Introduction

This is a book about science, and how it changed the shape of mountains. It is also a book about how mountains changed the shape of science. In 1800, the volcano Chimborazo (in what is now Ecuador) was believed to be the highest mountain in the world. It was only around 1820 that Dhaulagiri in the Himalaya was accepted as higher, though not before a brief outrage among savants in Europe who doubted the measurements made by East India Company (EIC) surveyors. Other mountains, including Nanda Devi and Kanchenjunga, then had brief turns in the spotlight before Everest was finally confirmed as supreme in 1856. *Science on the Roof of the World* is the story of the intervening decades, and the scientific, imaginative and political remaking needed to fit the Himalaya into a new global scientific and imperial order, and to confirm Everest as the world’s highest mountain.

Early efforts to map the Himalaya meant accounting for what were, at the turn of the nineteenth century, unprecedented if not unimaginable heights. Spanning some 2,400 kilometres in a roughly crescent-shaped band across Asia, the Himalaya are one of the most striking and celebrated geographical features of our planet. In the early nineteenth century, however, they remained little known to European science and geography, and far from a cohesive place. Within the vertiginous mountain locales and sweeping valleys of the Himalaya, geographies – both real and imagined – thus played central roles in the experiences of European surveyors and naturalists in a region of increasingly elevated political importance. They also shaped explorers’ interactions with the Himalayan peoples, who assisted and resisted their attempts to map the Himalaya as an imperial and scientific frontier. In illuminating these uncertain and contested spaces, *Science on the Roof of the World* traces interweaving and largely untold stories of scientific measurement and collecting, indigenous labour and expertise and frontier making and breaking, through the mountains and across the first half of the nineteenth century. In turn, these moments in the mountains become part of a broader story; of how uplands became aberrant, science became three-dimensional and the globe became vertical.
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While framed around the particularities of space, topography, terrain and landscape, this book is also about the Himalaya at a particular time. As much as for scientific edification, mapping and measuring greater and greater heights in the Himalaya in the first half of the nineteenth century was motivated by growing fears around the lack of information about the northern frontiers of EIC’s territory in India. This was coupled with mounting concerns about the relative permeability rather than impenetrability of the range, which meant that the mountains increasingly took on the role of a threatening ‘blank space’ at the edges of the empire. Indeed, despite the meanderings of several Jesuits, and the trade missions of George Bogle (1746–1781) and Samuel Turner (1759–1802) to Tibet in the late eighteenth century, European knowledge of the Himalaya in 1800 remained sparse and fragmentary.¹ As Peter Bishop has eloquently argued, ‘the immense verticality of the mountains, with their steep contrast between perpetually silent, snow-clad peaks and dark, densely vegetated valleys, echoed the intense horizontal mystery of the frontier’ in this period, but ‘as yet . . . the “frontier” lacked imaginative coherence’.² This is thus the story of uneven, incomplete and contested attempts to impose scientific, imperial and imaginative coherence on the Himalaya; a story bound up with both an increasingly expansionist British Empire in South Asia and an emerging global environmental order around altitude.

A central premise of this book is that the methods for surviving in these mountain environments mirrored the methods for making knowledge about them.³ Attempts by European surveyors and naturalists to address the scientific, political and imaginative incoherence of the Himalaya in the first half of the nineteenth century is particularly reflected in the reconfiguration of practices and theories. Here I am especially interested in the moments that instruments, collections and bodies broke down, as these are revealing of the social relationships that underpinned the knowledge being produced.⁴ Unlike many recent studies of imperial knowledge production which limit themselves to a particular branch of science – for

² Bishop, The Myth of Shangri-La, 88–89.
example, botany or medicine or astronomy – it is necessary here to address a broad range of sciences in order to understand the remaking of the Himalaya in the first half of the nineteenth century. As a result, this book ranges across different aspects of science and scientific practice, from instrumental measurement to altitude physiology, from fossils to botanic gardens and from glaciology to plant geography. While, on the one hand, a study of eclectic knowledge-making in the context of empire, this is thus necessarily also a story of the development of various modern scientific disciplines – from geology to biogeography – in which mountains were becoming central. Tracing these interlinked stories ultimately points to larger shifts in understandings of altitude in science, as the Himalaya were shaped in this period through the lens of global comparison, especially with the Alps and the Andes, and remade as commensurable within in a framework of empire. In turn, examining these reconfigurations offers new ways of comprehending the entangled relationship between scientific practice, environmental imaginaries and the reordering of global space in nineteenth-century imperial geography.

Even as it attends to these broader developments, *Science on the Roof of the World* also maintains a central focus on the roles of the Himalayan people who served as brokers, guides, porters and translators in European scientific and expeditionary practice. These demonstrate the overwhelming extent to which measuring the mountains depended on pre-existing local routes, expertise and labour. Even while ostensibly exploring the mountains, surveyors were almost never stepping off paths that had existed for millennia prior to their scientific interest. As remains true in the context of Himalayan mountaineering and trekking even today, foreign travellers would not have gotten very far or very high if they had not been able to rely on Himalayan peoples to identify the correct routes, transport their instruments and supplies, and share (or sometimes assume) the not insignificant risks of mountain travel.\(^5\) Indeed, this book features an eclectic cast of long-overlooked brokers and guides, including Pati Ram and Bhauna Hatwal Khasiah, and technicians like Hari Singh and Murdan Ali, as well as a large number of (usually unnamed and unidentifiable) ‘Bhotiyas’, ‘Lepchas’ and ‘Tartars’, who served as interpreters, porters and informants (see for example

In examining everyday interactions within expedition parties, I aim to reveal the many ways these relationships were central to the remaking of the mountains. More broadly, these interactions matter because they shaped the subsequent relationships of Himalayan peoples.

Figure 0.1). In examining everyday interactions within expedition parties, I aim to reveal the many ways these relationships were central to the remaking of the mountains. More broadly, these interactions matter because they shaped the subsequent relationships of Himalayan peoples.

6 These terms for ethnicity are problematic, frequently homogenising different groups of people. Alternatives are nevertheless often difficult to read out of the colonial documents, even as their imprecision was acknowledged by some contemporary travellers. For example, Joseph Hooker noted that ‘the inhabitants of these frontier districts belong to two very different tribes, but all are alike called Bhoteras (from Bhoœ, the proper name of Tibet)’. Joseph Dalton Hooker, Himalayan Journals; Or, Notes of a Naturalist in Bengal, the Sikkim and Nepal Himalayas, the Khasia Mountains (London: John Murray, 1854), Vol 1, 215. For more on these issues, see Felix Driver, ‘Hidden Histories Made Visible? Reflections on a Geographical Exhibition’, Transactions of the Institute of British Geographers 38, no. 3 (2013): 425; Christoph Bergmann, The Himalayan Border Region: Trade, Identity and Mobility in Kumaon, India (Dordrecht: Springer, 2016), 7–10.

to empire, and later to postcolonial South Asian states. In tracing the reconfiguration of practices and relationships, this book thus explains the many ways that the mountains came to be constituted as politically, culturally and environmentally marginal spaces in this period by imperial agents. In this context, I show how uplands were ultimately consolidated and confirmed as peripheral places in relation to the lowlands, which simultaneously came to be seen as both normal and normative – something that remains largely true today.

In revealing these histories, *Science on the Roof of the World* develops two main arguments through the mountains and across the first half of the nineteenth century. Firstly, it presents a close study of the sheer laboriousness of doing science in the Himalaya and the inherent dependency of surveyors and naturalists on pre-existing networks of labour and expertise, arguing for the necessity of further decentring the spaces of science. Secondly, it details the role of global comparison in the making of the mountains, and especially highlights the need to trace both connection and disconnection in understanding the rise of a vertically oriented view of the world. It is worth now considering these two sets of arguments separately and in turn, before reflecting on the way that together they help us to better understand the trajectories and implications of imperial science and geography in the nineteenth century.

**Science at the Edge of Empire**

As historical geographers and historians of science have come to insist, places ‘are very far from being just matters of physical location and symbolic meaning. They are also constitutive of social exchange, enabling or constraining activities that carried out within their confines’. My argument in this book follows from the ‘spatial turn’, a broadening body of scholarship that recognises the situatedness rather than placelessness of scientific practice, and increasingly acknowledges the analytical benefits to mapping out the geographies of science. In what follows, the high spaces of the Himalaya – the mountainous topography, the social and cultural geography, the human and non-human dimensions – are cast in protagonistic roles. In so doing, I argue for further decentring the spaces of science. Scholars have already convincingly broken down classic diffusionist

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models of the spread of scientific knowledge from Europe to colonial peripheries, and effected a reorientation to India-centred perspectives on scientific practice.\textsuperscript{10} The dismantling of these older paradigms, as brought about through the notion of ‘circulation’, and by scholarship that emphasises networks and webs, has been an important step.\textsuperscript{11} However, in this book, I seek to facilitate a further move away from viewing peoples and practices in science outside of Europe through, to use Pratik Chakrabarti’s term, ‘centres in the periphery’.\textsuperscript{12} Indeed, more needs to be done to effect an additional step, and to go beyond the overwhelming scholarly focus on major South Asian scientific ‘centres’, especially Calcutta, Madras, Benares and Bombay.\textsuperscript{13} As French naturalist and traveller Victor Jacquemont (1801–1832) wrote in the early 1830s: ‘[at] the distance at which I am not only from Europe, but also from Calcutta and Bombay, nothing is so much a matter of chance as the arrival of my letters’ (let alone journals or books with up-to-date scientific information).\textsuperscript{14} As he continued, with perhaps a touch of bombast: ‘I am waiting with great impatience for news . . . [but] it is fourteen thousand miles from Calcutta to London, and fifteen hundred from hence to Calcutta’ and moreover ‘the post in India goes on foot, and tigers sometimes eat the letter-carriers’.\textsuperscript{15} A central pillar of this book is

\begin{itemize}
  \item Pratik Chakrabarti, \textit{Western Science in Modern India: Metropolitical Methods, Colonial Practices} (Delhi: Permanent Black, 2004), 48, 94. For a similar argument, see Ballantyne, \textit{Orientalism and Race}, 15.
  \item Victor Jacquemont, \textit{Letters from India}, trans. anon (London: Edward Churilton, 1834), Vol 1, 294.
  \item Jacquemont, \textit{Letters from India}, Vol 1, 301.
\end{itemize}
thus investigating not only the unevenness with which information was carried out of the Himalaya, but also the unevenness with which up-to-date information was available to the eclectic array of naturalists, surveyors and travellers tasked with mapping and measuring what were only just becoming recognised were the world’s highest mountains.

Historians have not been insensitive to the tendency to seek out new scientific ‘centres’ (not least for archival reasons). Moreover, work on Calcutta – especially institutions like the Asiatic Society and the Botanic Garden – has been essential, not only to a more representative history of science in South Asia, but also to the particular stories told in this book. Indeed, both of these institutions played critical roles in circulating – if haphazardly – material and people between Europe and the mountains, and ultimately in the remaking of the Himalaya as a globally commensurable space. Likewise, Calcutta was itself a space of overlapping knowledge traditions, centres and peripheries, and incomplete attempts to create bounded spaces for science. Here the Asiatic Society, especially through its publications Asiatic Researches and the Journal of the Asiatic Society of Bengal, facilitated, alongside the natural historical investigations traced in this book, significant studies into literature, linguistics and ethnography, all of which also represent important strands of European imaginative investment in the Himalaya in this period. A different book might even have chosen to tell the story of the remaking of the Himalaya from these perspectives. In looking to illuminate some of the lesser-studied spaces and natural historical practices in the high mountains, however, I consider this scholarship on Calcutta as complementary, but ultimately only an essential step in a larger move. If what happened in the mountains is in some ways only half of the story, it is the half that has yet to be fully told. What follows is thus a sustained account of operating in displaced, disconnected and unevenly resourced locations, and the idiosyncrasies insisted on by those doing science there. Ultimately, this focus on decentralised locations allows for new insights into labour dependency, scientific practice and imperial insecurity. At the same time, I seek to move beyond simply delineating the relationship between science, adventure and authority in the ‘field’. Instead, I aim to demonstrate the potential


of a mountain-oriented approach to understanding these spaces as both imperial and scientific frontiers. We are increasingly reminded that frontiers mattered, often in unexpected ways, and that the ‘process of empire’ is especially visible at the edges. This book thus extends historical work on margins and peripheries, emphasising the way frontiers circumscribed the limits of knowledge and mastery in the early nineteenth century, and became conducive to particular forms of scientific practice and imperial ambition.

Scholars are nevertheless right to insist that European surveyors and naturalists, however peripherally they were located, were motivated by the understanding that they were participating in wider imperial and scientific projects, and that ‘somewhere in their minds, the centrality of Europe remained overwhelming’ as ‘the final site of fame, recognition, and support’, even if these would more often than not prove elusive. This book features an eclectic mix of surgeons and naturalists, including William Griffith and George Govan, adventurers such as William Moorcroft, ‘Mrs’ Hervey and James Baillie Fraser, and Bengal Infantry officers seconded as surveyors and administrators, including William Webb, James Herbert and Alexander Gerard. In many cases, rather than institutionally or state-sponsored explorers, these were EIC employees eclectically grafting their scientific proclivities onto regular duties. Few gained financially (itself still a suspect reason for pursuing science), and indeed most were unable to recoup their costs, even via less tangible rewards like social advancement and esteem, which remained strong but often elusive motivations for many on the edges of empire. The way these surveyors and travellers positioned themselves – from necessity and also choice – vis-à-vis both Calcutta and


19 Chakrabarti, Western Science in Modern India, 81.
London thus becomes an important facet of the story. Disproportionately, they made their careers mostly or wholly in Asia rather than Europe. Some were born there, many learned their science there and a significant number died there – hoping but perhaps not fully expecting to see England, Scotland or France again. This study does feature notable exceptions like Hugh Falconer (1808–65) and John Forbes Royle (1798–1858), who transitioned to metropolitan circles with some success (the latter, for example, curating the Indian displays at the Great Exhibition of 1851), or those such as Victor Jacquemont, who achieved relatively widespread – if posthumous – fame in Europe (albeit in this case a notoriety largely resulting from a series of published letters full of injudicious and incendiary comments about various EIC officials). Even in these cases, however, it was their experiences and the scientific practices and theories they developed in the Himalaya that they were able to leverage for their success, and with which their intellectual reputations were bound up. We therefore need to take seriously that for many of the actors in this study, it was not just ‘alternative centres’ like Calcutta, but the displaced spaces of the Himalaya that were overwhelmingly the tableaux on which their scientific orientations played out.

This book thus seeks to explain the many ways that, in locations isolated even from Calcutta, let alone London, naturalists and surveyors adapted – or devised new – instruments, practices and theories using the knowledge, techniques and resources they had available to them, and the varying degrees to which they were successful. Central to this was the materiality of the mountains, and the ways that both human and non-human worlds were affected by altitude. Instruments and bodies functioned differently – often poorly – in the mountains, and fossils, plants and animals were arranged in particular ways. These difficulties were further compounded by the way surveyors’ and naturalists’ abilities to operate in Himalayan environments were overwhelmingly dependent on networks of labour and expertise in which their agency was often limited and sometimes resisted. At the same time, while the challenges travellers dealt with in the high mountains were real, it is important to recognise that they often sought to emphasise these logistical difficulties and physiological hardships. In what follows, I pay particular attention to moments when travellers exaggerated the idiosyncrasy of their surroundings, either to excuse their failings or to leverage their ability to overcome these difficulties and produce authoritative knowledge. Indeed, accounts of scientific practice in the Himalaya in this period are rife with explanations of, and a sometimes almost desperate insistence on, challenges that could supposedly only be resolved by those who had first-hand experience of the high mountains (even as similar
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claims were made by imperial agents engaging with other ‘extreme’ environments, whether oceans, jungles or deserts). As this book argues, it is precisely this tension – between the necessary insistence on the peculiarity of remote locations and the universalising needs of early nineteenth-century imperial geography – that makes the story of the appropriation and remaking of the Himalaya such an instructive one, opening up the possibilities for examining circulation and connection, and global and globalising sciences anew.

Mountain Science as Global Science

These overlapping stories of scientific practice and indigenous labour ultimately contribute to a larger story. Indeed, they underpin my second main argument around the importance of global comparison in the rise of verticality as a framework for understanding both human and non-human worlds. As much as it is a close study of everyday scientific practice and brokered exploration in the high spaces of the Himalaya, this is thus also a global history of mountain sciences. Measuring altitude with any real degree of accuracy had never really been necessary or even desirable before about the mid-eighteenth century. As the nineteenth century dawned, however, accurate measurements of elevation were becoming a critical variable in many of the sciences of the period, including plant geography, physiology and geology. The height of a mountain became an essential facet of its identity, and a principal factor in its significance to an emerging global pantheon.\(^22\) Altitude was made a key characteristic, a point of data without which a given specimen – whether plant or rock or physiological reaction – had only a limited use in advancing the cause of natural history.\(^23\) By the mid-century, altitude was pervasive. As the Bengal Infantry Officer Henry Strachey (1816–1912) put it when describing Western Tibet in 1853: ‘having sketched the general plan of Nari in
