

GEOGRAPHY, SCIENCE AND NATIONAL IDENTITY

Scotland since 1520

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1

Introduction: geography, science and historical geographies of knowledge

This book is an attempt to understand the connections between geography, science and national identity in a particular geographical and historical context, and, in so doing, to write a historical geography of geographical knowledge. The focus is Scotland between the work of late Renaissance humanists concerned to 'situate' their nation historically and the engagement with geography as a form of identity in the work of Patrick Geddes and others in the early twentieth century.

I use the term 'historical geography of geographical knowledge' to signify two central concerns, elaborated upon in what follows. The first concern is with understanding the ways in which geographical knowledge in the past was used to constitute the 'space' that was Scotland and to shape ideas about the nature of Scotland as a geographical entity. 'Geographical knowledge' is understood here as a particular form of intellectual and scientific enquiry encompassing a variety of practices such as, for example, mapping, writing, picturing and natural historical surveying. In this first sense, then, geography itself as one form of intellectual enquiry – however understood by different people at different times in different places – is treated as part of a wider conception of geographical knowledge, part of a range of discursive practices through which ideas about the nation and national identity were realised. My second concern is to recover the sites and the social spaces in which geographical knowledge was undertaken and to plot the connections between the places of geographical knowledge production and its audiences and makers. Taken together, these two concerns inform the historical geography of geographical knowledge as I employ the term as being about *how* and *why* different forms of geographical knowledge were used in the past to constitute national identity, about *where* those different ideas were made and received and *for whom* they had the meanings they did.

These issues reflect wider interests within geography and other disciplines both in the nature of geographical knowledge and in the situated nature of science and other forms of intellectual endeavour. The 'critical turn' within the

history of geography, discussed further in this chapter, has been accompanied by a recognition from other disciplines that geography matters. Historians of science, for example, have studied the situated nature and movement of scientific knowledge and science as a social construction. That they and others have considered the place of scientific knowledge in these terms is a conscious rejection of earlier idealist notions of science as a universal practice derived without reference to the spaces of its production. In so doing, the local meanings of science have been brought into focus. Such interests are apparent, too, in the social sciences and in the humanities.

David Livingstone has noted these issues in discussing what he calls 'the historical geography of ideas'. Taking seriously the geography of knowledge or of scientific practice is not simply a matter of site and location. Spaces of and for knowledge are metaphorical as well as material. Place is an ordering term, a relational position for categories of knowing and for the objects of theoretical enquiry as it is also a site of display, for example, or a site either for knowledge production or for the didactic consumption and reception of theories, practices and natural objects. For Livingstone

Glimmerings of what a geography of scientific knowledge might amount to are thus indeed beginning to be glimpsed as sociologists and historians of science have begun to probe the role of the spatial setting in the production of experimental knowledge, the significance of the uneven distribution of scientific information, the diffusion tracks along which scientific ideas and their associated instrumental gadgetry migrate, the management of laboratory space, the power relations exhibited in the transmission of scientific lore from specialist space to public space, the political geography and social topography of scientific subcultures, and the institutionalization and policing of the sites in which the reproduction of scientific cultures is effected.

As he further notes, a geography of science 'will need to attend to spatial considerations at a variety of scales. Indeed, it will be one of the key methodological issues of such an undertaking to ascertain just what is the appropriate spatial scale at which to conduct any specific historical investigation, and then to determine how the various scales are to be related.'¹

For Scotland, something of these issues is apparent in a paper to the British Association for the Advancement of Science in September 1885 where H. A. Webster spoke to the title 'What has been done for the geography of Scotland, and what remains to be done'. Of Scotland, a country 'which has been traversed and retraversed in every possible direction by persons devoted to every department of knowledge, in which every district has been mapped and re-mapped, in which every county and town and parish has its local guide-book, its local antiquary, its local geologist, its local botanist, surely, you say, every geographical fact must have been recorded and made readily accessible to any

¹ D. Livingstone, 'Science and religion: foreword to the historical geography of an encounter', *Journal of Historical Geography*, 20 (1994), 372.

who feel interest therein'. Webster continued in order to note the contrary: 'I hope to show you that, to many questions which the geographer naturally asks, no answer is forthcoming, and that there are whole departments of geographical investigation at which we have only begun to work in a serious and fruitful manner.'²

I want to suggest that a historical geography of geographical knowledge can be the subject of 'serious and fruitful' enquiry. I hope to do so for Scotland with reference to questions concerning the different practices of geographical knowledge, the sites and spaces of geography's making, the audiences for such knowledge and the connections with other forms of national knowing. My concern is not only with the national scale. I consider the nature and making of local knowledge, the role of particular institutions and of individuals, even of single texts, as well as the connections between the making of national knowledge in different local places and at different times.

Before considering such questions, however, let me place these intentions in context by first considering recent writings on the history of geographical knowledge and then examining second, work within the history of science on the social and situated nature of scientific knowledge. The final part returns to the question of a historical geography of geographical knowledge through brief consideration of the historical geography of Darwinism and of modernity.

New histories of geography and of geographical knowledge

The history of geography was not, until recently, a particularly active or prominent field of geographical enquiry. In most cases, writings upon the history of geography were distinguished by uncritical notions of what geography was, by hagiographic portrayals of the subject's 'great men', and by too little attention to the wider social and intellectual contexts in which geography and geographers worked.

In recent years, however, there has been a notable resurgence of interest in the subject.³ This has been evident in attention to the following: the discursive nature of geographical knowledge; the genealogy of geography's key concepts; the connections between geography and power; and the fact that much work in the history of geographical knowledge has been undertaken by practitioners of other subjects.

² H. A. Webster, 'What has been done for the geography of Scotland, and what remains to be done', *Scottish Geographical Magazine*, 1 (1885), 487.

³ F. Driver, 'New perspectives on the history and philosophy of geography', *Progress in Human Geography*, 18 (1994), 92–100; 'Visualising geography: a journey to the heart of the discipline', *Progress in Human Geography*, 19 (1995), 123–34; 'Histories of the present: the history and philosophy of geography', *Progress in Human Geography*, 20 (1996), 100–9. For the contemporary context, see E. Baigent, 'Recreating our past: geography and the rewriting of the Dictionary of National Biography', *Transactions of the Institute of British Geographers*, 19 (1994), 225–8; J. Sidaway, 'The production of British geography', *Transactions of the Institute of British Geography*, 22 (1997), 488–504.

On context and the discursive production of geographical knowledge

For Felix Driver, writing in 1994, the 'progress' evident in work on the history of geography has been apparent in an engagement with the wider academic literature on the history and philosophy of the social sciences, a willingness to consider geographical knowledge as constituted as much by social relations and technical practices as by ideas and individuals, and by critical reflection on the wider purposes of writing about the history and present condition of geographical discourse.⁴ These advances have been reflected in and stimulated by Livingstone's *The geographical tradition* (1992). Livingstone's book has been widely and enthusiastically reviewed by geographers and historians of science alike as a key 'moment' in the new critical histories of geographical knowledge.⁵ In its attention to geography's context and its defence of 'situated messiness' – the ways in which geographical knowledge was (and is) both discursively complex *and* intellectually shaped in different places by different people at different times – Livingstone's work, argued Driver, 'set a new agenda for the history of geography'.⁶ It has done so, too, not just through Livingstone's thorough-going critique of conventional approaches to the history of geography but in his insistence that we must situate geography historically *and* geographically.

Understanding geographical knowledge as a *situated* concern can mean several things. Geographical knowledge, whatever that term means now or meant in the past, cannot be understood as something set apart from the intellectual, social and political milieux of its time. In this sense, recent work by scholars interested in the history and nature of geographical knowledge has been distinguished by attention both to the personal and political connections that underlay geography's emergence as an institutionalised academic subject in Britain from the later 1880s,⁷ and to the connections between geography and leading scientific ideas, such as neo-Lamarckianism and Darwinism.⁸

Matters of context are also epistemological. For David Stoddart, the later eighteenth-century encounter between European explorer-navigators and

⁴ Driver, 'New perspectives', 92.

⁵ Two fuller discussions of the book are A. Werritty and L. Reid, 'Debating the geographical tradition', *Scottish Geographical Magazine*, 111 (1995), 196–8; and 'Conversations in review', *Ecumene*, 3 (1996), 351–60. Good sees one of the book's strengths as its combination of the history of geographical thought with the history of the social and institutional settings of geography's practitioners: G. Good, *Sciences of the earth: an encyclopedia of events, people and phenomena* (New York), Vol. I, xix.

⁶ Driver, 'New perspectives', 92.

⁷ D. Stoddart *On geography* (Oxford, 1996); Livingstone, *Geographical tradition*, 177–215; T. Unwin, *The place of geography* (London, 1992), 83–5; F. Driver, 'Geography's empire: histories of geographical knowledge', *Environment and Planning D: Society and Space*, 10 (1992), 23–40.

⁸ D. Livingstone, 'Natural theology and neo-Lamarckism: the changing context of nineteenth-century geography in the United States and Great Britain', *Annals of the Association of American Geographers*, 74 (1984), 9–28; *Darwin's forgotten defenders: the encounter between evangelical theology and evolutionary thought* (Edinburgh, 1987); R. Peet, 'The social origins of environmental determinism', *Annals of the Association of American Geographers*, 75 (1985), 309–33.

native 'Others' provided the basis for the emergence of 'modern' geography as a whole. Such encounters took place not just in given geographical contexts such as the Pacific Ocean, North America, sub-Saharan Africa or the Indian sub-continent, but in particular 'scientific' ways: realism in description, systematic classification in collection, and comparative method in explanation.⁹ Other means of securing geographical knowledge should be noted: trusting native informants; circulating questionnaires; speculative and essentially Baconian fieldwork designed to gather facts about distant places and the unknown near at home. One must also consider the conjoint interests of politicians and natural philosophers whose concerns demanded the institutionalisation of natural knowledge in order to advance it and, of course, the shipping 'home' of new products (and even the people themselves) to become objects of wonder for different audiences within Europe's centres of geographical and scientific calculation.

Matters of context relate also to the politics of doing geography and for whom questions about the recovery of such knowledge have significance. Much recent geographical enquiry in general has been motivated by a desire to give voice to the hitherto marginalised.¹⁰ Such post-colonial perspectives are mirrored in the concerns of some historians of geography and others to understand exactly how geography was implicated in European imperialism and colonialism. At the same time, critical attention to the history of geographical knowledge has resulted from a concern to consider that history in relation to other intellectual or disciplinary histories, such as the history of science.¹¹ Yet others have discussed the history of geography and of geography's books as part of new perspectives on the history of (geographical) education.¹²

Sensitivity to historical context relates both to the need to consider the making and meaning of geographical knowledge in its own terms and to question the 'idea of geographical traditions' itself.¹³ As David Matless notes:

To raise, as Livingstone does, issues of geography's earthly situation is to question the boundaries of geographical knowledge. . . . Rather than seek a new and all-inclusive definition of geography, we might perhaps recognize that the discipline of geography has been and is now one *genre* of geographical knowledge among many, and that a crucial part of geography's history consists of disciplinary geography's marking out of itself.

⁹ Stoddart, *On geography*, 28–40.

¹⁰ D. Gregory, 'Post-colonialism', in R. J. Johnston, D. Gregory, G. Pratt and M. Watts (eds.), *The dictionary of human geography* (Oxford, 2000), 612–15.

¹¹ D. Livingstone, 'The history of science and the history of geography: interpretations and implications', *History of Science*, 22 (1984), 271–302.

¹² T. Ploszajska, *Geographical education, empire and citizenship: geographical teaching and learning in English schools, 1870–1944* (Historical Geography Research Group Publication Series, no. 35), (Cambridge 1999); F. Driver and A. Maddrell, 'Geographical education and citizenship: introduction', *Journal of Historical Geography*, 22 (1996), 371–2.

¹³ F. Driver *et al.*, 'Geographical traditions: rethinking the history of geography', *Transactions of the Institute of British Geographers*, 20 (1995), 403–4.

Matless has pointed to the implications of such claims for 'a historical geography of the grand categories of geography – region, space, landscape, geography, etc. – and of the role and make-up of the geographer: a genealogy of geography and of the geographical self'.¹⁴

For Clive Barnett, the history of geography understood as a matter of genealogy and of historical context is not axiomatically useful because such issues have little to say concerning 'the only context that really matters: the contemporary one', and because 'the new contextual and critical histories of geography tend to assume too easily that all geography in the past is the past of today's geography, sweeping any questions about the nature of the historical relation under the cover of expanded notions like 'geographical discourse' or 'geographical knowledge'.¹⁵

Arguing that the contemporary context is the *only* context that *really* matters smacks of a surrogate presentism, even of the wholesale dismissal of the past. It is one thing to argue that we ought not straightforwardly to see the history of geography as the Whiggish history of today's geography. There I am sympathetic to Barnett. Yet it is another thing to exclude the possibility of a historical investigation of geography's past *in its own terms*, which he seems to suggest. I would want to argue that we must take *more* seriously the attempt to understand geographical knowledge in the past. As with Gillian Rose,¹⁶ my concern is neither to insist upon a genealogy for geographical knowledge nor to privilege the present, but, rather, to recover its historical *and* geographical context as a question of historical geography. As Driver puts it:

The contextual approach to the history of geography is thus more concerned with mapping the lateral associations and social relations of geographical knowledge than with constructing a vision of the overall evolution of the modern discipline. It demands a far more historically (and geographically) sensitive approach to the production and consumption of knowledge than that provided by more conventional narrative histories.¹⁷

The idea of geographical knowledge as a discourse does not just refer to that set of intellectual and scientific practices at any given place or moment held to constitute such knowledge. It includes also the languages, the institutions and the different 'modalities' through which we have come to know the world.¹⁸ To argue that geographical knowledge is discursive is to recognise its

¹⁴ D. Matless, 'Effects of history', *Transactions of the Institute of British Geographers*, 20 (1995), 405–6.

¹⁵ C. Barnett, 'Awakening the dead: who needs the history of geography?', *Transactions of the Institute of British Geographers*, 20 (1995), 417–19.

¹⁶ G. Rose, 'Tradition and paternity: same difference', *Transactions of the Institute of British Geographers*, 20 (1995), 414–16; see also D. Livingstone, 'Geographical traditions', *Transactions of the Institute of British Geographers*, 20 (1995), 420–2.

¹⁷ F. Driver, 'Geography's empire', 35.

¹⁸ My use of the term 'modalities' is drawn from Foucault's 'enunciative modalities', where the social subject that produces a statement is understood not as an entity 'beyond' the discourse in question, but is something formed by the statement itself. M. Foucault, *The archaeology of knowledge* (London, 1972), 95–7.

constitutive power; as Driver and Rose note, 'To argue that geographical knowledge is discursively constructed is to insist on the importance of practices and institutions as well as concepts. Discourses always do their work in specific social contexts and with material consequences'.¹⁹

Considering discourse as specific representations, practices and performances through which meanings are produced, connected into networks and legitimized has been helpful for what Derek Gregory terms the 'revivified history of geography' in revealing the different ways in which geographical knowledge has been made.²⁰ It is interesting that this revivified history has been paralleled by a more critical history of (the) map(s), for example, and by an interest in 'mapping' as the processes, literal and figurative, of putting things in place.²¹ I take such interest to be part of wider concerns with representation in geographical knowledge, apparent in landscape painting and in photography,²² and with the attention paid to the socially constructed nature of meaning in post-modern human geography.²³

Certainly, concerns with context and with discourse have shifted the attention of historians of geographical knowledge away from paradigmatic notions of change,²⁴ and away from conceptions of 'grand theory' and meta-narrative towards the specific, the theoretical and the situated circumstances constituting the conditions of geography's making.

Geography as a form of geographical knowledge before c.1800

The 'marking out of itself' of disciplinary geography has been apparent in studies which, while focused upon different time periods and different countries, have collectively challenged the too-often repeated view that academic

¹⁹ F. Driver and G. Rose, 'Introduction: towards new histories of geographical knowledge', in F. Driver and G. Rose (eds.), *Nature and science: essays in the history of geographical knowledge* (Historical Geography Research Group Publication Series, no. 28) (Cheltenham, 1992), 4.

²⁰ D. Gregory, 'Discourse', in Johnston, Gregory, Pratt and Watts (eds.), *The dictionary of human geography* (Oxford, 2000), 180–1.

²¹ D. Burnett, 'The history of cartography and the history of science', *Isis*, 90 (1999), 775–780; J. Brotton, *Trading territories: mapping the early modern world* (London, 1997); D. Cosgrove (ed.), *Mappings* (London, 1999); M. Edney, *Mapping an empire: the geographical construction of British India, 1765–1843* (Chicago, 1997).

²² S. Daniels, *Fields of vision: landscape imagery and national identity in England and the United States* (Cambridge, 1993); J. Schwartz, 'The Geography Lesson: photographs and the construction of imaginative geographies', *Journal of Historical Geography*, 22 (1996), 16–45; J. Ryan, *Picturing empire: photography and the visualization of the British empire* (London, 1997).

²³ D. Gregory, *Geographical imaginations* (Oxford, 1993).

²⁴ P. Haggett and R. Chorley, 'Models, paradigms and the new geography', in P. Haggett and R. Chorley (eds.), *Models in geography* (London, 1967), 19–42; R. J. Johnston, 'Paradigms and revolutions or evolution?: observations on human geography since the Second World War', *Progress in Human Geography*, 2 (1978), 189–206; A. Buttner, 'On people, paradigms and "progress" in geography', in D. Stoddart (ed.), *Geography, ideology and social concern* (Oxford, 1981), pp. 81–98; D. Stoddart, 'The paradigm concept and the history of geography', in D. Stoddart, *Geography, ideology and social concern* (Oxford, 1981), pp. 70–80; M. Harvey and B. Holly, 'Paradigms, philosophy and geographic thought', in M. Harvey and B. Holly (eds.), *Themes in geographic thought* (Beckenham, 1981), 11–32; A. Mair, 'Thomas Kuhn and understanding geography', *Progress in Human Geography*, 10 (1986), 345–69.

geography in Europe has its 'origins' in the last quarter of the nineteenth century.²⁵

Lesley Cormack's *Charting an empire* (1997) examines the nature of geography and geographers in Cambridge, Oxford, and the 'third university' of Gresham College, London from 1580 to 1620. Geography, she claims, was central in inculcating a sense of English national identity that was inward looking in its attachment to local place and country, and outward looking in its attention to the English (and nascent British) empire. She identifies three sorts of geographers and of geography: a first small group focused on mathematical geography and its evident utilitarian connections; a second larger group concerned itself with descriptive geography; and a third group focused upon chorography, understood as regional or local studies. For Cormack, chorography was 'the most wide-ranging of the geographical arts, in that it provided the specific detail to make concrete the other general branches of geography'.²⁶

Cormack's work has been criticised for its prosopographical methodology and attention to the ownership of geography books, an approach which too readily divorces geography from its wider intellectual context and the other interests of the individuals concerned.²⁷ Nevertheless, Cormack's book, and her related work on empire and on geography as a courtly practice,²⁸ not only extend the chronological period over which geography was part of university education but provide a detailed study of the sites of early modern geography's involvement as a form of state knowledge.²⁹ Others have shown how geography was, from the later seventeenth century, also part of the rise of experimental science and the 'new' natural philosophy, and that chorography and mapping were practically important both in the emergence of the state and to the idea of national identity in the early modern period.³⁰

²⁵ H. Capel, 'Institutionalization of geography and strategies of change', in Stoddart, *Geography, ideology and social concern*, 37–69; E. Lochhead, 'The emergence of academic geography in Britain in its historical context', (Ph.D. thesis, University of California at Berkeley, 1980); G. Dunbar (ed.), *From traveller to scientist: the professionalization and institutionalization of geography in Europe and North America since 1870* (Dordrecht, forthcoming).

²⁶ L. Cormack, *Charting an empire: geography at the English universities, 1580–1620* (Chicago, 1997), 163.

²⁷ R. Mayhew, [Review], *Ecumene*, 5 (1998), 487–8.

²⁸ L. Cormack, "'Good fences make good neighbors": geography as self-definition in early modern England', *Isis*, 82 (1991), 639–61; 'Twisting the lion's tail: practice and theory at the court of Henry Prince of Wales', in B. Moran (ed.), *Patronage and institutions: science, technology and medicine at the European court* (Woodbridge, 1991), 67–84; 'The fashioning of an empire: geography and the state in Elizabethan England', in A. Godlewska and N. Smith (eds.), *Geography and empire* (Oxford, 1994), 15–30.

²⁹ Cormack's attention to geography in early modern Oxford is very different from J. Baker, *The history of geography* (Oxford, 1963), 119–29.

³⁰ D. Livingstone, 'Science, magic and religion: a contextual re-assessment of geography in the sixteenth and seventeenth centuries', *History of Science*, 26 (1988), 269–94; 'Geography, tradition and the scientific revolution: an interpretative essay', *Transactions of the Institute of British Geographers*, 15 (1990), 359–73. J. Black, 'Mapping early modern Europe', *European History Quarterly*, 25 (1995), 431–42; Brotton, *Trading territories*; D. Buisseret (ed.), *Monarchs, ministers and maps: the emergence of cartography as a tool of government in early modern Europe* (Chicago, 1992); Cormack, *Charting an empire*; M. Wintle, 'Renaissance maps and the construction of the idea of Europe', *Journal of Historical Geography*, 25 (1999), 137–65.

Robert Mayhew has advanced our understanding of geography as it was understood in eighteenth-century England in several respects. His work is insistent upon the recovery of geography's textual traditions and its connections with classical education, and, thus, with knowing how it was that geography was defined and used by its practitioners and understood by its audiences. Initial attention to Samuel Johnson's conception of geography as a rational discourse has been developed in further studies.³¹ Mayhew's attention to what he has called 'the character of English geography' between c. 1660 and 1800 centres upon his analysis of geography books, definitions of their function and audience, their readership and what he calls the 'milieu of book production'.³² Such a resolutely textual hermeneutic approach shows that geography in England in this period was part both of a commercial and practical tradition, with its emphasis upon practical utility and polite learning, and of a humanistic and scholarly tradition which allied geography with the classics and civil history. Although geography was not 'an independent discipline' in schools and universities in eighteenth-century England, mathematical and descriptive geography were taught to a range of ages and social classes, and grammar schools and Cambridge and Oxford universities taught geography as part of a humanist education. In these ways, geography in eighteenth-century England was understood in particular intellectual contexts and promoted in certain sites as a textual practice designed to enlighten and to politicise civic society.³³

In France, legislators confirmed the importance of geography for what eighteenth-century commentators understood as the 'Science of Man' by placing it in the Class of Moral and Political Sciences in the new National Institute (in 1795). These initiatives were not continued beyond 1803, however, and human geography was slow to develop in consequence.³⁴ Even so, scholars such as Turgot placed geography within his progressivist vision for the human sciences. His and others' conception of human progress was fundamentally geographical since the idea of a 'stage-by-stage' development of peoples depended upon global comparisons that were temporal *and* spatial.³⁵

³¹ Mayhew, *Geography and literature in historical context: Samuel Johnson and eighteenth-century conceptions of geography* (Oxford, School of Geography Research Papers, no. 54, 1997); 'Was William Shakespeare an eighteenth-century geographer?: constructing histories of geographical knowledge', *Transactions of the Institute of British Geographers*, 23 (1998), 21–37; 'Geography in eighteenth-century British education', *Paedagogica Historica*, 34 (1998), 731–69; *idem*, 'William Guthrie's *Geographical grammar*, the Scottish enlightenment and the politics of British geography', *Scottish Geographical Journal*, 115 (1999), 19–34.

³² R. Mayhew, 'The character of English geography, c. 1660–1800: a textual approach', *Journal of Historical Geography*, 24 (1998), 385–412.

³³ R. Mayhew, *Enlightenment Geography: the political languages of British geography, c. 1650–1850* (London, 2000).

³⁴ M. Staum, 'The Enlightenment transformed: the Institute Prize contests', *Eighteenth-Century Studies*, 19 (1985), 153–79; 'Human geography in the French Institute: new discipline or missed opportunity?', *Journal of the History of the Behavioural Sciences*, 23 (1987), 332–40; 'Paris Geographical Society constructs the Other, 1821–1850', *Journal of Historical Geography*, 26 (2000), 222–38.

³⁵ M. Heffernan, 'On geography and progress: Turgot's *Plan d'un Ouvrage sur la géographie politique* (1751) and the origins of modern progressive thought', *Political Geography*, 13 (1994), 328–43.

Godlewska's *Geography unbound* (1999) examines the several trajectories of geography in eighteenth-century France and emphasises the contemporary search for languages of accurate geographical representation, notably in the mathematical tradition. In that sense, she traces the discursive bases against which France both came to know itself through projects of state mapping and national description and sought to map its overseas territories.³⁶

Such work has advanced our knowledge of geography's history and historical geography since, as with Francis Sitwell's summary of what geography books were available before c. 1800,³⁷ the nature of geography and the communities who practised it as an intellectual concern is highlighted for given national contexts and at certain moments. But it is clear, too, that whilst eighteenth-century geography was a textual and institutionalised practice in these terms, geographical knowledge embraced more than either the textual or the disciplinary tradition of geography *sensu stricto*.

Other studies of geographical knowledge in the Enlightenment have shown such knowledge to be altogether more complicated and to have included the classification and display of natural knowledge, the imposition of European ways of thinking on nature's diversity, the visualisation of native 'otherness', and the voyages and travels of explorers.³⁸ Work on the teaching of geography within universities and in the public sphere also suggests that what was understood as geography varied with context.³⁹ Alongside an understanding of geography as a textual tradition and of its utility for eighteenth-century scholars in conceiving of conjectural history and the idea of historical change, for example,⁴⁰ geographical knowledge in the form of what the Royal Society in the period 1720–79 termed 'natural history' and 'mixed mathematics' (including astronomy, weights and measures, and geometry as well as geography) was an integral part of British commercial and imperial knowledge.⁴¹

Several things follow from these claims. The first concerns the need to establish the connections between geography and other forms of natural and social knowledge – 'globalising discourses of terrestrial knowledge' as Porter has it⁴² – in the eighteenth century and for other times. The second is in showing how

³⁶ A. Godlewska, *Geography unbound: French geographic science from Cassini to Humboldt* (Chicago, 1999).

³⁷ O. Sitwell, *Four centuries of special geography: an annotated guide to books that purport to describe all the countries in the world published in English before 1888, with a critical introduction* (Vancouver, 1993).

³⁸ C. Withers and D. Livingstone, 'Introduction: on geography and enlightenment', in D. Livingstone and C. Withers (eds.), *Geography and enlightenment* (Chicago, 1999), 1–28.

³⁹ C. Withers, 'Notes towards a historical geography of geography in early modern Scotland', *Scottlands*, 3 (1996), 111–24; 'Towards a history of geography in the public sphere', *History of Science*, 37 (1999), 45–78.

⁴⁰ G. Abbatista, 'Establishing "the order of time and place": "rational geography"', French erudition and the emplacement of history in Gibbon's mind', in D. Womersley (ed.), *Edward Gibbon: bicentenary essays. Studies on Voltaire and the eighteenth century*, 355 (1997), 45–72.

⁴¹ R. Sorrenson, 'Towards a history of the Royal Society in the eighteenth century', *Notes and Records of the Royal Society of London*, 50 (1996), 29–46; R. Drayton, 'Knowledge and empire', in P. Marshall (ed.), *The Oxford history of the British empire: the eighteenth century* (Oxford, 1998), 231–52; C. Bayley, *Empire and information* (Cambridge, 1996), 300–14.

⁴² R. Porter, 'The terraqueous globe', in G. Rousseau and R. Porter (eds.), *The ferment of knowledge* (Cambridge, 1990), 285–324.

the discursive nature of geographical knowledge depended upon the sites of its making. The third has to do with the fact that, as Cormack and Richard Sorrenson's work has shown, geography and geographical knowledge has long been concerned with what David Miller and Peter Reill have termed 'visions of empire'.⁴³

Geographical knowledge and imperialism

It is arguable that the enormous range of recent interest in the nature of imperialism, in the post-colonial analysis of culture, and in geography and empire has been prompted by Edward Said's influential *Orientalism* (1978).⁴⁴ Amongst historians of geography, Said's attention to the discursive power of 'imaginative geographies' has been drawn upon to re-assess the role of geography in the history of modern imperialism and to explore the enduring ideologies of imperialism in contemporary geographical knowledge.

Many scholars concerned with imperial geographies have considered them, for Britain and the legacy of Britain's empire anyway, in what Eric Hobsbawm termed the 'age of high empire'⁴⁵ – c. 1870 and 1914. As Driver has shown, the closing decades of the nineteenth century brought into being an altogether different world. It was a world in which exploration shifted from the sea to the land, and the closure of imperial space was accompanied by the popular and racialised representation of the colonised 'other', not least because the emergence of 'modern' geography as an institutionalised academic discipline was bound up both with the practicalities of empire and with the birth of a certain form of 'modernity' itself.⁴⁶

Two notable essay collections – *Geography and empire* (1994), and *Geography and imperialism* (1995), and Driver's *Geography militant* (2000) – have taken these issues further in directing this 'new agenda for theoretical and historical work on geography and empire'.⁴⁷ Significant advances have been made in understanding the connections between the French geographical movement and French imperialism in the nineteenth and early twentieth centuries,⁴⁸ and

⁴³ D. Miller and P. Reill (eds.), *Visions of empire: voyages, botany, and representations of nature* (Cambridge, 1996). ⁴⁴ Driver, 'Geography's empire', 30–5; 'New perspectives', 95–6; 'Histories of the present?', 100–2.

⁴⁵ E. Hobsbawm, *The age of empire* (London, 1987). ⁴⁶ Driver, 'Geography's empire', 26–30.

⁴⁷ Driver, 'Histories of the present?', 100.

⁴⁸ M. Heffernan, 'The limits of utopia: Henri Duveyrier and the exploration of the Sahara in the nineteenth century', *Geographical Journal*, 155 (1989), 342–52; 'The ambiguity of the Sahara: French images of the North African desert in the nineteenth century', *Maghreb Review*, 17 (1992), 178–88; 'A state scholarship: the political geography of French international science during the nineteenth century', *Transactions of the Institute of British Geographers*, 19 (1994), 21–45; 'The science of empire: the French geographical movement and the forms of French imperialism, c. 1870–c. 1920', in Godlewska and Smith (eds.), *Geography and empire* (Oxford, 1994), 92–114; 'The spoils of war: the *Société de Géographie de Paris* and the French empire, 1914–1919', in M. Bell, R. A. Butlin and M. Heffernan (eds.), *Geography and imperialism, 1820–1940* (Manchester, 1995), 221–64; M. Heffernan and K. Sutton, 'The landscape of colonialism: the impact of French colonial rule on the Algerian rural settlement pattern, 1830–1987', in C. Dixon and M. Heffernan (eds.), *Colonialism and development in the contemporary world* (London, 1991), 121–51.

between geographical interpretations of Italy and Italian colonialism in the 1920s and 1930s.⁴⁹ Advances have also been made in understanding both the Russian imperial geographical imagination⁵⁰ and, in Britain, the complex connections between geography's texts, state institutions and the idea of the 'imperial geographical citizen'.⁵¹ Other work has focused on particular figures such as the imperial (self-)propagandiser, Henry Morton Stanley,⁵² or upon David Livingstone as imperial missionary,⁵³ and upon discursive practices such as mapping and photography by which the empire was constituted 'out there' and consumed by domestic audiences.⁵⁴ The role of women in the making and representation of the empire, and, thus, the gendering of imperial geographical knowledge, has also been the focus of attention.⁵⁵

In several ways, then, the connections established in this and other work between geographical knowledge and imperialism, notably in the later nineteenth century, have been important to the recent heightened profile of the history of geography and of geographical knowledge. I want here to move away, however, from what Barnett has termed, for the nineteenth century, the 'overwhelming, although not exclusive fascination with geography's historical involvements with empire'.⁵⁶ This is borne of a concern to understand the

⁴⁹ L. Gambi, 'Geography and imperialism in Italy: from the unity of the nation to the "new" Roman empire', in Godlewska and Smith (eds.), *Geography and empire*, 74–91; D. Atkinson, 'Geopolitics, cartography and geographical knowledge: envisioning Africa from Fascist Italy', in Bell, Butlin and Heffernan (eds.), *Geography and imperialism*, 265–97.

⁵⁰ M. Bassin, 'Russia between Europe and Asia: the ideological construction of geographical space', *Slavic Review*, 50 (1991), 1–17; 'Inventing Siberia: visions of the Russian east in the early nineteenth century', *American Historical Review*, 96 (1991), 763–94; *Imperial visions: nationalism and geographical imagination in the Russian far east, 1840–1865* (Cambridge, 1999); J. Pallot, 'Imagining the rational landscape in late imperial Russia', *Journal of Historical Geography*, 26 (2000), 273–91.

⁵¹ R. A. Butlin, 'Historical geographies of the British empire, c.1887–1925', in Bell, Butlin and Heffernan (eds.), *Geography and imperialism*, 151–88.

⁵² F. Driver, 'Henry Morton Stanley and his critics: geography, exploration and empire', *Past and Present*, 133 (1991), 134–67.

⁵³ F. Driver, 'David Livingstone and the culture of exploration in mid-Victorian Britain', in *David Livingstone and the Victorian encounter with Africa* (National Portrait Gallery, London, 1996), 109–38; J. M. MacKenzie, 'David Livingstone and the worldly after-life: imperialism and nationalism in Africa', in *David Livingstone and the Victorian encounter with Africa* (National Portrait Gallery, London, 1996), 201–19.

⁵⁴ Edney, *Mapping an empire*; Ryan, *Picturing empire*.

⁵⁵ M. Domosh, 'Toward a feminist historiography of geography', *Transactions of the Institute of British Geographers*, 16 (1991), 95–104; D. Stoddart, 'Do we need a feminist historiography of geography – and if we do, what should it be?', *Transactions of the Institute of British Geographers*, 16 (1991), 484–7; M. Domosh, 'Beyond the frontiers of geographical knowledge', *Transactions of the Institute of British Geographers*, 16 (1991), 488–90; A. Blunt, *Travel, gender and imperialism: Mary Kingsley and West Africa* (New York, 1994); A. Blunt and G. Rose (eds.), *Writing women and space: colonial and postcolonial geographies* (New York, 1994); D. Gregory, 'Between the book and the lamp: imaginative geographies of Egypt, 1849–1850', *Transactions of the Institute of British Geographers*, 20 (1995), 29–57; G. Kearns, 'The imperial subject: geography and travel in the work of Mary Kingsley and Halford Mackinder', *Transactions of the Institute of British Geographers*, 22 (1997), 450–72; A. Mander, 'Geography, gender and the state: a critical evaluation of the development of geography 1830–1918', (D.Phil. thesis, University of Oxford, 1995); C. McEwan, '“The Mother of all the Peoples”: geographical knowledge and the empowering of Mary Slessor', in Bell, Butlin and Heffernan, *Geography and imperialism*, 125–50; 'Cutting power lines within the palace? countering paternity and eurocentrism in the 'geographical tradition', *Transactions of the Institute of British Geographers*, 23 (1998), 371–84; 'Gender, science and physical geography in nineteenth-century Britain', *Area*, 30 (1998), 215–23. ⁵⁶ Barnett, 'Awakening the dead', 418.

nature of geographical knowledge in one national context over the *longue durée*. My intentions are lent support by the work of Cormack, Richard Drayton, John Gascoigne, Mayhew and Sorrenson which has extended the historical range of geography's concerns with empire in ways which do not presume to connect the 'age of high empire' to earlier 'moments' for geography and empire but which require, simply, further study in particular geographical contexts. My concern to detail a historical geography of geographical knowledge in one national context has also been stimulated by writings in the history of science.

The social and situated nature of scientific knowledge

In an editorial published in 1995, Thrift, Driver and Livingstone commented: 'If it were necessary to choose the most vibrant and exciting areas of research in the social sciences and humanities today, then surely the study of science as a social construction would figure large'.⁵⁷ Such interest was the result of attention to several things: the theoretical nature of power in society; the reflexivity of knowledge; an understanding of knowledge making as a practical activity; and, notably, an 'emphasis on space'. The study of science as a social construction has, they argued, 'been pursued through a peculiarly spatial imaginary which always attaches insight to the site'. Sites were not, however, simply spatial 'containers': 'The locales in which scientific knowledge is produced are not seen as passive backdrops, but as vital links in the chain of production, validation, and dissemination' [of knowledge]. In considering that the study of science as a social construction has produced its own geographies of scientific knowledge and that such geographies open up possibilities for further research, brief attention was paid by them to three things: to the sites of scientific knowledge; to the 'different networks of people and things which have allowed scientific knowledge to be constructed at a distance'; and to 'the process of constitution of the fields in and through which scientific knowledge can be legitimately gathered'.⁵⁸

As Livingstone has elsewhere noted, attention to space in these ways is apparent in work on the situated nature of rationality, the local nature of culture and the spatial constitution of historical understanding.⁵⁹ Against such collective interest in the spatialised nature of knowledge, Livingstone in turn elsewhere sketched out a geography of science by reviewing works in a threefold 'rudimentary taxonomy': studies addressing the regionalisation of scientific style; studies of the political topography of scientific commitment; and those considering what he termed the 'social space of scientific sites'.⁶⁰

⁵⁷ N. Thrift, F. Driver and D. Livingstone, 'The geography of truth', *Environment and Planning D: Society and Space*, 13 (1995), 1. ⁵⁸ Thrift, Driver and Livingstone, 'The geography of truth', 2-3.

⁵⁹ D. Livingstone, 'The spaces of knowledge: contributions towards a historical geography of science', *Environment and Planning D: Society and Space*, 13 (1995), 5-34.

⁶⁰ Livingstone, 'Spaces of knowledge', 16-29.

Such attention by geographers to the socially constructed and situated nature of scientific knowledge reflects the long standing and more thoroughgoing interests of historians of science in the sociology of scientific knowledge. Prior to Thomas Kuhn's influential *The structure of scientific revolutions* (1962), scientific knowledge was, in general, held to be objective, universal and true; consequently the sites of its making and the conduct of its practitioners were immune from serious scrutiny. Subsequent work by Barry Barnes, David Bloor and others has treated questions of objectivity, truth and the (presumed) universality of knowledge as effects to be explained, however, rather than as direct outcomes of the scientific method. Thus, the sociology of scientific knowledge has increasingly focused on what scientists actually do and, in turn, upon the social and the located nature of knowledge making. As Jan Golinski makes clear, understanding 'scientific knowledge primarily as a human product, made with locally situated cultural and material resources, rather than as simply the revelation of a pre-given order of nature', has initiated a 'remarkably productive period in the understanding of science as a human enterprise'.⁶¹

The 'geographical turn' in the history of science

Crosbie Smith and Jon Agar review work by historians of science on territorial themes and knowledge making under two general headings: 'Of the Territory' and 'Of Privileged Sites'.⁶² Such distinctions have influenced my thinking as the following sections will reveal. But two points are worth making. The first has to do not with sites and intellectual territory as absolute distinctions but rather with the connections *between* them in terms, for example, of the ways in which knowledge travels, in certain discursive forms, from 'there' – a given geographical space *and* intellectual territory – to 'here', a certain site or sites, and *vice versa*. Second, recent expressions of interest in the spatiality of knowledge and, in particular, current localist emphases, are not the only conceptions of the geography of scientific endeavour. Studies of national *styles* of science have considered the different national expressions and origins of, for example, psychology,⁶³ chemistry,⁶⁴ embryology,⁶⁵ and ecology⁶⁶ as well as what might be held to be a 'national style' in science more generally, either by reference to the cognitive processes employed, to the social

⁶¹ J. Golinski, *Making natural knowledge: constructivism and the history of science* (Cambridge, 1998), 14, 16.

⁶² C. Smith and J. Agar, 'Introduction: making space for science', in C. Smith and J. Agar (eds.), *Making space for science: territorial themes in the shaping of knowledge* (London, 1998), 1–24.

⁶³ K. Danziger, *Constructing the subject: historical origins of psychological research* (Cambridge, 1999).

⁶⁴ M. Nye, "'National styles'?: French and English chemistry in the nineteenth and early twentieth centuries", *Osiris*, 8 (1993), 30–52.

⁶⁵ J. Maienschein, 'Epistemic styles in German and American embryology', *Science in Context*, 4 (1991), 407–28.

⁶⁶ M. Nicholson, 'National styles, divergent classifications: a comparative case study from the history of French and American plant ecology', *Knowledge and Society*, 8 (1989), 139–86; W. Brock, 'Humboldt and the British: a note on the character of British science', *Annals of Science*, 50 (1993), 365–72.

hierarchies of scientific institutions, or to the practical and public consequences of doing science.⁶⁷ Others have examined thematic questions within science at the national *scale*. This is less apparent in considering the rise of science across Europe, but is particularly clear, for example, in work on the Enlightenment and on the Scientific Revolution in national context.⁶⁸

This is not to say that scholars working on national styles and on scientific ideas and movements in national context are insensitive to the problematic notion of the 'nation' itself and to the historical construction of ideas of national identity.⁶⁹ It is to observe in such work a tendency to assume the nation as *the* frame of reference, *the* spatial scale at which science, however manifest, is to be understood. The same is true, of course, of those who have referred to national 'schools' in the history of geography.⁷⁰ I do not want to reify the question of national identity (however understood), by giving it a 'taken-for-granted' status at the outset.

My concern is to reverse the gaze as it were. Rather than start with the nation and with national identity as presumed 'things', in which science (*qua* geographical knowledge) of a certain sort emerges, I want to consider how given forms of geographical knowledge themselves came to constitute the idea of Scotland as a national space. This is what I mean by the 'making' of Scotland through geographical knowledge. Recognising, then, with Livingstone, the need to attend to such issues at a variety of spatial scales, I am further prompted by those who have argued, for example, for an idea of Enlightenment *above* national context in which the exchange of scientific and commercial information can be read as international, transnational *and* between particular individuals and institutions,⁷¹ and by a concern to explore the local nature and sites of scientific knowledge.

Local sites of knowledge making

In discussing the ways in which cartographic knowledge in and of early modern Europe was made in particular locations for particular political

⁶⁷ M. Crosland, 'History of science in a national context', *British Journal for the History of Science*, 10 (1977), 95–113; J. Harwood, *Styles of scientific thought* (Chicago, 1993); J. Merz, *A history of European thought in the nineteenth century* (4 volumes, Edinburgh, 1896–1914); A. Crombie, *Styles of scientific thinking in the European tradition* (3 volumes, London, 1994); N. Reingold, 'The peculiarities of the Americans, or are there national styles in the sciences?', *Science in Context*, 4 (1991), 347–66.

⁶⁸ D. Goodman and C. Russell (eds.), *The rise of scientific Europe 1500–1800* (Milton Keynes, 1991); W. Clark, J. Golinski and S. Schaffer (eds.), *The sciences in enlightened Europe* (Chicago, 1999). On science in national context, see, for example, R. Porter and M. Teich (eds.), *The enlightenment in national context* (Cambridge, 1981); *The scientific revolution in national context* (Cambridge, 1992).

⁶⁹ B. Anderson, *Imagined communities* (London, 1991 edition); E. Said, *Orientalism* (Harmondsworth, 1978); *Culture and imperialism* (London, 1993). In contrast, one recent work on nationhood ignores the role of geographical imagination: A. Hastings, *The construction of nationhood: ethnicity, religion and nationalism* (Cambridge, 1997). Similarly, in the Scottish context, geographical knowledge as a way of constructing the 'shape' of the nation has been ignored: see J. Hearn, *Claiming Scotland: national identity and liberal culture* (Edinburgh, 2000).

⁷⁰ Livingstone, *Geographical tradition*, 4–11.

⁷¹ J. Robertson, 'The Enlightenment above national context: political economy in eighteenth-century Scotland and Naples', *The Historical Journal*, 40 (1997), 667–97.

purposes, David Turnbull has commented that 'the picture of science that has emerged from empirical investigations of both contemporary and historical scientists is that all knowledge is constructed at specific sites through the engagements of particular scientists with particular skills, material tools, theories and techniques. . . . Thus a fundamental characteristic of scientific knowledge is its localness'.⁷² As Adir Ophir and Steven Shapin point out, this 'influential *localist* genre, marked by attention to national and regional features of an enterprise once regarded as paradigmatically universal', is relatively recent. As they note, localist concerns have close links with the relativist agenda established by sociologists of scientific knowledge: 'relativism can be practically defined through the notion that all knowledge claims and judgments secure their credibility not through absolute standards but through the workings of *local* causes operating in contexts of judgment'.⁷³ Such claims offer themselves to empirical testing since the making of science (and, thus, of geographical knowledge) may depend upon knowing in *which* sites it was made and what the connections were between them, and upon illustrating the epistemological bases to meaning in and between given sites. Shapin has considered just such issues. We could, he argues, simply take for granted the local nature of science's making:

That is to say, suppose one regarded it as established beyond doubt that science is indelibly marked by the local and the spatial circumstances of its making; that scientific knowledge is embodied, residing in people and in such material objects as books and instruments, and nowhere else; and, finally, that scientific knowledge is made by and through mundane – and locally varying – modes of social and cultural interaction. If one granted all this, one would be treating the 'localist' or 'geographical' turn in science studies as a great accomplishment – telling us a series of important things about science which previous understandings have systematically ignored or denied.

Admitting such work to be a 'considerable achievement', it is, for Shapin, not enough:

And yet I also want to say that it is still incomplete and that it is danger of missing something very important about science. The problem here is not that the geographical sensibility has been taken too far but that it has not been taken far enough. We need to understand not only how knowledge is made in specific places but also how transactions occur between places.⁷⁴

In moving, then, to consider the sites of knowledge making and issues to do with 'the territory' – with 'fields of knowledge', with how knowledge 'travels', with how it does so successfully, and with its audiences – my interest is both

⁷² D. Turnbull, 'Cartography and science in early modern Europe: mapping the construction of knowledge spaces', *Imago Mundi*, 46 (1996), 5–24.

⁷³ A. Ophir and S. Shapin, 'The place of knowledge: a methodological survey', *Science in Context*, 4 (1991), 5–6.

⁷⁴ S. Shapin, 'Placing the view from nowhere: historical and sociological problems in the location of science', *Transactions of the Institute of British Geographers*, 23 (1998), 6–7.

historical and epistemological. That this is so demands some attention to the nature of science's making as a question of historical geography. It was once generally accepted that 'modern science' was born towards the end of the seventeenth century, a period most contemporaries experienced as one of unprecedented change and crisis in virtually every dimension of European life. The question of *the* 'Scientific Revolution', and, thus, of there being an emergent 'modern science' geographically everywhere the same and shared by all, has been the subject of considerable debate.⁷⁵ For Lisa Jardine, the concerns of late seventeenth-century French cartographers and mathematicians to 'break new ground', as she puts it, support the claims of Godlewska and Cormack on early modern geographical knowledge as part of 'revolutions' in conceptions of (e)state measurement.⁷⁶ In his *The scientific revolution*, Shapin concentrates upon several issues to do with changes in knowledge about the natural world and changes in the means to securing that knowledge. These, principally, were the mechanization of nature (with reference to the increasing use of mechanical metaphors to construe natural things); the depersonalization of natural knowledge; the attempted mechanization of knowledge making (related to the foregoing in the emphasis placed by contemporaries upon the use of explicitly formulated methodological rules that aimed to discipline the production of *natural* knowledge by managing the effects of *human* intervention); and the intention to use such reformed natural knowledge to achieve given ends.⁷⁷ What is also clear, notably in some of Shapin's other work, is that making and disseminating natural knowledge in such ways in the later seventeenth century was always a situated practical activity. One such local site was the laboratory.

Since the seventeenth century, the laboratory has been recognised as 'the preeminent site for making knowledge in the experimental sciences', and is so, notes Golinski, because it 'straddles the realms of private seclusion and public display . . . On the one hand, the laboratory is a place where valuable instruments and materials are sequestered, where skilled personnel seek to work undisturbed, and where intrusion by outsiders is unwelcome. . . . On the other hand, what is produced there is declaredly "public knowledge"; it is supposed to be valid universally and available to all'.⁷⁸ Managing the tensions between the private and the public realm was also, however, to make social distinctions concerning who had access to scientific knowledge, who was to be trusted in the production of it, and, in turn, of trusting the forms in which knowledge moved in and out from such sites, as, say, either written reports or verbal accounts. Controlling the venues of knowledge in late seventeenth-century

⁷⁵ S. Shapin, *The scientific revolution* (Chicago, 1996); see the theme issue, 'The scientific revolution as narrative', *Configurations*, 6 (1998); J. Henry, *The scientific revolution and the origins of modern science* (London and New York, 1997); P. Dear, *The scientific enterprise in early modern Europe* (Chicago, 1997).

⁷⁶ L. Jardine, *Ingenious pursuits: building the scientific revolution* (London, 1999), 177–222.

⁷⁷ Shapin, *Scientific revolution*, 65–117. ⁷⁸ Golinski, *Making natural knowledge*, 84.

England and establishing the several 'bases of believability' was a matter of bounding and disciplining a community of practitioners, of policing experimental discourse, and of publicly warranting that the knowledge produced in such places was reliable and authentic. Social status mattered here: 'What underwrote assent to knowledge claims was the word of a gentleman, the convention regulating access to a gentleman's house, and the social relations within it'.⁷⁹

Iwan Morus' study of the use of laboratories and other 'spaces of display' among practitioners of electrical science in early nineteenth-century London, for example, notes the distinction between Faraday's use of the laboratory as a private space with no audience participation, in contrast to those 'commercial electricians' for whom experimentation was a matter of public theatre.⁸⁰ Graeme Gooday has shown that the nineteenth-century teaching laboratory operated through the 'rigid spatial structuring of laboratory life'.⁸¹ This claim is paralleled in Simon Schaffer's study of the Royal Greenwich Observatory, where demands for accurate measurement necessitated the rigorous bodily control of staff. He has also noted the shifting status of physics laboratories as domestic space and as scientific space within the Victorian country house.⁸² In studying T. H. Huxley's working environment – notably, his laboratory and lecture theatre – Sophie Forgan and Graeme Gooday signal towards, as they put it, 'a fully researched historical geography of London science'.⁸³ Other studies of laboratories have emphasised the spatialised constitution of knowledge making, and the differential social access to such knowledge.⁸⁴

Other work on sites of knowledge, perhaps particularly for the eighteenth century, has considered science's 'audience' and the ways in which a 'public' for science was constituted in certain locales and through performance. Schaffer has shown, for example, how eighteenth-century natural philoso-

⁷⁹ S. Shapin, 'The house of experiment in seventeenth-century England', *Isis*, 79 (1988), 404.

⁸⁰ I. Morus, 'Currents from the underworld: electricity and the technology of display in early Victorian England', *Isis*, 84 (1993), 50–69.

⁸¹ G. Gooday, 'Precision measurement and the genesis of physics teaching laboratories in late Victorian Britain', *British Journal for the History of Science*, 23 (1990), 25–51; '"Nature in the laboratory": domestication and discipline with the microscope in Victorian life science', *British Journal for the History of Science*, 24 (1991), 307–71; Teaching telegraphy and electrotechnics in the physics laboratory: William Ayrton and the creation of an academic space for electrical engineering in Britain 1873–1884', *History of Technology*, 13 (1991), 73–111; 'Instrumentation and interpretation: managing and representing the working environments of Victorian experimental science', in B. Lightman (ed.), *Victorian science in context* (Chicago, 1997), 409–37; 'The premisses of premises: spatial issues in the historical construction of laboratory credibility', in Smith and Agar (eds.), *Making space for science*, 216–45.

⁸² S. Schaffer, 'Late Victorian metrology and its instrumentation: a manufactory of ohms', in R. Bud and S. Cozzens (eds.), *Invisible connections: instruments, institutions and science* (Washington, 1992), 23–56; 'Physics laboratories and the Victorian country house', in Smith and Agar (eds.), *Making space for science*, 149–80.

⁸³ S. Forgan and G. Gooday, 'Constructing South Kensington: the buildings and politics of T. H. Huxley's working environments', *British Journal for the History of Science*, 29 (1996), 435–68.

⁸⁴ This work is reviewed in L. Pyenson and S. Sheets-Pyenson, *Servants of nature: a history of scientific institutions, enterprises and sensibilities* (London, 1999).

phers used their lectures – indeed, their own bodies – to constitute particular moral and political claims about the workings of the natural world.⁸⁵ Stewart has added to our understanding of the ‘map’ of scientific knowledge in eighteenth-century London through attention to the Royal Society and to London’s coffee-houses as information exchanges.⁸⁶ Other sites of scientific knowledge have been the subject of similar attention: the lecture hall,⁸⁷ the library,⁸⁸ the museum,⁸⁹ botanical and zoological gardens,⁹⁰ even the public house.⁹¹ Much further work remains to be done on these and other ‘spaces of science’.⁹²

Yet the social and spatialised nature of scientific knowledge – and a historical geography of geographical knowledge as I propose it here – cannot ever be just a matter of sites. For one thing, sites, certainly in the institutional sense, are never single places. In his use of the term ‘heterotopia’, Foucault encapsulated the sense in which several spatial settings with different purposes coexist in given sites. For Ophir and Shapin, ‘The development of modern science – both natural and human – is closely linked to the institutionalization of special heterotopic sites. By the mid-seventeenth century one could already point to the chemical laboratory and the mechanical operator, the observatory, the botanical garden, and the room of curiosities’. As they note and as the above has shown, other sites were established later.⁹³ Foucault’s notion of heterotopic sites extended from his work on the nature of power embodied in institutionalized sites such as prisons and the asylum, and, thus, from a concern to see power relations as *spatial* relations.⁹⁴ Such matters of power and of its spatial constitution are always social *and* epistemological, always a matter of warranted authority in terms of who has the power to undertake and to make knowledge in certain ways, and who not. The making of what, at any given time and in any given place, becomes regarded as scientific knowledge is also dependent upon the movement of such knowledge across the boundaries between the site itself and what lies, to cite Golinski, ‘beyond the laboratory walls’.⁹⁵

⁸⁵ S. Schaffer, ‘Natural philosophy and public spectacle in the eighteenth century’, *History of Science*, 21 (1983), 1–43.

⁸⁶ L. Stewart, ‘Public lectures and private patronage in Newtonian England’, *Isis*, 77 (1986), 47–58; ‘Other centres of calculation, or, where the Royal Society didn’t count: commerce, coffee-houses and natural philosophy in early modern London’, *British Journal for the History of Science*, 32 (1999), 133–54.

⁸⁷ P. Bourdieu, *In other words* (Cambridge, 1992). ⁸⁸ R. Chartier, *The order of books* (Cambridge, 1994).

⁸⁹ S. Forgan, ‘The architecture of display: museums, universities and objects in nineteenth-century Britain’, *History of Science*, 32 (1994), 139–62; Pyenson and Sheets-Pyenson, *Servants of nature*, 125–49; C. Yanni, *Nature’s museums: Victorian science and the architecture of display* (London, 1999).

⁹⁰ A. Cunningham, ‘The culture of gardens’, in N. Jardine, J. A. Secord and E. C. Spary (eds.), *Cultures of natural history* (Cambridge, 1996), 38–56; Pyenson and Sheets-Pyenson, *Servants of nature*, 150–72.

⁹¹ A. Secord, ‘Science in the pub: artisan botanists in early nineteenth-century Lancashire’, *History of Science*, 32 (1994), 269–315. ⁹² D. Livingstone, *Spaces for Science* (Chicago, forthcoming).

⁹³ Ophir and Shapin, ‘The place of knowledge’, 14.

⁹⁴ M. Foucault, *The order of things: an archaeology of the human sciences* (London, 1970); ‘Of other spaces’, *Diacritics*, 16 (1986), 22–7. ⁹⁵ Golinski, *Making natural knowledge*, 91–102.

Of movement: travelling knowledge, 'the field' and audiences

It may be claimed that the 'modern' science which emerged from the later seventeenth century depended more upon the testimony of nature than upon the testimony of humans, more, that is, upon the personal experience of nature than upon what others might say or ancient authorities propound. For Shapin, 'Here is the root idea of modern *empiricism*, the view that proper knowledge is and ought to be derived from direct sense experience'. It is also, as he acknowledges, a problematic route to reliable knowledge about the world: 'And here too are the foundations of the modern mistrust of the social aspects of knowledge making: if you really want to secure truth about the natural world, forget tradition, ignore authority, be skeptical of what others say, and wander the fields alone with your eyes open'.⁹⁶

Such remarks about knowledge making and the implications arising from them are of considerable importance for questions of geographical knowledge understood historically. For one thing, the emergence of 'modern' science is, profoundly, a matter of geography – not alone in terms of the sites of its making, but in relation to being 'in the field', to exploring the world in various embodied and instrumentalised ways. For another, early modern geography and geographical knowledge as discerned by Cormack and others was clearly part of the emergent 'new' natural philosophy. There is a third sense, however, in which being 'in the field' is fundamentally geographical; it concerns the geographical movement of knowledge itself and the displacement of knowledge from one site to another.

Not everyone could or did travel. Voyages of discovery to new empires were expensive, and, at smaller scales, even national or regional travels and surveys could be arduous and costly. Furthermore, even where possible, wandering the fields alone is of little value unless one's measured results can be made sense of by others elsewhere. This presents problems both of how to get reliable knowledge in ways understandable to others, and, if one cannot travel, of how to get such knowledge from distant authorities. Drawing upon the above remarks about trust, this is, as Shapin has stressed, a matter of trust 'inscribed in space'.⁹⁷

Such questions have received attention in work on the importance of travel and travel narratives for the early Royal Society, and the problems of communicating 'at a distance' in the Scientific Revolution.⁹⁸ The use of circulated

⁹⁶ Shapin, *The scientific revolution*, 69–70.

⁹⁷ S. Shapin, *A social history of truth: civility and science in seventeenth-century England* (Chicago, 1994), 245.

⁹⁸ D. Carey, 'Compiling nature's history: travellers and travel narratives in the early Royal Society', *Annals of Science*, 54 (1997), 269–92; J. Carrillo, 'From Mt Ventoux to Mt Mayasa: the rise and fall of subjectivity in early modern travel narrative', in J. Elsner and J-P. Rubiés (eds.), *Voyages and visions: towards a cultural history of travel* (London, 1999), 57–73; R. Iliffe, 'Material doubts: Hooke, artisan culture and the exchange of information in 1670s London', *British Journal for the History of Science*, 28 (1995), 285–318; D. Lux and H. Cook, 'Closed circles or open networks?: communicating at a distance during the scientific revolution', *History of Science*, 36 (1998), 179–211; Shapin, *A social history of truth*, 243–309; C. Withers, 'Reporting, mapping, trusting: making geographical knowledge in the late seventeenth century', *Isis*, 90 (1999), 497–521.