163 Departments (McGrath, 1976; Stone, 1995). The majority of the Northern Rhodesian Survey  
164 Department's time was spent on the cadastral survey of European property, which represented  
165 a very small proportion of the total area of the territory.<sup>9</sup> Topographic survey was carried out  
166 on an *occasional* basis during the tours surveyors made to mark out property, and on an *semi-*  
167 *enthusiast* basis by local administrators (Pullan, 1978; Stone, 1982). The earliest results of this  
168 work were published between 1917 and 1926 as a provisional 1:250,000 series that putatively  
169 covered the whole colony (Pullan, 1978). However, the majority of the data recorded on these  
170 sheets was unmeasured, much of it was estimated (rivers represented by dotted lines) and huge  
171 expanses were left blank. This can be understood when looking at the annual activity of the  
172 Northern Rhodesian Survey Department. Figure 3 shows the work-done in 1927 (the year of the  
173 first aerial survey). The department employed nine surveyors. The cartographic coverage that  
174 the department achieved that year is represented not by grids or squares but by scattered  
175 scrawls of thin inked in-lines, which give some idea of the pace of accumulation of topographic  
176 data. Although the expansion of the copper industry in the 1920s and 1930s altered these  
177 patterns slightly (the rate of European settlement fluctuated but generally increased), the  
178 nature of the mapping by the Northern Rhodesian Survey Department remained largely the  
179 same up to 1955.

80 This slow rate of accumulation led to frustration in some parts. In 1936, when Brigadier  
181 Winterbotham, Director General of the British Ordnance Survey, addressed the British  
82 Association for the Advancement of Science, he went so far as to suggest that his audience was

---

<sup>9</sup> The measures for the alienation of land are not straightforward, because they didn't include land held under concession but only that which was transmuted into private property. By 1955 this still represented a small fraction of the colony, about 7%. See the annual reports of the Survey Department (National Archives UK CO/799) (hereafter NA UK).

183 witnessing a “cycle of indifference [to mapping]”, (1936, page 102). We are not used to accounting  
184 for governmental ‘indifference’ to modern cartography. How should we do so? Retrospectively,  
185 Jeffrey Stone has suggested that British apathy towards colonial mapping in this period  
186 stemmed from confidence in the long-term nature of colonial rule (1995, page 107). This offers  
187 us part of an explanation (a temporal framework for defining cartographic value) but not the  
188 whole. In 1936, Brigadier Winterbotham reached the conclusion that, despite global financial  
189 depression, the imperial government considered itself, “rich enough to survive the handicap of  
190 inadequate mapping” (Winterbotham, 1936, page 102). Whilst his claim was deliberately  
191 provocative, it seems to be closer to the mark.

192 The contextual studies of colonial cartography that speak to ‘spatial ordering’ tend to frame its  
193 economic potential within the aims of a Foucauldian governmentalist state (Crampton and  
194 Elden, 2008). Thus for example, Craib argues that in Mexico in the late 1880s, the government  
195 used cartography to frame the country as a coherent, stable site for investment (2004). For  
196 Mitchell the mapping of Egypt served to render a fiscal landscape more efficiently in the effort  
197 to counter intransigent national debt (Mitchell, 2002). The intensity of cartographic activity  
198 between the years 1927-1931 that we will examine here seems to speak to a ‘gestural  
199 governmentality’ that would blossom into more substantial bureaucratic territorial  
200 management (Hannah, 2000, page 37). However, this is not supported by the longer-term view  
201 of topographic production. On the contrary, when considering the topographic production over  
202 a longer period up to 1955 (Figure 1), it seems that earlier economic attitudes to imperial  
203 territories in tropical Africa prevail, in which it was anticipated that the influx of private capital  
204 would organically produce profit from the innate natural wealth of the continent (Ehrlich, 1973;  
205 Frankel, 1938; Tilley, 2011). I would argue that whilst the patterns of Northern Rhodesian  
206 topography could be seen to reflect political miscalculation or hesitance, they are better  
207 understood as resulting from a temporary injection of capital into mapping, within the  
208 framework of British imperial government in the late 1920s and early 1930s that had an  
209 extremely *laissez-faire* attitude to resource management.<sup>10</sup>

---

<sup>10</sup> The Northern Rhodesian government didn’t do a great deal facilitate *or* regulate independent economic actors. This can be seen mostly clearly in the fact that the colony did not instate a geological

210 In sum, I propose that the isolated blocks of mapping in Figure 1 do not represent a monolithic,  
211 homogeneous spatial order, or the absence of a spatial order, but rather a spatial interest that  
212 was *tactical*. Above all, these topographic maps did not anticipate economic activity but were  
213 produced in the wake of relatively unregulated commercial activity, *post hoc*. From this  
214 perspective, the analytical benefit of the ‘cartographic economy’ becomes clearer. To  
215 understand the role of these maps in the history of the colony we need to address the  
216 contingencies and specificities of their creation, and the diversity of forces in play. The  
217 following sections examine the histories of two sections of topography – *Block A* and *Block D*  
218 (Figure 1) – and interrogate the conditions of their ‘tactical’ emergence more closely.

#### 219 1.4 Timing, risk and the cartographic economy

220 From the mid-1920s, Northern Rhodesia aroused the interest of international mining  
221 corporations. This heralded a great deal of cartographic activity, including the first uses of  
222 aerial photography. The mapping was born of three interconnected motives. Firstly, the  
223 potential value of deposits required property and concession boundaries to be demarcated at a  
224 greater level of precision, thus activating the value of cartographic records: “A country with a  
225 valuable mining industry cannot afford to be careless of inches” (Worthington, 1938, page 30).

226 Second was the mapping that facilitated the expansion of related infrastructure, such as roads,  
227 townships and hydroelectric schemes. Thirdly, and most importantly, was the mapping related  
228 to the discovery of minerals. The nature of the copper deposits in Northern Rhodesia (large, but  
229 quite far below the surface, and of quite a low grade) necessitated the identification of wider  
230 geological patterns (Bradley, 1952). Thus systematic prospecting and mapping was carried out  
231 across vast stretches of territory, to trace underlying strata.

232 The techniques used to visualise Copperbelt ore have recently been investigated by Tomas  
233 Frederiksen (2013). Frederiksen identifies the new intensive and systematic forms of  
234 documentation involved in making the copper deposits ‘legible’ to the headquarters of the  
235 mining companies in London. This documentation (which bypassed government and went  
236 straight to the boardrooms) allowed mining engineer-financiers to decide how to locate

---

department until 1950 despite the fact that the value of Northern Rhodesia’s mineral exports increased  
from £52,000 p.a. to nearly £4.5 million p.a. between 1913 and 1935 (Frankel, 1938, page 212).

boreholes, and where to begin exploitation. However, Frederiksen implies that expenditure on knowledge production (which according to retrospective assessments reached £471,181 between 1926 to 1934), can be taken for granted (Bancroft and Guernsey, 1961, page 90).<sup>11</sup> I propose that these decisions to invest in territorial visualisation need more careful consideration.

In amongst the mining companies' cartographic expenditure detailed above were the costs incurred by Rhodesia Congo Border Concession Ltd. (RCBC) on hiring the Aircraft Operating Company Ltd. (AOC) to carry out Northern Rhodesia's first aerial photographic survey (1927-1929). This endeavour alone was an enormous investment. There was no air infrastructure in the colony: few planes had ever flown over it, and only a handful of aircraft existed in Southern Africa (Blake, 1971). The planes arrived in pieces from England on a steamer, then travelled by rail and finally motorcar to the RCBC concession (Anon., 1927). With the planes came eight Europeans who occupied an extensive base-camp with several technical workshops, for over a year (McAdam, 1974). It had seemed that the new, two-engine planes would be most appropriate for flying long distances over the flat, bushy terrain, as they would mitigate the risk of engine failure and forced landing (Anon., 1928). However, the RCBC would not wait the several months these planes would take to commission and build. Instead they decided to use single-engine planes, and cut emergency landing grounds right across the concession at twenty-mile intervals (Anon., 1928).

The RCBC's decision to commission aerial photography was not without risk. In 1927 this technology was at an experimental stage. It had been employed for reconnaissance and mapping during the First World War, and in the 1920s was being tested within industrial projects. This had seen most success in Canada where it was supported by a nexus of governmental, military and industrial partners (Cronin, 2007; Dyce, 2013; Matthes, 1926). In the UK of the interwar period, however, there was little government support for aerial photography for either military or civil purposes (Collier, 2002), and its use was principally developed by small commercial interests. These companies had accomplished a handful of projects including timber surveys, route reconnaissance, and prospecting for oil, in Burma, Borneo and South

---

<sup>11</sup> This is almost incomparable to government cartographic activity. The Survey Department's expenditure for the whole year in 1927 was only £5,812 on salaries, and £142 on instruments) (Annual Report, Survey Department of Northern Rhodesia, 1927. NA UK CO799/3, page 490).

64 America (Anon., 1926, 1930), and it was far from guaranteed that the technique would be  
65 successful for copper prospecting in Central African conditions.

66 So why was the RCBC prepared to risk bringing the AOC to Northern Rhodesia? There are two  
67 reasons, both important in understanding the mechanisms of the cartographic economy. First  
68 of these was timing. The RCBC had been granted exclusive prospecting rights, but only for a  
69 five-year period. They were also committed to particular levels of spending in 'developing' their  
70 concession. The Northern Rhodesian authorities included these clauses in their contract in  
271 response to prospecting practices of earlier years, which had tended to be badly funded and  
272 had resulted in disparate claims without strong evidence that would support their exploitation  
273 (Slinn, 1971). So whilst, according to Stone, the Northern Rhodesian government were possibly  
274 experiencing a *lack* of temporal incentive to mapping the colony (1995), the RCBC were under  
275 pressure to realise a profitable future. It was for this reason that the RCBC could not wait for  
276 double-engine aeroplanes to be constructed, and it accounts for their investment not just in  
277 aerial survey, but in several experimental methods that it was hoped would increase the  
278 rapidity and accuracy of their geological investigations (Bancroft and Guernsey, 1961).

279 These time pressures increased the value of visualisations of the concession, but the mining  
80 companies had a second reason to be willing to take the risk: profit was being drawn from the  
281 enterprise at multiple points. Ostensibly, mining engineers were reducing the risk of mining  
282 investment by creating sounder, more reliable knowledge about potential ore-bodies and their  
283 extractability. However, these engineer-financiers were generating revenue for themselves in  
84 the process of assessing that potential; income they could still enjoy regardless of whether  
285 valuable minerals were discovered (Phimister and Mouat, 2003). The value of knowledge *about*  
86 the concession was being produced separately from the value of the *concession itself*. In fact  
287 aerial photography failed as a method of prospecting for copper under these conditions, but the  
88 result of the mining companies' ability and motivation to take risks in the process of visualising  
89 Northern Rhodesian territory was that, after years of disparate activity by the Survey  
90 Department, large stretches of the colony were available to the distanced gaze.

291 Although the colonial government would never have initiated such expenditure, they were  
292 keen to take advantage of the resultant photography. The RCBC was satisfied with the  
293 photographs alone, and the Survey Department didn't have the manpower or expertise to turn  
94 the photography into maps, so they solicited the imperial government for extraordinary funds  
295 to commission the AOC itself to produce topography. The Colonial Office agreed to provide the

96 £6,000 from the recently erected East Africa Loan Scheme to fund the private production of  
97 topographic maps of *Block A* (Figure 1) (Annual Report, Survey Department of Northern  
98 Rhodesia, 1927. NA UK CO799/3).

99 A high-capital cartographic technology had arrived in Northern Rhodesia because the  
00 government had imposed time limits on the investigation of the concessions; now the time  
01 pressures were returned onto them. The AOC were keen to do as much business as possible  
02 before they left the region. The company campaigned vigorously in 1927 and 1928 for more  
03 photographic commissions (McAdam, 1974). Using the classic pitch (key to double-glazing sales)  
04 that the costs would be lower *whilst they were in the neighbourhood*, the AOC provided  
05 motivation for organisations to find partners who would share the costs of further projects.

06 Between 1927 and 1931 this included four 'extensions' to the RCBC aerial photography,  
07 commissioned by the Northern Rhodesian government; most of which was funded by loans  
08 authorised by the Colonial Office, but partly by other private interests. These extensions  
09 resulted in further topography. The first photographic extension (source for the map sheets of  
10 *Block B* on Figure 1) extended the coverage of the Copperbelt. The second (map sheets in *Block*  
11 *C*) was subsidised by Robert Williams Co. Ltd., who wished to incorporate the transportation  
12 potential of the Upper Zambezi into their rail network. The third (map sheets in *Block D*) –  
13 which we will discuss in the next section – documented the profitable farmland along the line  
14 of rail. Finally the Northern Rhodesian government also commissioned air photography of six  
15 townships (lying within these other areas) (Pullan, 1976).

16 By 1929 one-fifth of the territory was photographed (*Annual Report, Survey Department of*  
17 *Northern Rhodesia*, 1929, 435, CO799/5, NA UK), yet the regular cycle "of indifference" and *post*  
18 *hoc* practice, had not been broken. Each of these projects were financed by extraordinary funds,  
19 and each diversified the participants in the Northern Rhodesian cartographic economy. The  
20 Northern Rhodesian government had *temporary* access to aerial photography as a cartographic  
21 technology. This solution would have been unavailable without sources of more fluid finances  
22 being made available. Without the exceptional financing for aerial photography, the annual  
23 records of topographic work of the years 1928-1935 would have most likely resembled the sparse  
24 lines shown in Figure 3.

25 By detailing the influence of investment, risk and time pressure on the value of Northern  
26 Rhodesian topography in *Block A* we begin to see what levels of complexity are disguised by



idea that topographic maps cohere to ‘one map of one territory’. We have seen that the value of topographic mapping was affected by government policy on concessions, the financial structure of the mining industry, and the interests of the AOC. The following section, which recounts the history of the production of the topographic maps in *Block D* (Fig. 1), reveals more about the role of different parties in actively manipulating the conceptual frameworks for the ‘rational’ assessment of colonial resources.

## 1.5 Ecology, economy: the rhetorics and reality of colonial resource management

Examining the history of the third section of topography *Block D* allows us several further insights into the cartographic economy. Firstly, it unravels the separate interests of a triumvirate of colonial presences in Northern Rhodesia; the colonial scientific officers, the colonial secretariat and the AOC. Secondly, it allows us to see the role of the AOC at work in shaping the value of ‘inscribed’ territory for both the scientists and secretariat of Northern Rhodesia.

Recent histories that have treated aerial photography in Northern Rhodesia have variously conflated these groups. The AOC usually features as a tool—innovative and clever, but fundamentally inert—that state scientific experts worked to their own ends. The scientific experts, on the other hand, are credited with using both the content of the images and the techno-rhetoric of aerial photography to promote their interest in environmental systems and relations. This confusion can be seen in how the work of Ray Bourne is narrated. Bourne was an envoy of the Imperial Forestry Institute, sent by the Colonial Office to Northern Rhodesia in 1928 to investigate the timber potential of the expansive forests in the colony. Peter Adey describes him as driving the use of aerial photography in Northern Rhodesia for forestry, a means for the Northern Rhodesian government to open the territory up “to the distanced gaze for the imposition and projection of power and reach” (2010, page 86). In Helen Tilley’s *Living Laboratories*, Ray Bourne “seized the opportunity of demonstrating the value of employing aerial survey” (2011, page 144). Elsewhere in *Imperial Ecology*, Peter Anker linked Bourne’s presence to the goal of establishing clear political boundaries (2001, page 83).

355 Although Bourne was enthusiastic about aerial photography, in his own words it ‘happened’  
 356 that the AOC was in the field carrying out the project for the RCBC (1928, page 8). Yet he has  
 357 consistently been seen to epitomise the proactive state inscription of natural resources and  
 358 territory. We can see from the previous section that these narratives displace both the primacy  
 359 of the copper industry in bringing the AOC to Northern Rhodesia, and the energetic  
 360 propagation of aerial photography by the AOC themselves. Those authors have also mis-  
 361 assigned the agency of colonial scientists *within* government. The history of the mapping from  
 362 air photography in *Block D* gives us insight into the failure of the rhetoric of rational resource  
 363 management to vanquish short-term tactical attitudes to resource exploitation.

364 The aerial photography behind the maps of *Block D* resulted from work carried out for the  
 365 Agricultural Survey Commission in 1929 (Pullan, 1976). The purpose of the Commission was to  
 366 consider how the farmland along side the line of rail should be distributed to settler farmers  
 367 (Memorandum, Chief Agriculturalist, Northern Rhodesia, April 1932. National Archives of  
 368 Zambia MAG2/9/5).<sup>12</sup> This allocation had, (somewhat like the early prospecting) been  
 369 proceeding in a relatively *ad hoc* manner. The outcome, it was suggested in 1926, was  
 370 detrimental both to agricultural production and to colonial societal fabric (Annual Report,  
 371 Survey Department of Northern Rhodesia, 1926. NA UK CO799/2). As the mining industry grew  
 372 rapidly at the end of the decade, this problem gained a further intensity; food supplies needed  
 373 to be secured for the miners (Governor of Northern Rhodesia to the Colonial Office, April 4<sup>th</sup>  
 374 1929. NAZ MAG2/7/3). The Commission was keen to discover “the best manner in which [the  
 375 land] should be divided into farms of economic acreage,” (Chief Secretary, Northern Rhodesia,  
 376 to the Deputy Commissioner, Trade and Information Office of Great Britain, 29<sup>th</sup> September,  
 377 1930. NAZ MAG/2/9/1), primarily in relation to transport and hydrography. A strip of aerial  
 378 photography that ran 15 miles each side of the railway was provided by the AOC to assist them  
 379 in this task.

380 In 1931, a second set of aerial photographs of railway-belt land was produced. This was not a  
 381 commissioned project, but an initiative of the AOC themselves. The air and groundwork were  
 382 carried out single-handedly by Captain Charles Robbins, an employee of the AOC (*An*  
 383 *Experiment in the Classification of Land with the Use of Aerial Photographs*. C. R. Robbins, 1932. NAZ  
 384 MAG2/9/3). The project was intended to extend the market for the AOC’s work by proving the

---

<sup>12</sup> National Archives of Zambia hereafter ‘NAZ’.

potential of aerial photography for the classification of soil types. It was recorded that Robbins felt that, “the local authorities, particularly the Agricultural Survey Commission were not making full use of the air photographs available” (R. Bourne to the Under Secretary of State for the Colonies, 14<sup>th</sup> August, 1933. NAZ MAG2/9/5). As a result Robbins was, “determined to show the possibilities of such a method conducted exclusively by his company”, which was described as, “a freak performance for demonstration purposes, and, as such the most remarkable one-man effort I have ever studied” (Memorandum, Chief Agriculturalist, 1932. NAZ MAG2/9/1). The illusion that this was innovative government science, rather than a theatrical sales endeavour, was deliberately fostered by the AOC. They astutely called the project an “experimental aerial ecological survey” (*An Experiment in the Classification of Land with the Use of Aerial Photographs*. C. R. Robbins, 1932. NAZ MAG2/9/3). Robbins’ account of the project published in the *Journal of Ecology* follows a strategy that the AOC used elsewhere in their publicity: framing experimental projects as a successful response to pre-existing government demand (Cochran-Patrick, 1931; Robbins, 1934). Thus, Peter Anker and Helen Tilley have read the ‘ecological’ in bolder terms than is perhaps just, when they set the use of air survey within the narrative of the growth of ecological attitudes within colonial science (Anker, 2001; Tilley, 2011).

Robbins’ exercise shows that the AOC were keen to extend their services to the interpretative aspect of aerial photography, but the company were following this ambition through in a number of ways. They were also increasing in-house expertise, and building a network of contacts within the fields of forestry, geology and “general economic development” (Anon., 1929b, page 1343). The interdisciplinarity of the AOC’s product was more usually promoted as an ‘economic survey’ than an ecological one (Anon., 1929a, 1929b; Crosthwait, 1930). Their eagerness to promote their services via the organs of scientific societies, was matched or exceeded by their activity in responding to debates about the role of colonial resources in solving British unemployment questions. According to the AOC, aerial photography could increase understanding of those resources, decrease the risk to those considering emigration, and decrease the cost of trade through a better siting of production and transport

412 infrastructures (Anon., 1929a, 1929b; Crosthwait, 1930). For example, in 1930, in response to an  
413 imperial report on the scale and structure of the political units of East Africa, Herbert  
414 Crosthwait, Director of the AOC prepared a paper for the Royal African Society, expounding  
415 the value of an “economic survey, for which maps are necessary”, and without which potential  
416 projects would founder in “imperfect and ill-digested information” (1930, pages 333–334).

417 ‘Economic survey’ was a term that could be applied to just about any of the work that the AOC  
418 were commissioned to do, and was generally used to emphasise the reconnaissance aspect of  
419 the air photography over that of providing detailed or precise measurements. Most  
20 importantly, it was more flexible term than the ‘ecological’ survey. It could cede non-  
421 problematically to less rigorous epistemological principles.

422 The topographic outcome between 1928 and 1955 (Figure 1) suggests that the patterns of the  
423 ecologists’ interests, and priorities had little influence on Northern Rhodesian policy more  
424 broadly. ‘Economic’ rather than ‘ecological’ thinking won the day. The government scientists in  
425 Northern Rhodesia built most of their knowledge from decades of traverses by foot and  
426 automobile (Wigg, 1949). Elsewhere in the colony, when scientific officers attempted  
427 investigations, they didn’t have even provisional base maps and had to sketch their own *ad hoc*  
428 substitutes (*Summary of Work: Mankoya and Lealui Districts. Forestry Officer for Barotseland*, J.  
429 Martin, 1939. NAZ SEC1/975). It was the skill of the AOC to be able to marry the contradictory  
430 positions represented by the rhetoric of holistic decision-making frameworks and scientific  
431 planning, and the reality of government interest in visualising isolated, profitable areas. The  
432 ‘economic survey’ of the AOC, was (in the words of Captain Robbins) in fact offering the  
433 possibility to, “*Eliminat[e]... those areas which... were of lesser economic interest... [confining the]*  
434 *labours of expert investigation to those areas more likely to yield profitable results [so that each*  
435 *would receive] attention in direct proportion to its importance” (emphasis added) (An*  
436 *Experiment in the Classification of Land with the Use of Aerial Photographs*. C. R. Robbins, 1932. NAZ  
437 MAG2/9/3).

438 The original model of a neoliberal governmental regime describes state observation techniques  
439 being deployed for the purpose of *deciding the appropriate level* of state intervention (Foucault,  
40 2009; Osborne, 1996). However, it is hard to see how the Northern Rhodesian attitude towards

141 topography might reflect these goals for data collection. The ‘importance’ of an area of territory  
142 was almost always determined in advance, and under fairly aleatory circumstances. This is  
143 perhaps not surprising, it could in fact be expected that twentieth century cartography might  
144 compound rather than alleviate ‘uneven development’. However, in the case of Northern  
145 Rhodesia, insufficient analysis of the difference between the values of the ‘ecological’ and  
146 ‘economic’ surveys; and the failure of existing studies to identify the influence of commercial  
147 interests in shaping cartographic production have obscured this perspective. As a result the  
148 rhetoric of the importance of holistic territorial visualisation to rational resource management  
149 has been taken somewhat too seriously. In considering colonial cartography more broadly, that  
150 rhetoric should be treated with caution.

## 151 **Conclusion**

152 These histories of the uptake of aerial photography and the progress of colonial mapping are  
153 particular to Northern Rhodesia, but the model of a cartographic economy has viability  
154 elsewhere. Although the high-capital nature of aerial photography highlights questions of  
155 investment and value, all forms of territorial visualisation (including traditional land-based  
156 survey) are based on anticipated returns. As Edgar Barton Worthington suggested in his 1938  
157 review, *Science in Africa*, “Survey work, like other branches of development, should be financed  
158 by pledging the future” (1938, page 35). The intermittent reviews of African cartography from  
159 throughout the twentieth-century suggest the variety of commitments that were ‘pledged’ in  
160 the production of topography. The imperial policy of assigning responsibility for ‘routine  
161 mapping’ to local colonial survey offices means that the history of each of these will be  
162 somewhat different. Each territory saw shifting rates of colonial interest and capital investment  
163 (whether through settlers, plantation farming or mineral extraction). Patterns in mapping  
164 reflect the prevailing institutional and technological cartographic capacities at peak moments  
165 of interest.

166 If we don't take the value of topographic mapping to be self-evident, or its action to necessarily  
167 be ‘homogenising’ then we can begin to find more complex causal explanations for the patterns  
168 that can be observed in the case of early twentieth-century Northern Rhodesia. The model of a

69 cartographic economy has delivered four conclusions that are occluded by earlier studies. First  
70 of these is that the short period between 1927 and 1931 represents a transient moment during  
471 which topographic mapping was produced as the result of temporary circumstances that united  
472 different groups with divergent interests. Second is that the influences on the production of  
473 topography in Northern Rhodesia were relatively decentralised. Third, the value of  
474 governmental topography was not fixed, but could be 'produced' through various mechanisms  
475 – including the imposition of timeframes on resource exploitation, or the availability of  
476 technologies. Those timeframes could be manipulated in favour of those who profited from  
477 mapping projects. Finally, focusing on governmental scientific offices (including cartographic  
478 ones) might tend to discover an ambition to produce complete and homogeneous territorial  
479 representations. Yet what we have learned from more rounded histories of colonial agricultural  
80 science or anthropology applies equally to colonial knowledge of territory: ambitions were not  
481 necessarily shared across governmental authorities. Colonial epistemological positions were  
82 operated within tactically, by variety of parties.

83 Cartographic heterogeneity was more than an incidental effect of colonial rule. We need finer  
84 vocabularies to describe how cartography might serve to enable and to regulate social activity,  
85 and to differentiate between its usage within various forms of governmental and profit-making  
86 regimes. This would allow us a better grasp on the role of mapping in the evolving spatialities  
87 of post-independence Zambia, and beyond.

## 88 2 Bibliography

89 Adey P, 2010 *Aerial Life: Spaces, Mobilities, Affects* (Wiley-Blackwell, Oxford, UK)

90 Agrawal A, 2005 *Environmentality: Technologies of Government and the Making of Subjects* (Duke  
491 University Press, Durham)

92 Anderson B, 1983 *Imagined communities: reflections on the origin and spread of nationalism* (Verso, London,  
493 UK)

94 Anderson W, 2009, "From subjugated knowledge to conjugated subjects: science and globalisation, or  
495 postcolonial studies of science?" *Postcolonial Studies* 12(4) 389–400

96 Anker P, 2001 *Imperial Ecology: Environmental Order in the British Empire, 1895-1945* (Harvard University  
497 Press, Cambridge, MA)

- .98 Anon., 1926, "Surveying by Aeroplane" *Flight* 18(45) 735–736
- .99 Anon., 1927, "Commercial Air Surveying" *Aeroplane* 32(20) 570–575
- 00 Anon., 1928, "Air Survey: Rapid Progress of Unsubsidized Enterprise" *The Times*
- .01 Anon., 1929a, "Air Surveying and its Development: Aircraft Operating Co.'s Pioneering Work" *Flight*  
02 (Special Issue) 270–271
- .03 Anon., 1929b, "A New Air Survey Contract in Northern Rhodesia" *Flight* 21(52) 1342–1345
- 04 Anon., 1930, "Profiting by Aircraft" *Flight* 22(5) 163–165
- .05 Bancroft J A, Guernsey T D, 1961 *Mining in Northern Rhodesia: A Chronicle of Mineral Exploration and*  
06 *Mining Development* (British South Africa Company, Salisbury, Southern Rhodesia)
- .07 Barton G, 2001, "Empire forestry and the origins of environmentalism" *Journal of Historical Geography*  
08 27(4) 529–552
- 09 Biggs M, 1999, "Putting the State on the Map: Cartography, Territory, and European State Formation"  
.10 *Comparative Studies in Society and History* 41(02) 374–405
- 511 Blake A, 1971, "The Saga of Old '250' The South African Air Force's First Multi-Engined Aircraft"  
512 *Military History Journal (South African Military History Society)* 2(2)
- 513 Blomley N, 2003, "Law, Property, and the Geography of Violence: The Frontier, the Survey, and the  
514 Grid" *Annals of the Association of American Geographers* 93(1) 121–141
- 515 Bourne R, 1928 *Aerial Survey in Relation to the Economic Development of New Countries: With Special*  
516 *Reference to an Investigation Carried Out in Northern Rhodesia* (Clarendon Press, Oxford, UK)
- 517 Bradley K, 1952 *Copper Venture: The Discovery and Development of Roan Antelope and Mufulira. With 8*

- i18 *Drawings* (Mufulira Copper Mines and Roan Antelope Copper Mines, London, UK)
- i19 Branch J, 2012, "Colonial reflection' and territoriality: The peripheral origins of sovereign statehood"  
20 *European Journal of International Relations* **18**(2) 277–297
- i21 Branch J, 2014 *The Cartographic State: Maps, Territory, and the Origins of Sovereignty* (Cambridge  
i22 University Press, Cambridge, UK)
- i23 Braun L F, 2005, "Spatial institutionalisation and the Settler state: survey and mapping in the Eastern  
i24 Transvaal, 1852-1905" *South African Historical Journal* (53) 146–178
- i25 Chasseaud P, 2013 *Mapping the First World War: The Great War through maps from 1914-1918* (Collins,  
i26 Glasgow, UK)
- i27 Cochran-Patrick C K, 1931, "Aerial Reconnaissance Mapping in Northern Rhodesia" *Geographical*  
i28 *Review* **21**(2) 213
- i29 Collier P, 2002, "The Impact on Topographic Mapping of Developments in Land and Air Survey: 1900-  
30 1939" *Cartography and Geographic Information Science* **29**(3) 155–174
- i31 Craib R B, 2004 *Cartographic Mexico: A History of State Fixations and Fugitive Landscapes* (Duke  
i32 University Press, Durham, NC)
- i33 Crampton J W, 2011, "Cartographic calculations of territory" *Progress in Human Geography* **35**(1) 92–103
- i34 Crampton J W, Elden S, 2008 *Space, knowledge and power: Foucault and geography* (Ashgate, Aldershot,  
i35 UK)
- i36 Cronin M, 2007, "Northern Visions: Aerial Surveying and the Canadian Mining Industry, 1919-1928"  
i37 *Technology and Culture* **48**(2) 303–330
- i38 Crosthwait H L, 1930, "Aerial Survey of East and Central African Territories" *African Affairs*  
i39 **XXIX**(CXVI) 333–342



- 40 Demeritt D, 2001, "Scientific forest conservation and the statistical picturing of nature's limits in the  
541 Progressive-era United States" *Environment and Planning D: Society and Space* **19**(4) 431 – 459
- 542 Donaldson J W, 2008, "Pillars and perspective: demarcation of the Belgian Congo–Northern Rhodesia  
543 boundary" *Journal of Historical Geography* **34**(3) 471–493
- 44 Dyce M, 2013, "Canada between the photograph and the map: Aerial photography, geographical vision  
545 and the state" *Journal of Historical Geography* **39** 69–84
- 46 Edney M H, 1999 *Mapping an Empire: The Geographical Construction of British India, 1765-1843* (Oxford  
547 University Press, Oxford, UK)
- 48 Edney M H, 2011, "Cartography without 'Progress': Reinterpreting the Nature and Historical  
49 Development of Mapmaking", in *The Map Reader* Eds M Dodge, R Kitchin, and C Perkins (John Wiley  
50 & Sons, Ltd), pp 73–82
- 551 Ehrlich C, 1973, "Building and Caretaking: Economic Policy in British Tropical Africa, 1890-1960" *The  
552 Economic History Review* **26**(4) 649
- 553 Elden S, 2013 *The Birth of Territory* (University of Chicago Press, Chicago, IL)
- 554 Escolar M, 1997, "Exploration, cartography and the modernization of state power" *International Social  
555 Science Journal* **49**(151) 55–75
- 556 Ferguson J, 1990 *The Anti-politics Machine: "Development", Depoliticization, and Bureaucratic Power in  
557 Lesotho* (University of Minnesota Press, Minneapolis, MN)
- 558 Foucault M, 2009 *Security, Territory, Population: Lectures at the College de France, 1977-1978* Eds M  
559 Senellart, F Ewald, and A Fontana (Palgrave Macmillan, Basingstoke, UK)
- 60 Frankel S H, 1938 *Capital Investment in Africa: Its Course and Effects* (Oxford University Press, Oxford,  
561 UK)

- Frederiksen T, 2013, "Seeing the Copperbelt: Science, mining and colonial power in Northern Rhodesia" *Geoforum* 44 271–281
- Gann L H, 1964 *A History of Northern Rhodesia: Early Days to 1953* (Chatto & Windus, London, UK)
- Ghertner D A, 2010, "Calculating without numbers: aesthetic governmentality in Delhi's slums" *Economy and Society* 39(2) 185–217
- Haffner J, 2013 *The View from Above: The Science of Social Space* (MIT Press, Cambridge, MS)
- Hannah M G, 2000 *Governmentality and the Mastery of Territory in Nineteenth-Century America* (Cambridge University Press, Cambridge, UK)
- Harley J B, 1989, "Deconstructing the Map" *Cartographica* 26(2) 1–20
- Harvey D, 1982 *The Limits to Capital* (Blackwell, Oxford, UK)
- Harvey D, 1989 *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Blackwell, Oxford, UK)
- Hull M S, 2012 *Government of Paper: The Materiality of Bureaucracy in Urban Pakistan* (University of California Press)
- Larsgaard M L, 1993 *Topographic mapping of Africa, Antarctica, and Eurasia* (Western Association of Map Libraries, Provo, UT)
- Lefebvre H, 2009 *State, Space, World: Selected Essays* Eds N Brenner and S Elden (U of Minnesota Press)
- MacDonald A, 1996 *Mapping the World: A History of the Directorate of Overseas Surveys 1946-1985* (HMSO, London, UK)
- Matthes G H, 1926, "Oblique Aerial Surveying in Canada" *Geographical Review* 16(4) 568–582
- McAdam J, 1974, "The Flying Mapmakers: Some Notes on Early Developments of Air Survey in Central and Southern Africa" *Rhodesiana* 30 44–64
- McGrath G, 1976 *The surveying and mapping of British East Africa 1890 to 1946: origins, development and*

- 85 *coordination* (Department of Geography, York University, Toronto, CA)
- 86 Meebelo H S, 1986 *African proletarians and colonial capitalism: the origins, growth, and struggles of the*  
87 *Zambian labour movement to 1964* (Kenneth Kaunda Foundation, Lusaka, Zambia)
- 88 Michael B A, 2007, "Making Territory Visible: The Revenue Surveys of Colonial South Asia" *Imago*  
89 *Mundi* 59(1) 78–95
- 90 Mitchell T, 2002 *Rule of Experts: Egypt, Techno-politics, Modernity* (University of California Press,  
91 Berkeley, CA)
- 92 Monmonier M, 2002, "Aerial Photography at the Agricultural Adjustment Administration: Acreage  
93 Controls, Conservation Benefits, and Overhead Surveillance in the 1930s" *Photogrammetric Engineering*  
94 *and Remote Sensing* 68(11) 1257–61
- 95 Monmonier M S, 1985 *Technological Transition in Cartography* (University of Wisconsin Press, Madison,  
96 WI)
- 97 Osborne T, 1996, "Security and vitality: drains, liberalism and power in the nineteenth century", in  
98 *Foucault and political reason: liberalism, neo-liberalism and rationalities of government* Eds A Barry, T  
99 Osborne, and N S Rose (University of Chicago Press, Chicago, IL), pp 99–122
- 00 Phimister I, Mouat J, 2003, "Mining, Engineers and Risk Management: British Overseas Investment,  
01 1894–1914" *South African Historical Journal* 49(1) 1–26
- 02 Pullan R A, 1976, "The history and use of aerial photography in Zambia" *Zambia Geographical Journal* 31  
03 33–52
- 04 Pullan R A, 1978 *A First Check List of the Published Maps of Northern Rhodesia, 1890-1949* (Zambia  
05 Geographical Association, Lusaka, Zambia)
- 06 Ramaswamy S, 2001, "Maps and Mother Goddesses in Modern India" *Imago Mundi* 53 97–114

- 07 Robbins C R, 1934, "Northern Rhodesia; An Experiment in the Classification of Land with the Use of  
08 Aerial Photographs" *The Journal of Ecology* 22(1) 88
- 09 Scott J C, 1998 *Seeing Like State: How Certain Schemes to Improve the Human Condition Have Failed* (Yale  
10 University Press, New Haven, CT)
- 611 Slinn P, 1971, "Commercial Concessions and Politics During the Colonial Period the Role of the British  
512 South Africa Company in Northern Rhodesia 1890–1964" *African Affairs* 70(281) 365–384
- 513 Smith J R, 2006, "The Backbone of Colonial Mapping in Eastern Africa", in (ICA-ACI, Utrecht  
514 University, Utrecht, The Netherlands)
- 515 Stoler A L, 2010 *Along the Archival Grain: Epistemic Anxieties and Colonial Common Sense* (Princeton  
516 University Press, Princeton, NJ)
- 517 Stone J C, 1982, "The District Map: An Episode in British Colonial Cartography in Africa, with  
518 Particular Reference to Northern Rhodesia" *Cartographic Journal, The* 19(2) 104–112
- 519 Stone J C, 1995 *A Short History of the Cartography of Africa* (E. Mellen Press, New York, NY)
- 20 Tilley H, 2011 *Africa as a living laboratory: empire, development, and the problem of scientific knowledge, 1870-  
521 1950* (University of Chicago Press, Chicago, IL)
- 522 Whitehead M, Jones R, Jones M, 2007 *The Nature of the State: Excavating the Political Ecologies of the  
523 Modern State* (Oxford University Press, Oxford, UK)
- 524 Wigg L T, 1949, "Vegetation-Soil Map of Northern Rhodesia" *Empire Forestry Review* 28(1) 43–48
- 525 Wills A J, 1985 *An Introduction to the History of Central Africa: Zambia, Malawi, and Zimbabwe* 4th edition  
526 (Oxford University Press, Oxford, UK)
- 527 Winichakul T, 1994 *Siam Mapped: A History of the Geo-Body of a Nation* (University of Hawaii Press,  
528 Honolulu, HI)
- 529 Winterbotham H S L, 1936, "Mapping of the Colonial Empire", in *Report of the Annual Meeting of the*

30 *British Association for the Advancement of Science (Blackpool)* (Office of the British Association, London,  
31 UK), pp 101–116

32 Wood D, Fels J, 1992 *The Power of Maps* (Guilford Press, New York, NY)

33 Worthington E B, 1938 *Science in Africa: A Review of Scientific Research Relating to Tropical and Southern*  
34 *Africa* (Oxford University Press, Oxford, UK)

35