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"Clean out of the map": Knowing and doubting space at India's high imperial frontiers

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Abstract

During the second half of the nineteenth century, land frontiers became areas of unique significance for surveyors in colonial India. These regions were understood to provide the most stringent tests for the men, instruments, and techniques that collectively constituted spatial data and representations. In many instances, however, the severity of the challenges that India's frontiers afforded stretched practices in the field and in the survey office beyond breaking point. Far from producing supposedly unequivocal maps, many involved in frontier surveying acknowledged that their work was problematic, partial, and prone to contrary readings. They increasingly came to construe frontiers as spaces that exceeded scientific understanding, and resorted to descriptions that emphasized fantastical and disorienting embodied experiences. Through examining the many crises and multiple agents of frontier mapping in British India, this article argues that colonial surveying and its outputs were less assured and more convoluted than previous histories have acknowledged.

Keywords

Cartography, surveying, colonialism, India, geography, space, frontiers

Introduction

Trudging ever deeper into the forested uplands to the east of Bengal in forlorn pursuit of an elusive enemy beyond the control of the British Indian state, members of the 1871–2 Lushai Expeditionary Force pondered how to comprehend and convey their surroundings. In dispatches to the *Indian Express* newspaper of Calcutta, 'Correspondents' with each of the two military parties extolled the contribution to spatial knowledge made by trigonometrical survey detachments accompanying the expedition. One attested that the surveyors had "further opened to the ken of Geography and British Indian progress, a not

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small region deemed an entangled and impenetrable jungle."[1] Some dispatches drew on the surveyors' work in specifying latitude and longitude at the time of writing to the nearest second. Others supposed that previously published maps would be available to at least some readers, with one advising those "who [possess] the 'Reconnaissance of the Lushai country,' Surveyor-General's office, 1870" to locate a topographic feature mentioned in the narrative "in the letter O in the title of the map, the words LUSHAI COUNTRY."[2] But as the party traveled further from colonial territory and ennui set in in the face of fleeing communities and unfulfilled objectives, the spatial imaginary described to the readers of the *Indian Express* took on new qualities. Maps were invoked less frequently; the reader was instead called upon to reference a different repertoire of images, including "Gustave Dore's Flood in his illustrations of the Bible," a romanticist rendering intended to evoke the extraordinary climatic conditions and perceptions of existential threat in these frontier environs: "[it] seemed as if we had but the *mauvais quart d'heure* between us and death."[3] Darkly comic references with more than a hint of self-lampooning also began to jostle with references to longitude and latitude in the effort to make sense of the expedition's environs for those back in urban Bengal.

> It is a melancholy thing when one progresses, as it were, beyond all human ken – out of the sphere of sympathy; a Latitudinarian in fact. Yet so it is; we have arrived at No Man's Land, and Laputa or Brobdingnag may at any time burst upon our view… I go to bed, in fact, every night, expecting in the morning to be greeted by the Great Panjandrum with the button on top, who shall announce our arrival in China. Eastward Ho! is the name of our novel adventure. By the last accurate accounts General Bourchier has marched clean out of the map, a military blunder which the Quarter Master General's Department will find it hard to pardon.[4]

This dense intermingling of allusions to and puns on Christian theology, the novels of Jonathan Swift and Charles Kingsley, Samuel Foote's satire, and colonial military-institutional politics poked fun at the limitations of existing map-images of the region and the fetishization of accuracy. It conjured up a space defined by unreality, rendered more comprehensible by assimilation into fictional worlds than by earthly coordinates.

This version of the Lushai Hills was a "fabulous geography."[5] It should be understood as a product of what Johannes Fabian has described as agents of empire being "out of their minds," unable and unwilling to purify their accounts of irrational, anarchic qualities.[6] It

1. "The Looshai Campaign, Right Wing," *Indian Observer*, undated: Senate House Library, London (hereafter "SHL"), 811-II-29, f.56.
2. "From our Correspondent with the Left Column," *Indian Observer*, undated: SHL, 811-II-29, f.30.
3. "From our Correspondent with the Right Column," *Indian Observer*, 22 December 1871, 6 January 1872: SHL 811-II-29, f.3.
4. "From our Correspondent with the Right Column," *Indian Observer*, 16 February 1872, undated: SHL, 811-II-29, f.29.
5. Sumathi Ramaswamy, *The Lost Land of Lemuria: Fabulous Geographies, Catastrophic Histories* (Berkeley, CA: University of California Press, 2004).
6. Johannes Fabian, *Out of Our Minds: Reason and Madness in the Exploration of Central Africa* (Berkeley: University of California Press, 2000); the concept of purification in modern knowledge production is discussed in Bruno Latour, *We Have Never Been Modern*, trans. by Catherine Porter (Cambridge, MA: Harvard University Press, 1993).

directly contradicts the notion that high imperial surveyors and their multiple audiences imagined space as an idealized map, there to be dominated, with "nothing hidden or convoluted, no shadows, no 'double entendre'."[7] As surveying extended further into colonial India's frontiers in the later nineteenth century, British spatial imaginaries became not less but more convoluted, shadowy, and riven with double entendres. Maps, written narratives, and sketches often contained signs of equivocality. The sometimes multiple or indeterminate authors of these representations failed or did not seek to eradicate their particular labors in constituting them. In addition, those involved in the production and reception of spatial artifacts increasingly called them into question, suggesting they could not truly or comprehensively convey the spaces to which they pertained.

Frontier regions to the west and north of Sind and Punjab and bounding Assam's Brahmaputra Valley were arenas of increased action and significance for agents of empire in the second half of the nineteenth century. This was especially the case for those concerned with understanding and representing space. Beneath local specificities, three broad junctures of frontier surveying can be discerned. Sporadic military ventures into the ill-defined fringes of British power during wars and annexations from the 1820s to the 1840s involved hastily undertaken route surveys – measurements of distance and bearing between places with occasional calculations of location by astronomical sightings. British and Indian agents continued to execute route surveys for various purposes long afterwards, and during the 1850s surveyors began to 'fix' topographical features in frontier regions by trigonometrical observations – the calculation of angles and distances in series of connected optical observations starting from physically measured 'baselines'. As colonial state interference increased from the later 1860s, the era of distant sightings gradually gave way to the increasing presence of trigonometrical survey detachments among frontier uplands and deserts. One significant manifestation of this trend was the Survey of India's advent of a 'Superintendent of Frontier Surveys', institutionalizing a unified conception of the British Indian frontier stretching from the deserts abutting Persia in the west to the forested highlands of Upper Burma in the east via the high Himalaya. This article focuses on the latter two periods covering the second half of the nineteenth century, when trigonometrical surveying of British India's frontier regions came to the fore.

Surveyors and 'men of science' in colony and metropole widely deemed comprehending the mountains, deserts, and river courses that lay tantalizingly beyond the limits of governed British India to be one of the defining goals of imperial institutions and techniques of knowing space. This article shows how these areas were not only considered hinterlands of nearly unparalleled opportunity, but also appeared to present challenges that struck at the heart of established means of fixing and rendering space. For many involved in gathering spatial knowledge, it was precisely these difficulties that valorized their efforts. British India's frontiers served a vital role in countering increasingly common insinuations

7. Bruno Latour (referring to paper maps), cited approvingly in Matthew H. Edney, "Bringing India to Hand: Mapping an Empire, Denying Space," in Felicity Nussbaum (ed.) *The Global Eighteenth Century* (Baltimore: Johns Hopkins University Press, 2003), pp.65–78, 71. Edney develops this point to contend that maps "allowed Europeans to conceptualise the world and to think that they could dominate the world itself" (p.78).

in the later nineteenth century that knowing space involved little more than the application of a standardized set of procedures, and that the era of heroic battling against nature had closed. Explorers and surveyors engaged at frontiers accordingly made sure to foreground their difficulties in a host of official, scientific, and popular accounts. However, the tensions between self-erasure and self-promotion were not always sustainable, nor were the struggles of knowing frontier space merely canny rhetorical ploys.

The claims set out above and explored throughout the article engage the concern of a number of theorists and historians of cartography in recent years to focus on the operative impact of maps and other spatial representations. One of the most fecund aspects of this strand of scholarship is the insistence that we should not assume that particular spatial representations were understood and used in homogeneous, stable ways. As one theoretical intervention puts it, "maps do not emerge in the same way for all individuals."[8] Moving away from J. B. Harley's notion of maps as texts, which exaggerated the power of map-images to create uniform realities, toward maps as elements within broader assemblages that are performed in various ways, leads to a focus on distribution and use.[9] This shift implies – as in equivalent moves in literary theory and intellectual history[10] – heightened attention to diversity and skepticism toward the notion that a single representation or representative mode can have a uniform effect. In Michel de Certeau's words, "a '*polytheism*' *of scattered practices* survives, dominated but not erased by the triumphal success of one of their number."[11] This article draws out fragmented evidence of frontier map usage, showing that agents of imperial surveying widely understood map-images and narratives of frontier spaces to be fragile communicative devices prone to unstable reception.

This article also contends that spatial representations were not only disrupted by processes of collation, production, and reception beyond 'the field', but were equivocal all the way back to initial acts of information gathering. Knowledge of frontier spaces was composed of processes in which "the actors were trembling."[12] Moreover, these actors

8. Rob Kitchin, Chris Perkins, and Martin Dodge, "Thinking about Maps," in Martin Dodge, Rob Kitchin, and C. R. Perkins (eds.) *Rethinking Maps* (Abingdon: Routledge, 2009), pp.1–25, 16.
9. J. B. Harley popularized the notion of 'maps as texts'; see especially J. B. Harley, "Texts and Contexts in the Interpretation of Early Maps," in J. B. Harley, *The New Nature of Maps: Essays in the History of Cartography*, ed. Paul Laxton (Baltimore: Johns Hopkins University Press, 2001), pp.33–49. For critiques of this position, many reflecting the shift to 'maps as performances', see the essays in *Cartographica* 50(1) (2015).
10. Among the most important works in this vein are: Hans Robert Jauss, *Toward an Aesthetics of Reception*, trans. by Timothy Bahti (Minneapolis: University of Minnesota Press, 1982); Roger Chartier, *The Order of Books: Readers, Authors, and Libraries in Europe between the Fourteenth and Eighteenth Centuries*, trans. by Lydia G. Cochrane (London: Polity, 1994); Michel de Certeau, *The Practice of Everyday Life*, trans. by Steven Rendall (Berkeley: University of California, 1984).
11. De Certeau, *Practice of Everyday Life* (note 10), p.48, emphasis in original.
12. Latour, *We Have Never Been Modern*, p.126 (note 6). Latour refers here to precarious activities that are subsequently "purified" and constituted as aspects of "formidable" totalities: "capitalism, imperialism, science, technology, domination." In this article, I show that colonial surveyors acknowledged and ensured that purification remained limited in the case of frontier mapping.

tended to emphasize that they were not only trembling (literally in some cases), but also laughing and being laughed at, stumbling, and dying. Admissions of fallibility were not merely about meeting popular demand for tales of danger; they appeared with surprising consistency across written and visual genres, forming part of private correspondence within the survey establishment as well as mass-market accounts. These crises also had epistemological effects that were not necessarily overcome through the use of 'reason' or in 'centers of calculation'.[13] Surveyors did not assume the existence of an authoritative epistemological domain sealed from a shifting array of challenges to stable knowledge experienced 'in the field'. The persistent presence of particular circumstances in published representations of frontier India suggests that the "tension between the local view and the broader overview" identified by D. Graham Burnett and others in Britain's American colonies was a widespread and long-lasting element of spatial knowledge production in the British Empire.[14]

The article both develops and departs from Matthew Edney's much-cited assessment of cartography in India during the earlier colonial period.[15] It takes a lead from Edney's concept of 'cartographic anarchy', which brilliantly describes the chaos and heterogeneity of survey work on the ground in British India.[16] However, it dissents from his notion that surveyors and mapmakers 'cloaked' these circumstances to a degree that enabled them to believe that "the cartographic archive and its constituent surveys was indeed a perfect geographical panopticon."[17] The agents examined in this article did not consider maps or any other representative form in such strident terms. They instead diagnosed, bemoaned, and theorized those 'anarchic' processes that Edney claims to have himself exhumed from a deep grave of colonial erasure and elision. Colonial surveyors were reflexive and anxious about spatial knowledge in multiple and shifting ways over the later nineteenth century, engaging just as much as recent scholars in critical assessments of cartography.

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13. On the use of 'reason' in imperial mapping in India, see Matthew H. Edney, *Mapping an Empire: The Geographical Construction of British India, 1765–1843* (Chicago, IL: University of Chicago Press, 1997), pp.48–51; on the concept of 'centers of calculation', see Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987), ch.6.
14. D. Graham Burnett, *Masters of All They Surveyed: Exploration, Geography, and a British El Dorado* (Chicago, IL and London: University of Chicago Press, 2000), pp.167–70; Daniel W. Clayton, *Islands of Truth: The Imperial Fashioning of Vancouver Island* (Vancouver: UBC Press, 1999), p.232.
15. Edney, *Mapping an Empire* (note 13); Bernardo Michael also shows the widespread nature of practical difficulties in British surveys in India, but, like Edney, suggests that these challenges were largely occluded in and overcome by the map-image. See Bernardo A. Michael, "Making Territory Visible: The Revenue Surveys of Colonial South Asia," *Imago Mundi* 59, 1 (2007), 78–95, 89–91; Bernardo A. Michael, *Statemaking and Territory in South Asia: Lessons from the Anglo-Gorkha War (1814–1816)* (London: Anthem Press, 2012), ch.6.
16. Edney, *Mapping an Empire*, p.29; ch.5 (note 13).
17. Edney, *Mapping an Empire*, p.34 (note 13); see also his claim that "[t]he texts and maps did not present truth, nor do the maps constitute panopticons. The British simply believed that they did" (*Mapping an Empire*, p.26).

The core contentions outlined above develop through the four sections that form the rest of this article. Broadly chronological, each section also addresses distinct elements and junctures within the broad project of knowing the frontier spaces of colonial India. The first closely examines the activities, actors, and instruments that constituted survey data during the mid-nineteenth-century period, when trigonometrical surveyors viewed prominent features of frontiers from a distance. It shows how the challenges of accurate altitude measurement, deemed an essential feature of effective triangulation, led these men not only to undertake a host of much celebrated improvisations, but also, contrastingly, to begin to perceive that even perfectly processed survey data could never represent territory with full accuracy. This, I suggest, was a key moment in which doubts about an irreducible gap in the project of knowing territory started to fester, setting the scene for later shifts in attitudes toward depicting and experiencing space among surveyors at colonial India's frontiers.

Before addressing this later period, the second section focuses on the significance of widespread debates among members of the British Indian survey establishment about frontier maps as material objects. Surveyors and users alike were not fixated solely on ideals of accurate data, but also sharply aware of the challenges of making and distributing useful images of frontier environs. The advent of surveys of these areas from the 1850s was a key driver of technological shifts in map production and dissemination in colonial India. These were processes entailing multiple anxieties as well as apparent triumphs, with the flow of geographical information often far from consistent or well-directed. The third section takes this story of concerns over representation back to the field, looking at the period from the 1860s when surveyors ventured into frontier regions rather than gazing at them from distant vantage points. It shows how surveying frontiers came to assume huge significance for colonial agents, but was simultaneously beset with multiple difficulties that frequently appeared to constitute insurmountable barriers to gathering effective data. These concerns went beyond those of earlier decades, and were acknowledged to seriously compromise spatial information rather than being resolvable through the use of reason or by further survey work.

The final section of the article demonstrates how trends established over previous decades reached a peculiar resolution during the closing decades of the nineteenth century. Impediments to comprehending frontier spaces combined with cultures of romanticism, mysticism, and anti-empiricism to undergird widely held ideas among surveyors and 'men of science' that these regions were somehow elusive, maintaining a margin of unknowability beyond even the calculations of trigonometrical surveying and the planar projections of map-images. Many agents of empire came to understand these regions in ways that foregrounded the bodily over the cerebral, the immersed experience over the removed gaze, and the playful over the serious.[18] They operated within and contributed

18. Martin Dodge and Chris Perkins note the "seriousness" with which scholars associated with the New History of Cartography, especially J. B. Harley, treat maps. They suggest an alternative focus on "the playful exercise of mapping in banal everyday contexts" and "the ludic possibilities of mapping." Martin Dodge and Chris Perkins, "Reflecting on J.B. Harley's Influence and What He Missed in 'Deconstructing the Map'," *Cartographica* 50 (2015): 37–40, 38.

to spatial imaginaries that involved heterogeneous modes of understanding and communicating, and which doubted the value of 'scientific' surveying even as they undertook it. Crucially, unlike conceptions among colonial agents of the earlier nineteenth century that 'jungle' and upland areas were regions of disorder but also of potential reform, India's high imperial frontier deserts and mountains came to be understood as permanently resistant to 'improvement'.

Developing this contention of the distinctive nature of late nineteenth-century surveyors and explorers' understandings of frontier space, the article concludes by suggesting that knowing frontiers took on forms that incorporated but ultimately exceeded well-developed notions of 'the sublime'. These forms of knowledge, I suggest, can usefully be understood alongside Martin Heidegger's conception of the "world-picture."[19] Recent scholars of imperial representation have employed this theory, but have not made use of its core tension. Timothy Mitchell and Derek Gregory, for instance, claim that European empires "enframed" their colonized territories and communities as "objects to be viewed," separated absolutely from the viewing subject of the colonizer.[20] They overlook Heidegger's contention that the "unlimited power for the calculating, planning and moulding of all things" in the "modern age" produces a sort of surplus – what Heidegger terms "the gigantic" – which "becomes … incalculable."[21] Many of the late nineteenth-century actors engaged in producing knowledge of India's frontiers construed them in ways akin to Heidegger's "gigantic": shadowy arenas "withdrawn from representation" in which to challenge and to lose oneself at a time when technologies of triangulation had apparently fixed the imperial subcontinent.[22]

"Impossible to level": frontiers and the problem of altitude in the 1850s

According to those who planned and executed it, the run of triangles extending during the 1850s from a coastal baseline at Karachi to the Attock River at the northern limits of recently annexed Punjab was fully deserving of the appellation 'Great', which was applied to only a select few trigonometrical series. From the outset, however, the Great Indus Series was riddled with difficulties that had palpable effects on its final form. In his initial instructions to the lead surveyor, surveyor-general Andrew Waugh classified the undertaking as "essentially a frontier series," and accordingly told him to route the survey "as near the boundary as political circumstances will admit or physical circumstances render desirable." Waugh's reiteration of this point – "keep as near the western frontier as practicable" – amounted to little in the field, where it transpired that the "political" and "physical circumstances" of the frontier mitigated against surveying there. Broken

19. Martin Heidegger, "The Age of the World Picture," in *The Question Concerning Technology and Other Essays*, trans. by William Lovitt (New York: Harper, 1977), pp.115–54.
20. Derek Gregory, *Geographical Imaginations* (Oxford: Blackwell, 1994), ch.1; Timothy Mitchell, "The World As Exhibition," *Comparative Studies in Society and History* 31 (1989): 217–36.
21. Heidegger, "The Age of the World Picture," pp.134–6 (note 19).
22. Heidegger, "The Age of the World Picture," p.136 (note 19).

terrain and lurid tales of violent tribesmen pushed the line of survey further east, into colonial territory. The lead surveyor of the southern portion of the series in the first season he took the field issued a host of complaints: the difficulty of ascending hills; the lack of water; severe storms and torrential rain; freezing temperatures; dilapidated observation towers; and inadequate *puckal*s (water carriers). An attack by local inhabitants on a trigonometrical station, which destroyed one heliotrope and damaged another, capped this succession of problems, prompting the lead surveyor to state plainly that "the series should never have approached so near the frontier." He abandoned the originally agreed route along the hills that formed the designated boundary of colonial sovereignty in Sind, shifting the series further east – and thereby further from its original designation as a frontier series.[23]

Relocating the Great Indus Series from the frontier hills to the governed plains may have reduced the anxieties related to "political circumstances," but the terrain generated a new array of concerns. Substantially adapted instruments and surveying methods were put to work to surmount these challenges, with varied perceived success. Their shortcomings were not limited to the realm of temporary aberrations, but were understood by key survey personnel to have profound epistemological implications regarding the limits of 'accurate' mapping. Along with the difficulties of limited resources, competing calls on survey parties' time and personnel, and damaged equipment that were part and parcel of what Edney has usefully termed the "cartographic anarchy" of trigonometrical surveying throughout colonial India,[24] the length of the Great Indus Series and the environs through which it was routed generated specific concerns. The components of "cartographic anarchy" could in theory be overcome – instruments repaired, resources allocated, terrain covered at a later stage. But as Great Trigonometrical Survey (GTS) parties made their way across the plains of western Punjab and narrated their difficulties, senior surveyors came to perceive an apparently irreducible void between the territory and their representation of it. This was a moment of realization for those at the apex of the colonial surveying establishment that the map – and even the raw observational data that undergirded map-images – was not, nor could ever aspire to be, the territory.

What precipitated this realization, and why did it happen during the execution of the Great Indus Series rather than in another place, at another time? The surveyors engaged in the field during the mid to late 1850s wrote mostly of quotidian problems and of overcoming them. They repeatedly discussed their apprehension toward using the "great theodolite" (a 34-inch theodolite manufactured by Troughton & Simms that reached India in 1830),[25] deemed "too valuable to risk" in case of attack by frontier communities, especially when armed guards were unavailable during the Rebellion of 1857–8. The difficulty of obtaining labor to construct towers from which to make observations in flatter terrain was another recurring theme in their reports. But these were surmountable difficulties, causing postponements and in some instances requiring resurveys with the

23. Details and quotations from R. H. Phillimore, *Historical Records of the Survey of India. Volume V. 1844 to 1861: Andrew Waugh* (Dehra Dun: Survey of India, 1968), pp.44–5.
24. Edney, *Mapping an Empire*, ch.5 (note 13).
25. Phillimore, *Historical Records*, pp.150–1 (note 23).

larger theodolite, rather than terminally compromising the accuracy of the work.[26] A knottier issue emerged in the correspondence between James Thomas Walker, a lead surveyor on the series and later surveyor-general, and Andrew Waugh. The problem concerned 'leveling', the measurement of vertical angles in trigonometrical observations necessary to calculate altitude. Leveling came to Walker's notice as he worked in the flat plains at the western outskirts of Punjab, where the proximity to the ground of the visual 'rays' (lines of sight) that constituted single observations made them prone to distortion in the vertical axis. This phenomenon, generally termed 'refraction', was widely discussed among nineteenth-century surveyors.[27] In this instance, however, Walker claimed that it presented difficulties that confounded the leveling technique of taking vertical angles by theodolite employed on triangulated surveys throughout India. For Waugh, meanwhile, the Great Indus Series was prominent among an array of considerations that seemed to necessitate new leveling techniques. The error figure in the altitude calculated by connected trigonometrical series that ran from sea level at Hooghly heights in Bengal to sea level at Karachi was, Waugh complained, "not sufficiently in keeping with the wonderful precision attainable in all the other results of the survey."[28] The ongoing extension of the Great Indus Series deep into the continental interior sharpened Waugh's concern. It was, he said, "a matter of great interest to bring up an accurate datum from the sea to the Himalayas, in connexion with the determination of the heights of those stupendous pinnacles of the earth."[29] Frontier and transfrontier peaks loomed large in the surveyor-general's imagination as the ultimate challenge for the determination of altitude by his men and instruments, acting as a key impulse to the development of new ways of leveling.

The adapted leveling techniques, using spirit levels in place of problematic theodolite observations, emerged through the interplay of a vast array of elements. Waugh's numerous instructions and his ongoing analysis of the results of Walker's team while they remained in the field constituted attempts at direction from the survey's headquarters in distant Dehra Dun. But the experimentations of Walker and his retinue in the shadow of frontier uplands at the outskirts of Punjab diluted and sometimes directly contradicted these centralizing efforts. Walker assembled a leveling party comprised of heterogeneous elements, newly recruiting Indian surveyors and assistants. He employed one of these surveyors, Ramchand, on the basis of previous experience with the German explorer Adolf Schlagintweit in Central Asia,[30] seemingly overlooking the low regard in which survey officials held the ventures of Schlagintweit and his two brothers.[31] Instruments

26. Phillimore, *Historical Records*, pp.46–9 (note 23).
27. Kathryn Yusoff, "Climates of Sight: Mistaken Visibilities, Mirages and 'Seeing Beyond' in Antarctica," in Denis Cosgrove and Veronica della Dora (eds.) *High Places: Cultural Geographies of Mountains, Ice and Science* (London: I.B. Tauris, 2009), pp.48–63.
28. India Office Records, British Library, London (hereafter "IOR"), X/39/2: A. S. Waugh, *Report on the Survey of India for the Three Years Ending 1858–59* (London: Her Majesty's Stationery Office, 1863), p.6.
29. IOR/X/39/2, p.6 (note 28).
30. Phillimore, *Historical Records*, pp.76–7 (note 23).
31. Phillimore, *Historical Records*, pp.146–7 (note 23).

came from various sources, including three Troughton and Simms spirit levels cadged from the Punjab Canal Department. 'Precision' measuring devices were lost en route and those that remained required a great deal of tinkering in the field to make them work tolerably.[32] Some underwent substantial redesigns, such as the addition of glass cases to levels to protect them from "currents of air."[33] Working practices similarly fluctuated, with surveyors and sets of instruments deployed in varying combinations in an attempt to mitigate against, in Waugh's words, errors whose "constant character gave reason for anxiety in regard to their accumulating tendency in a long line of 960 miles."[34] The trigonometrical series' length was not the only distance that mattered to the surveyors and their superiors in Dehra Dun. Waugh and Walker extolled the production of new levels based on Walker's drawings, a process of communication and manufacture which successfully bridged the 1,500 miles that intervened between western Punjab and the Great Trigonometrical Survey's Mathematical Instrument Department in Calcutta, tasked with executing modifications.[35] Walker also boasted that each leveling observation was exactly equidistant "in the whole distance from the sea to Attock," insinuating that the 'long line' of the Great Indus Series that caused Waugh so much anxiety could be mastered by rigorous sub-division into manageable chunks.[36]

The stories that Walker and Waugh told sought to valorize the sprawling assemblage of people, correspondence, and instruments that constituted the ever-shifting leveling operation on the Great Indus Series, acclaiming its ability (under their direction) to overcome the tyranny of distance. In both his "Short Account of the Levelling Operations of the Great Trigonometrical Survey" submitted to his superiors in 1860 and in his paper to the Royal Astronomical Society in London four years later, Walker presented the complex conjunctions of men and instruments he put to work as a pioneering triumph.[37] To his London audience, he compared his undertakings favorably to the leveling executed between Bristol and the English Channel in 1837 for the British Association for the Advancement of Science under the direction of William Whewell, thereby not-so-humbly insinuating that he and the GTS had bettered a leading man of science and institution in the metropole.[38] This element of Walker's renderings of his operations had a long-term

32. For more on this aspect of instrumental practice in the nineteenth century, see Fraser MacDonald and Charles W. J. Withers (eds.), *Geography, Technology and Instruments of Exploration* (Farnham: Ashgate, 2015), especially Richard Dunn, "North by Northwest? Experimental Instruments and Instruments of Experiment," in MacDonald and Withers (eds.) *Geography, Technology and Instruments of Exploration*, pp.57–76; Simon Schaffer, "Easily Cracked: Scientific Instruments in States of Disrepair," *Isis* 102 (2011): 706–17.
33. IOR/X/39/2, p.7 (note 28).
34. IOR/X/39/2, p.7 (note 28).
35. IOR/X/39/2, p.7 (note 28).
36. IOR/X/39/2 (note 28), appendix: J. T. Walker, "Short Account of the Levelling Operations of the Great Trigonometrical Survey of India," 25/09/1860, p.27.
37. Walker, "Short Account" (note 36); J. T. Walker, "On the Methods of Determining Heights in the Trigonometrical Survey of India," *Memoirs of the Royal Astronomical Society* 33 (1863–4): 103–14.
38. Walker, "Determining Heights," pp.107–8 (note 37); on the British Association's leveling, see W. Whewell, "Account of a Level Line, Measured from the Bristol Channel to the

impact. In his *Records of the Survey of India* published fifty years after Walker's "Short Account" (and shortly before his own appointment as Surveyor-General of India), Sidney Burrard stated that "in 1858 Indian levelling was started upon correct and scientific lines."[39] Burrard's acclamation of Walker's undertaking echoed Waugh's assessment that "the work was most ably and scientifically executed."[40]

In this supposedly monumental feat of "planning and calculating and adjusting and making secure," it is tempting to detect Heidegger's "World-Picture" in the making.[41] Yet Waugh's report and Walker's narratives indicated something quite different as well. Both detailed their immense frustration at an insurmountable gap between survey data and the territory. The newly developed leveling practices meant that "differences between observers were much reduced," but only "in some cases" did Waugh judge them to have been "counteracted." Despite increasingly intricate systems for noting errors and computing corrections, Waugh wrote that "it is, humanly speaking, impossible to level an instrument practically without some residual error."[42] Walker, meanwhile, lingered in his paper to the Royal Astronomical Society on the "good deal of uncertainty that exists in reading the [standard] level," owing to optical distortion of the air bubble within the liquid by which readings were taken, "which some observers might guard against more than others." Despite the promises of spirit-leveling to have "no place for personal errors" on the part of individual surveyors, the experience of the operation in the Great Indus Series "lead[s] to the eventual conclusion that these [errors] may be the largest and most serious of all."[43] Moreover, Walker avowed, these "discordances" between individual observers appeared to have been "continuous" in stable conditions "of bright sunshine and calm, such as is of frequent occurrence in tropical countries."[44] This admission acted contrary to his earlier effort to raise the colony above the metropole, suggesting instead that climate terminally disadvantaged the subcontinent relative to the British Isles.

Waugh and Walker's accounts exhibit profound ambivalence to the capacities of surveying. While aggrandizing the amalgamations of men, missives, and machines that constituted the GTS's spatial knowledge as it extended to touch upon the mountain fringes of the subcontinent (and taking extra care to foreground their own roles in these processes), they also dwelt on the seepage of subjective perceptions into survey data, despite their intricate efforts to stem the flow. They acknowledged that this practical shortcoming had effects well beyond 'the field'. It could not be elided through sleights-of-hand in centers of calculation and compilation, instead impacting survey work's epistemological status. However intricate the instruments, however efficient the passage of materials in networks spanning key offices across the colonial subcontinent, however well suited to specific terrains of plains or hills the

English Channel," and Thomas Bunt, "Account of the Leveling Operation between the Bristol Channel and the English Channel," in *Report of the Eighth Meeting of the British Association for the Advancement of Science; held at Newcastle in August 1838*, Vol. 7 (London: John Murray, 1839), pp.1–18.

39. Burrard, quoted in Phillimore, *Historical Records*, p.80 (note 23).
40. IOR/X/39/2, p.8 (note 28).
41. Heidegger, "The Age of the World Picture," p.135 (note 19).
42. IOR/X/39/2, p.7 (note 28).
43. Walker, "Determining Heights," p.110 (note 37).
44. Walker, "Determining Heights", p.114 (note 37).

working methods, however 'scientific' the structure of checks and balances applied to the calculation of altitude, the experience of the Great Indus Series led leading surveyors of British India to perceive that human fallibility would always intrude, constituting an unbridgeable void at the most fundamental level between map and territory.

"Rough accurate maps": frontier representations as material objects

Just as the advance of trigonometrical surveying to the edges of colonial India's frontiers from the 1850s had a major impact on the perceived epistemological limits of survey data, so too did it have substantial effects on maps as material objects. This advance coincided with significant shifts in the production and dissemination of spatial knowledge of the colonial subcontinent, and was much more than mere temporal concurrence. Making effective representations of frontier spaces was among the leading elements in driving the Survey of India to experiment with new methods of image reproduction. The Survey's earliest attempts at color lithography – an unusually laborious, materially intensive, and delicate process – were motivated by the desire to best represent the extreme topography captured in recent surveys of the Himalaya and portions of the Punjab frontier by allowing for visually striking hill-shading.[45] These attempts were variously successful. The sheets of the Himalaya surveys were celebrated not only by survey officials in India, but also by metropolitan authorities who awarded the Atlas a prize medal at the Great Exhibition of England in 1862. On the other hand, an attempt at reproducing a map of the Derajat region to the west of Punjab was a thorough failure, ill-aligned printing stones and warped paper being inadequate to the task in hand.[46] The slow introduction from 1865 of photographic reproduction techniques at the survey's printing office, following instruction from the Ordnance Survey in Southampton, seemed to have particular merits for frontier maps.[47] Far quicker than lithographic reproduction, which required the preparation of stone imprints for each image, photozincography was heralded for fulfilling what the head of the India Office's Geographical Department, Clements Markham, termed "the great demand in India … not for highly finished, but for rough accurate maps."[48] One of the key uses of photozincography came during frontier military 'expeditions' and the Second Anglo-Afghan War (1878–80), when it allowed for the swift dissemination of such 'rough' map-images of relevant spaces to army officers.[49]

45. Phillimore, *Historical Records*, pp.330–1 (note 23).
46. Phillimore, *Historical Records*, p.330 (note 23).
47. Phillimore, *Historical Records*, p.331 (note 23); Clements R. Markham, *A Memoir on the Indian Surveys*, 2nd ed. (London: W.H. Allen and Co., 1878), p.176.
48. Markham, *Memoir*, p.177 (note 47). Survey officials also perceived photozincography to have the benefit of reducing reliance on the "often uneducated … Natives" who were an integral part of lithographic reproduction: see IOR/X/39/6: Lt.-Col. J. T. Walker, *General Report on the Great Trigonometrical Survey of India and the Topographical Surveys of the Bengal presidency for 1864–65* (Dehra Dun: GTS, 1866), pp.40–1.
49. An example of such a map for use at the north-eastern frontier, on the 1874 'Dafla Expedition', is Cambridge University Library, Maps.B.364.87.1.

This was not, however, a case of the unmitigated triumph of imperial technologies for representing space. The surveyor-general acknowledged that printing these map-images on calico rather than paper to make them sufficiently hard-wearing to take into the field had the effect of slightly reduced printing precision and rendering them "not so well suited for the insertion of correction and additional matter."[50] By the early twentieth century, the leading frontier surveyor turned London-based man of science Thomas Holdich critiqued photozincography for producing "crude unfinished-looking sheets which might well lead to an impression of absolute inaccuracy."[51] These comments remind us that high imperial surveyors and map-users understood maps as working documents with particular flaws and limitations designed for specific purposes, not perfected, authoritative, and singular spatial figurations. The demands of representing frontiers and using map-images in them pushed the Survey of India to explore new ways of making maps that were tolerably fit for purpose. And while leading survey officials extolled the supposed successes, they also fretted over drawbacks and limitations, understanding map-images as imperfect material artifacts rather than idealized assertions of spatial mastery.

In some important respects, map-images and series covering frontier and 'transfrontier' spaces were consolidated and rationalized in the later nineteenth century through processes that began in earnest from the 1870s. Up to this point, the most widely circulated maps of the north-west and north-east frontiers were relatively small-scale images manufactured on an individual basis. Many of these images drew upon (and acknowledged) numerous sources, combining disparate information and representational conventions with some difficulty, and often recycling idiosyncratic details from the originals. An 1862 map of "The North-Eastern Frontier with Burma and part of China," for instance, reproduced annotations referring to situated observations such as: "On the 24th May 1827 when the Snow was fast melting on the mountains at its source, the Namyen River was here but 80 yards broad and fordable."[52] Map-images of particularly sensitive frontier areas were also produced on an ad hoc basis.[53] Commercial presses such as J. B. Tassin's Calcutta-based operation produced frontier maps for public consumption.[54] In part, this gap in the market existed because the survey's own printing capacity was very limited at this time, which also meant that frontier maps such as the 1856 "Map of the Trans-Indus Frontier" had to be sent to London to be lithographed, work that apparently proceeded at a leisurely pace.[55]

50. IOR/V/24/3978: J. T. Walker, *General Report on the Operations of the Survey of India ... During 1879-80* (Calcutta: Government Press, 1881), pp.40–1.
51. T. H. H[oldich], "Report of the Indian Survey Committee, 1904–1905," *The Geographical Journal* 27 (1906): 392–5, 394.
52. National Archives of India, New Delhi (hereafter "NAI"), Cartographic, Survey of India, F.98/24-25; the annotation appeared originally in the map accompanying R. Wilcox, "Memoir of a Survey of Asam and the Neighbouring Countries, executed in 1825-6-7-8," *Asiatic Researches* 17 (1832): 314–469.
53. See, for example, maps of Hazara during the 1850s: NAI Cartographic, Survey of India, F.11/11 (1851 image); NAI Cartographic, Survey of India, F.5/17 (1856 update).
54. IOR/X/1562/1-4: "J.B. Tassin's Map of North-Western Frontier, May 1848"; Phillimore, *Historical Records*, p.325 (note 23).
55. Phillimore, *Historical Records* (note 23), p.317.

From the mid-1860s, the number of map-images of frontier regions in circulation increased with the expansion of the Survey of India's printing department. In 1864–5 over 3,000 lithographed copies were produced of the six-sheet "Map of the North-Eastern Frontier of Bengal, Bhootan and Assam." A series of transfrontier maps to represent both trigonometrical surveying and the route surveys of British and Indian explorers was initiated in 1871–2, with the intention of "[proving] useful in studying questions connected with any part of our extensive frontier or with any of the foreign territories lying beyond it." Accompanying route plans were written "for the use of travellers who are constantly applying to [the survey] for such information."[56] A North-Eastern Frontier series was produced from 1884, with multiple editions produced of most sheets to accommodate new survey data. The Intelligence Branch, founded in 1878, took center stage in compiling and representing spatial information concerning frontiers in map-images and route books, including information for particular forays beyond administered British India such as military 'expeditions'.[57] In addition, frontier areas were finally included within the published sheets of the "Atlas of India" project, which had been initiated in the 1820s and was to remain incomplete when superseded in 1905.[58]

There were, however, features that went against the impression of order given by the incorporation of frontier spaces into new and existing map series. Many sheets within these series continued to draw on multiple data sources, combining various surveying techniques and levels of details. They often contained large blank areas and codified uncertainty in forms such as question marks after toponyms and dashed lines to convey hypothetical river courses. A typical example was a note in a 1911 map of a portion of the uplands to the north of the Brahmaputra valley: "Broken lines on this map indicate conjectural features. The position of many villages is doubtful."[59] Such omissions were not necessarily prompts to invasive expansion or even further surveying, contrary to J. B. Harley's reading of 'terra incognita' on European imperial maps in the North American context.[60] For instance, the incumbent surveyor-general opined in 1861 (wrongly, as it turned out) that the patchy data gathered on the north-western frontier during the 1850s was "the best and only information we are ever likely to possess" for the sheets of the "Atlas of India" covering the region.[61] There were also perceived problems with the circulation of even those series with large print runs. Holdich claimed in 1906 that there

56. IOR/X/39/13: T. G. Montgomerie, *General Report on the Operations of the Great Trigonometrical Survey of India, during 1871–72* (Dehra Dun: GTS, 1872), p.17.
57. James Hevia, *The Imperial Security State: British Colonial Knowledge and Empire-Building in Asia* (Cambridge: Cambridge University Press, 2012); for an example of an Intelligence Department map, see Assam State Archives, Dispur, Maps Collection, No.195: "Map to Accompany the Preliminary Report on the Chin-Lushai country dated December 1892."
58. Phillimore, *Historical Records*, p.311 (note 23); British Library, Maps Collection, Survey of India (S.I.) 13.
59. Assam State Archives, Dispur, Maps Collection, No.246: "Abor Country."
60. J. B. Harley, "New England Cartography and the Native Americans," in *The New Nature of Maps*, pp.169–95, 190–1 (note 9).
61. H. L. Thuillier, quoted in Phillimore, *Historical Records*, p.311 (note 23).

was "little or no outflow" of maps "into the thirsty regions of the frontier," meaning that "officers commanding frontier stations were often lamentably ignorant of their own immediate geographical surroundings."[62] Many map-images, even those in series that aspired to even and universal coverage of portions of the colonial subcontinent, contained fairly unmistakable marks of fallibility and did not necessarily contribute to projects of frontier administration.

These maps were also only an element within a far broader array of frontier spatial renderings produced in the later decades of the nineteenth century. Despite the ostensible strategic sensitivity of the regions to which it pertained, new information on frontiers seeped well beyond the colonial state's departments and personnel. There were significant exchanges of information pertaining to India's frontier regions with French, German, and Russian geographers during this period.[63] These communications resulted in quirks such as the first map of one journey into Central Asia by Indian explorers being produced not in India or Britain, but in Germany, by the founding editor of the prominent geographical journal *Petermanns Mittheilungen* (who apologized for the image failing to do "full justice" to the survey information).[64] The cultural cache of India's frontiers often strained or overrode imperatives to secrecy.[65] As in the case of the Lushai Expedition's 'Correspondents' for the *Indian Express*, agents of empire disseminated spatial knowledge in a range of guises blurring the boundaries of the official and the public. Survey officials were central to the increasing prominence of depictions and descriptions of frontier and transfrontier spaces in books, periodicals, newspapers, and the meetings and journals of learned societies, especially the Royal Geographical Society.[66] These processes and publications constituted an explosion of fascination among agents of empire and various publics in colony, metropole, and beyond, which was both effect and cause of the bursts of colonial penetration that occurred with ever-greater frequency from the late 1860s. The term 'explosion' alludes not only to the quantity of representations, but also their frequent mutual incompatibility. Their impact was diverse and dynamic; India's frontiers were not subsumed within unitary and rigid frameworks of colonial spatial knowledge.

62. T. H. H., "Report of the Indian Survey Committee," p.393 (note 51).
63. Derek Waller, *The Pundits: British Exploration of Tibet and Central Asia* (Lexington: The University Press of Kentucky, 1990), ch.9; Royal Geographical Society archives, London (hereafter "RGS"), JWA/3.
64. RGS, JWA/3: August Petermann to J. T. Walker, 27 March 1869.
65. On J. T. Walker's uneasy relationship with the Government of India on issues of secrecy concerning explorations in Central Asia, see Waller, *The Pundits*, ch.9 (note 63).
66. The leading surveyors and publications involved are detailed in the remainder of the article. Among the earliest books to foreground frontier surveying was R. G. Woodthorpe, *The Lushai Expedition* (London: Hurst and Blackett, 1873). T. G. Montgomerie began reporting the work of Indian surveyors to the Royal Geographical Society from the late 1860s. On exploration narratives from the late eighteenth to mid-nineteenth centuries, see Innes M. Keighren, Charles W. J. Withers, and Bill Bell, *Travels into Print: Exploration, Writing, and Publishing with John Murray, 1773–1859* (Chicago, IL: The University of Chicago Press, 2015).

Sites for "sore-eyes": surveying in frontier regions from the later 1860s

Let us return from offices, printing presses, and learned societies to 'the field'. The complex and sometimes contradictory nature of colonial knowledge of frontiers during the explosion of the later nineteenth century was not only a product of multiple representations and audiences. Surveyors and 'explorers' were often at the crest of the imperial wave as it broke over portions of India's fringes. From the outset, however, they relied on a host of others: military escorts, locally embedded administrators, and, not least, informants and laborers drawn from frontier populations. The aims, actions, and spatial imaginaries of the heterogeneous actors involved in networks of surveying were frequently far from coordinated, which could have substantial effects on survey data and representations.[67] Nor was there uniformity among particular categories of imperial agent: even – or rather, especially – surveyors interpreted their roles and the spaces in which they operated in multiple ways. It is to some leading instances of this multiplicity that I now turn, taking forward the story of the Great Indus Series and focusing on moments of crisis during the subsequent decades in which established surveying practices, instruments, and representational techniques seemed inadequate to comprehend India's frontiers.

During the 1850s and 1860s, frontier surveying generally took place from distant vantage points, consisting primarily of theodolite sightings of topographical features beyond the colonial state's administrative limits. Surveyors were primarily concerned with issues of accuracy, seeking to discipline refractory instruments, generate robust working practices, and find means by which the vast distances involved in cartographic data production and transmission could be overcome. Despite their feverish (and not infrequently fever-ridden[68]) activity and foregrounding moments of success in their narratives, they acknowledged their frequent failures to innovate and maintain methods that worked tolerably well. As in the Great Indus Series, trigonometrical surveying in Assam proceeded fitfully and relied on compromises and ad hoc experimentation to working practices in order to cope with the difficulties. Visual occlusion in Assam was less about refraction and more about lush vegetation, and the smoke and haze generated by agriculturalists to clear the ground for crops.[69] Later surveyors heavily criticized the fixing of frontier peaks during these surveys, suggesting that haste and visual obstructions had caused prominent mountains to be mistaken for each other.[70]

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67. On the complexities of such reliance in the exploration of Central Africa, see Fabian, *Out of Our Minds*, ch.2 (note 6).
68. Phillimore, *Historical Records*, p.467 (note 23).
69. X/39/10: Lt.-Col. J. T. Walker, *General Report on the Operations of the Great Trigonometrical Survey of India, during 1868–69* (Dehra Dun: GTS, 1869), pp.6–7; NAI, Cartography, Dehra Dun Vol. 431: Walker, Superintendent GTS, to W. C. Rossenrode, i/c Eastern Frontier Party, GTS, 13 July 1870; NAI Cartography, Dehra Dun Vol. 431: Walker to W. G. Beverley, i/c Assam Valley Triangulation, undated; Walker to Lt. H. J. Harman, i/c Assam Triangulation, 14 September 1874.
70. IOR/V/24/3986: "Notes by Colonel H.B. Tanner, on Reconnaissances and Explorations in Nepal, Sikkim, Bhutan and Assam," p.xlviii.

Both of these aspects of frontier trigonometrical surveying in the mid-nineteenth century – observing frontiers from a distance and the central anxiety of 'accuracy' – altered during the following decades. Trigonometrical and topographical survey parties began to enter the frontier, and lone route surveyors – including the famed Indian 'pundits' – went beyond into Tibet and Central Asia.[71] And while concerns over limitations to the accuracy and coverage of survey data persisted as mapping parties took to the frontier hills and deserts, a new anxiety arose among surveyors and others engaged in the construction and assessment of spatial knowledge. Many frontier surveyors and other interested agents began to express what might be termed ontological doubts about the shortcomings of the numerical data of trigonometrical surveying and derivative map-images to constitute true or complete spatial knowledge. Even as technologically advanced trigonometrical surveying spread to the very outskirts of colonial influence in southern Asia, alternative means of understanding and representing frontier spaces seemed increasingly valid and necessary.

A prominent aspect of colonial skepticism about maps of frontier India concerned the ambivalent roles of indigenous agency in creating spatial knowledge. Non-Europeans were involved in frontier surveying in many forms, ranging from porters to informants and guides to assistant surveyors. Only in rare instances was their involvement perceived to achieve the kind of 'circulation' between British and Indian actors that Kapil Raj has identified in the case of Thomas Montgomery "transforming" his Indian assistant Abdul Hamid into "an intelligent instrument of measure" able to conduct route surveys in frontier regions.[72] Fierce debates in the colony and in metropolitan institutions, especially the Royal Geographical Society, over the efficacy of data generated by Indian route surveyors indicate that such 'circulation' was contingent, laborious, and subject to disagreement among interested British parties.[73] And in many other cases in frontier locales, knowledge did not flow between surveyors and local informants, but rather indicated seemingly immovable blockages.

Take, for instance, the difficulty of obtaining information relating to human settlements in frontier locales. Surveyors in the Lushai Hills during the 1880s complained at length of difficulties in fixing villages on their maps as the inhabitants of the hills employed various naming practices and many of the villages moved with annually shifting cultivation.[74] The surveyor-general noted that in maps of much of the Lushai Hills,

71. Waller, *The Pundits* (note 63); Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (Basingstoke: Palgrave Macmillan, 2007), ch.6.
72. Raj, *Relocating Modern Science*, pp.181–3; on circulation, see also Raj, "Beyond Postcolonialism … and Postpositivism: Circulation and the Global History of Science," *Isis* 104 (2013): 337–47.
73. For example, Waller, *The Pundits*, pp.125–7 (note 63); J. T. Walker, "Four Years' Journeyings Through Great Tibet, by One of the Trans-Himalayan Explorers of the Survey of India," *Proceedings of the Royal Geographical Society and Monthly Record of Geography* 7 (1885): 65–92.
74. IOR/V/24/3988: "Report on the Survey Operations with the Chittagong Column, Chin-Lushai Expeditionary Force, by Lieutenant W.J. Bythall," in H. R. Thullier, *General Report on the Operations of the Survey of India ... During 1889–90* (Calcutta: Government Press, 1891).

he and other surveyors "considered [it] useless to show the village sites or enter the names of the chiefs, as the information would soon be obsolete."[75] This region, with its semi-nomadic populations, seemed fundamentally inimical to the type of fixed information represented on the Survey of India's map-images. A distinct difficulty with ascertaining place-names in frontier locales showed on the opposite side of the colonial subcontinent during a survey operation in 1898 in Malakand. In his popular account of this venture Winston Churchill, then a young journalist, wrote of a rather farcical solution to the impossibility of obtaining reliable information.

> Our guide … squatted on the ground and pronounced the names of all the villages, as each one was pointed at. To make sure there was no mistake, the series of questions was repeated. This time he gave to each an entirely different name with an appearance of great confidence and pride. However, one unpronounceable name is as good as another, and the villages of the valley will go down to official history, christened at the caprice of a peasant.[76]

In this case, toponymic data gathering was portrayed as a ridiculous venture, facilitating the creation of map-images that fulfilled the formal expectation of representing named places, but lacked any pretension to specific accuracy. Churchill's anecdote gestures toward moments of incomprehension in the encounters that constituted spatial knowledge even in the era of trigonometrical surveying – moments that surveyors themselves understood as destabilizing the authority of colonial maps.

Another perceived barrier to obtaining spatial knowledge of frontiers was the reliance of large trigonometrical survey parties on a significant number of laborers to carry unwieldy equipment such as theodolites, plane tables, and food supplies. In forested uplands of the north-east, these men, who were generally recruited from nearby hill regions, were also made to clear ground to enable observations. However, recruitment was frequently fraught with violence, and in many cases colonial officials found effective communication with laborers impossible. The lead surveyor of a triangulated series to the Burmese boundary in 1882 reported: "I turned the telescope to search for the first of my new stations, and found that the hill had not been touched, but that, through laziness probably, my cutters must have taken to a low hill at half the distance, on which I saw a signal put up."[77] Luggage porters were often overburdened and ill-equipped to deal with the harsh conditions. One expedition into the Mishmi Hills to the north-east of the Brahmaputra Valley left half of the thirty-strong porterage party frostbitten, with some requiring partial amputations of their feet.[78] The violent and practically problematic use of local labor by

75. IOR/V/24/3996: C. Strahan, *General Report on the Operations of the Survey of India ... During 1897–98* (Calcutta: Government Press, 1899), pp.24–5.
76. Winston Spencer Churchill, *The Story of the Malakand Field Force: An Episode of Frontier War* (London: Longmans, Green, and Co., 1899), p.159.
77. IOR/V/24/3980: "Report by Major W.F. Badgley…on the Survey of part of the Burma-Manipur boundary, dated February 1882," in J. T. Walker, *General Report on the Operations of the Survey of India ... During 1881–82* (Calcutta: Government Press, 1883), p.35.
78. IOR/V/24/3998: "Narrative Report of Capt. C.L. Robertson…on Survey Operations with the Mishmi Expedition," in St. G. C. Gore, *General Report on the Operations of the Survey of India ... During 1899–1900* (Calcutta: Government Press, 1901), appendix pp.18–19.

survey parties generated difficulties that impacted the quantity and quality of the data collected and showed up as sparsely detailed portions of resulting map-images.

When they entered regions beyond the full administration of the colonial state, mapping parties often induced fierce resistance from local populations, who comprehended the march of heavily militarized outsiders through their villages as imperiling their relative independence. That Lushais supposedly believed thirty-foot-high survey marks for theodolite sightings to be "effigies of [Queen Victoria], placed on their hill tops as evidence of her greatness and the power of her army to penetrate where it would" might, notwithstanding its mediation through a colonial narrator, provides an insight into the threatening appearance of survey detachments.[79] And on occasion it seems that frontier inhabitants objected specifically to surveying and the resulting map-images. One surveyor reported that a community to the north of Assam agreed to allow him into their hills only on the conditions that he journey without his retinue and "provided I made no map for the Queen to see."[80] In this instance, concern over the circulation of map-images and the potential effects of their reception clearly extended to upland people.

Forceful resistance could impinge on the material ensembles that constituted colonial cartographic knowledge. Accompanying an army column through the Kurram valley during the Second Anglo-Afghan War in 1878, Robert Woodthorpe was shot at. Although the bullet merely grazed his body, it did significantly more damage to his equipment, "[driving] a piece of his clothes into his sketch book, which was considerably damaged."[81] This incident impacted the outturn of spatial information on an opportunistic foray into an otherwise inaccessible region, highlighting the fragility of even the least sophisticated elements within the instrumental repertoires undergirding surveys.[82] Woodthorpe also avowed that, on the same expedition, "the circumstances of hasty marches and hostile people" who deliberately destroyed target marks for theodolite observations rendered the resulting data less accurate than they should have been.[83] The limitations of the survey certainly showed on the map produced from its data, which contained details of valleys only and left uplands largely blank.[84] In many other similar instances too, 'silences' in map-images were not only the product of willful colonial elision, as J. B. Harley posited,[85] but also of all manner of 'states of disrepair' in the complex

79. Woodthorpe, *The Lushai Expedition*, pp.193–4 (note 66).
80. IOR/X/39/17: J. B. N. Hennessey, *General Report on the Operations of the Great Trigonometrical Survey of India, during 1875–76* (Dehra Dun: GTS, 1877), p.7.
81. IOR/V/24/3977: J.T. Walker, *General Report on the Operations of the Survey of India During 1878–79* (Calcutta: Government Press, 1880), pp.49–50.
82. On the importance of notebooks as instruments of exploration and survey, see Eugene Rae, Catherine Souch, and Charles W. J. Withers, "'Instruments in the Hands of Others': The Life and Liveliness of Instruments of British Geographical Exploration, c.1860–c.1930," in Macdonald and Withers (eds.) *Geography, Technology and Instruments of Exploration*, pp.139–60 (note 32).
83. V/24/3978: "Extract from a report by Major R.G. Woodthorpe, R.E., Season 1879–80," in J. T. Walker, *General Report on the Operations of the Survey of India ... During 1879–80* (Calcutta: Government Press, 1881), p.23.
84. NAI Cartographic, Survey of India, F.113/10.
85. J. B. Harley, "Silences and Secrecy: The Hidden Agenda of Cartography in Early Modern Europe," in *The New Nature of Maps*, pp.83–107 (note 9).

and delicate chains of humans, instruments, and communicative technologies that produced cartographic knowledge of high imperial frontiers.[86]

Surveyors' perceptions of resistance to their activities in frontier regions often refused any strict division between human and nonhuman elements. Nature appeared purposive and threatening. In his diary of a military-survey expedition north of Brahmaputra valley in 1884, Woodthorpe noted: "we were attacked but not by Abors [the local community]: the river had risen rapidly & suddenly a great wave coming down [sic] like a wall."[87] When attempting to comprehend and convey their more farcical attempts to know frontier spaces, agents of empire often anthropomorphized features of the landscape. One official in the Naga Hills claimed to his superior that the Lanier River, flowing through the hills, "has finally laughed us to scorn by disappearing through the great Saramethi range instead of continuing on in its northerly course … the very reverse of that we had all anticipated."[88] Colonizers' sensations of being objects of derision tended to be powerful: we might think of George Orwell's comment a few decades later that "every white man's life in the East … was one long struggle not to be laughed at."[89] Francis Younghusband, meanwhile, wrote of a restrictive rather than mocking landscape in noting "precipitous mountains which *forbade* [his travel companion] following any route than that which led down the valley of the river he was in."[90] Surveyors' and explorers' attributions of activity and intentionality to particular features of frontier landscapes were numerous and significant. Collectively, they indicate that agents beyond the fringes of the colonial subcontinent often perceived themselves surrounded by all too lively natural forces, under threat of being mastered by all they sought to survey.

These instances illustrate the notion widespread among surveyors in the later nineteenth century that climatic conditions and terrain in frontier India presented insurmountable difficulties to generating satisfactory data. Although when viewed from a distance or summited with favorable climatic conditions, mountains were integral to the production of spatial knowledge of India's frontiers, being among the peaks and ridges tended to undermine trigonometrical and topographical surveying. In written accounts, many frontier surveyors oscillated between admitting the cartographic shortcomings induced by extreme topography and celebrating these elements in the course of aggrandizing their own labor. This was particularly apparent in survey expeditions to the northern fringes of Assam from the mid-1870s on, which tended to accompany 'punitive' military parties, meaning they had limited time in the area and no obvious opportunities to rectify shortcomings. Woodthorpe and his retinue were unable to progress far into the Miri and Mishmi Hills in 1877–8 as, although "the few inhabitants of the country were friendly, … the physical difficulties were great and the weather most

86. On the concept of 'states of disrepair', see Simon Schaffer, "Easily Cracked: Scientific Instruments in States of Disrepair," *Isis* 102 (2011): 706–17.
87. Pitt Rivers Museum archives, Oxford, Woodthorpe papers: "Aka Diary, 1884," 11 March 1884.
88. John Butler, Deputy Commissioner, Naga Hills, to Secretary to Chief Commissioner, Assam, 25/02/1874: NAI Foreign Political A, April 1874, No.177, f.3.
89. George Orwell, *Shooting an Elephant and Other Essays* (London: Penguin, 2003), p.38; see also Fabian, *Out of Our Minds*, pp.95–8 (note 6).
90. RGS, Younghusband papers, RGS CB7/102: Younghusband to Douglas Freshfield, 13/06/1893.

unfavourable, rain poured in torrents, rendering the jungle paths almost impassable, and greatly impeding the movements of the party."[91] Operating in broken terrain with few major paths, the surveyors were forced to travel by unusual means. Woodthorpe delighted in sketching his travails and pronounced himself satisfied with the "very fairly reproduced" lithographed version of his drawing for the GTS's annual report (Figure 1).[92] Clearly, the labor of traveling mattered to Woodthorpe and to his institutional superiors, the act of crossing the Dibong River by a "curious kind of bridge" being presented as an exotic curiosity and a heroic undertaking. But such a representation came at a price: it also indicated Woodthorpe's inability to make as much progress into the frontier hills as hoped. This shortcoming showed on the maps that relied on the data he collected, including the Indian Atlas sheet covering the region published in 1882, which contained blank patches and one sizable tract without topographical detail labeled "uninhabited jungle."[93]

Figure 1. Sketches by R. G. Woodthorpe to illustrate "a curious kind of bridge" across the Dibong River.[94]

91. IOR/V/24/3976: J.T. Walker, *General Report on the Operations of the Survey of India During 1877–78* (Calcutta: Government Press, 1879), p.16.
92. RGS, JWA/2: Woodthorpe to J. T. Walker, 27 June 1878.
93. Assam State Archives, Dispur, Map Collection, No.1079: Indian Atlas, sheet 138 N.W.
94. IOR/V/24/3976: Walker, *General Report 1877–78*, facing p.125 (note 91).

Occasionally, reaching a frontier summit afforded surveyors viewpoints from which to map far greater expanses than was possible in lower areas. But often lines of sight remained limited and underwhelming, fog and smoke from fires used to clear sites for cultivation rendering the types of vision necessary for trigonometrical and topographical surveying "an absolute impossibility."[95] During his trigonometrical expedition to the Naga Hills during the 1870s, Woodthorpe reported that mist limited his party's field of observation to "the country immediately bordering our march." The resulting observations were akin to those on a route survey rather than the comprehensive triangulation intended.[96] Reporting to his superiors on his work in similar atmospheric conditions on the opposite side of the Brahmaputra valley eight years later, Woodthorpe repeated a phrase he had employed in his private diary in the Naga Hills, admitting that he identified some topographical features through "guesses at truth."[97]

Topographical surveying was even more difficult than triangulation in labyrinthine hills: as the surveyor-general described in 1865, "to execute work of this style, the ground must be open to view, and not hid by forests and jungle, as is very frequently the case; it is often impossible to see the same point from two places." He opined that to hack down forests in order to unveil every topographical detail "would be too laborious and expensive, and would cause much havoc and injury."[98] Instead, such surveys in the Khasi and Garo Hills to the south-west of Assam during the 1860s were conducted at half the standard topographical scale.[99] Surveyors engaged in this region also estimated distances to particular points from a single view, meaning that the accuracy of data seemed to the Survey of India to depend to an even greater extent than usual "on the skill and integrity of the Surveyor."[100] All manner of problems could compromise these very qualities, not least the extreme prevalence of illness, including one case that struck at the visual heart of topographical surveying, self-diagnosed as "sore-eyes."[101] The lack of trigonometrical surveying's internal checks and balances in topographical work further exacerbated these problems, the only method of verifying data being an entire re-survey. When such work was undertaken in the Khasi and Garo Hills, "very glaring discrepancies" in the

95. The quotation relates to surveying in the Lushai Hills in 1898–9. IOR/V/24/3997: St. G. C. Gore, *General Report on the Operations of the Survey of India ... During 1898–99* (Calcutta: Government Press, 1900), p.27.
96. IOR/L/P&S/7/11: Woodthorpe's report on survey expedition into the Naga Hills during the winter of 1875–6, ff.115–20, pp.5–6.
97. IOR/V/24/3983: "Extract from the Narrative Report of Lieutenant-Colonel R.G. Woodthorpe…in charge No.6 Party, North-East Frontier Topographical Survey," in G. C. De Prée, *General Report on the Operations of the Survey of India ... During 1883–84* (Calcutta: Government Press, 1885), ix; Pitts Rivers Museum archives, Oxford, Woodthorpe Papers: "Naga Hills Diary, 1876," f.15.
98. IOR/X/39/6: Lt.-Col. J. T. Walker, *General Report on the Great Trigonometrical Survey of India and the Topographical Surveys of the Bengal Presidency for 1864–65* (Dehra Dun: GTS, 1866), p.5.
99. IOR/X/39/7: Lt.-Col. J. T. Walker, *General Report on the Great Trigonometrical Survey of India and the Topographical Surveys of the Bengal Presidency for 1865–66* (Dehra Dun: GTS, 1866).
100. IOR/X/39/6, pp.4–5 (note 98).
101. IOR/X/24/3987: H.R. Thuillier, *General Report on the Operations of the Survey of India During 1888–89* (Calcutta: Government Press, 1890), p.70.

surveys of the 1860s led to fines and dismissals of the "offending Surveyors."[102] "Defective" work continued to be unearthed over a decade later, requiring laborious revisions to maps of the area.[103]

The expansive deserts of the Sind frontier and Baluchistan came with their own problems of vision during the simultaneous extension of triangulation, topographic surveying, and reconnaissance work from the late 1870s. The region's drifting sands prompted questions over the appropriateness of representing it through fixed data and map-images. G. P. Tate, who was deputed to the north-western reaches of Baluchistan with the Baluch–Afghan boundary commission in 1895, noted that maps of the area based on reconnaissance work undertaken less than a decade previously were wholly unreliable. The majority of the region, he reported, "is covered with a sea of sand-hills," which were inexplicable by extant western terms, instead being best explained by Baluchi categories of "drift sand and those sand-hills which are fairly stable; the former they call *bud*, and the latter *reg* or *rek*."[104] The extremes of temperature in much of Baluchistan led survey parties to race through as quickly as possible, occasionally abandoning efforts at ascertaining altitude by leveling and having recourse to the technique of boiling point observations, which the survey establishment widely disparaged.[105] Sandstorms and mirages frequently obscured or distorted the surveyors' views, "[making] it most difficult to take observations during the greater portion of the day."[106] These problems were not simply surmounted by the development of new techniques or use of different instrumentation. It was not only the sand that moved: the degree of refraction fluctuated wildly and could, one surveyor admitted, "delude even the most experienced. Objects invisible at one moment would at the next be seen far above the eye of the spectator."[107]

Among the mountains further north, visual occlusion took on another distinct form. In a popular account of his journey, Woodthorpe vividly recounted the distinctly limited field of sight when progressing through the towering landscape near Chitral in the mid-1880s. "From the low elevation of his route," he wrote,

> it is seldom that the traveller sees the higher peaks and ranges on either side. His view is bounded by the bare precipices and fantastic pinnacles of the lower ranges, and as he crosses, with discomfort, the shingle slopes every [sic] ready to move down under his weight, he gazes upwards with wonder at their vast height and at the frowning rocks above. Passing onwards he has difficulty in picking his way, for signs of a pathway are almost invisible among massive boulders heaped up in confusion… Now he comes to a precipice, round the face of which, at a

102. IOR/X/24/3987: Thuillier, *General Report 1888–89*, p.5 (note 101).
103. IOR/V/24/3976: Walker, *General Report 1877–78*, pp.22–3 (note 91).
104. IOR/V/24/3994: "Extract from the Narrative Report of Mr. G.P. Tate…on the Survey Operations with the Baluch-Afghan Boundary Commission," in C. Strahan, *General Report on the Operations of the Survey of India … During 1895–96* (Calcutta: Government Press, 1897), p.ii.
105. IOR/V/24/3994, p.iii (note 104).
106. Quotation from IOR/V/24/3977: Walker, *General Report 1878–79*, p.7 (note 81); see also Tate, *The Frontiers of Baluchistan: Travels on the Borders of Persia and Afghanistan* (London: Witherby & Co., 1909), p.35.
107. IOR/V/24/3983: "Extract from the Narrative Report of Mr. T.E.M. Claudius… Officiating in charge No.3 Party, Baluchistan Topographical Survey," in De Prée, *General Report 1883–84*, p.x (note 97).

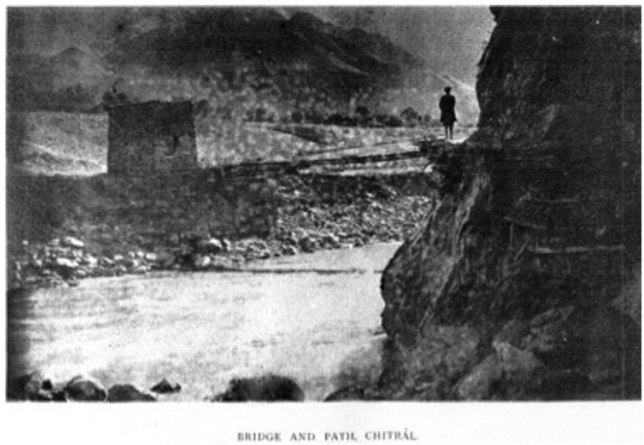

Figure 2. "Bridge and Path, Chitral."[109]

> dizzying height above the foaming torrent below, runs what, by courtesy only, can be called a road, consisting as it does of a narrow cornice, some three feet wide at the most.[108]

A photograph (see Figure 2) of the published account, labeled "Bridge and Path, Chitral," reinforces the integral features of this space as described in the text. The image is significantly underexposed, and its right quarter wholly occupied by a dark, looming cliff. A small, silhouetted figure stands on the narrow path bounding the cliff face – the same path from which the photograph appears to have been taken, with a river lurking below.

In stark contrast to romanticist landscape images depicting individuals occupying a "summit position" above the surrounding environs (most notably in Caspar David Friedrich's *Wanderer above the Sea of Fog*), neither the photographer nor the figure in Lockhart and Woodthorpe's shot has a privileged vantage point.[110] They are trapped within the maze of mountains, with no immediate prospect of attaining the surrounding heights. The photograph depicts a disempowered viewing subject; its ambivalence consists in the image's ability to simultaneous portray the overwhelming scale of the surrounding terrain while also supporting a narrative constructing the heroism of those who labor through such difficulties. Surveyors' tales of being overcome by the scale and knottiness of frontier

108. W. S. A. Lockhart and R. G. Woodthorpe, *The Gilgit Mission 1885–86* (London: Eyre and Spottiswoode, 1889), p.14.

109. Lockhart and Woodthorpe, *The Gilgit Mission*, facing p.15 (note 108).

110. I have adopted the term "summit position" from Peter H. Hansen's account of modernity and mountaineering, *The Summits of Modern Man: Mountaineering after the Enlightenment* (Cambridge, MA: Harvard University Press, 2013). Caspar David Friedrich, *Der Wanderer über dem Nebelmeer* (1818), oil on canvas, Kunsthalle Hamburg, Hamburg. For more on the viewpoint of Friedrich's landscapes, see Hugh Honour, *Romanticism* (New York: Westview, 1979), pp.78–9. I am indebted to Simon Schaffer and Chris Pinney for suggesting the comparative possibilities of Friedrich's work in relation to the image in Lockhart and Woodthorpe's account.

spaces were, then, simultaneously expressions of anxiety and self-attributions of heroism. The tension maintained in these accounts and images represented instances in which the surveyors' vision was not so much that of Apollo, gazing down serenely, as that of fallen Icarus, or of Dionysus, befuddled and intoxicated by the surrounding grandeur.[111]

"A higher land": theorizing the unknowable frontier

As vision often failed or seemed unreliable, surveyors and explorers often admitted a sense of being lost in frontier space. The sense of being engulfed by the vastness and complexity of frontier landscapes is especially apparent in the soldier–mountaineer Charles Bruce's claim that a party of troops marching through the high peaks of Chilas "had to all intents and purposes disappeared into space."[112] In contrast to the labyrinthine mountains, the danger of the desert lay in its lack of features or its changeability. A report written by a newspaper correspondent who traveled with the surveyors and political agents of the Baluch–Afghan Boundary Commission of 1896 told of how a number of guides became separated from the main party in "a perfect hurricane," and "were only accidentally found, nearly dead." The correspondent continued, "One can imagine no more horrible death than that from being lost in this desert country."[113] The overriding sensation that many surveyors and explorers conveyed not only to the adventure-hungry public but also in ostensibly authoritative reports to institutional superiors was that of being overwhelmed by frontier spaces. These renderings indicated their disempowerment as observing subjects, suggesting that frontiers possessed an essential incomprehensibility. However, they were simultaneously bound up with a particular form of heroic self-fashioning, which centered not on masterfully knowing space but rather being absolutely and dangerously immersed within it.

In such instances, we can discern a 'sentimental' protagonist akin to the figure that Mary Louise Pratt identifies in many British travel accounts around the turn of the nineteenth century.[114] The appearance of the narrator in accounts of frontier spaces as a man "composed of a whole body rather than a disembodied eye" to whom "things happen … and he endures and survives" suggests that the traveling, corporeal self was not always minimized or erased in knowledge-producing ventures from around 1850 on.[115]

111. On Icarian knowledge, see Michel de Certeau, "Walking in the City," in *The Practice of Everyday Life*, trans. by Steven Rendall (Berkeley, CA: University of California, 1984), pp.91–110; Burnett, *Masters of All They Surveyed*, pp.175–6 (note 14). On the opposition of Apollo and Dionysus, see Friedrich Nietzsche, *The Birth of Tragedy and Other Writings*, ed. Raymond Geuss and Ronald Speirs, trans. by Ronald Speirs (Cambridge: Cambridge University Press, 1999).
112. C. G. Bruce, *Twenty Years in the Himalaya* (London: Edward Arnold, 1910), p.197.
113. F. P. Maynard (ed.), *Letters on the Baluch-Afghan Boundary Commission of 1896* (Calcutta: Baptist Missionary Press, 1896), pp.61–3.
114. Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 1992), ch.4.
115. The quotation is from Pratt, *Imperial Eyes*, p.78 (note 114); David Arnold, *The Tropics and the Traveling Gaze: India, Landscape, and Science 1800–1856* (Delhi: Permanent Black, 2005), pp.228–9; Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007).

Instead, this subject was not only revivified but enhanced as the nineteenth century drew to a close, owing to a distinct formulation of the spaces in which he operated. Unlike the jungle and upland locales of earlier nineteenth-century India, which were considered dangerous but also amenable to improvement,[116] the mountains and deserts of the high imperial frontier were constructed as being unreformable.

The significance of this shift is apparent if we consider the man whose writings most vividly expressed the benefits of maintaining frontier spaces as fundamentally elusive and of losing oneself within them: Francis Younghusband, the explorer, Indian Army officer, and later President of the Royal Geographical Society. In both official and popular accounts of his explorations in the late 1880s and 1890s of the high mountains between northern British India and Central Asia, Younghusband first alluded to the spiritualist leanings that were to become an integral feature of his perceptions of geography and empire. "Separated from the haunts of civilisation by chain after chain of inhospitable mountains," he wrote in his official report of an 1889 mission to gather knowledge of routes between Kashmir and Central Asia, "I seemed, indeed, to be intruding on the abode of some great invisible but all-pervading Deity – the Emblem of Eternal Rest – and to have risen from the world beneath to a higher land."[117] Notwithstanding his fastidious earlier perusal of those portions of the fifth edition of the Royal Geographical Society's manual *Hints to Travellers* dealing with surveying observations and his rendering of numerous map-images,[118] Younghusband later conveyed that his experiences north of Kashmir led him to doubt the efficacy of disenchanted vision alone. "Clearly it is not the eye, but the soul that sees… The whole panorama may be vibrating with beauties that we ordinary men cannot appreciate."[119] Younghusband's conception of the mountainous Indian frontier as an essentially spiritual space, the seminal features of which could not be fixed by a mechanical gaze nor represented on map-images, were widely communicated to British geographical elites in colony and metropole and deemed sufficiently credible for him to reach the institutional pinnacle of imperial geography. He was also far from alone in describing portions of British India's frontier as exceeding conventionally knowable space. To cite one example among many, George Robertson, a doctor in the Indian Army, wrote of a moment during his travels in the same region as Younghusband a year earlier: "The fantastic thought arose in my mind that behind that transparency, that translucent cloud-film, a veritable faery country had been revealed to me, stretching far into the nothingness beyond."[120] Feeling lost, not being able to trust sensory data or locate oneself in Euclidean space, experiencing a connection between self and surroundings that eluded description or depiction: these were exactly the sensations that many high imperial explorers and surveyors sought, and found, at India's frontiers.

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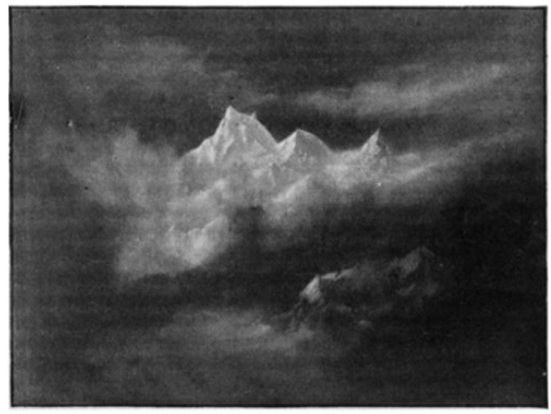
116. Arnold, *The Tropics*, chs.3–4 (note 115); K. Sivaramakrishnan, "British Imperium and Forested Zones of Anomaly in Bengal, 1767–1833," *The Indian Economic and Social History Review* 33 (1996): 243–82.
117. Younghusband, *Report of a Mission to the Northern Frontier of Kashmir in 1889* (Calcutta: Government of India Press, 1890), p.41.
118. See RGS, GFY/1/4: Younghusband's copy of Francis Galton (ed.), *Hints to Travellers*, 5th ed. (London: Stanford, 1883) used on his 1887 overland journey from Peking to India.
119. Francis Younghusband, *Kashmir* (London: Adam and Charles Black, 1909), pp.15–16.
120. George Scott Robertson, *The Káfirs of the Hindu-Kush* (London: Lawrence & Bullen, 1896), pp.vii–viii.



A LOST SNOWPEAK, HINDU KUSH.
(*From a Drawing by Colonel H. C. B. Tanner.*)

Figure 3. "A lost snowpeak, Hindu Kush."[123]

These men wrote not only of themselves, but also of topographical features or spatial knowledge being 'lost' in frontier space. In a heavily illustrated paper to the RGS on the mountains to the north of Punjab and Kashmir, Younghusband labeled a moodily stylized rendering of a jagged mountain, from a drawing by the senior surveyor Henry Tanner (of whom more shortly), "a lost snowpeak, Hindu Kush" (Figure 3). Notions of being adrift also occurred in relation to some attempts to extend trigonometrical series into the frontier hills. Such undertakings depended upon previously 'fixed' stations, requiring that the surveyors first rediscovered the location of these stations. Moments of belated connection with existing series were celebrated as near providential events.[121] But at other times no such connection was made. The survey of the Mishmi Hills at the turn of the twentieth century, undertaken to rectify the omissions of Woodthorpe's party with its crossing of the "curious kind of bridge" some twenty years before, was one such instance. The lead surveyor found that many of the stations established twenty years earlier in the Assam Triangulation Series

> had been entirely carried away by the different large rivers, and the forest had everywhere grown up to such an extent which not only made it very difficult to find such stations as were still extant, but which, when they were found, rendered it impossible to see anything from them without an expenditure of time and labour in jungle-clearing which, in the present instance, it was not possible to undertake.[122]

121. For example, Thomas Holdich's description of the Pamirs triangulation in "The Use of Practical Geography Illustrated by Recent Frontier Operations," *The Geographical Journal* 13 (1899): 465–77, 474–5.
122. IOR/V/24/3998: *Narrative Report of Capt. C.L. Robertson*, appendix p.18 (note 78).
123. F.E. Younghusband, "Chitral, Hunza, and the Hindu Kush," *The Geographical Journal* 5 (1895): 409–26, 410.

The lack of information or evidence of the whereabouts of these stations meant the trigonometrical calculations in the frontier hills could not be integrated into the grid of triangulation that spread across South Asia, which constituted the essential precondition for a trigonometrical survey to be locatable. In this instance, the entire survey itself was lost, unmoored from the rest of the triangulated imperial subcontinent.

Into the last decades of the nineteenth century, there remained a strong concern among imperial agents and interested parties in the colony, metropole, and beyond with obtaining the types of appropriately noted theodolite sightings and topographical details that were taken to constitute accurate surveying data. There was also a keen awareness of the potential limitations to obtaining such information, along with plentiful discussion of appropriate modes of representation in map-images. However, surveyors and officials during this period increasingly called into question whether survey data and maps could convey the truth of frontier spaces. Some suggested that the essence of these areas – their extreme topography and sublime vistas – demanded direct experience and could not be reduced to textual or visual representations, especially not a top-down, flattened map perspective. Frontier maps were prone to skeptical receptions, especially from those with first-hand experience of the regions represented. Take, for example, a Punjab frontier official's claim in his 1890 memoir that "to look at a frontier map, even one of those famous India Office 'large maps,' … does not convey much idea of that country."[124]

Surveyors' accounts of frontier regions for both popular and official audiences in the later nineteenth century also tended to diverge from Edney's observation that earlier colonial geographical narratives were "textual equivalent[s] of the purely mechanistic vision that creates an unassailable distance between the observer and observed." A host of these narratives did not "reject self-reference" so that "geographical observation was turned outward from, not in toward, the British self," but rather reveled in it, constructing themselves as thoroughly entangled with the surrounding environs.[125] Many accounts placed the vulnerable surveyor's body center stage. In his memoirs, Thomas Holdich described himself at the high mountain summit of the Takht-i-Suliman in 1883, "chained… to the theodolite in spite of chattering teeth and numbed fingers."[126] Holdich and most other frontier surveyors also wrote extensively – in both published accounts and official correspondence – of the journeys they undertook to reach the sites at which they collected their data. In contrast to Tim Ingold's claim that agents of modern western knowledge presented processes of data collection as a uniform series of immediate and static observations,[127] frontier surveyors' accounts freely attested to involuntary corporeal movements and celebrated the improvised practices required to operate often unwieldy machinery. Once again, admitting the potential failings of knowledge production seemed worth it in order to emphasize the surveyor's heroic labor.

124. Edward E. Oliver, *Across the Border or Pathan and Biloch* (London: Chapman and Hall, 1890), p.274.
125. Edney, *Mapping An Empire*, pp.66–8 (note 13).
126. T.H. Holdich, *The Indian Borderland 1880–1900* (London: Methuen, 1901), p.88.
127. Tim Ingold, *Lines: A Brief History* (London: Routledge, 2007), pp.88–9.

Although some surveyors could acknowledge the moving and corporeal practices of mapping and maintain faith in the stability of cartographic vision, for others there seemed to be a disjuncture between embodied practices of mapping and the truth claims of the map-view. This fragmented mode of vision engaged romanticist tropes, frequently invoking the esthetics of sublimity.[128] Surveyors' use of sublime imagery in their narrative accounts implied that theirs was an intoxicated Dionysian gaze, often suggesting the entanglement of surveyor–explorer and frontier landscape. Narrating for a popular audience his experience of surveying the Neza-i-Sultan, a steep-sided shaft of rock near the meeting point of the Persian, Afghan, and Baluchistan borders, G. P. Tate wrote:

> It was a brilliant moonlit night, and the shaft of the great mass of agglomerates standing out against the dark blue sky oppressed our minds by its towering heights and vast dimensions. The description we had read of this stupendous column in Sir Charles Macgregor's book[129] entirely failed to convey the impression we derived from our visit to the Neza.[130]

Tate's description implied that certain features of the frontier could not be accessed from removed representations, the immersive experience being accessible only from a grounded, embodied vantage point. His critique of a recent written description indicates that imperial spatial knowledge was far from cumulative or uniform. And the act of viewing he relates was a disconcerting experience, not an exercise in assured mastery and stable understanding.

The writings of one of Tate's contemporaries, Henry Tanner, contain some of the most significant suggestions of the limitations of map-images, and attempt to formulate alternative modes by which to comprehend and convey frontier spaces. Tanner was one of a generation of surveyors in the later nineteenth century whose work centered on the fringes of the colonial subcontinent, his expertise and experience ranging from Baluchistan to the high mountains north of Punjab and the Himalaya around Darjeeling and north of Assam. His concerns returned to the problems of understanding altitude that had been in play since the extension of triangulation to the mountainous fringes of British India under Andrew Waugh. After leading a trigonometric survey party to Gilgit in 1879–80, which claimed to have 'fixed' 145 peaks beyond the bounds of administered British India, Tanner became acutely aware of the shortcomings of data collected when working among frontier peaks and valleys. "I do not wish it to be understood that the points have the accuracy of those hitherto accepted by the Great Trigonometrical Survey," he stated, since he was able to take observations from only a few viewing points owing to the difficulty of moving among the valleys and passes of Gilgit. Individual

128. On early to mid-nineteenth-century romanticism in British representations of India see David Arnold, *The Tropics and the Traveling Gaze: India, Landscape, and Science 1800–1856* (Delhi: Permanent Black, 2005), pp.74–109.

129. The reference is to Charles Metcalfe Macgregor's *Wanderings in Balochistan* (London: W.H. Allen & Co., 1882), which has a sketch of the Neza facing p.191 and a written description on p.170, in which Macgregor terms it a "really wonderful peak" that "looked as if it was the ruin of one of the towers which are seen in various parts of Persia. Yet of course it could not be one of these, as it was of too enormous dimensions to be the work of man."

130. Tate, *The Frontiers of Baluchistan*, p.44 (note 106).

observations were also liable to inaccuracies, Tanner warned, as "on some of the peaks it was necessary to place the instrument [theodolite] at the very edge of giddy precipices, and then, sometimes, one only of the verniers of the horizontal limb could be read, and that with considerable risk and difficulty."[131] Here once again we see agents of imperial cartography 'trembling', but, contra Latour, choosing not to 'purify' these experiences through narrative elision and instead admitting the epistemic consequences of their fallibility even in official correspondence.

Under these circumstances of dubious instrumental practices, Tanner turned to alternative registers to convey the landscape. Even his official report to the Survey of India overlooked data, instead focusing impressionistically on the "fantastic shapes," the "vast wilderness of isolated mountains," and "the faint, cloud-like group round [the high peak] Tirich Mir" that he had discerned as he stood at Gurunjur, then the most northerly station connected to the grid of GTS triangulation. In the same narrative, he characterized the view of the northern slopes of the huge peak of Nanga Parbat as "the most magnificent snow view on the globe," beyond description by his "feeble pen."[132] In a retelling of his vision of Nanga Parbat to the Royal Geographical Society in 1891, Tanner delighted in the absolute remove of this frontier scene from British India, saying: "Facing you stretch the slopes of pure snow, untainted with the dust of the plains."[133]

Having taken charge of the Darjeeling and Nepal boundary surveys, which afforded opportunities to observe the highest Himalayan peaks further to the east, Tanner returned to the topic of knowing mountain spaces at the fringes of Britain's imperial possessions in South Asia. Far from being rectified, his faith in the possibility of precisely calculating the heights of these peaks continued to wane. "From an extensive experience in Himalayan surveying," he wrote to the surveyor-general in 1884:

> I can safely state that even when carrying on our work with the aid of the best maps, instruments, and requisite knowledge of surveying, we are liable, until we compute the positions of our points, to mistake one mountain for another, even though we may have learnt their appearance by heart from other stations… Two of my assistants last year mistook other mountains for Everest, and I myself recorded "Everest" against a mountain 5,000 feet lower than it.[134]

In this same report, Tanner admitted that he assumed different distances to Himalayan mountains even after numerous theodolite observations, giving a range of possible altitudes and "never pretending to fix the peaks absolutely."[135]

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131. IOR/V/24/3978: "Extract from a Report on Operations Connected with the Survey of Gilgit, by Lieut.-Colonel H.C.B. Tanner," 28/12/1880, in Walker, *General Report 1879–80*, p.42 (note 50).
132. IOR/V/24/3978: *Report on the survey of Gilgit*, p.43 (note 131).
133. H. C. B. Tanner, "Our Present Knowledge of the Himalayas," *Proceedings of the Royal Geographical Society and Monthly Record of Geography* 13 (1891): 403–23, 407.
134. IOR/V/24/3983: "Extract from the Narrative Report of Lieut.-Col. H.C.B. Tanner…in charge Darjeeling and Nepal Boundary Surveys," in De Prée, *General Report 1883–84*, p.xxxii (note 97).
135. IOR/V/24/3983: "Extract from the Narrative Report," p.xxxiii (note 134).

Figure 4. Thomas Holdich, "Nanga Parbat from the Bunji Valley of the Indus" (undated, c.1895).[138]

As well as freely admitting the difficulties of ascertaining altitude and the tendency for the Himalaya to remain elusive even after extended experience of them, Tanner suggested the limitations of defining high peaks by altitude above sea level. In his 1884 report and again in the paper he gave to the RGS in 1891, he provided a table comparing various mountains in the Himalaya along with Mont Blanc.[136] The table relegated the importance of altitude – the calculation of which Waugh had couched as the pride of GTS operations, but which Tanner merely termed their "accepted" rank – and instead advanced the heights of the faces of these mountains relative to the surrounding topographical features as the true measure of their significance. By this measure, he judged Nanga Parbat – widely celebrated and depicted in non-map forms by his contemporaries in the survey cadre (Figure 4) – to be "king of mountains." His justification for this alternative measure was esthetic. Notwithstanding his claim that Nanga Parbat "baffles description" – a clear expression of the elusiveness of particular frontier features – Tanner described his experience as a grounded observer taking in the north face of the mountain in 1880.

> It is a scene that is not grasped or taken in at once, but after a while the stupendous grandeur of the view is appreciated. It is quite overwhelming in its magnitude; it is in fact one of the grandest spectacles that nature offers to the gaze of man. Great height, vast breadth, and appalling depth are combined, and like the panorama of the Tibet snow, as described to me by Captain Harman, it is "immense." There is nothing small or mean about it; it is on a scale which is gigantic.[137]

136. IOR/V/24/3983: "Extract from the Narrative Report," xxxiii–xxxv (note 134); Tanner, "Our Present Knowledge," p.408 (note 133).
137. IOR/V/24/3983: "Extract from the Narrative Report," xxxiii–xxxiv (note 134).
138. RGS, X610/023579.

In this rendering of Nanga Parbat, Tanner employed the lexicon and imagery of the sublime, evoking the sense of gargantuan scale and hints of terror that were central constituents of sublimity. His conclusion that Nanga Parbat's unique importance lay in its "immense" and "gigantic" appearance also suggests one way in which we can bring to light the truly distinctive character of late-nineteenth-century frontier surveying from what went before and elsewhere: through reading it alongside Martin Heidegger's notion of "the gigantic." Heidegger posited that "the gigantic" – for example, huge numbers in the sciences and the annihilation of distances through technologies – advances as modern man "brings into play his unlimited power for the calculating, planning and moulding of things."[139] This conception broadly accords with familiar renderings of high imperial mapping that foreground its fantastically huge calculations and supposed power to generate univocal renderings of space. But in exploring what was at stake in conceiving frontier spaces in late nineteenth century British India, we would do well to examine Heidegger's subsequent claim that:

> as soon as the gigantic … becomes a special quality, then what is gigantic, and what can seemingly always be calculated completely becomes, precisely through this, incalculable. This becoming incalculable remains the invisible shadow that is cast around all things everywhere when man has been transformed into *subiectum* and the world into a picture. By means of this shadow the modern world extends itself out into a space withdrawn from representation.[140]

Tanner's admission of the limitations of trigonometrical surveying in the face of the "gigantic" scales at play in frontier topography points toward the ambivalence that Heidegger conjures here. The seeming triumph of immense technological assemblages centering on a masterful subject – in this case the extension of theodolites, men, and instrumental paraphernalia to some of the most intractable places on earth – simultaneously seemed to reveal a margin that remained elusive and unknowable through such means. This margin developed from the realization among leading surveyors engaged in the Grand Indus Series during the 1850s that there was an irreducible gap between raw survey data and territory, and thereby a limit to cartographic improvement. By the 1880s and 1890s, the concept of "a space withdrawn from representation" took on an enhanced, distinctive form among frontier surveyors and explorers. Often construed as both integral constituent and ultimate product of the construction of the world-as-picture in 'the modern age',[141] as the nineteenth century drew to a close map-images seemed to many of those whose fieldwork undergirded them to be unable to represent frontier spaces in full. These regions instead seemed to demand embodied, spiritualized experience. Having developed the means to calculate them completely enough for almost any practical purpose, surveyors insisted that frontier environs had become incalculable.

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139. Heidegger, "The Age of the World Picture," pp.134–5 (note 19).
140. Heidegger, "The Age of the World Picture," pp.135–6 (note 19).
141. For example, Martin Jay and Sumathi Ramaswamy, "Section I: The Imperial Optic," in Martin Jay and Sumathi Ramaswamy (eds.) *Empires of Vision: A Reader* (Durham, NC: Duke University Press, 2014), pp.23–43, 33.

Conclusion

Surveyors and explorers of Tanner's era began to call into question the value and meaning of survey data in regions that seemed to call for embodied, sublime experience. Frontiers passed from being spaces colonial surveyors a few decades before had constituted as the ultimate challenge for cartographic calculation and representation, to spaces that called into question the sufficiency of such practices to constitute true and complete spatial knowledge. Immersed in the vertical and horizontal expanses of British India's high imperial frontier, surveyors imagined themselves to be "clean out of the map", not only in having ventured beyond extant cartographic knowledge but by virtue of being in spaces that seemed to reveal the limitations of such knowledge.

This article has shown how the rigors of trigonometrical sightings of frontier regions in the mid-nineteenth century caused leading surveyors in colonial India to perceive an irreducible margin between survey data and territory. It has suggested that agents involved in frontier surveying were intensely aware not only of the potential shortcomings of producing data but also of representing it, extensively pondering the fallibility of producing and circulating maps as material products requiring labor-intensive engagement. It has traced the appearance of seemingly intractable barriers to the successful prosecution of surveys when trigonometrical parties began to enter frontier regions in the later decades of the nineteenth century. Finally, it has argued that one key development of this era was the advent of a widely shared notion of frontiers as spaces that eluded map representation, demanding alternative modes of engagement. In sum, the article presents surveying and imperial spacemaking in the era of high empire as an altogether more fraught and uncertain endeavor than has been generally understood. Far from considering themselves masters of the surrounding terrain, surveyors and explorers were sharply conscious of limitations to map-knowledge that could not always be elided or fixed at a later stage. Unlike their predecessors in the jungles and uplands of the subcontinent, they did not maintain faith in the possibility of adapting and improving the landscapes in which they were entangled, instead maintaining that these regions posed challenges of an insurmountable nature. They were altogether more reflective and reflexive – and their numerical, written, and visual products were far less assured and monolithic – than many recent accounts of maps and modern imperialism have allowed for. A shadow accompanied their attempts to proclaim their own heroism and celebrate the gigantic technological assemblages that they put to work: the idea that frontier spaces could be destructive of both the surveyor's self and the knowledge he produced.

This deeply ambivalent oscillation between celebration and fear produced by the perception that colonial India's frontiers exceeded representation was arguably among the earliest and most prominent manifestations of doubts among British agents of empire over the value of spatial knowledge. Concerns first expressed in the 1860s that opportunities for 'discovery' were becoming ever more sparse drove a pervasive sense of crisis in British imperial exploration and geography around the turn of the twentieth century.[142]

142. Charles W. J. Withers, *Geography and Science in Britain, 1831–1939: A Study of the British Association for the Advancement of Science* (Manchester and New York: Manchester University Press, 2010), p.85.

And as Priya Satia has elucidated, a conjuncture of cultural or 'metaphysical' uncertainties, preferences for a pure, minimalist aesthetic, and epistemological doubts generated among imperial agents of the early twentieth century the notion that Arabia was a "land of mirage, myth, and imprecise borders."[143] To Satia's list of factors might be added the prevalence of officials who had cut their teeth at India's frontiers among the British cadre in the Middle East.[144] As this article has evidenced, a similar set of concerns encompassing knowledge, self, and spirituality were entangled with understandings of high imperial India's mountain and desert outskirts. Going "clean out of the map" may have expressed limits to spatial knowledge, but also seemed to usher in a new playground for men bored by an era of unprecedented imperial domination.

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143. Priya Satia, *Spies in Arabia: The Great War and the Cultural Foundations of Britain's Covert Empire* (Oxford: Oxford University Press, 2008), quotation on pp.13–14.
144. Toby Dodge, *Inventing Iraq: The Failure of Nation Building and a History Denied* (London: Hurst & Company, 2003), pp.120–1.